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Keywords

– electoral rules; forms of government; female representation; regression discon- tinuity; difference in discontinuities

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Electoral systems and female representation in politics: evidence from a regression discontinuity[2]

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Abstract

This work looks at the policies aimed at promoting female participation in local legislative bodies using a series of changes to electoral law in Poland. Using an exogenous population threshold dividing municipalities into ones with proportional and ones with majoritarian elections, we estimate the effect of the electoral system on female representation. Moreover, we use difference-in-discontinuities to look at the effect of an introduction of a female quota on female participation in local councils. Contrary to the literature for the national elections, we find that more females are elected to local councils in the majoritarian system. We link this observation to countering party bias in list placements and lower costs of electoral participation in the majoritarian system. We find that the female quota has a strong positive effect on the percentage of females in the local council. It increases the pool of female candidates and has a positive effect on their list placements. It does not, however, create spillovers to neighboring regions.

JEL classification: D72, B52
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1. Introduction

The question of female representation in politics has recently gained more attention. It is important for at least two reasons. Firstly, women are under-represented on the political stage across the globe and scholarship is looking for policies, which would help establish a more gender-balanced political process. Secondly, a growing body of literature shows that

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female politicians take different decisions from their male counterparts, so understanding the factors behind differences in female representation across countries, can help understand the differences in policies and their impact.

This work looks at the policies aimed at promoting female participation in legislative bodies using a series of changes to electoral law in Poland. We use local elections, specifically elections to municipal councils as our empirical laboratory. Several aspects of the law make it perfect for a well-identified causal analysis of how electoral rules affect female representation in politics. Firstly, the law in place in 2010, stipulated a population threshold (20,000) dividing the municipalities into ones with majoritarian and ones with proportional elections. We use this threshold to conduct a regression discontinuity analysis. Secondly, the threshold has been removed in 2014 allowing us to run placebo regressions. Finally, the threshold has been reintroduced again in 2018, with an addition of introducing a female quota in the municipalities above the 20.000 threshold - in this case we can look at the effect of the quota and compare it to the effect of the electoral rule itself on female representation.

There is a consensus in the literature, that using proportional representation as compared to majoritarian elections is associated with a higher number of elected females (Norris, 1985; Matland and Studlar, 1996; Castles, 1981; Rule, 1981; Kenworthy and Malami, 1999). Several features of proportional representation are believed to be responsible for this phenomenon. Firstly, majoritarian elections are typically associated with choosing a strongest candidate to run for office in particular district, while a proportional representation list composition should be reflecting of a wide spectrum of voters. In this, gender might be a more important factor in a candidate-centered majoritarian election, in particular if the voters are biased against females. Secondly, district magnitude differs significantly between electoral systems: proportional systems have consistently higher district magnitudes, so parties can pull from deeper in their lists, which scholars have argued increases the chances of women being elected (Norris, 2006; King, 2002). Thirdly, electoral systems affect the competitiveness of particular seats (Profeta and Woodhouse, 2018). Since females are typically more competition-averse than males (Niederle and Vesterlund, 2007), this might translate into differences in female participation. Finally, incumbency advantage is believed to be responsible for strong persistence of individuals of same-gender (male) in elected positions (Lippmann, 2017; Schwindt-Bayer, 2005).

All of the above arguments suggest that proportional elections have an advantage over majoritarian regimes in promoting female nomination and election. Yet, these arguments are mainly established for the national elections in the old democracies, overlooking the fact that at the local level and in young democracies the nomination and election dynamics may differ. Typically, the costs of entering electoral races are much lower in the local than national elections. In the Polish context, this particularly considers the majoritarian elections, where practically anyone can take part in electoral race as backing by a particular political party or electoral committee is not mandatory and the ballot access requirements are very low (see Brancati (2008) for the argument why low ballot access requirements favour independent candidates). This situation may be particularly attractive for female candidates who, as stipulated before, have a tendency to be competition–averse and by individually putting themselves as candidates avoid intra–party/intra–committee competition, first, for the nomination and, second, for the favourable placement on the list. Generally females might prefer electoral systems where they can bypass party leadership, who is often perceived by women as providing female recruits less strategic and financial support than the male recruits (Butler and Preece, 2016). The whole electoral system in Poland is also quite young, which means that stringent party elites are not yet developed, which gives more room for independent local committees, instead of established political parties. Independent local committees, contrary to party elites, might be less biased against female participation. Furthermore, the local independent committees may be more focused on competences of candidates, contrary to political parties, which recruit the candidates, who can then potentially compete in the elections at the higher level, thus the competitiveness for them may be of crucial importance. Paradoxically, at the local level, majoritarian elections may be therefore more favourable towards female representation. Which argument prevails – whether the majoritarian or proportional representation increase female representation – an is empirical question, and we aim to test it by utilizing the quasi-experimental setting at the local level in Poland.

The second strand of literature, which we relate to, is the literature on gender quotas in elections. Quotas are believed to reduce gender bias in elections (Beaman et al., 2009) and therefore help clear way for more females in politics (Baskaran and Hessami, 2018; Bhalotra et al., 2017). Several mechanisms are believed to be responsible for the "pathbreaking": affecting voter attitudes, changes in party behavior, or affecting behavior of femeles themselves. Nevertheless, contrary results have also been observed (Broockman, 2014; Bertrand et al., 2018; Geys and Sørensen, 2019; Joo and Lee, 2018; Ferreira and Gyourko, 2014). Secondly, quotas might affect the quality of elected officials (O'brien and Rickne, 2016). Besley et al. (2017) find, for instance, that female quota help replace ”mediocre” males with more qualified females. Other studies have found a positive link between (both male and female) politicians' education levels and quota implementation (Baltrunaite et al., 2014; Casas-Arce and Saiz, 2015; Weeks and Baldez, 2015). Also in this case, however, there is evidence to the contrary: Allen et al. (2016) find that "quota" females are no different than other elected officials, and Campa (2011) finds no effect of quotas on quality. The Polish context again serves as an ideal laboratory for testing these competing hypotheses.

Our main results allow us to formulate several policy-relevant conclusions. Firstly, majoritarian elections seem to help females become elected, compared to proportional elections by the virtue of higher list placement. The mechanism in place is the role of partisanship as compared to independent committees. Nation-wide party lists, more prevalent in proportional elections, typically place females on lower places - only less than 30 percent of first list placements in proportional elections are occupied by females. On the other hand, in single-seat districts in the majoritarian system, female are, by definition, placed on first places and since voters in the analyzed elections do not seem to have preference for any gender, it is easier for women to get elected from single-seat districts. And since political parties have less females elected than independent committees, and the latter are, more likely to become elected in majoritarian elections. Secondly, lower costs of participating in elections is promoting more female candidates, who do not have a backing from a political party. Finally, we find that the female quota has a strong positive effect on the percentage of females in the local council. We identify two effects responsible to this increase: firstly, the quota increases the pool of available female candidates. While in 2010 there were no differences between the fraction of female candidates in the overall candidate pool, in 2018 there is a sharp jump at the population threshold. Secondly, the quota is responsible for higher placements of females on the electoral lists - the size of the effect is about one position for a list length of six. It does not, however, affect the voting behavior (voter bias), nor does it create any spillovers to neighboring municipalities.

2. The institutional background

Municipalities (Polish: *gmina*) are the principal units of administrative division in Poland, and constitute the lowest tier of government. There are currently 2,478 municipalities, varying in size between 1,400 and 1.7 million inhabitants. The legislative and controlling body of each gmina is the elected municipal council (*rada gminy*) or, in a town, the town council (*rada miasta*). Executive power is, since 2002, held by the directly elected mayor of a municipality. We do exclude from the analysis the municipalities, which have special rights of provinces (*gminy na prawach powiatu*).

2.1. Elections in 2010

In small municipalities (below 20,000), the councilors were elected in small districts via plurality rule. In most municipalities that meant elections from single-seat districts. The electoral law prescribed, however, that the maximum of five members should be elected from one district, hence, in larger districts representatives were elected through block voting. As a result, the most popular party might have been able to win all seats, creating even larger disproportionality between votes and seat distribution than in the case of single–seat districts (Lijphart, 2012).

In municipalities larger than 20,000 inhabitants, proportional elections were in place. Since 2002 the d'Hondt method has been implemented to translate votes into seats; before 2002, Sainte–Laguë method had been applied. Moreover, in the municipalities with the proportional systems, more members were elected from each district than in the municipalities with majoritarian regimes, i.e. five to eight, as stipulated by the law.

It is important to stress that starting in 1998 candidates to the municipal councils need to be supported by an electoral committee. The committee can be established by political parties, public associations and organizations. It can also be created by a group of five voters, of whom one is nominated as a proxy of the committee. Furthermore, in municipalities with proportional elections the registration of candidates' list in a district was conditional on gathering at minimum 150 of voters' signatures in a district. Another rule stated that the candidates' list in proportional elections had to contain at minimum the same number of candidates as to the number of mandates assigned to a given district. It turns out that the registration of candidates' list was much easier in majoritarian elections. In smaller municipalities only 25 signatures from district population were required to register a list, and the list was eligible for elections if it contained just one name. Given that in municipalities with proportional elections the costs of entering political markets were much higher (Szczepanowska, 2010) and the fact proportional systems introduce the idea of competing elites, ideologies or sectoral interest rather than geographical interests (Shugart and Carey, 1992; Gendzwill and Zoltak, 2014), it was much easier for national political parties to penetrate local political markets under proportional elections[4]. Kantorowicz (2017) and Kantorowicz and Köppl-Turyna (2019) show that there is indeed a substantial difference in share of council members affiliated with political parties between majoritarian and proportional systems.

Summary of the institutional features of the municipal electoral systems used in the year 2010 is presented in Table 1.

Table 1: Institutional details of electoral systems in 2010

	Majoritarian	**Proportional**
Population size	<20,000	>=20,000
Electoral rule	Plurality	Proportional (d'Hondt)
District magnitude	1 to 5	5 to 8
No of signatures to register a party list in a district	Min. 25	Min. 150
No. of candidates on the list	Min. 1	Min. 5
Confounding factors		
Council size	15	21
Campaign spending limitation	750PLN	1000PLN

2.2. Elections in 2014

According to the electoral law erected in 2011[5], the local elections conducted in November 2014 have used an entirely new election procedure. In particular, the 20,000 inhabitants threshold has been removed and all members of the councils in all municipalities have been elected in single-seat districts.

2.3. Elections in 2018

A further change to the electoral law has been introduced for the elections in 2018 by the electoral law of 2018 [6]. Firstly, the 20,000 inhabitants threshold has been reintroduced.

[4] It is important to underscore that before the 1998 elections national political parties were banned from putting forth their candidates in local elections. They could merely support particular candidates or local committees (Kotarba, 2016).

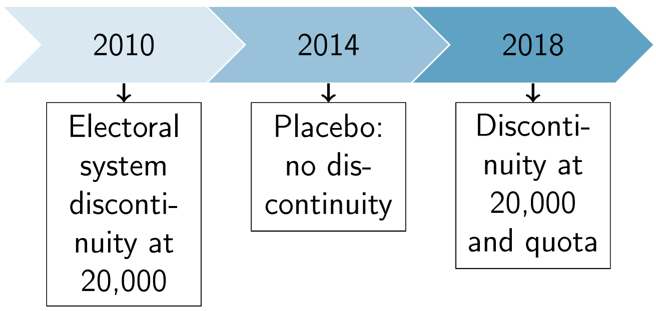
[5] *Ustawa z dnia 5 stycznia 2011 r. Kodeks wyborczy, DzU 2011, nr 21, poz. 112.*

[6] *Ustawa z dnia 15 czerwca 2018 r. o zmianie ustawy - Kodeks wyborczy oraz niektórych innych ustaw, Dz.U. 2018 poz. 1349*

However, unlike in 2010, all municipalities below 20,000 inhabitants now use single-seat districts (i.e. no block voting is used anymore). Secondly, in the proportional elections in municipalities above 20,000 inhabitants, a gender quota has been introduced, which prescribes that on each list at least 35 percent of candidates have to be female (and male). No particular brackets for list placements for each gender are in place.

Overview of the design of the study is shown in Figure 1.

Figure 1: Overview of the institutional design



3. Data and the empirical model

3.1. Data

The data used comes from the National Electoral Commission of the Republic of Poland. It contains information about all candidates to local councils, including their gender, age, citizenship, position on the electoral list, the fraction of obtained votes, and whether the person has been elected to the council or not. We can match this information with data about the institutional set-ups of each municipality, i.e., the electoral system in place, the size of the council, number of mandates from each electoral district in each municipality and other.

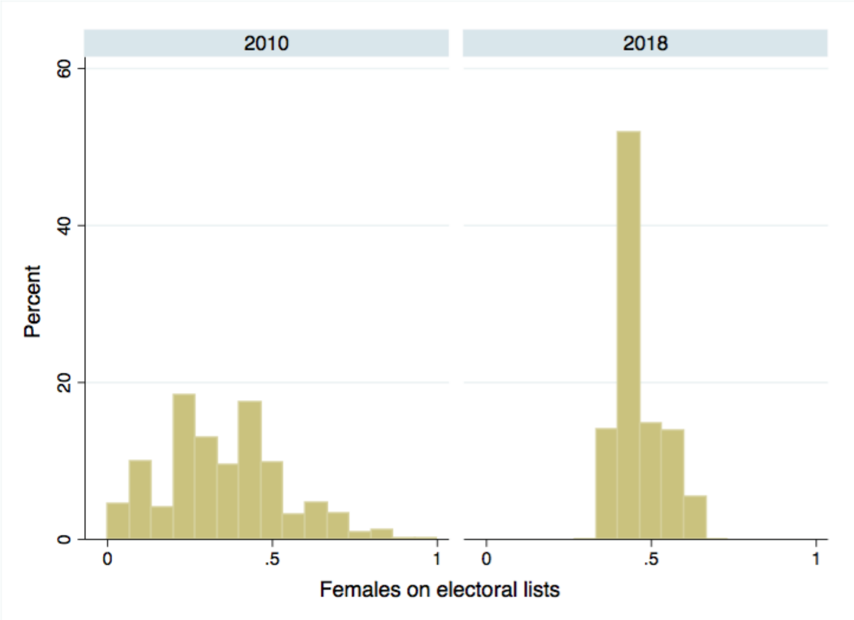
In the 2010 municipal election, a total of 159,863 candidates, among which 51,035 women, competed for 37,818 seats in local councils. The fractions of female candidates above and below the 20,000 inhabitants threshold are almost the same at 31.6% and 32.4%, respectively. If we exclude block voting, there are 146,227 candidates, among which 31,7% were female.

In municipalities above 20,000 inhabitants, proportional representation is in place, while in those below the threshold single-seat districts and block voting were used. Thus, within one municipality below 20,000 inhabitants some districts are single-seat, while in others between two and five candidates are elected, using block voting - which results in mixed cases. Since we want to compare the electoral outcomes over time, we will include in 2010, only these municipalities, in which more than 75 percent of the electoral districts were single-seat.

In year 2014, we observe 131,799 candidates, among which 43,527 were women, who competed for 36,109 councils seats. Also in this case, the fractions of females at both sides of the population threshold of 20,000 inhabitants are almost the same at 33.8% and 29.9%, respectively.

In year 2018, we have data on 118,059 candidates, among which 45,083 were women. Candidates competed for 34,464 councils seats. The gender quota is binding only above the 20,000 threshold. This results in a higher fraction of female candidates in these municipalities. Below the threshold, the fraction of female candidates is at 35.2%, above the threshold this number is higher at 45.9%. The quota also affected how much females are present on the electoral lists compared to the municipalities above 20,000 inhabitants in 2018. The average fraction of females rose in these municipalities from 33.4% in 2010 to 45.9% in 2018, by about 13 percentage points. Figure 2 presents the histograms of female representation on lists in 2010 and 2018 in municipalities above 20,000 inhabitants. What is clearly visible, it that most of the parties in 2018 keep the fraction of females at or only slightly above the required quota. Only about 40% of the lists have more than 50% females on the lists.

Figure 2: Females on electoral lists above the 20,000 threshold - the effect of the quota



3.2. Empirical approach and identification

The question of how electoral rules (and other institutional and political factors) affect female participation in politics can be addressed in two ways:

1. What is the probability of a female candidate being elected?
2. What is the probability of encountering a woman among elected candidates?

The relationship between the two approaches can be easily summarized by the Bayes' formula:

$$P(female|elected) = \frac{P(elected|female) \times P(female)}{P(elected)}, \tag{1}$$

where $P(female)$ is the pool of females among all candidates and $P(elected)$ is the general, gender-independent probability of getting elected in a particular electoral system. As it is *a priori* unclear which approach gives a better answer to the question of female representation in politics, we shall look at both probabilities and try to establish the institutional reasons behind the differences. Using our data, we can separately estimate each of the probabilities in the formula.

At the municipal level, the dependent variables are the fraction of females in the council, and the fraction of elected among female candidates in a municipality. In these cases, the dependent variable is continuous, but obviously taking values between 0 and 1. Standard linear or polynomial estimations do not guarantee in this case that the fitted values would remain within the $[0,1]$ interval. A standard solution to this problem is to apply the log-logit transformation (Papke and Wooldridge, 1996) of the form $\log \frac{y}{1-y}$, where y is the fractional response. In this case, however, we cannot recover the $E(y|x)$, but we can still interpret the sign and the significance of the discontinuity, without interpreting the actual size of the effect. We consider this approach as a robustness check to the standard polynomial model.

In main text, we focus on the actual policy-relevant outcome, that is the fraction of females in the councils in each analyzed election. This outcome, however, depends, on the individual probabilities of each female actually being elected. Therefore, we also look at the individual-level probabilities of becoming elected as a female, and of encountering a female among elected officials.

On the top of that, we apply the difference-in-discontinuities design to look at the effect of the quota on female participation. We exploit the difference-in-discontinuities design, as proposed by e.g. Grembi et al. (2016). It can be implemented with local linear (or polynomial) regression (LLR) as

$$y_{it} = \alpha_0 + \alpha_1 \times p_{it} + P_i \times (\gamma_0 + \gamma_1 \times p_{it}) + D_i[\delta_0 + \delta_1 \times p_{it} + P_i(\underbrace{\beta_0}_{\text{D-in-D estimator}} + \beta_1 \times p_{it})] + \varepsilon_{it}. \quad (2)$$

In this case P_i corresponds to the municipalities with a proportional election system, and D_i is a dummy for elections in 2018, in which a female quota has been introduced in those municipalities only; further p_{it} is the population. As between 2010 and 2018, the only change to the electoral system (above 20,000), was the introduction of the female quota, this specification allows us to clearly identify the effect of the quota on our variables of interest.

3.3. Validy of the RD design

Several conditions have to be met or the design to be valid, or the treatment considered randomized. Firstly, assignment must predict the treatment - which is the case, as the law prescribes, which municipalities belong in which electoral system. Secondly, no manipulation of assignment should be possible - which is analyzed in Section 3.3.1. Thirdly, assignment must not be correlated with any outcome-determining factor - this assumption is looked at in Section 3.3.2. Finally, confounding factors should not be present at the analyzed population threshold. As indicated in Table 1, two policies change at the 20,000 threshold: the size of the council and the limit to campaign financing. Regarding campaign expenditure limits, there is evidence that these are not strictly enforced, and thus are not binding (Szyszko, 2014). It is a well-known practice in Poland for parties to engage in so-called "pre-campaigning", in order to circumvent expenditure limits. This means that politicians begin agitation before the beginning of the official campaign, i.e., when the expenses of campaigning go unreported (Szyszko, 2014; Kantorowicz and Köppl-Turyna, 2019). When it comes to the council size, in the robustness section, we look at the changes to female representation at a different threshold. We exploit the fact, that in municipalities above 50,000 inhabitants, the council size increases to 23 persons, and above 100,000 to 25.

3.3.1. Sorting

For the regression-discontinuity assumptions to be valid, we need to establish whether sorting around the cut-off does not appear. Following Eggers et al. (2017), there is evidence that the density test of McCrary (2008) is sensitive to the choice of the bin sizes and assignment of borderline integer observations (as in the case of population) to the first bin on the left of the threshold. Table 2 presents results of density testing with different bandwidths and bin sizes, to control for sensitivity.

Table 2: McCrary density tests - p-values reported

	2010		2014		2018	
Bin size	Bwidth=10	Bwidth=5	Bwidth=10	Bwidth=5	Bwidth=10	Bwidth=5
100	0.2384	0.3096	0.7897	0.2269	0.3588	0.6535
200	0.2192	0.3040	0.7955	0.2329	0.3620	0.6347
300	0.3349	0.3850	0.7769	0.2121	0.3669	0.6922
400	0.2320	0.3103	0.7492	0.2097	0.3639	0.6263
500	0.1876	0.2214	0.8074	0.2266	0.3273	0.7138
1000	0.4196	0.2784	0.7435	0.1962	0.2828	0.7767

Bandwidths in thousand.

Alternatively, one can test density continuity with local polynomial density estimators (see, Cattaneo et al., 2016, 2019), which avoids pre-binning of the data. Results are summarized in Table 3 and similarly point to no sorting present at the population threshold.

Table 3: Polynomial density tests - p-values reported

	2010		2014		2018	
Order	Triangular	Uniform	Triangular	Uniform	Triangular	Uniform
1	0.3256	0.3776	0.1151	0.0742	0.8329	0.9537
2	0.4722	0.5664	0.4289	0.2486	0.7537	0.7892
3	0.3754	0.7862	0.1945	0.2452	0.5249	0.7272
4	0.6309	0.7129	0.3017	0.2191	0.7743	0.8826

3.3.2. Continuity of the municipal characteristics

Further, we need to make sure that variables potentially affecting the female representation - determined prior to the realization of the assignment variable - have the same distribution just above and just below the cutoff, so that local randomization is given. In the Appendix (Figure A.11), we show a variety of continuity checks of several important variables. Since the variables are very stable over time, we only report the values for the year 2010, other years look virtually the same. Population variables could affect the probability of voting for females independent of the electoral system: young people could vote more "progressively" (young defined as population between 18 and 30 years of age), as opposed to older population (defined as above 65). More dense areas, that is cities, could be more positive towards females, but there is no visible discontinuity in the population density. Finally, percentage of females in the overall population could matter. Also in this case, we do not observe any discontinuity.

4. Results

4.1. Year 2010

Tables 4 and 5 show the results at the municipality level, that is the percentage of women in the local council (Table 4) and the percentage of elected among females in municipality (Table 5). In both cases, we observe a discontinuity at the population threshold. Above the threshold, where proportional elections are used, there are about 15 percentage points less females in the councils. Similarly, above the threshold, there are less elected among female candidates. The size of the effect equals 13 to 15 percentage points and is significant at the 5% level (1% level for the linear specification).

Table 4: Percentage of females in the local council, Year 2010, $P(female|elected)$

	(1)	(2)	(3)
RD Estimate	-0.141**	-0.158**	-0.149
	[0.067]	[0.071]	[0.088]
Robust 95% CI	[-.303 , -.006]	[-.326 , -.014]	[-.333 , .049]
Kernel Type	Triangular	Triangular	Triangular
BW Type	CCT	CCT	CCT
Eff. Observations L	72	149	139
Eff. Observations R	108	136	134
Conventional p-value	0.035	0.027	0.090
Robust p-value	0.042	0.033	0.145
Order Loc. Poly. (p)	1	2	3
Order Bias (q)	2	3	4
BW Loc. Poly. (h)	2.560	4.493	4.453
BW Bias (b)	3.742	5.524	5.388

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in brackets.

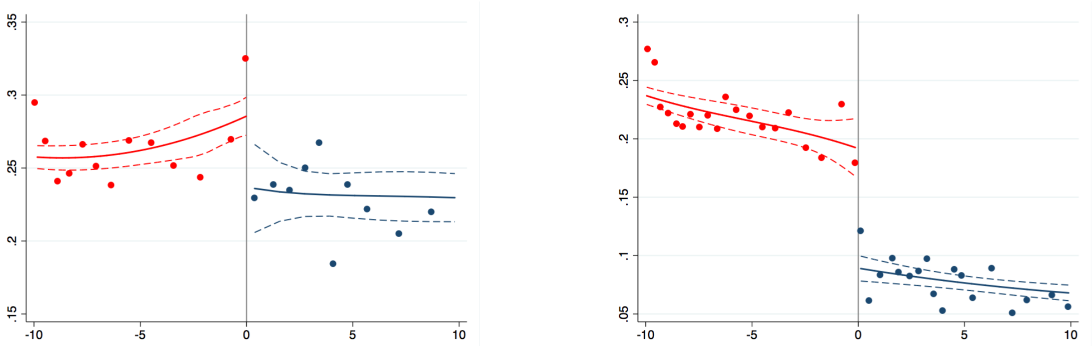
Figure 3 shows the discontinuity in year 2010.

Table 5: Percentage of elected among females in municipality, Year 2010, $P(elected|female)$

	(1)	(2)	(3)
RD Estimate	-0.153***	-0.144**	-0.134*
	[0.045]	[0.052]	[0.054]
Robust 95% CI	[-.257 ; -.051]	[-.236 ; -.023]	[-.232 ; -.013]
Kernel Type	Triangular	Triangular	Triangular
BW Type	CCT	CCT	CCT
Eff. Observations L	44	49	75
Eff. Observations R	74	82	108
Conventional p-value	0.001	0.006	0.013
Robust p-value	0.003	0.017	0.028
Order Loc. Poly. (p)	1	2	3
Order Bias (q)	2	3	4
BW Loc. Poly. (h)	3.618	4.027	5.706
BW Bias (b)	4.487	4.971	7.302

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in brackets.

Figure 3: Election in 2010



(a) Percentage of females in the council (b) Percentage of elected among females

4.2. Year 2014

We do not observe any discontinuity when we look at the municipal level (Tables 6 and 7). There are no differences in the fraction of females in the local council, nor there are any differences in the probabilities of being elected among female candidates.

Figure 4 shows the discontinuity in year 2014.

4.3. Year 2018

Finally, Tables 8 and 9 show the respective probabilities in the year 2018. As expected, gender quotas above the threshold indeed have their effect: in larger municipalities, there

Table 6: Percentage of females in the local council, Year 2014 $P(female|elected)$

	(1)	(2)	(3)
RD_Estimate	0.038 [0.043]	0.044 [0.053]	0.039 [0.070]
Robust 95% CI	[-.056 ; .146]	[-.073 ; .167]	[-.121 ; .188]
Kernel Type	Triangular	Triangular	Triangular
BW Type	CCT	CCT	CCT
Eff. Observations L	89	137	143
Eff. Observations R	53	79	84
Conventional p-value	0.375	0.406	0.583
Robust p-value	0.380	0.443	0.672
Order Loc. Poly. (p)	1	2	3
Order Bias (q)	2	3	4
BW Loc. Poly. (h)	2.825	4.051	4.240
BW Bias (b)	4.199	5.277	4.958

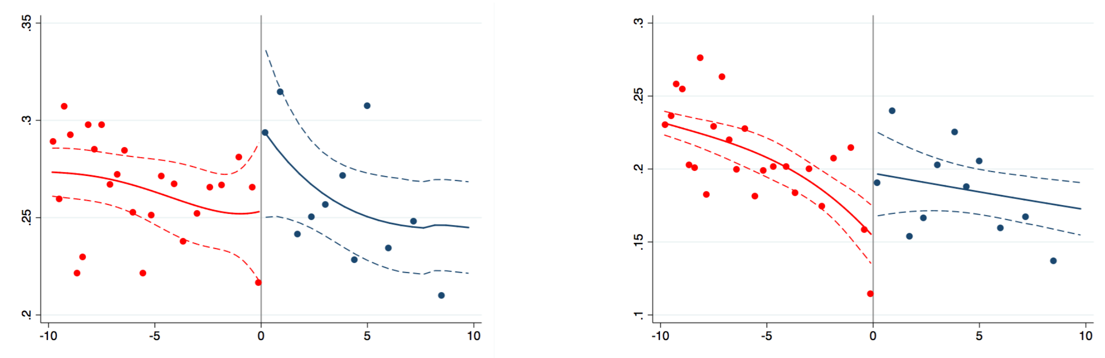
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in brackets.

Table 7: Percentage of elected among females in municipality, Year 2014 $P(elected|female)$

	(1)	(2)	(3)
RD Estimate	0.023 [0.025]	0.034 [0.031]	0.115*** [0.042]
Robust 95% CI	[-.039 ; .075]	[-.03 ; .105]	[.037 ; .213]
Kernel Type	Triangular	Triangular	Triangular
BW Type	CCT	CCT	CCT
Eff. Observations L	223	347	215
Eff. Observations R	114	134	113
Conventional p-value	0.352	0.279	0.006
Robust p-value	0.532	0.272	0.006
Order Loc. Poly. (p)	1	2	3
Order Bias (q)	2	3	4
BW Loc. Poly. (h)	5.920	7.798	5.780
BW Bias (b)	10.116	10.837	8.080

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in brackets.

Figure 4: Election in 2014



(a) Percentage of females in the council

(b) Percentage of elected among females

are about 7 to 10 percentage points more females in the council, than in the smaller ones. However, when we look at the inverted probability in Table 9, individual females have a *lower* chance of getting elected above the threshold. Above the threshold, percentage of elected among all female candidates is lower by some 8 percentage points. This suggests, that the quota has a "mechanical" effect on the females' election chances: it produces a larger pool of female candidates but it does not change the probability of being elected as a female.

Table 8: Percentage of females in the local council, Year 2018 $P(female|elected)$

	(1)	(2)	(3)
RD Estimate	0.076** [0.033]	0.107** [0.046]	0.138** [0.059]
Robust 95% CI	[.011 ; .16]	[.012 ; .215]	[.02 ; .269]
Kernel Type	Triangular	Triangular	Triangular
BW Type	CCT	CCT	CCT
Eff. Observations L	203	284	354
Eff. Observations R	110	127	135
Conventional p-value	0.021	0.020	0.019
Robust p-value	0.025	0.029	0.023
Order Loc. Poly. (p)	1	2	3
Order Bias (q)	2	3	4
BW Loc. Poly. (h)	5.619	6.941	7.983
BW Bias (b)	10.312	10.130	11.435

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in brackets.

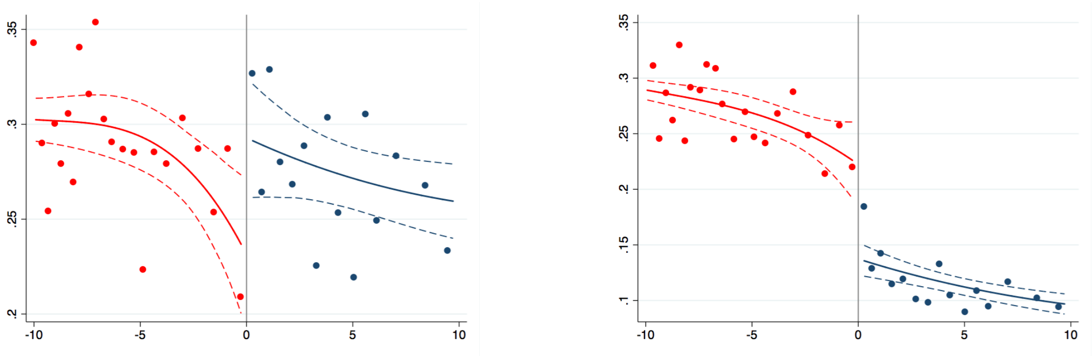
Figure 5 shows the discontinuity in year 2018.

Table 9: Percentage of elected among females in municipality, Year 2018 $P(elected|female)$

	(1)	(2)	(3)
RD Estimate	-0.088***	-0.073*	-0.052
	[0.024]	[0.035]	[0.045]
Robust 95% CI	[-.136 ; -.026]	[-.144 ; .008]	[-.142 ; .047]
Kernel Type	Triangular	Triangular	Triangular
BW Type	CCT	CCT	CCT
Eff. Observations L	316	426	506
Eff. Observations R	131	140	150
Conventional p-value	0.000	0.036	0.244
Robust p-value	0.004	0.081	0.323
Order Loc. Poly. (p)	1	2	3
Order Bias (q)	2	3	4
BW Loc. Poly. (h)	7.399	8.699	9.599
BW Bias (b)	12.966	13.220	13.507

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in brackets.

Figure 5: Election in 2018



(a) Percentage of females in the council (b) Percentage of elected among females

4.4. Difference in discontinuities: effect of the quota

Since the female quota has been introduced only in the municipalities above 20,000 inhabitants, we can directly look at its effect using the difference-in-discontinuities approach. Tables 10 and 11 present the estimation results. Introduction of the quota had a strong positive effect on the percentage of females elected to the local councils. Nevertheless, as it is clear from Table 11, this effect does not come from increasing the probability of being elected among female candidates.

Table 10: Percentage of females in the council, difference in discontinuities between 2010 and 2018

	(1)	(2)	(3)
DiD Estimate	0.113**	0.145**	0.157**
	[0.050]	[0.071]	[0.079]
Robust 95% CI	[.013 ; .212]	[.005 ; .284]	[.000 ; .313]
Kernel Type	Triangular	Triangular	Triangular
BW Type	CCT	CCT	CCT
Conventional p-value	0.022	0.030	0.037
Robust p-value	0.025	0.042	0.049
Order Loc. Poly. (p)	1	2	3
Order Bias (q)	2	3	4
BW Loc. Poly. (h)	7.289	8.159	11.227
BW Bias (b)	11.844	10.614	13.334

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in brackets.

Table 11: Percentage of elected among females in municipality, difference in discontinuities between 2010 and 2018

	(1)	(2)	(3)
DiD Estimate	0.029	0.028	0.043
	[0.044]	[0.057]	[0.063]
Robust 95% CI	[-.056; .114]	[-.071 ; .152]	[-.069 ; .177]
Kernel Type	Triangular	Triangular	Triangular
BW Type	CCT	CCT	CCT
Conventional p-value	0.579	0.561	0.492
Robust p-value	0.508	0.618	0.501
Order Loc. Poly. (p)	1	2	3
Order Bias (q)	2	3	4
BW Loc. Poly. (h)	6.980	8.686	12.585
BW Bias (b)	10.773	11.561	14.419

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in brackets.

5. Channels of transmission

5.1. Individual-level probabilities

The analysis so far, has concentrated on the aggregate outcome of the election, represented by the female representation in the municipal council. A question remains, however, whether the observed differences are reflected in individual-level probabilities. Appendix B analyzes this question in more depth, here we present a summary of the main results in graphic form. Summarizing, the following pattern emerges: in 2010, the majoritarian system was associated with higher individual probabilities of election for females, or of encountering a female among elected candidates. in 2018, the probability of encountering a females among elected candidates is higher in the proportional system, which can be attributed to the quota. However, an individual probability of a female being elected is still higher below the population threshold, which is in line with aggregate observations. This means, that the quota increases the pool of candidates but it is still more likely to become elected as a female in the majoritarian system.

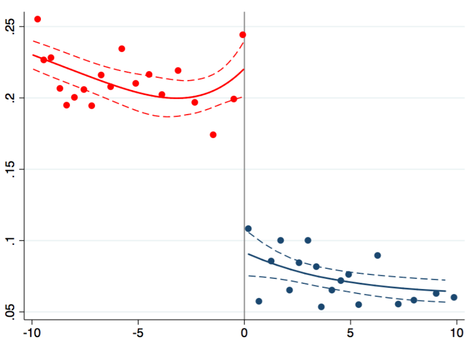
5.2. Female representation on electoral lists

As required by Equation 1, the conditional probability of encountering a female among candidates elected to local councils depends on two unconditional probabilities: $P(female)$, that is the fraction of females on electoral lists and $P(elected)$, the probability of getting elected. Both of these are potentially affected by the electoral rules.

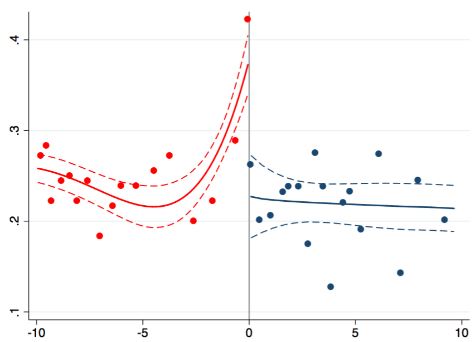
Figure 7 shows the percentage of females on electoral lists in 2010 and 2018.

Two conclusions can be made. Firstly, the fraction of females on the electoral lists does not differ between the two electoral systems in 2010. This means, that a priori, there is a comparable number of females who stand for election. Nevertheless, below 20,000 inhabitants, these females are by definition placed on the top of the list, while in the proportional representation system they are typically on lower places. Secondly, in 2018

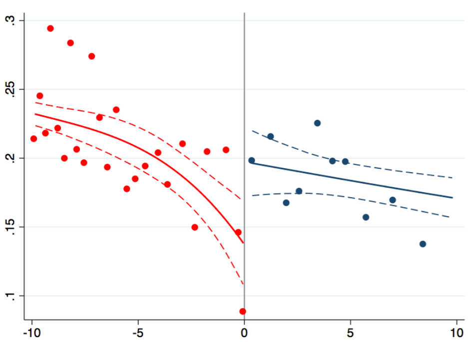
Figure 6: Individual-level probabilities



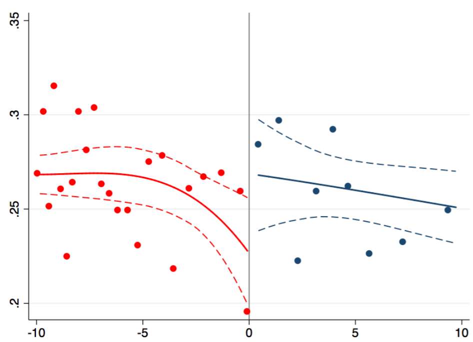
(a) Individual probability that a female candidate gets elected: 2010



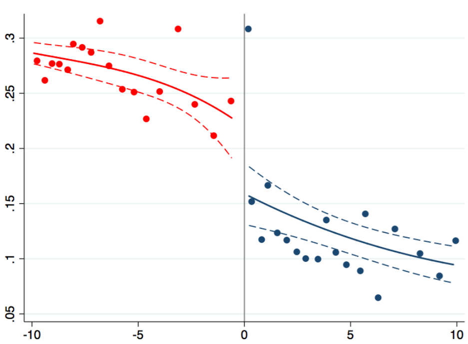
(b) Individual probability of encountering a female among elected: 2010



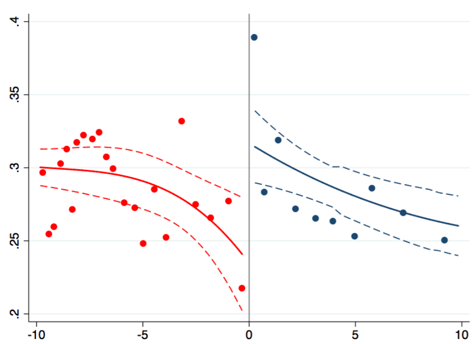
(c) Individual probability that a female candidate gets elected: 2014



(d) Individual probability of encountering a female among elected: 2014



(e) Individual probability that a female candidate gets elected: 2018



(f) Individual probability of encountering a female among elected: 2018

Table 12: Percentage of females on electoral lists: $P(female)$, municipality level, year 2010

	(1)	(2)	(3)
RD Estimate	-0.024	-0.030	-0.034
	[0.018]	[0.021]	[0.024]
Robust 95% CI	[-.069 ; .014]	[-.076 ; .016]	[-.086 ; .015]
Kernel Type	Triangular	Triangular	Triangular
BW Type	CCT	CCT	CCT
Eff. Observations L	57	105	161
Eff. Observations R	106	132	148
Conventional p-value	0.178	0.147	0.154
Robust p-value	0.201	0.196	0.169
Order Loc. Poly. (p)	1	2	3
Order Bias (q)	2	3	4
BW Loc. Poly. (h)	5.321	8.047	10.086
BW Bias (b)	8.130	10.477	12.147

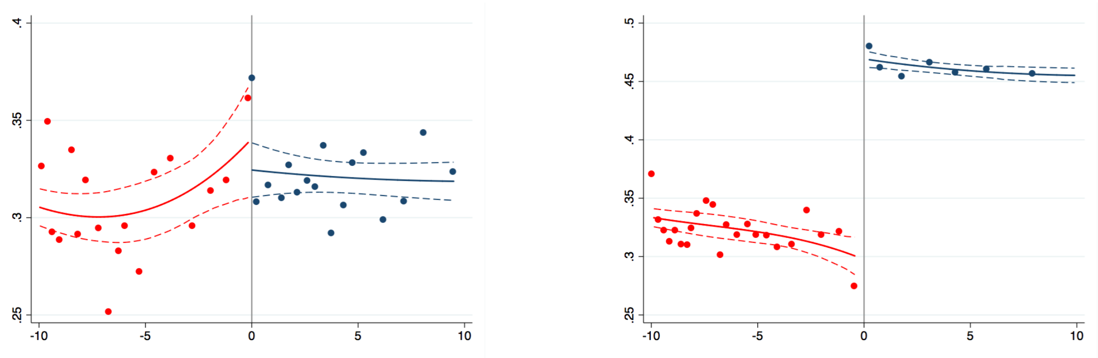
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in brackets.

Table 13: Percentage of females on electoral lists: $P(female)$, municipality level, year 2018

	(1)	(2)	(3)
RD Estimate	0.172***	0.200***	0.224***
	[0.016]	[0.023]	[0.030]
Robust 95% CI	[.14 ; .213]	[.157 ; .256]	[.169 ; .292]
Kernel Type	Triangular	Triangular	Triangular
BW Type	CCT	CCT	CCT
Eff. Observations L	184	210	237
Eff. Observations R	98	112	120
Conventional p-value	0.000	0.000	0.000
Robust p-value	0.000	0.000	0.000
Order Loc. Poly. (p)	1	2	3
Order Bias (q)	2	3	4
BW Loc. Poly. (h)	5.200	5.719	6.364
BW Bias (b)	8.726	8.906	9.450

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in brackets.

Figure 7: Percentage of females on electoral lists



(a) 2010 (b) 2018

there is a significant jump at the 20,000 threshold. The size of the effect is at about 20 percentage points. Difference in discontinuities results (Table 14) further show, that more than 10 percentage points can be attributed to the introduction of the female quota.

Table 14: Percentage of females on electoral lists, difference in discontinuities between 2010 and 2018

	(1)	(2)	(3)
DiD Estimate	0.120***	0.137***	0.164***
	[0.041]	[0.044]	[0.051]
Robust 95% CI	[.039 ; .201]	[.049 ; .224]	[.061 ; .265]
Kernel Type	Triangular	Triangular	Triangular
BW Type	CCT	CCT	CCT
Conventional p-value	0.002	0.002	0.002
Robust p-value	0.003	0.002	0.002
Order Loc. Poly. (p)	1	2	3
Order Bias (q)	2	3	4
BW Loc. Poly. (h)	2.891	4.822	5.769
BW Bias (b)	4.714	6.734	7.208

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in brackets.

5.3. Probability of election

The second unconditional probability, $P(elected)$ defines the overall probability of being elected from a totality of candidates in a municipality, independent of gender. As we can see from Tables 15 and 16, there is visible jump in the election probability at the 20,000 threshold.

Table 15: Probability of election, year 2010: $P(elected)$

	(1)	(2)	(3)
RD Estimate	-0.095*** [0.013]	-0.098*** [0.017]	-0.081*** [0.021]
Robust 95% CI	[-.126 ; -.065]	[-.135 ; -.059]	[-.12 ; -.032]
Kernel Type	Triangular	Triangular	Triangular
BW Type	CCT	CCT	CCT
Eff. Observations L	6235	7154	6689
Eff. Observations R	21799	23929	22622
Conventional p-value	0.000	0.000	0.000
Robust p-value	0.000	0.000	0.001
Order Loc. Poly. (p)	1	2	3
Order Bias (q)	2	3	4
BW Loc. Poly. (h)	6.879	7.665	7.246
BW Bias (b)	9.360	9.344	9.633

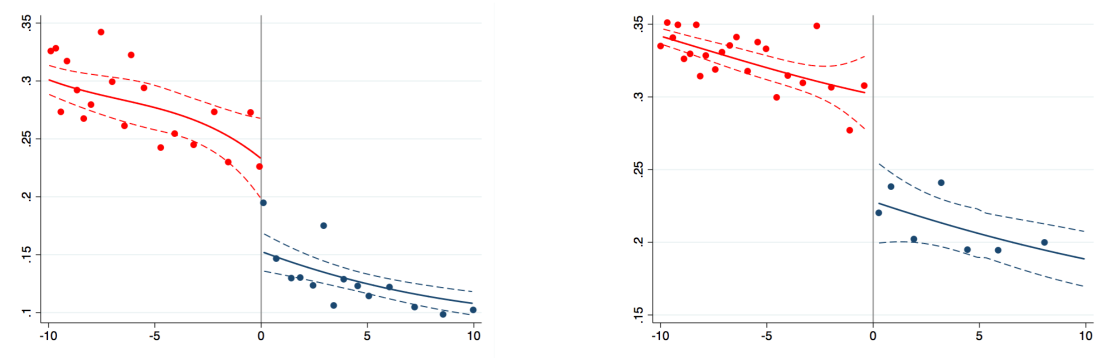
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in brackets.

Table 16: Probability of election, year 2018: $P(elected)$

	(1)	(2)	(3)
RD_Estimate	-0.063*** [0.013]	-0.056*** [0.015]	-0.052* [0.021]
Robust 95% CI	[-.088 ; -.03]	[-.086 ; -.019]	[-.096 ; -.006]
Kernel Type	Triangular	Triangular	Triangular
BW Type	CCT	CCT	CCT
Eff. Observations L	11185	21914	23247
Eff. Observations R	13009	16312	16634
Conventional p-value	0.000	0.000	0.013
Robust p-value	0.000	0.002	0.026
Order Loc. Poly. (p)	1	2	3
Order Bias (q)	2	3	4
BW Loc. Poly. (h)	6.039	9.297	9.570
BW Bias (b)	10.744	14.073	13.238

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in brackets.

Figure 8: Probability of election



(a) 2010 (b) 2018

5.4. Partisanship

In Kantorowicz and Köppl-Turyna (2019), we show that the 20,000 population threshold is responsible for a jump in partisanship of local councils. In particular, it can be established that the proportional system is associated with a much higher percentage of local councilors and mayors who are members of nation-wide parties, as opposed to independent voter committees which prevail in the majoritarian system. We link this observation to lower costs of participation in elections below the threshold. The question arises of whether the observed patterns with regard to female participation can be linked to different partisanship. To answer this question we calculate the percentage of females in the electoral council, looking separately at candidates elected from independent lists vs nation-wide parties. Tables 17 to 22, and Figures 9 and 10 present the results.

According to the results, partisanship is an important driver of the results. In year 2010, no difference can be observed in the percentage of councillors from independent committees in the two systems. Difference in year 2018, which is a result of the female quota, is also weaker than in the case of all councillors. The latter results, is also confirmed by the difference-in-discontinuities estimates, which show that the quota had a much weaker effect on the independent committees. On the other hand, taking only the members of the council elected from nation-wide countries, the effects are much stronger than the overall effect.

Above the threshold in 2010, there are almost 20 percentage points less females elected from nation-wide parties. This effect disappears completely in 2018 and no discontinuity is present. The difference-in-discontinuity result points to a strong and significant change as a result of the quota. Thus, the quota has primarily an effect on nation-wide parties, where less females are present. In 2018, the quota has just barely equalized the share of females between the systems, when it comes to nation-wide candidates.

Table 17: Percentage of females in the council elected from independent committees, year 2010

	(1)	(2)	(3)
RD Estimate	-0.038	-0.066	-0.082
	[0.050]	[0.065]	[0.073]
Robust 95% CI	[-.165 ; .066]	[-.22 ; .063]	[-.245 ; .063]
Kernel Type	Triangular	Triangular	Triangular
BW Type	CCT	CCT	CCT
Eff. Observations L	81	111	159
Eff. Observations R	112	123	137
Conventional p-value	0.449	0.308	0.260
Robust p-value	0.401	0.280	0.248
Order Loc. Poly. (p)	1	2	3
Order Bias (q)	2	3	4
BW Loc. Poly. (h)	5.985	7.235	8.988
BW Bias (b)	8.979	9.157	10.265

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in brackets.

Table 18: Percentage of females in the council elected from independent committees, year 2018

	(1)	(2)	(3)
RD Estimate	0.083**	0.113*	0.123
	[0.041]	[0.061]	[0.076]
Robust 95% CI	[.002 ; .19]	[-.018 ; .259]	[-.04 ; .289]
Kernel Type	Triangular	Triangular	Triangular
BW Type			
Eff. Observations L	230	308	474
Eff. Observations R	118	130	146
Conventional p-value	0.040	0.062	0.104
Robust p-value	0.045	0.088	0.138
Order Loc. Poly. (p)	1	2	3
Order Bias (q)	2	3	4
BW Loc. Poly. (h)	6.198	7.410	9.424
BW Bias (b)	11.129	10.502	12.726

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in brackets.

Table 19: Percentage of females in the council elected from independent committees, difference in discontinuities between 2010 and 2018

	(1)	(2)	(3)
DiD Estimate	.151*	.159*	.129
	[0.076]	[0.095]	[0.133]
Robust 95% CI	[.001; .300]	[-.028; .347]	[-.132; .391]
Kernel Type	Triangular	Triangular	Triangular
BW Type	CCT	CCT	CCT
Conventional p-value	0.032	0.067	0.218
Robust p-value	0.048	0.097	0.334
Order Loc. Poly. (p)	1	2	3
Order Bias (q)	2	3	4
BW Loc. Poly. (h)	7.099	9.545	8.826
BW Bias (b)	11.277	12.708	11.080

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in brackets.

Table 20: Percentage of females in the council elected from nation-wide parties, year 2010

	(1)	(2)	(3)
RD Estimate	-0.199***	-0.212***	-0.243***
	[0.067]	[0.068]	[0.076]
Robust 95% CI	[-.371 ; -.077]	[-.376 ; -.089]	[-.419;-.098]
Kernel Type	Triangular	Triangular	Triangular
BW Type	CCT	CCT	CCT
Eff. Observations L	86	254	426
Eff. Observations R	76	124	141
Conventional p-value	0.003	0.002	0.001
Robust p-value	0.003	0.002	0.002
Order Loc. Poly. (p)	1	2	3
Order Bias (q)	2	3	4
BW Loc. Poly. (h)	4.003	8.306	10.808
BW Bias (b)	7.071	12.801	14.143

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in brackets.

Table 21: Percentage of females in the council elected from nation-wide parties, year 2018

	(1)	(2)	(3)
RD Estimate	0.105	0.111	0.124
	[0.071]	[0.111]	[0.125]
Robust 95% CI	[-.055 ; .28]	[-.143 ; .365]	[-.148 ; .409]
Kernel Type	Triangular	Triangular	Triangular
BW Type	CCT	CCT	CCT
Eff. Observations L	204	233	467
Eff. Observations R	117	122	150
Conventional p-value	0.138	0.317	0.322
Robust p-value	0.189	0.393	0.359
Order Loc. Poly. (p)	1	2	3
Order Bias (q)	2	3	4
BW Loc. Poly. (h)	7.963	8.389	11.984
BW Bias (b)	12.201	11.506	15.210

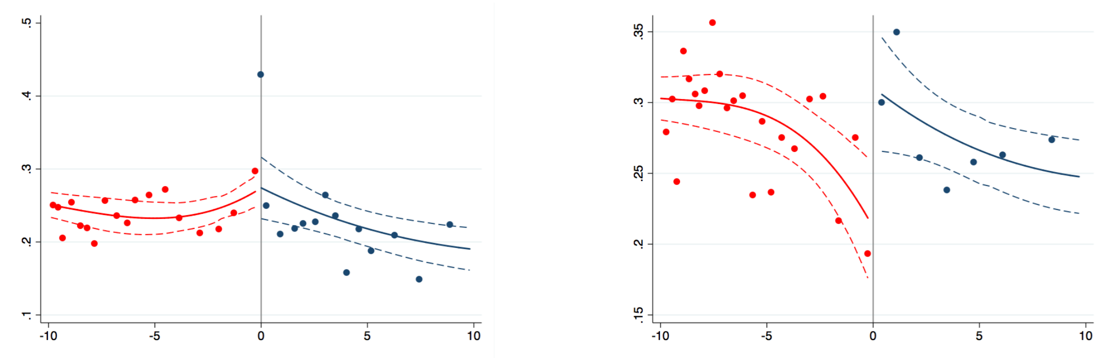
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in brackets.

Table 22: Percentage of females in the council elected from nation-wide parties, difference in discontinuities between 2010 and 2018

	(1)	(2)	(3)
DiD Estimate	0.268***	0.311***	0.382***
	[0.119]	[0.136]	[0.160]
Robust 95% CI	[.075; .543]	[.075; .612]	[.068; .697]
Kernel Type	Triangular	Triangular	Triangular
BW Type	CCT	CCT	CCT
Conventional p-value	0.008	0.008	0.014
Robust p-value	0.009	0.012	0.017
Order Loc. Poly. (p)	1	2	3
Order Bias (q)	2	3	4
BW Loc. Poly. (h)	6.021	9.895	13.148
BW Bias (b)	10.135	13.103	15.348

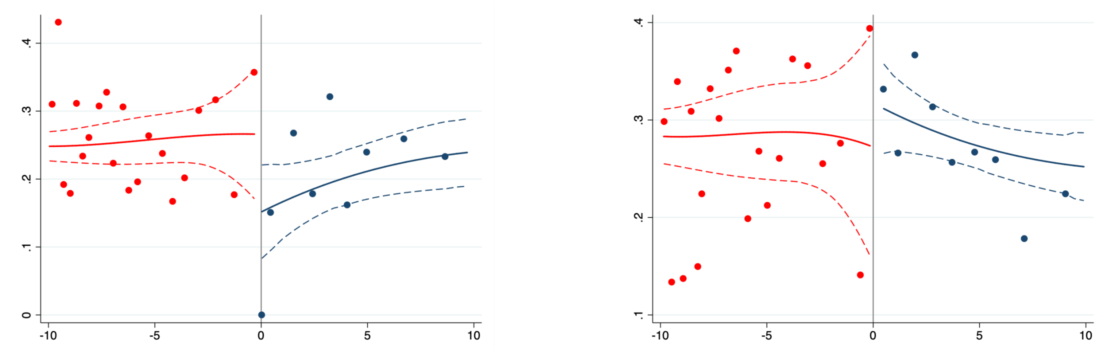
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in brackets.

Figure 9: Percentage of females in council elected from independent committees



(a) 2010 (b) 2018

Figure 10: Percentage of females in council elected from nation-wide parties



(a) 2010 (b) 2018

5.5. The effect of the quota on list placements

Did the female quota introduced in 2018 affect how women are placed on electoral lists, and how many votes they receive? To answer this question, we look at the relative placement of females on lists, the voter rankings and the relative change in the placement of females between the electoral list and the voter ranking. To do so, first, we normalize the placements. As the lengths of electoral lists are different, we normalize the position on the list with respect to the list length: *relative position* is defined as the actual position divided by the length of the electoral list, in which a lower number corresponds to a higher position on the electoral list. Similarly, we define the *relative voter ranking* within a particular list, as the ranking of votes divided through the list length. Finally, a *relative change* of placement as *relative voter ranking-relative position*, in which a positive number corresponds to worse ranking by the voters compared to the list placement.

Tables 23, 24, and 25 present the results.

Table 23: Relative list placement, difference in discontinuities between 2010 and 2018

	(1)	(2)	(3)
DiD Estimate	-0.133***	-0.126***	-0.172***
	[0.029]	[0.028]	[0.039]
Robust 95% CI	[-.189 ; -.077]	[-.181 ; -.070]	[-.250 ; -.093]
Kernel Type	Triangular	Triangular	Triangular
BW Type	CCT	CCT	CCT
Conventional p-value	0.000	0.000	0.000
Robust p-value	0.000	0.000	0.000
Order Loc. Poly. (p)	1	2	3
Order Bias (q)	2	3	4
BW Loc. Poly. (h)	3.738	8.353	6.185
BW Bias (b)	7.263	11.883	8.301

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in brackets.

Table 24: Relative voter ranking, difference in discontinuities between 2010 and 2018

	(1)	(2)	(3)
DiD Estimate	-0.127***	-0.124***	-0.133 ***
	[0.031]	[0.032]	[0.037]
Robust 95% CI	[-.188 ; -.069]	[-.186 ; -.062]	[-.205 ; -.0.061]
Kernel Type	Triangular	Triangular	Triangular
BW Type	CCT	CCT	CCT
Conventional p-value	0.000	0.000	0.000
Robust p-value	0.000	0.000	0.000
Order Loc. Poly. (p)	1	2	3
Order Bias (q)	2	3	4
BW Loc. Poly. (h)	3.287	6.148	7.727
BW Bias (b)	6.146	9.941	10.143

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in brackets.

The difference-in-discontinuities coefficient on the relative list placement is remarkably stable. Across all specifications, introduction of the female quota improved the average position of females by more than 0.135, which corresponds to about one position in a list

Table 25: Relative change, difference in discontinuities between 2010 and 2018

	(1)	(2)	(3)
DiD Estimate	0.016	0.021	0.022
	[0.026]	[0.032]	[0.039]
Robust 95% CI	[-.036 ; .067]	[-.040 ; .080]	[-.054 ; .098]
Kernel Type	Triangular	Triangular	Triangular
BW Type	CCT	CCT	CCT
Conventional p-value	0.433	0.537	0.560
Robust p-value	0.548	0.509	0.573
Order Loc. Poly. (p)	1	2	3
Order Bias (q)	2	3	4
BW Loc. Poly. (h)	5.702	7.480	8.2411
BW Bias (b)	8.525	9.719	9.804

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in brackets.

of length eight. At the third order polynomial, the predicted effect is even higher: one position on a list of length six. The coefficient on the relative voter placement also shows a strong a consistent jump at the threshold of a similar size to the relative list placements. This suggests that the voters are not biased against (or towards) females, and they do not place them lower (or higher) than their relative placements on the electoral lists. The latter result is confirmed by the insignificant coefficient on the relative change of placement between the list and the voter ranking. The quota did not have an effect on the voter bias - neither a positive nor a negative one. Voters rank the females in the same positions as their list placements also after an introduction of the quota.

5.6. Spillovers to neighboring municipalities

The female quota has a mechanical effect on the number of females on the electoral lists, as shown in Table 13. An interesting question remains, of whether the quota affects the chances of females in neighboring municipalities. Interactions between inhabitants of neighboring municipalities may raise awareness of a higher number of females on the lists. In order to analyze this channel, we analyze existence of spatial spillovers between the municipalities with female quotas in 2018 and the neighboring borrows. Several specifications are tested, with different weighting matrices and different distance thresholds. Here we present the results, for which a threshold of 30 kilometers is used in the adjacency matrix [7]. Tables 26 and 27, show the percentage of females in the council and the percentage of elected among females in those municipalities, which themselves do not have a quota but border a municipality with a quota (or a one without). Tables show no effect at all: existence of female quotas in neighboring municipalities does not anyhow affect the chances of females.

Table 26: Percentage of females in the council, year 2018, RD on neighbors' population

	(1)	(2)	(3)
RD Estimate	-0.005	-0.013	-0.015
	[0.015]	[0.017]	[0.020]
Robust 95% CI	[-.044 ; .023]	[-.052 ; .019]	[-.059 ; .024]
Kernel Type	Triangular	Triangular	Triangular
BW Type	CCT	CCT	CCT
Eff. Observations L	1275	2907	4664
Eff. Observations R	729	1125	1213
Conventional p-value	0.724	0.450	0.463
Robust p-value	0.554	0.367	0.407
Order Loc. Poly. (p)	1	2	3
Order Bias (q)	2	3	4
BW Loc. Poly. (h)	4.304	7.248	9.414
BW Bias (b)	8.334	13.912	16.120

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in brackets.

6. Robustness analysis

As mentioned before, one of the assumptions of a valid RD design is a lack of confounding factors. At the analyzed threshold of 20,000, the causal interpretation of our results could be confounded by the change in the size of the council. Nevertheless, given that the size of the council increases at the 20,000 threshold, we see no reason to believe that this would somehow *decrease* the chances of women for being elected, given that they are

[7]Further results, upon request, show similar patterns

Table 27: Percentage of elected among females, year 2018, RD on neighbors' population

	(1)	(2)	(3)
RD Estimate	-0.000	-0.002	0.004
	[0.013]	[0.016]	[0.022]
Robust 95% CI	[-.032 ; .026]	[-.039 ; .031]	[-.041 ; .05]
Kernel Type	Triangular	Triangular	Triangular
BW Type	CCT	CCT	CCT
Eff. Observations L	1887	3147	3608
Eff. Observations R	851	1149	1156
Conventional p-value	0.996	0.880	0.868
Robust p-value	0.843	0.835	0.859
Order Loc. Poly. (p)	1	2	3
Order Bias (q)	2	3	4
BW Loc. Poly. (h)	5.397	7.530	8.123
BW Bias (b)	9.806	12.535	12.757

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in brackets.

typically placed lower at electoral lists. This suggests, that if anything, our results *under-estimate* the effect of the electoral system. At the 50,000 inhabitants threshold, there is a further increase in the size of the council and we will look at the change in female representation at this threshold. While not a definitive proof, no change in female representation at this threshold is a tentative evidence of validity. As there are much fewer municipalities around the 50,000 mark, we combine years 2010 and 2018 for this analysis. Tables C.34 and C.35 in the Appendix show the results. No visible discontinuity is present, but since there are only a few observations available, these results could be not precise.

The size of the council has, however, one more effect. It indirectly affects the impact of the percentage of females on electoral lists $P(female)$, as the same percentage of females is elected to councils of different sizes. As a robustness check, we therefore look at the *number of female candidates per seat*, in which we normalize the number of females by the size of the council. The results are shown in Tables C.40 and C.41 in the Appendix, and show that the different council sizes do not play a role, as also in this specification we do not see any differences between the number of females per seat in 2010, and a significant jump in the year 2018.

The results of the log-logit transformation model for the municipal level in 2010 are presented in Tables C.36 and C.37 in the Appendix and confirm the main conclusions. When it comes to 2018, Table C.39 shows confirmation of the main result, when it comes to the percentage of elected among females, which remains higher in the majoritarian system. However, Table C.38 shows that the percentage of females in the council is not necessarily higher in the proportional system, after the loglogit transformation has been applied. This means, that the quota had an effect on improving the female representation, but not necessarily above the level, which has been achieved through the majoritarian election.

Figure C.12 shows the sensitivity of the regression discontinuity estimate for the percentage of females in the council in years 2010 and 2018 to the choice of bandwidth. As can be observed, the results are very stable across bandwidths between 1,000 and 10,000 inhabitants. Similarly, Figure C.13 shows that the coefficient on the difference in discontinuity (the effect of the quota) is stable across bandwidth lengths.

7. Conclusions

Our results have important policy implications. Contrary to the literature for national level elections, we find that single-seat districts might be a better choice for promoting female representation. Firstly, in majoritarian elections, women have lower costs of entering the electoral race. Secondly, because the majoritarian elections give women opportunity to free themselves from party nomination procedures and intra–party competition. The latter conjecture is clearly visible in our data: much fewer females are elected from nation-wide parties compared to independent committees, and nation-wide parties are more prevalent in proportional elections.

We also show that implementing a binding gender quota helps increase the representation of females. Yet, the effect here does not come from changing the probability of each female being elected, but simply through increasing the pool of eligible females. Even in the quota system, the probability of each female being elected to the council is still higher in the majoritarian system. For the case of nation-wide parties, the quota also barely raises the percentage of females in the council to the level achieved in single-seat districts. This raises a question of which policy should be used to promote female representation in politics. It seems that, in our set-up, majoritarian election is at least as good as a tool for increasing the pool of females in the municipal councils as an introduction of a quota. And, given some previous results in the literature, majoritarian elections promoting independent committees might be more favorable to other aspects of local governance, such us e.g., less vertical fiscal imbalances.

The natural–experiment setup, which we exploit in this study, ensures high internal validity, which is typically not given in previous analyses of the topic. Yet, because we estimate the local average treatment effect (around threshold of 20,000) and because we examine sub-national electoral systems, we caution against generalization of the results to the central level elections.

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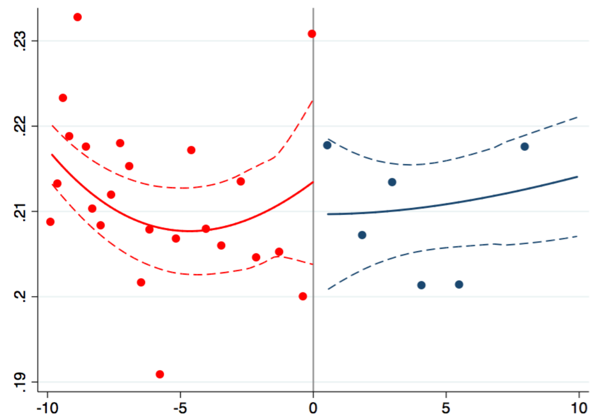
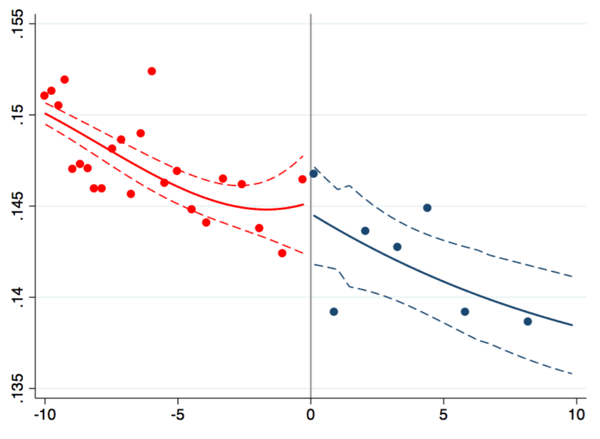
Appendix A. Continuity of covariates

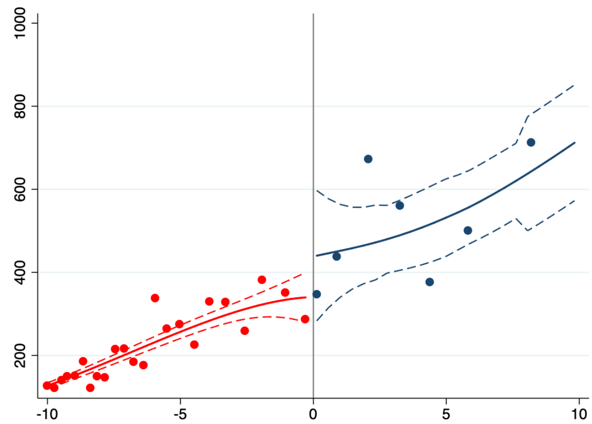
Figure A.11: Continuity of the covariates



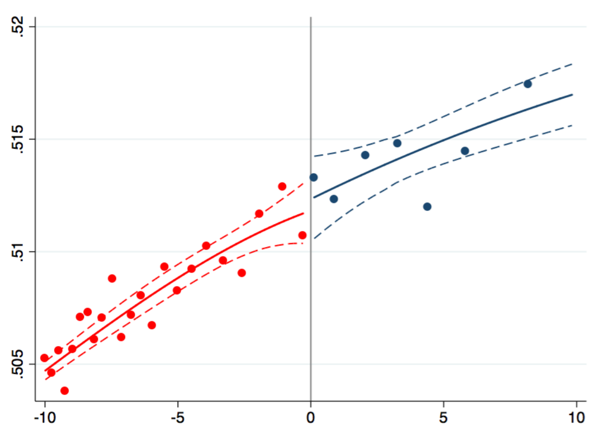
(a) Older population



(b) Young population



(c) Population density



(d) Percentage of females

Appendix B. Estimations at the individual level

Appendix B.1. Year 2010

At the individual level, we need to estimate the binary choice of whether a female candidate is elected or not, or respectively, whether a elected candidate is a female. In this case, the dependent variable is binary, and we can apply a RD binary outcome model.

For a categorical outcome model, which *a fortiori* can be applied to the binary outcome model, we have for an individual i and the outcome $\tilde{Y}_i$, which can take a value that belongs to $(J+1)$ mutually exclusive categories. In a (sharp) RD design, the binary treatment T_i is driven by a continuous variable $X_i \in R$ and a cutoff c, that is $T_i = \mathbf{1}(X_i \geq c)$. Let $\tilde{Y}_i(1)$ and $\tilde{Y}_i(0)$ be the potential outcomes for the treated ($T_i = 1$) and untreated ($T_i = 0$) groups, respectively. For j, the conditional outcome probabilities for the two groups are

$$
\begin{aligned}
\mathbb{P}(\tilde{Y}_i(1) = j|X_i = x) = \mu_{+,j}(x) \\
\mathbb{P}(\tilde{Y}_i(0) = j|X_i = x) = \mu_{-,j}(x),
\end{aligned}
\tag{B.1}
$$

where the continuous functions $\mu(\cdot)$ are unknown. The average treatment effect τ can be defined as

$$
\begin{aligned}
\tau_j =& \mathbb{P}(\tilde{Y}_i(1) = j|X_i = c) - \mathbb{P}(\tilde{Y}_i(0) = j|X_i = c) \\
& \mu_{+,j}(c) - \mu_{-,j}(c) \\
& \lim_{x \to c+} \mathbb{P}(\tilde{Y}_i = j|X_i = x) - \lim_{x \to c-} \mathbb{P}(\tilde{Y}_i = j|X_i = x).
\end{aligned}
\tag{B.2}
$$

While estimation of $\hat{\tau}_j$ can be performed using the standard non-parametric approach of Calonico et al. (2014), as mentioned by Xu (2017) the bandwidth selecting procedure by Imbens and Kalyanaraman (2012) which is developed for the local linear estimator becomes suboptimal (still with the optimal rate though) for the local nonlinear estimator of the probability function. Moreover, the bias corrector and the robust standard error under bias correction proposed by Calonico et al. (2014) no longer apply. Thus, for the binary outcome models we additionally use the procedures proposed by Xu (2017). Xu

(2017) proposes both, a bandwidth selection algorithm, and a robust estimator of the average treatment effect. In general, in the CCT specifications we apply the triangular kernel, as it leads to optimal variance and bias properties. While the choice of kernel typically should not affect the results too much, in those cases, in which estimation with linear kernel point to different conclusions, we shall report both.

According to Table B.28, the probability of a female candidate being elected is about 12 percentage points higher in the majoritarian system, or 14 percentage points if we consider the second-order or a third-order polynomial. All results are significant at 1% level. Similarly, the results of the binary choice model point to the effect of 12.5 percentage points, significant at the 1% level.

Similarly, the probability of encountering a female among elected candidates is also higher by about 9 to 13 percentage points in the majoritarian system, significant at 5% level. The results is less clear-cut for the binary choice model, but nevertheless significant at 10% level (when considering the robust standard errors).

Table B.28: Probability that a female candidate gets elected: $P(elected|female)$, linear (polynomial) probability model in (1)-(3), categorical outcomes model in (4), Year 2010

	(1)	(2)	(3)	(4)
RD Estimate	-0.120***	-0.137***	-0.139***	-0.125***
	[0.023]	[0.029]	[0.031]	[0.024]
Robust 95% CI	[-.179 ; -.074]	[-.21 ; -.081]	[-.211 ; -.0 $>$ 76]	[-.181, -.087]
Kernel Type	Triangular	Triangular	Triangular	Uniform
BW Type	CCT	CCT	CCT	Xu (2017)
Eff. Observations L	1768	2152	4016	1215
Eff. Observations R	6913	7741	9199	5391
Conventional p-value	0.000	0.000	0.020	0.000
Robust p-value	0.000	0.002	0.063	0.000
Order Loc. Poly. (p)	1	2	3	1
Order Bias (q)	2	3	4	2
BW Loc. Poly. (h)	6.459	7.718	10.673	4.606
BW Bias (b)	9.337	9.298	12.077	9.514

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in brackets.

Table B.29: Probability of encountering a female among elected: $P(female|elected)$, linear (polynomial) probability model in (1)-(3), categorical outcomes model in (4), Year 2010

	(1)	(2)	(3)	(4)
RD Estimate	-0.089**	-0.090**	-0.134**	-0.062*
	[0.038]	[0.040]	[0.053]	[0.044]
Robust 95% CI	[0.038]	[0.040]	[0.053]	[-.162, .009]
Kernel Type	Triangular	Triangular	Triangular	Uniform
BW Type	CCT	CCT	CCT	Xu (2017)
Eff. Observations L	960	2325	2025	1215
Eff. Observations R	2100	2898	2793	2352
Conventional p-value	0.019	0.025	0.012	0.009
Robust p-value	0.023	0.032	0.010	0.081
Order Loc. Poly. (p)	1	2	3	1
Order Bias (q)	2	3	4	2
BW Loc. Poly. (h)	4.897	8.890	8.228	5.901
BW Bias (b)	7.508	10.860	10.030	9.534

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in brackets.

Appendix B.2. Year 2014

Tables B.30 and B.31 present the results of the regression discontinuity estimations for the year 2014 at the individual level. In both cases, we do not observe any discontinuity at the 20,000 threshold. Only in specification (4) in Table B.30 the result is significant, however, given all other results this seems to be a rouge result.

Table B.30: Probability that a female candidate gets elected: $P(elected|female)$, linear (polynomial) probability model in (1)-(3), categorical outcomes model in (4), Year 2014

	(1)	(2)	(3)	(4)
RD Estimate	0.069	0.065	0.089	0.089***
	[0.042]	[0.048]	[0.062]	[0.036]
Robust 95% CI	[-.029 , .169]	[-.046 , .166]	[-.031 , .233]	[.035, .177]
Kernel Type	Triangular	Triangular	Triangular	Uniform
BW Type	CCT	CCT	CCT	Xu (2017)
Eff. Observations L	989	1371	1320	1212
Eff. Observations R	488	927	927	927
Conventional p-value	0.101	0.179	0.152	0.000
Robust p-value	0.165	0.266	0.134	0.003
Order Loc. Poly. (p)	1	2	3	1
Order Bias (q)	2	3	4	2
BW Loc. Poly. (h)	1.297	2.020	1.930	1.796
BW Bias (b)	1.797	2.674	2.561	6.618

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in brackets.

Table B.31: Probability of encountering a female among elected: $P(female|elected)$, linear (polynomial) probability model in (1)-(3), categorical outcomes model in (4), Year 2014

	(1)	(2)	(3)	(4)
RD Estimate	0.024 [0.026]	0.026 [0.033]	0.053 [0.045]	0.065 [0.076]
Robust 95% CI	[-.04 ; .085]	[-.047 ; .104]	[-.037 ; .156]	[-.065, .234]
Kernel Type	Triangular	Triangular	Triangular	Uniform
BW Type	CCT	CCT	CCT	Xu (2017)
Eff. Observations L	3985	6523	5217	1279
Eff. Observations R	2562	2940	2835	1013
Conventional p-value	0.355	0.428	0.237	0.021
Robust p-value	0.484	0.456	0.225	0.270
Order Loc. Poly. (p)	1	2	3	1
Order Bias (q)	2	3	4	2
BW Loc. Poly. (h)	6.710	9.049	8.018	2.672
BW Bias (b)	10.085	11.224	10.129	3.571

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in brackets.

Appendix B.3. Year 2018

Table B.32: Probability that a female candidate gets elected: $P(elected|female)$, linear (polynomial) probability model in (1)-(3), categorical outcomes model in (4), Year 2018

	(1)	(2)	(3)	(4)
RD Estimate	-0.081*** [0.019]	-0.068** [0.025]	-0.063* [0.030]	-0.088*** [0.020]
Robust 95% CI	[-.116 ; -.03]	[-.118 ; -.007]	[-.125 ; .006]	[-0.120; -0.042]
Kernel Type	Triangular	Triangular	Triangular	Uniform
BW Type	CCT	CCT	CCT	Xu (2017)
Eff. Observations L	3724	6239	9460	5357
Eff. Observations R	6005	7088	8275	6873
Conventional p-value	0.000	0.007	0.037	0.000
Robust p-value	0.001	0.028	0.076	0.000
Order Loc. Poly. (p)	1	2	3	1
Order Bias (q)	2	3	4	2
BW Loc. Poly. (h)	6.251	8.492	10.818	7.829
BW Bias (b)	11.718	12.115	14.086	36.755

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in brackets.

In line with the aggregated results, individual level probabilities show that the majoritarian system is still associated with a higher individual probability of being elected as a female (Table B.32). However, a probability of encountering a female among elected candidates is now higher in the proportional system, due to the female quota in place. (Table

Table B.33: Probability of encountering a female among elected: $P(female|elected)$, linear (polynomial) probability model in (1)-(3), categorical outcomes model in (4), Year 2018

	(1)	(2)	(3)	(4)
RD Estimate	0.072**	0.101**	0.129**	0.089***
	[0.028]	[0.038]	[0.050]	[0.036]
Robust 95% CI	[.02 ; .144]	[.023 ; .19]	[.029 ; .24]	[.035, .177]
Kernel Type	Triangular	Triangular	Triangular	Uniform
BW Type	CCT	CCT	CCT	Xu (2017)
Eff. Observations L	3004	4171	5038	1212
Eff. Observations R	2331	2688	2814	927
Conventional p-value	0.010	0.008	0.009	0.000
Robust p-value	0.009	0.013	0.012	0.003
Order Loc. Poly. (p)	1	2	3	1
Order Bias (q)	2	3	4	2
BW Loc. Poly. (h)	5.689	7.119	8.017	1.796
BW Bias (b)	11.180	10.778	11.697	6.618

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in brackets.

B.33).

Appendix C. Additional Tables and Figures

Table C.34: Percentage of females in the council at the placebo 50,000 threshold

	(1)	(2)	(3)
RD Estimate	0.003	0.026	0.048
	[0.090]	[0.121]	[0.153]
Robust 95% CI	[-.202 ; .212]	[-.228 ; .325]	[-.283 ; .394]
Kernel Type	Triangular	Triangular	Triangular
BW Type	CCT	CCT	CCT
Eff. Observations L	27	42	51
Eff. Observations R	17	21	25
Conventional p-value	0.974	0.829	0.754
Robust p-value	0.961	0.730	0.748
Order Loc. Poly. (p)	1	2	3
Order Bias (q)	2	3	4
BW Loc. Poly. (h)	4.145	5.265	6.171
BW Bias (b)	6.796	6.831	7.372

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in brackets.

Table C.35: Elected among females in a municipality at the placebo 50,000 threshold

	(1)	(2)	(3)
RD_Estimate	0.002	0.019	0.039
	[0.041]	[0.042]	[0.067]
Robust 95% CI	[-.073 ; .102]	[-.06 ; .116]	[-.106 ; .185]
Kernel Type	Triangular	Triangular	Triangular
BW Type	CCT	CCT	CCT
Eff. Observations L	22	31	26
Eff. Observations R	14	18	17
Conventional p-value	0.960	0.658	0.554
Robust p-value	0.748	0.531	0.592
Order Loc. Poly. (p)	1	2	3
Order Bias (q)	2	3	4
BW Loc. Poly. (h)	3.003	4.362	3.983
BW Bias (b)	4.792	6.503	6.063

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in brackets.

Table C.36: Percentage of females in the council, year 2010, log-logit transformation

	(1)	(2)	(3)
RD Estimate	-0.638**	-0.672**	-0.824**
	[0.264]	[0.289]	[0.346]
Robust 95% CI	[-1.304 ; -.138]	[-1.375 ; -.113]	[-1.634 ; -.147]
Kernel Type	Triangular	Triangular	Triangular
BW Type	CCT	CCT	CCT
Eff. Observations L	57	118	148
Eff. Observations R	88	125	133
Conventional p-value	0.016	0.020	0.017
Robust p-value	0.015	0.021	0.019
Order Loc. Poly. (p)	1	2	3
Order Bias (q)	2	3	4
BW Loc. Poly. (h)	4.497	7.690	8.687
BW Bias (b)	7.625	10.102	10.159

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in brackets.

Table C.37: Elected among females, municipality level, year 2010, log-logit transformation

	(1)	(2)	(3)
RD Estimate	-1.113*** [0.235]	-1.168*** [0.274]	-1.179*** [0.285]
Robust 95% CI	[-1.704 ; -.653]	[-1.781 ; -.592]	[-1.771 ; -.565]
Kernel Type	Triangular	Triangular	Triangular
BW Type	CCT	CCT	CCT
Eff. Observations L	62	102	204
Eff. Observations R	95	118	147
Conventional p-value	0.000	0.000	0.000
Robust p-value	0.000	0.000	0.000
Order Loc. Poly. (p)	1	2	3
Order Bias (q)	2	3	4
BW Loc. Poly. (h)	4.803	6.914	10.341
BW Bias (b)	7.781	8.550	12.285

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in brackets.

Table C.38: Percentage of females in the council, year 2018, log-logit transformation

	(1)	(2)	(3)
RD Estimate	0.344* [0.183]	0.475* [0.262]	0.605* [0.335]
Robust 95% CI	[-.037 ; .817]	[-.092 ; 1.086]	[-.09 ; 1.345]
Kernel Type	Triangular	Triangular	Triangular
BW Type	CCT	CCT	CCT
Eff. Observations L	218	304	400
Eff. Observations R	115	130	139
Conventional p-value	0.061	0.070	0.071
Robust p-value	0.073	0.098	0.086
Order Loc. Poly. (p)	1	2	3
Order Bias (q)	2	3	4
BW Loc. Poly. (h)	5.912	7.286	8.549
BW Bias (b)	10.343	10.539	11.836

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in brackets.

Table C.39: Elected among females, municipality level, year 2018, log-logit transformation

	(1)	(2)	(3)
RD Estimate	-0.656***	-0.591**	-0.564*
	[0.167]	[0.233]	[0.297]
Robust 95% CI	[-1 ; -.233]	[-1.09 ; -.06]	[-1.18 ; .085]
Kernel Type	Triangular	Triangular	Triangular
BW Type	CCT	CCT	CCT
Eff. Observations L	294	459	636
Eff. Observations R	130	145	160
Conventional p-value	0.000	0.011	0.058
Robust p-value	0.002	0.029	0.090
Order Loc. Poly. (p)	1	2	3
Order Bias (q)	2	3	4
BW Loc. Poly. (h)	7.184	9.265	10.964
BW Bias (b)	12.682	14.201	15.701

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in brackets.

Table C.40: Females per seat - year 2010

	(1)	(2)	(3)
RD Estimate	0.030	0.023	0.015
	[0.032]	[0.035]	[0.037]
Robust 95% CI	[-.053 ; .087]	[-.057 ; .09]	[-.061 ; .091]
Kernel Type	Triangular	Triangular	Triangular
BW Type	CCT	CCT	CCT
Eff. Observations L	26	45	58
Eff. Observations R	39	75	87
Conventional p-value	0.347	0.500	0.692
Robust p-value	0.634	0.657	0.696
Order Loc. Poly. (p)	1	2	3
Order Bias (q)	2	3	4
BW Loc. Poly. (h)	1.985	3.647	4.391
BW Bias (b)	3.276	4.490	5.228

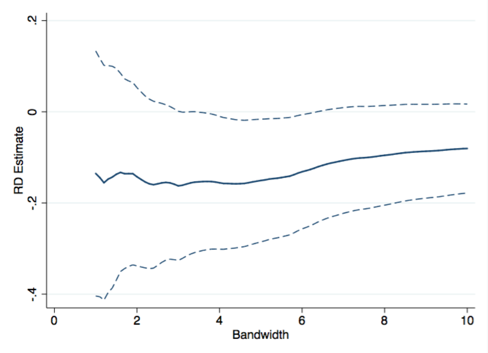
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in brackets.

Table C.41: Females per seat - year 2018

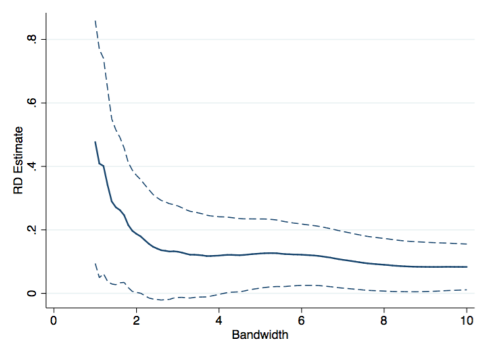
	(1)	(2)	(3)
RD Estimate	0.138***	0.133***	0.128***
	[0.008]	[0.010]	[0.013]
Robust 95% CI	[.117 ; .154]	[.109 ; .154]	[.098 ; .155]
Kernel Type	Triangular	Triangular	Triangular
BW Type	CCT	CCT	CCT
Eff. Observations L	197	335	429
Eff. Observations R	100	134	140
Conventional p-value	0.000	0.000	0.000
Robust p-value	0.000	0.000	0.000
Order Loc. Poly. (p)	1	2	3
Order Bias (q)	2	3	4
BW Loc. Poly. (h)	5.386	7.792	8.842
BW Bias (b)	11.524	12.659	13.261

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in brackets.

Figure C.12: Sensitivity with respect to bandwidth: percentage of females in the council



(a) Year 2010



(b) Year 2018

Figure C.13: Sensitivity with respect to bandwidth: percentage of females in the council - difference in discontinuity