Are women mayors more effective in reducing the crime rate? Sharp regression discontinuity evidence from Peru

¿Son las alcaldesas más eficaces para reducir la tasa de delincuencia? Una aplicación de regresión discontinua "sharp" en Perú

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Abstract

Did women mayors improve local security in their districts as compared to their male counterparts? Our analysis is focused on the impacts that women mayors had on the delinquency rate in Peru between 2015 and 2017. We apply sharp regression discontinuity (SRD) on official government data to estimate impacts. Despite the relatively small number of districts with female mayors, SRD passed all required assumptions and falsification tests. Our results indicate that female leadership in municipalities can reduce delinquency rate in 9 cases per 1,000 inhabitants in Peruvian districts, starting from the second year of the 4-year mandatory period. These findings complement those in recent literature that emphasize the role of women in public management.

Keywords

Female leadership – local policy – delinquency rate – regression discontinuity – Peru

Resumen

¿Las alcaldesas mejoraron la seguridad local en sus distritos en comparación con sus homólogos masculinos? El análisis de la presente investigación se centra en los impactos que tuvieron las alcaldesas en la tasa de morosidad en Perú entre 2015 y 2017. Se aplica regresión discontinua sharp (SRD) a los datos oficiales gubernamentales para estimar los impactos. Pese al número relativamente pequeño de distritos con alcaldesas, el SRD pasó todas los criterios y pruebas de

falsificación requeridas. Los resultados indican que el liderazgo femenino en los municipios puede reducir la tasa de morosidad en 9 casos por 1,000 habitantes en los distritos peruanos, a partir del segundo año del período obligatorio de cuatro años. Estos hallazgos complementan los de la literatura reciente que enfatizan el papel de la mujer en la gestión pública.

Palabras clave

Liderazgo femenino – política local – tasa de delincuencia – regresión discontinua – Perú

1. Introduction

The role of women in politics has been the center of debate in recent years, both in developed and developing countries (see Chattopadhyay and Duflo, 2004; Svaleryd, 2009; Edlund and Pande, 2001; Schwindt-Bayer, 2006; Pino, 2017; Andreoni and Vesterlund, 2001; Song et al., 2004; Swamy et al., 2001; Dollar et al., 2001; Beaman et al., 2009). In general, the literature suggests that men and women have different preferences and performance regarding policy.

Although it is theoretically possible for the elected representative, whether male or female, to act solely according to the interest of the electorate, without regard to his or her own preferences, the empirical evidence suggests that there is a divergence between male and female candidates regarding policy decisions and outcomes (see Svaleryd, 2009; Edlund and Pande, 2001; Schwindt-Bayer, 2006; Pino, 2011). For example, Chattopadhyay and Duflo (2004) found that female decision-makers in India invest more in infrastructure that is relevant to the needs of women; Brollo and Troiano (2016), using Brazilian data, found that female mayors are less likely to engage in corruption

and tend to contract fewer temporary workers than male mayors; and Braga (2016), using Italian municipal data, found evidence of measurable impacts of female political leadership on public policy. On the other hand, Ferreira (2014), analyzing the data from US local elections between 1950 and 2005, found no evidence that having a female mayor had any impact on policy outcomes.

These different results may be due to the specific institutional and environmental contexts addressed by each study. This is an important point, because it suggests that it may not be appropriate to generalize results from one setting to another. Developing economies, in particular, tend to share certain characteristics which differ from developed economies. Some of these characteristics can make it especially difficult to estimate the specific effect of female leadership at the local level.

One such characteristic in developing economies is that it is less frequent for women to hold a position of local authority. In the case of Peru, having relatively few districts with a female mayor leads to an important reduction in sample size when trying to compare outcomes between female and male leadership in municipalities. For example, in the district

elections of the year 2014, out of a total of 1,647 district mayors elected, only 48 were women.

Research in less developed countries also has to deal with low availability of data. Regarding this point, according to an official victimization survey in Peru (INEI, 2017), approximately 80% of actual crimes went unreported in 2017; this poses a serious challenge in order to correctly measure the local crime rate.

Developing economies are also prone to weak institutions and high levels of corruption. This is also the case of Peru, as suggested by several reports in recent years (see, for example, Heuser, 2018).

Another characteristic of developing economies refers to stereotypes against female leadership in public institutions. Some studies argue that "machismo" (male chauvinism) is present in a large part of the Peruvian population, as is the case for Latin America in general (see, for example, Arciniega, Anderson, Tovar-Blank, and Tracey, 2008). To the extent that a stereotype about the role of women in society could be more prevalent in the most dangerous and violent districts, for example, direct comparison of crime rates between districts with male mayors and those with female mayors would lead to biased estimations.

In general, the intrinsic characteristics of municipalities may make it difficult to correctly estimate a mayor's performance. To overcome such endogeneity problems, regression discontinuity (RD) designs have been used in several studies related to the elections of political authorities (see Meyersson, 2014; Ferreira and Gyourko, 2014). In particular, it has been pointed out that the RD approach can lead to the unbiased estimation of the impact that a female mayor (as opposed to a male mayor) has on the crime rate (see Schochet, Cook, Deke, Imbens, Lockwood, Porter and Smith 2010).

The present study analyses the impact that women mayors had on the delinquency rate in Peru between 2015 and 2017. To estimate impacts, we apply Sharp Regression Discontinuity (SRD) on official government data. There are many works applying Sharp Regression Discontinuity Design (SRDD) on political elections (see, for example, Lee, Moretti and Butler 2004; Meyersson 2014; Ferreira 2014; Rocha 2015).

This paper is structured as follows: Section 2 presents the institutional background of elections and operations of municipalities in Peru. Section 3 presents data and summary statistics. Section 4 presents the empirical strategy. Section 5 presents results and internal validity tests. Section 6 concludes.

2. Institutional Background

According to the Political Constitution of Peru (1993), "municipal elections alternate with the general elections so that they are held in the middle of the presidential term" (Fifth Provision, Final and Transitory Provisions). Article 194 states that "mayors and councilors are elected by direct suffrage, for a period of four (4) years. There is no immediate re-election for mayors. After another period, at least, they can apply again, subject to the same conditions". To win the mayoral race, a candidate must have the largest share of votes in his district. In the rare cases of two candidates receiving the same number of votes, a coin is flipped to decide who will be declared the new mayor. Voting is personal, equal, free, secret and obligatory for all citizens until

the age of seventy; it is optional after that age (Constitución Política del Perú, 1993, Article 30).

Local governments have the legal authority to organize, regulate, and administer "local public services of their responsibility" (Constitución Política del Perú, 1993, Article 195). In particular, municipalities provide public safety services, with the cooperation of the National Police of Peru (Art. 195). In this setting, districts mayors in Peru are empowered by municipal law to fight crime and delinquency (Law No. 27972, Ley Orgánica de Municipalidades). These efforts could be manifested through coordination with the National Police, the management of the municipal public safety service known as Serenazgo, investments on local infrastructure that may help to combat crime or through other efforts. The service of Serenazgo, in particular, is present only in highly-populated districts and has responsibilities related to assuring public safety and order (for example, controlling street vending, etc.); sometimes, contiguous municipalities may share the same Serenazgo service force.

3. Data and Summary Statistics

We use a novel dataset to perform the analysis with data collected from four different sources: the National Office of Electoral Processes (Oficina Nacional de Procesos Electorales, ONPE), for the 2014 election results; the National Jury of Elections (Jurado Nacional de Elecciones, JNE), for characteristics of the candidates (gender was obtained candidate résumés); the National Registry of Crimes and Misdemeanors (Registro Nacional de Delitos y Faltas), collected by the National Institute of Statistics and Informatics (Instituto Nacional de Estadística e Informática, INEI), for the

reported crime record in 2015, 2016, and 2017; the National Registry of Municipalities (Registro Nacional de Municipalidades, RENAMU) for characteristics of municipalities; and the National Population and Housing Census (Censo Nacional de Población y Vivienda) of 2007 and 2017, carried out by INEI, for sociodemographic characteristics of each district.

In the present analysis, we only consider two generic crime categories: 'crimes against patrimony' and 'crimes against life, body and health'. These two categories have the highest number of cases nationwide, representing more than 70% of total crimes. Although police agencies report many other types of crimes, their incidence is quite minor and they are not reported in all districts; furthermore, their connection with municipal district management is less evident (such is the case, for example, of the category 'terrorism').

Total crime incidence is not available for the years previous to the 2014 elections. In the absence of this information, the crime incidence in the first quarter of 2015 was used in the analysis as the main predetermined covariate, given that this indicator corresponds to the first few months of the newly-elected administration and an impact too early into the new mayor's term of office is not expected.

Crime rates were corrected by the total number of permanent inhabitants in each district, as reported in the 2017 Census, which contains the most up-to-date and reliable information of the total population.

Table 1 presents the descriptive statistics for each group of districts in the 2015-2018 period: those with female mayors and those with

male mayors. The only statistically significant difference is in the proportion of women in the district: districts with female mayors have a smaller proportion of women in their populations (2 percentage points less than in districts with male mayors).

Simple comparison between districts with female and male mayors indicates that districts with female mayor had on average higher levels of crime in 2015, 2016 and 2017 (See Table 2). Districts with zero crimes are not showed. For the years 2015,

Table 1
Predetermined covariates and placebo outcomes: summary statistics

Variable	Source		(1) All	(2) Male	(3) Female	(4)=(3)-(2) Difference
				Mayor's gender		
			Mean (S.D.)	Mean (S.D.)	Mean (S.D.)	Mean (S.E.)
Ln (permanent population district 2017)	Censo Nacional de Población y Vivienda 2017		8.15	8.16	7.83	-0.33
			(1.38)	(1.38)	(1.42)	(0.21)
Average age of population 2017	Censo Nacional de Población y Vivienda 2017		33.08	33.07	33.45	0.38
			(4.67)	(4.66)	(5.11)	(0.75)
Proportion of women in district 2017	Censo Nacional de Población y Vivienda 2017		0.50	0.50	0.48	-0.02**
			(0.03)	(0.03)	(0.05)	(0.01)
Proportion of urban households 2007	Censo Nacional de Población y Vivienda 2007		0.46	0.46	0.49	-0.03
			(0.30)	(0.30)	(0.31)	(0.04)
Proportion of people with Spanish as mother tongue 2007	Censo Nacional de Población y Vivienda 2007		0.69	0.69	0.81	-0.12**
			(0.36)	(0.36)	(0.27)	(0.05)
Proportion of mayors with high education (institute or university concluded)	JNE		0.62	0.62	0.64	-0.02
			(0.01)	(0.01)	(0.07)	(0.07)
Security perceived problems 2014 /1	RENAMU	2014	3.50	3.51	3.21	-0.31
			(2.62)	(2.63)	(2.32)	(0.34)
		2015	4.17	4.18	3.85	-0.33
			(2.92)	(2.92)	(3.02)	(0.44)
Security Council Session (SCS) 2014 /2	RENAMU	2014	3.35	3.34	3.52	0.18
			(4.40)	(4.43)	(3.35)	(0.50)
		2015	4.71	4.68	5.67	0.98
			(4.87)	(4.87)	(4.74)	(0.70)
Obs.			1,633	1,585	48	1,633

*, **, *** significance at 10%, 5% and 1% respectively.
1/ Perceived security problems are declared by an informant in the municipality and recorded in a questionnaire in RENAMU. Sample size varies because of non-response rate. In 2014, 6 districts with male mayors didn't answer the question. In 2014, the questionnaire had 15 options, 14 of which were used in this table (terrorism has been dropped since it is not present in every district). In 2015, INEI added 5 options (20 in total); for the present study, we have used the same options as for 2014.
2/ Security Council Sessions are meetings between municipal authorities and institutions such as police; sessions take place once a year.
Source: Own elaboration.

Table 2
Crime rate: summary statistics of outcome variables

			Mayor's gender			Difference (3)-(2)=(4)
			All (1)	Male (2)	Female (3)	
			Mean (S.D.)	Mean (S.D.)	Mean (S.D.)	Mean (S.E.)
			t test, unequal variance			
Crime rate per 1k inhabitants	2015		4.78	4.72	6.56	1.84*
			(6.32)	(6.27)	(7.51)	(1.25)
		Obs.	1,257	1,220	37	1,257
	2016		5.06	4.99	7.78	2.80**
			(6.29)	(6.09)	(11.06)	(1.90)
		Obs.	1,249	1,215	34	1,249
	2017		5.66	5.45	13.08	7.64***
			(9.68)	(6.84)	(41.28)	(6.70)
		Obs.	1,350	1,312	38	1,350

Source: Own elaboration.

Figure 1
Win margin of female candidates for district mayor, 2014
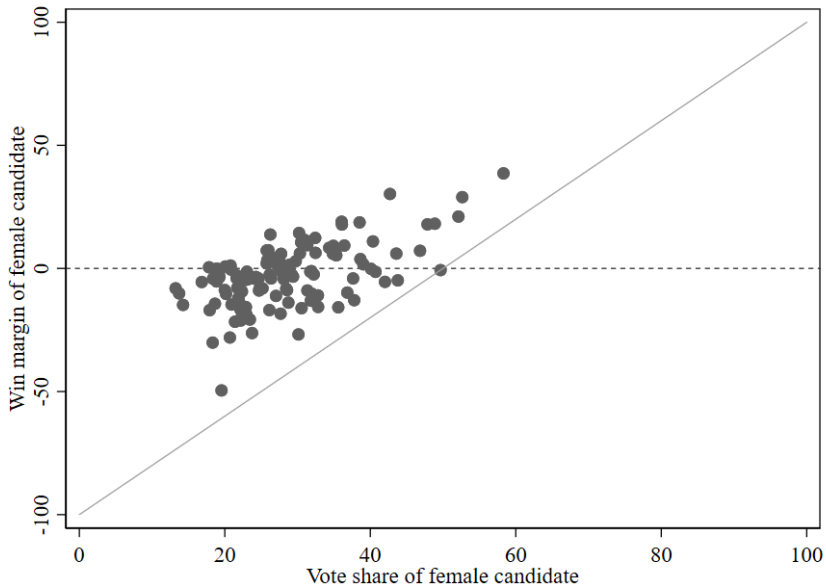
Note: For each district, the horizontal axis shows vote share of female candidate. The vertical axis shows the difference between the male and the female candidate. Diagonal line shows hypothetic results obtained if there had been only two candidates (female and male).
Source: Own elaboration.

2016 and 2017, approximately 97 percent of districts have less than 20 crimes per 1,000 inhabitants in each of the three years.

Figure 1 shows the win margin (positive or negative) and the vote share of the female candidate in the 2014 elections, considering all districts where the female candidate resulted in first or second place. The maximum share of votes of a female candidate who won the election was 60 percent.

4. Empirical Strategy

In this study, we utilized Sharp Regression Discontinuity (SRD) design, because the sample selected for treatment was effectively treated. There are at least two frameworks in RD design: continuity-based RD and local randomization RD. As pointed out by Sekhon and Titiunik (2017), local randomization RD imposes strong assumptions on RD design in order to conceive it as a random experiment, and, even in that case, the independence of score and potential outcome cannot be demonstrated without making additional assumptions. The continuity-based framework, on the other hand, is sufficient for RD estimation (McCrary 2008; Sekhon and Titiunik 2017) and imposes less stringent assumptions, albeit at the cost of external validity and extrapolation. We applied RD using the continuity-based framework because we cannot assure that the win margin and the crime rate are entirely unrelated.

The estimation procedure was preceded by the determination of model parameters. For simplicity, we set polynomial function order in grade 1, considering that no differences were found in the results when using a grade 2 polynomial. For the bandwidth selection of the score for estimation, we use conventional mean square error (MSE) optimal bandwidth choice; for inference, we

Figure 2
Density test
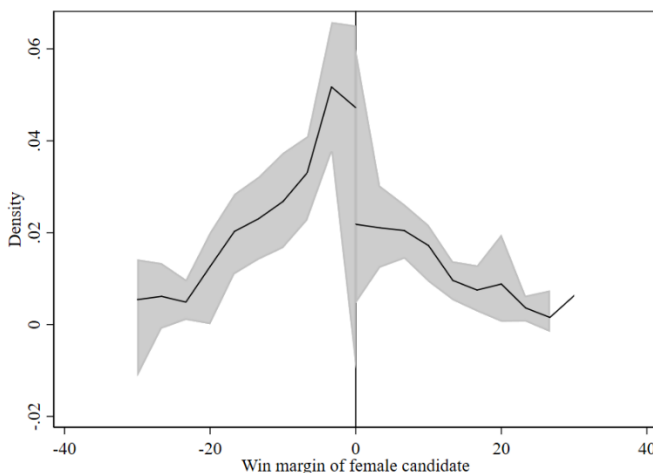
Source: Own elaboration.

Table 3
Predetermined covariates and placebo outcomes

Variable	Bandwidth		Observations		rho		Coef.	Err. Std./1	P value
	h-	h+	h-	h+	h-/b	h+/b			
Ln(permanent population district 2017)	7.3	7.3	37	19	0.54	0.54	-0.22	0.84	0.647
Average age of population 2017	7.0	7.0	37	18	0.54	0.54	-0.51	4.33	0.907
Proportion of women in district 2017	12.3	12.3	55	29	0.62	0.62	0.00	0.03	0.875
Perceived security problems 2014	7.9	7.9	38	22	0.46	0.46	-0.88	1.69	0.780
Security Council Session (SCS) 2014	7.9	7.9	38	22	0.46	0.46	-0.79	2.13	0.491
Crime rate per 1k hab. 1T 2015	9.3	9.3	38	20	0.67	0.67	-3.71	3.47	0.154
Proportion of urban households 2007	7.9	7.9	38	22	0.47	0.47	-0.09	0.21	0.492
Proportion of people with Spanish as mother tongue 2007	10.7	10.7	51	27	0.55	0.55	-0.08	0.16	0.737
High education (institute or university concluded)	7.5	7.5	27	16	0.48	0.48	0.08	0.16	0.502

*, **, *** significance at 10%, 5% and 1% respectively.
/1 Robust standard errors.
Source: Own elaboration.

used inference-optimal bandwidth choice, as proposed by Calonico, Cattaneo and Farrell (2018).

The score is defined as the difference between vote share received by the first and the second place candidates. Difference is positive if a female candidate won the election and negative if the winner is a male candidate. Thus, the cutoff point is fixed at 0.

Local or as-if-random and continuity assumptions were tested. With regard to the as-if-random assumption, a Bernoulli's test was used from 2 to 15 bandwidths. The continuity assumption was tested with McCrary's density test (McCrary, 2008).

Next, four falsification tests were used, as proposed by Cattaneo, Idrobo and Titiunik (2019). The first was an evaluation of stability in placebo outcomes and predetermined variables using a bandwidth selection process for estimation and inference for each variable (in the continuity-based framework, bandwidth is used only as a range for smoothness of the regression function and, thus, is performed before carrying out the main estimation). The three succeeding tests were used after obtaining the main estimation results to check for robustness. One of these tests examines the sensitivity to different bandwidth selector algorithms (loss functions); the other tests used were the so-called "donut hole" test and the placebo cutoffs test.

5. Internal Validity and Results

Internal validity pretests. Bernoulli's test shows no compliance to local or as-if-random assumption for bandwidths of more

Figure 3
Predetermined covariates
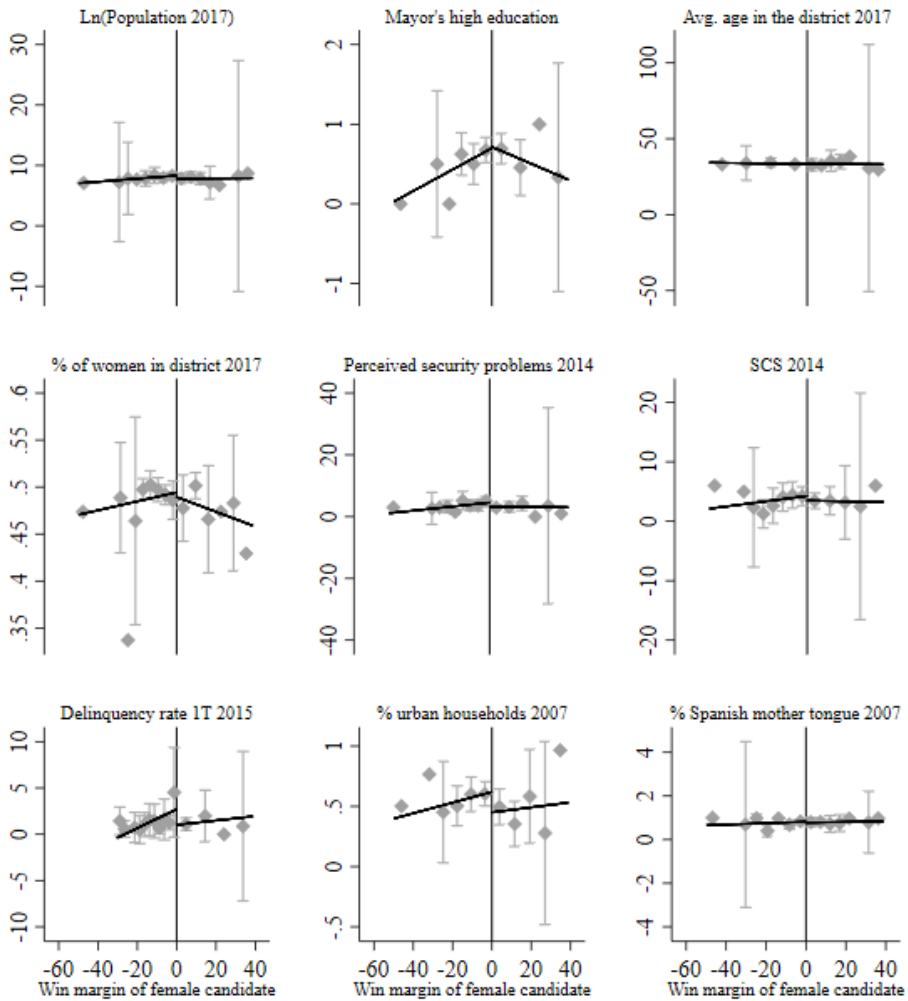
Source: Own elaboration.

than 4 points to the right and 4 points to the left, which mean that the local-randomization approach is not appropriate. Although the local randomization assumption does not hold for our data with a bandwidth of more than 4 points of radius, this does not invalidate the RD design (Sekhon and Titiunik 2017, Cattaneo, Frandsen and Titiunik 2015; Skovron and Titiunik 2015).

The critical assumption in RD designs is the continuity of expected potential outcomes

(De la Cuesta and Imai 2016). In order to test for continuity, we used the density test proposed by McCrary (2008). As shown in Figure 2, the continuity assumption holds for bandwidths of less than 10 points and, thus, RD design is valid for our purpose.

Analysis of predetermined variables was performed, but information availability was a problem. A natural predetermined variable would have been the crime rate reported in 2014, that is, immediately before treatment. However, INEI registry for all crimes begins only as of 2015 (before 2015, only death-related crimes are recorded in the Registro Nacional de Delitos y Faltas). As a consequence, we used the crime rate reported for the first quarter of the 2015 as a predetermined variable, under the assumption that the effect of a new mayor on this variable is negligible so early in the term of office. As additional predetermined covariates, we use educational achievement of candidates, size of district population, average age of population, proportion of women in district population, security problems perceived by district officials, number of sessions of the district security council, proportion of urban households, and proportion of people with Spanish as mother tongue.

There are no statistically significant differences in the main predetermined covariates of interest (see Table 3 and Figure 3). The similarity between the treatment and control sample is desirable to ensure that the future difference may be due solely to the treatment of female mayor.

Results. We found that treatment districts had lower crime rates than control ones. For 2017, using a unique bandwidth that minimizes bias and variance, results show that districts treated had 9.09 fewer crimes per thousand inhabitants than control districts (see Table 4). Using a different bandwidth for the left and the right of the cutoff, the treated districts have 6.87 fewer crimes per thousand inhabitants than control districts. For 2016, the second year of mandatory, results show 9.41 fewer crimes for districts treated, both when using a unique bandwidth and when using a different bandwidth. These differences were statistically significant at the conventional levels. However, differences were not statistically significant for 2015.

Figure 4 shows the estimated discontinuity regression functions for each year with the corresponding 95 percent confidence intervals. Note that, for 2016 and 2017, there is no overlap of confidence intervals between control and treatment samples, which confirms the statistical significance of the treatment variable.

Internal validity postests. We tested the sensitivity of results using different selection bandwidth algorithms (loss functions). We utilized bandwidths that minimize the asymptotic coverage error rate (CER), as proposed by Cattaneo, Idrobo and Titiunik (2019), and found no significant differences in results. We also tested for arbitrary cutoff points, with similar results. So far by now, evidence suggests that the effect of female leadership at the district mayor's office on the crime rate is significant at the usual confidence levels. Compared to male mayors, female mayors reduce the outcome variable as much as 9 crimes per 1,000 inhabitants, with results perceptible from the second year in office.

Table 4
Impact of female mayor on crime rate

	Crime rate					
Year	2015		2016		2017	
Polynomial order	Lineal					
Loss function selector	MSE					
Bandwidth	Unique	Different	Unique	Different	Unique	Different
Woman mayor	-11.78	-9.32	-9.41***	-9.41***	-9.09*	-6.87*
	(-1.55)	(-1.41)	(-2.64)	(-2.61)	(-1.77)	(-1.65)

	h-	h+	h-	h+	h-	h+	h-	h+	h-	h+	h-	h+
Bandwidth	9.2	9.2	11.2	4.7	7.2	7.2	7.3	7.1	7.3	7.3	11.9	4.5
Observations	38	19	43	10	28	12	28	12	31	16	43	10
rho(h/b)	0.68	0.68	0.76	0.47	0.65	0.65	0.74	0.60	0.55	0.55	0.71	0.41

*, **, *** significance at 10%, 5% y 1% respectively.
Note: Z statistic in parenthesis.
Source: Own elaboration.

Figure 4
Impact on crime rate

C.I. 95%; Polynomial order 1; uniform kernel

Source: Own elaboration.

6. Conclusions

This study applied sharp regression discontinuity (SRD) to estimate the effect on local crime rates of a female mayor as opposed to a male mayor as district authority. Results suggests that female mayors reduced crime incidence in local districts during the 2015-2017 term; the effect was statistically significant in the last two years in office. These results are robust in the SRD with balance checks in variables such as education of district mayor, size of population, average age in district, percentage of women in the population, delinquency rate before the new mayor took office, percentage of urban households, administrative efforts against criminality before elections, and percentage of population with Spanish as their mother tongue.

As in Braga (2016), we find evidence of a different performance of the mayor's office depending on the mayor being male or

female. The reduction in crime rates could be explained by a number of factors, one of them being a lesser relationship with corruption (Brollo and Troiano, 2016). Other possible mechanisms include a greater interest than male mayors in activities related to security. These results are different from those found in Ferreira (2014) for US cities; this may due to differences in characteristics, such as social, political or institutional, between cities in these countries.

The results lead us to expect that there are differences in municipal management between female mayors and male mayors. However, the sample size of the treatment group is small, due to the limited number of female candidates that won elections for district mayor in 2014. Another drawback is that crime data are not easily available for years previous to 2015. Election results for the 2019-2022 term of office should permit a larger sample and, thus, allow for better estimates.

This work presents some evidence of the impact of female mayors in reducing the crime rate in districts in Peru, but results must be taken with caution. These findings could be helpful to understand and appreciate the possible benefits of local female leadership in Latin American societies. More research is need to confirm these results and explore causal relations in district management.

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