

Measuring Local-Level Patronage: A Mixed-Membership Approach

Katherine McKiernan

March 23, 2021

Abstract

Scholars of distributive politics often discuss the importance of patronage networks as tools that politicians use to reward supporters. However, there is no observational data concerning the actual extent to which public service hiring practices rely on patronage. There are two common strategies used to estimate patronage. The first approach rests on the assumption that particular features of employees are strongly correlated with patronage networks. As a result, they treat all employees who share the chosen trait, whether it is temporary employee status or copartisanship with elected officials, as signs of patronage. This strategy does not account for other reasons employees with these identifiers may have been hired. The second strategy uses survey experiments designed to elicit sensitive information in order to estimate the proportion of the population who are clients in patronage networks. The results of these experiments are then incorporated in multivariate regression analysis to compare rates of patronage across income groups, job categories, or gender. This approach is able to improve our estimates of patronage for in many key subpopulations, but it is an expensive strategy that requires a large number of respondents and repeated surveys in order to capture change overtime and across subnational units. In order to address these challenges, I propose estimating local-level patronage using a Bayesian Mixed-Membership model. My proposed estimation strategy combines data on municipal-level demographics that are commonly used to poststratify results from survey experiments with patterns in public-service hiring across a variety of employee characteristics. By combining these two sources of observational data, I am able to consider both the patterns in shared employee traits across a variety of categories and the demographic context where these employees are hired. I apply my estimation strategy to the case of Colombia, where I use data on teachers to estimate patronage at the municipal level. I validate my estimates using survey questions from the Latin American Public Opinion Project (LAPOP) administered during the same mayoral term. Finally, I use my estimates of municipal patronage to show how considering municipal-level variation in the use of patronage can help us understand how citizens view their local elected officials.

1 Motivation

To what extent do politicians rely on patronage in order to build and maintain voter networks? Patronage, or the non-programmatic redirecting of resources towards party members, is one of the most ubiquitous forms of resource allocation. Through patronage, politicians can reward party loyalists (Oliveros 2016, Yildirim & Kitschelt 2019) and shape the bureaucracy (Jiang 2018). However, studies of patronage face many challenges in estimating how often politicians rely on patronage networks. This limits the questions that can be asked about the effects of patronage in different political contexts. While the literature has proposed many theories about where patronage occurs and its consequences (Berenschot 2018*a*, Berenschot 2018*b*, Jiang 2018, Kemahlioglu 2011, Levitsky 2003, Smith & de Mesquita 2011, Stokes, Dunning, Nazareno & Brusco 2013), it has not been able to fully explore the effects of within-country variation in the use of patronage. In order to better understand how patronage effects electoral politics, bureaucratic effectiveness, and political accountability, subnational research offers an effective tool because the national political landscape is held fixed (Giraudy, Moncada & Snyder 2014). Therefore, an estimation strategy that highlights variation in patronage at the subnational level offers a meaningful point of entry to answering new questions about non-programmatic resource allocation.

Measuring patronage is particularly difficult because public service hires are never explicitly categorized as members of patronage networks. Thus, while public service hiring records are public, there is no explicit designation for when these employees reflect patronage systems. Second, social criticisms of patronage networks as a type of corrupt political favoritism reduce the likelihood that public service employees will self-identify as members of patronage networks.

Three main techniques have been used to overcome these barriers to studying patronage. First, many scholars have relied on in-depth qualitative interviews that provide rich data scholars use to classify specific political parties as patronage parties, assign countries the label of patronage democracies, and better trace the dynamics of patronage networks

(Auyero 2000, Berenschot 2018a, ?, Zarazaga 2014). Second, researchers, drawing on qualitative studies, have used specific characteristics of public employees, notably their identities as copartisans or the relative use of temporary employees, as proxies for patronage more broadly (Jiang 2018, Kemahlioglu 2011, Oliveros 2016). This approach provides a clear tool for estimating patronage, but does not account for the copartisans who can be hired by other means or temporary employees as a result of low state capacity. Finally, survey list experiments designed to reduce social desirability bias and elicit sensitive information that are common in studies of vote buying (Blair & Imai 2012, Blair, Imai & Lyall 2014, Gonzalez-Oscantos, de Jonge, Meléndez, Osorio & Nickerson 2012, Greene 2017) have been applied in order to show that public servants hired via patronage are more likely to behave as brokers (Oliveros 2016). However, this approach has not been used to estimate patronage directly. Improvements on list experiments, such as augmented list experiments and post-stratification techniques (Blair, Chou & Imai 2019, Carkoglu & Aytac 2015, Corstange 2009, Mares & Young 2019), can use specific observable demographic variables to improve estimates across geographic units. However, these techniques cannot capture variation due to unmeasured historical patterns in patronage. Moreover, repeating these strategies in order to track changes in patronage over time carries a large financial burden and cannot be applied retrospectively to consider the use of patronage for eras with no existing survey experiments.

I propose using a mixed-membership approach in order to estimate patronage at the local level. I use existing data on both the demographic characteristics of subnational units and observed features of public sector employees in order to estimate municipal-level patronage in Colombia. Specifically, I use data on teacher hires in 2013. Colombia is an excellent case to test the estimation strategy because the country has a rich history of patronage hires. The 1991 Colombian constitution reshaped the political party system, fractured the two traditional political parties, and facilitated the rise of non-traditional parties and personalistic candidates (Dargent & Muñoz 2011, Bedoya Marulanda & Arenas Gómez 2015). Throughout these changes, the use of patronage persisted as a major vehicle for building and

maintaining clientelist networks. Moreover, the dynamics of patronage vary widely throughout the country due to differences in the historical legacies of the Liberal and Conservative parties prior to party reforms in 1991 and the presence of external actors during the long civil conflict (Eaton 2006). Notably, these features make it difficult to trace the use of patronage using political party networks, which have changed dramatically since 1991.

The mixed-membership model addresses the limitations of existing measures because it combines the employee information used to proxy patronage with demographic features commonly used to post-stratify the results of survey experiments in order to robustly estimate the use of patronage. By introducing an estimation strategy that can capture variation in the use of patronage across subnational units, within-country research on the effects of patronage can be conducted and include areas for which the researcher cannot conduct in-depth field research. For example, we do not know whether patronage, like clientelism, can reduce citizen’s level of trust in their elected officials. I apply my estimates of municipal-level patronage to answer this question and demonstrate how this estimate can be used to improve our understanding of non-programmatic resource allocation. Moreover, my mixed-membership approach provides a framework that researchers can use to estimate past levels of patronage and track how the use of patronage has changed alongside national changes such as electoral reforms and party system realignments.

2 A Model for Local-Level Clientelism

2.1 Mixed Membership Models

Mixed-Membership models are used to classify data into latent classes (Airoldi, Blei, Eroshova & Feinberg 2014, Joutard, Airoldi & Love 2008). Unlike many classification models that assume an item can belong to only one class, Mixed-Membership models have the advantage of allowing each observation to have partial membership in multiple classes. Thus, rather than assigning categorical measures, they classify items along a continuum. In the

case of patronage, this is particularly useful because it allows politicians to engage in both meritocratic and patronage-driven hiring practices for *each* hire.

In particular, I focus on Hierarchical Bayesian Mixed-Membership Models (Joutard, Airoidi & Love 2008). These models are especially nuanced in their approach to assigning class membership. First, these models are able to pool information at different levels of analysis. As a result, they can account for nested data, such as employees nested in municipalities. Moreover, since Bayesian analysis relies on iterative sampling in order to update expectations, additional data at any level of analysis (be it individual employees or municipal demographics) will inform subsequent updates across all parameters.

These models have been applied most frequently in political science in text analysis models, such as the canonical latent dirichlet allocation (LDA) model and the structural topic model (STM) that extends the LDA in order to include additional document-level data. These modeling strategies have allowed political scientists to classify political speeches, websites, and/or statements based on what topics are addressed. In the STM approach, additional information about the documents provide essential context that improves the estimates of topics (Roberts, Stewart, Tingley & Airoidi 2013, Roberts, Stewart & Airoidi 2016). When this logic is applied to the study of patronage, additional information about the demographic characteristics of municipalities provides invaluable context for analyzing the profiles of employees working in the public service. This additional context allows for a partial pooling where employees in the same, or similar, municipality's are not assigned class membership using the same parameters as employees from municipality's with different demographic conditions.

2.2 Applying Mixed Membership Models to Clientelism

I build on this tradition by applying mixed membership models to the study of patronage. I estimate the relative use of patronage in a given municipality using data about municipal demographics and observed job and employee characteristics. Specifically, I use the following

estimation strategy in order to estimate the relative use of patronage when hiring teachers throughout Colombia. I build two separate matrices to estimate the model: a municipal demographic matrix where each row is a municipality and each column is a demographic characteristic and a public hiring characteristic matrix where each row is a municipality and each column is an observable trait of public employees or the jobs they fill. In the case of Colombia, the demographic characteristic matrix has rows for 1098 of Colombia's 1122 municipalities and columns for three key demographics: fiscal performance, citizen levels of need, and population. The public hiring matrix has rows for each municipality and columns for 33 different observable characteristics of the job or employee, such as employee qualifications, whether the job is temporary, and the bonus an employee received.

In order to evaluate the frequency that any public employee characteristic is observed, I use data on teachers who are hired in Colombia. The model assumes each observable employee characteristic a teacher may possess belongs to one of two classes of hiring types—the patronage class or the meritocratic class—and determines how likely it is to see the observed number of employees who share any given characteristic under each hiring motivation. For example, in Betania, a small agricultural municipality outside of Medellin, 75 teachers were hired in 2013. Of those, 74 were educated for their position and two received a 20% bonus. Under my estimation strategy, the 74 qualified employees and the two employees who received larger bonuses may both be assigned to the meritocratic class, both be assigned to the patronage class, or be assigned to different classes based on the probabilities of observing those numbers under each hiring strategy.

Notably, this estimation strategy assumes that each public employee characteristic is independent of all other characteristics. In other words, whether the employee has the requisite qualifications must be independent of whether that employee received a 20% bonus. The key implication of this assumption is that it is the observed characteristics, not the combinations of characteristics, that are central to classifying patronage. The decision to allow each characteristic to be drawn independently can be likened to the bag of words

assumption central to structural topic models. My decision to allow each characteristic to be drawn independently is justified by the rich tradition of using a single characteristic as a proxy for patronage (Jiang 2018, Kemahlioglu 2011, Oliveros 2016). Unlike these existing measures, however, my decision to include multiple independent characteristics of jobs and employees improves upon existing estimates that rely on a single employee characteristic. Including additional characteristics allows for better estimations of patronage because the estimation strategy highlights the possibility for any characteristic to be observed, albeit at different rates, under both patronage-based and meritocratic-based hiring systems.

Meanwhile, the municipal demographic matrix uses demographic data for each municipality that can facilitate, or constrain, the use of patronage. This matrix is essential for allowing the characteristics to occur at different frequencies in varying municipalities and makes it possible to combine the data on employees and the municipalities where they work. The demographics selected, in the case of Colombia fiscal responsibility, need, and population, are chosen because they can affect the likelihood of observing a characteristic, such as education, under each hiring class. For example, in any municipality having fewer qualified teachers may signal patronage, but lower numbers of unqualified teachers may also be common in municipalities with high levels of need. Thus, including demographic data improves the accuracy of the estimates of the proportion of employees in the patronage and the meritocratic class.

The data generating process proceeds as follows:

1. For each municipality m , sample a patronage mixed-membership scalar π_m from a Beta distribution with mean $\mu_m = g^{-1}(\mathbf{x}_m^\top \beta)$, where \mathbf{x}_m is a vector of municipality-specific demographic characteristics.
2. For each municipal employee characteristic, c , sample the probability of observing a hire with the characteristic in a patronage-based system θ_c^p from a $\text{Beta}(a_c, b_c)$. Do the same for the probability of observing that characteristic under the meritocratic based system, $\theta_c^m \sim \text{Beta}(a'_c, b'_c)$. These probabilities do not need to sum to 1.

3. For each municipality m and count of hires with shared characteristics c ,
 - (a) Sample a patronage indicator z_{mp} from a Bernoulli(π_m)
 - (b) Sample the observed number of hires sharing a characteristic y_{mc} from a Binomial($n_m, [\theta_c^p]^{z_{mp}} \times [\theta_c^p]^{1-z_{mp}}$) where n_m is the total number of public service employees in a municipality.

The final estimates for municipal-level patronage, π_m , are the estimates most consistent with both the municipal-level demographics and the observed frequency of each employee characteristic.

This modeling strategy can be applied using any relevant characteristics of public-service employees available in a range of contexts. In order to prepare the public hiring characteristic matrix, the researcher selects relevant observable characteristics about the employee and the nature of the public service job. The researcher then converts these characteristics to a series of dummy variables where one indicates that an employee has the observable characteristic. Using this information, the researcher can count the number of times each characteristic occurs in a given municipality across hires.

3 Data

I test the estimation strategy using public teacher hires in Colombia. Using teacher data is particularly valuable for estimating patronage because permanent teachers hired through the public service process occur alongside temporary appointments used to fill a gap while waiting for civil service placements.¹ Furthermore, qualitative interviews suggest that the number of teachers is often inflated to help the municipality receive additional funds from the central government, increasing the opportunity for politically-motivated hiring practices.²

¹Various interviews conducted from July-August 2016 and July-December 2018 in Bogota, the Antioquia Department, and the Valle de Cauca Department, Colombia. Through these two rounds of field work, I interviewed over 60 experts, mayors, legislators, and municipal bureaucrats.

²Interview conducted with a municipal bureaucrat in the Valle de Cauca Department in July 2016

I begin by preparing municipal-level covariates that focus on the features of municipalities past research has shown to be associated with patronage (Kitschelt & Wilkinson 2007, Weitz-Shapiro 2012, Lucciasano & Macdonald 2012, Stokes et al. 2013). First, I consider the fiscal responsibility of the municipality. In Colombia, this indicator is produced by the central government and considers whether the municipality manages their funds efficiently. A municipality with better transparency in their financial reporting and more efficient spending patterns is less likely to hire unnecessary employees, a potential indicator of patronage. Then, I consider the level of material need in the municipality using the number of homes enrolled to receive additional social benefits. Patronage is possible in both high and low income areas as a way to reward party loyalists, but can be particularly effective as a way to provide jobs for individuals with high levels of need. One limitation of this approach is that it estimates poverty levels based on enrolled households. This may underestimate actual levels of need because of eligible households that have not successfully registered for additional benefits. Third, I consider the population of the municipality. When political networks are strong, patronage can thrive in both rural and urban areas (Auyero 2000, Brusco, Nazareno & Stokes 2004, Levitsky 2003). Moreover, since Colombian municipalities often over-report school enrollments in order to attract additional funds from the central government ³, I use school-aged population, rather than the overall population, and am agnostic about the effects of population. Each of these three variables is available through the National Department of Statistics (DANE). In order to generalize these results, researchers can adapt the way variables are measured or variables included to their particular country context.⁴

In order to determine to what extent any given employee profile reflects patronage hiring practices, I use data on the observable characteristics of these employees. This data is

³Interview conducted with a municipal bureaucrat in the Valle de Cauca department in July 2016

⁴For example, in country contexts with more direct measures of municipal-level poverty or capacity, these values can be used instead of measures of fiscal responsibility or social program enrollment. Similarly, if a researcher hopes to evaluate the effect of patronage on poverty, they can lag their measure representing need since patronage in any given year may be caused by past levels of need and contribute to future levels of need. In the appendix, I include a sensitivity analysis where I lag all municipal-level demographics by one year.

collected by the Department of Education. The data has a row for every public educator and columns for various characteristics that define the teacher's job description, educational attainment, and demographic information. First, I identify whether a teacher has the requisite qualifications by coding whether their educational attainment matches the minimum requirements for the position they are hired for. Next, I consider where the employee's job is located using two indicators. The first is the visibility of the position. Using data provided by the Department of Education, this identifies whether the employee is positioned in a single school, a single district, or in a "floating" position, such as a substitute teacher that moves where they are needed. A floating position is an employee who is less visible, and thus may be more difficult to monitor. The second is a simple measure of whether the teacher is in an urban or rural area. However, this binary measure does not account for the broader makeup of the municipality.⁵ Third, I consider how the teacher is paid: using the municipality's resources or the resources from the national government ear-marked for education spending as well as the bonus(if any) that the teacher received. In my data, very few employees are paid from the municipality's own funds, and being paid using independent funds may signal that this employee is political. Moreover, while bonuses may be a reward for good performance, particularly high bonuses may signal other means of distributing benefits. Finally, in order to fully characterize the nature of temporary employment, I identify the type of vacancy the employee fills (tenured permanent vacancy, a temporary long term vacancy, a temporary short term vacancy, a trial vacancy for a permanent employee, or a generic temporary vacancy), the type of teacher the employee is(a classroom teacher, a classroom aid, or a guidance counselor), and if the employee is from a minority ethnic group.⁶

⁵In the appendix, I perform sensitivity analysis where I adjust this assumption in two ways. First, I include the proportion of the municipality classified as rural to the municipal demographic matrix. This modification conditions the location of the position on the overall rural population. In the second test, I include only the proportion of the municipality that is rural. In both cases, the resulting estimates of patronage follow the same pattern. However, due to data availability this approach reduces the number of municipalities where I can estimate patronage.

⁶Given that ethnic favoritism is much less common in Colombia than in contexts such as India, I have no expectations about how ethnicity may affect patronage, but rather include it to fill the profile of each independent employee. Including this measurement is important- in the sensitivity analysis omitting the ethnicity variable changes estimates and no longer pass the validity tests focused on corruption.

Each feature is a dummy variable, coded 0 or 1. In order to adjust this to other contexts, the included employee characteristics can be modified. Moreover, if the researcher is considering multiple areas of public employment, indicator variables can be added to highlight which particular type of public service the employee performs rather than estimating each type of public service industry separately.

Each of the potential indicators can, and often does, occur in meritocratic environments. For example, municipalities with lower levels of education may be forced to hire temporary employees who do not meet the education thresholds for their position. Similarly, there are likely qualified teachers in “floating” positions based solely on need. In using the mixed-membership approach, I do not assume, *ex ante*, that these variables should always indicate an increase, or decrease, in clientelism. Rather, I focus on how the combination of observable characteristics, the frequency with which each characteristic occurs, and the municipal environment can help us estimate the relative use of patronage.

4 Results and Validity Checks

I estimate the level of clientelism from 0 to 1 using the above model in Stan. I use a single chain of 100,000 iterations with a burn-in of 10,000 iterations. The model converges with a maximum Rhat value of 1.00. Across 1098 municipalities in Colombia, municipal estimates of patronage range from 0.1575 to 0.6621 with a mean level of patronage of 0.3619. The estimate suggests that patronage is quite common in Colombia, but highlights the variation in just how often it occurs in any given municipality. A map with the distribution of levels of patronage can be found in Figure 1.

Figure 1 displays the variation across Colombia. On average, areas along the coast and the Amazon rainforest are darker, indicating higher levels of patronage. This offers some face validity given high rates of poverty and enduring political dynasties, as well as ongoing effects from the civil conflict, in these areas of the country. Moreover, qualitative research has

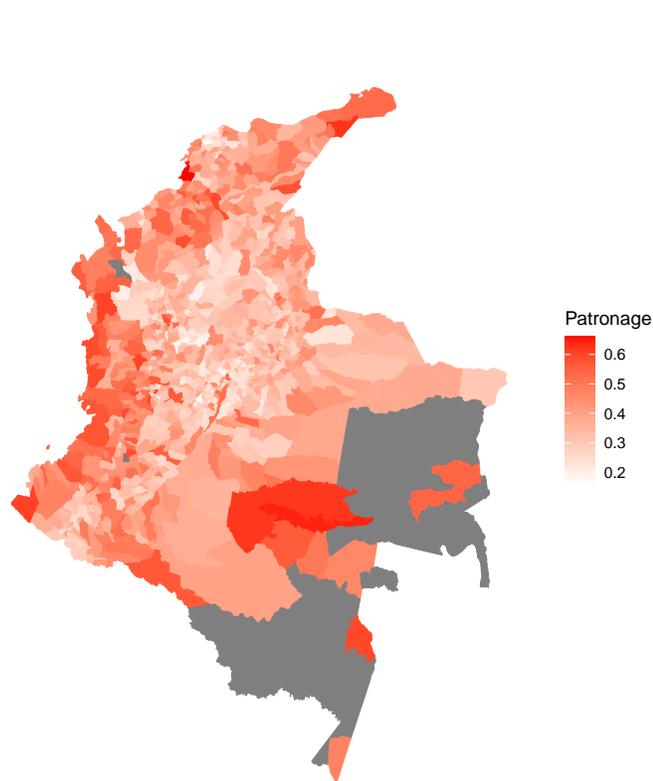


Figure 1: Estimates of Patronage in Colombia, 2013

established that patronage is quite frequent along the coast. Ocampo (2014) draws attention to the prevalence of patronage in the department of Córdoba from 1950-2010. In my data, the mean level of patronage in Córdoba is 0.427 while in the rest of Colombia, excluding Córdoba, the mean is 0.366. This difference is statistically significant at the $p < 0.01$ level and suggests that patronage is much more common in this region of the country. **Highlight Córdoba on Map**

In the darker municipalities, I expect that public jobs are more likely to be filled with government allies as a means to maintain political support. While this use of patronage does not necessarily reduce the quality of services provided (Jiang 2018), it does limit access to desirable public jobs for many citizens. If the use of patronage in these areas is effective, it should be correlated with increased support for the local government among public service workers relative to the rest of the municipal population. Conversely, in the lighter

municipalities where patronage is less common, we should observe more variation in political allegiances within the public service. These municipalities likely use other criteria beyond politics to determine the longevity of political careers or the formula for bonuses. In these areas, the views of public service workers should more closely align with the distribution of preferences within the municipality, writ large.

4.1 Validation Tests: Corruption

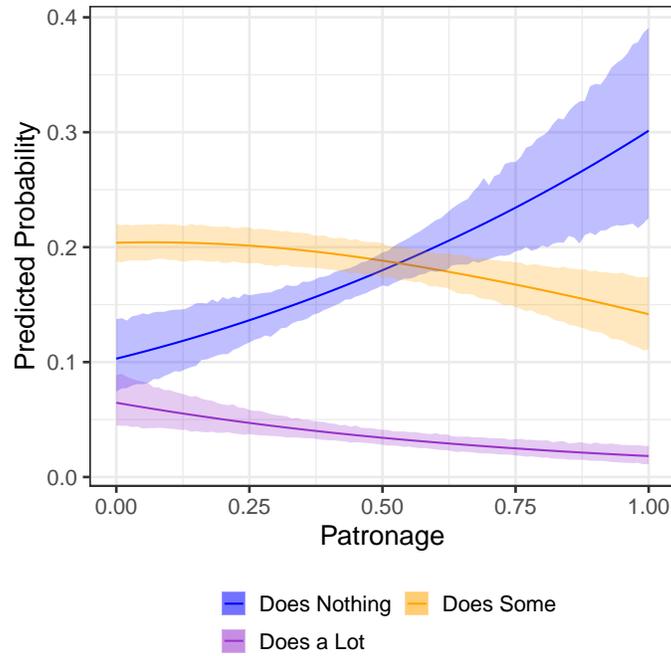
While patronage is distinct from corruption, the two phenomena often tend to covary. I expect that municipalities with higher levels of patronage are also more likely to be municipalities that citizens perceive as corrupt. I test whether my measure of patronage aligns with this expectation using data from the Latin American Public Opinion Project (LAPOP) surveys in Colombia from 2012, 2013, and 2014. These surveys were all taken during the mayoral term that ran from January 1, 2012 to December 31, 2015 so that the same leaders were in office as during the year used to estimate municipal-level patronage. I identify two questions from the 2012, 2013, and 2014 rounds of LAPOP surveys that measure perceptions of corruption.

I consider a question asking citizens to what extent the government combats corruption. Survey respondents answer on a scale from 1 “they do nothing” to 7 “they do a lot”. If my estimate of patronage captures clientelism, I would expect citizens in municipalities with high levels of patronage to be less likely to report that the government is working to combat corruption. I estimate a bivariate ordered logit and find support for this: the coefficient is negative and statistically significant.⁷ In Figure 2a, I highlight three categories of responses: the government does nothing, the central category where the government does some, and the government does a lot. As the level of patronage increases, the probability that respondents answer that the government does nothing increases while the probability that respondents say the government does some or the government does a lot decreases. This is because in

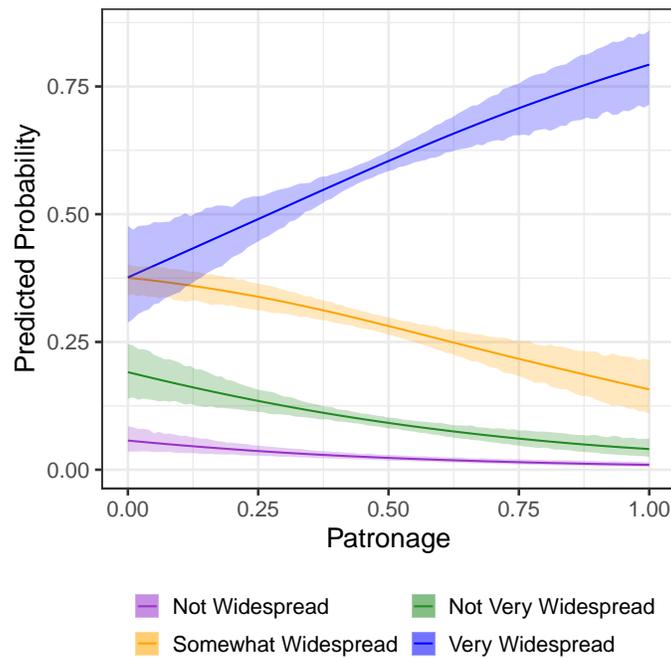
⁷Regression Table is available in the Appendix

areas with higher levels of clientelism, citizens may see the government as less committed to helping curb clientelism since the corrupt public figures may be the government's own patronage hires.

I repeat this test using a question asking citizens how widespread corruption is in public officials. Citizens could respond to this question on a four-point scale ranging from "not widespread" to "very widespread". I expect that citizens in municipalities with higher estimates of patronage are more likely to respond that corruption is "very widespread". I find support for this expectation; the coefficient for patronage is positive and statistically significant. As seen in Figure 2b, where there are higher levels of patronage the probability that citizens identify corruption as very widespread increases, and the probability that citizens respond that corruption is not widespread decreases. Again, this response is intuitive: as citizens witness more patronage, they are less likely to say that corruption in public officials is anything short of widespread. These tests, as well as the qualitative support, suggests that the measure is capturing where patronage is most common throughout the country.



(a) Predicted Probability of Perceptions that the Government Prevents Corruption



(b) Predicted Probability of Responses for Perception of Corruption in Public Officials

Figure 2: Predicted Probability of Survey Responses Given Clientelism in the Respondent's Municipality

Moreover, in a direct test of whether my estimates of patronage correlate with self-reported exposure to clientelism I find positive, though not statistically significant, results. The lack of significance can be partially explained by social desirability bias both contributing to under reporting and higher non-response rates for this question. **Poststratify Here**

5 Applying the Measure

Without a measure of local-level patronage, it has not been possible to understand how the presence of patronage affects how people feel about their government, on average. When politicians use non-programmatic resource allocation, they shape voters expectations of redistribution (Calvo & Murillo 2012, Schneider 2020). Moreover, patronage employees are more likely to provide favors when approached by citizens between elections (Oliveros 2016). As a result, citizens may be responsive to patronage politics (Wantchekon 2003). However, despite evidence that citizens may receive benefits if they vote for politicians engaged in non-programmatic resource allocation, they may not trust these politicians. When considering clientelist politicians, Weitz-Shapiro (2012) finds that citizens who are unlikely to receive clientelist benefits are more likely to oppose clientelist politicians. Similarly, citizens who fail to sanction corrupt politicians during elections are less likely to trust these politicians (Boas, Hidalgo & Melo 2019, Pereira & Melo 2015).

Using my estimates of local-level patronage, I am able to test whether patronage affects how citizens view their locally elected politicians. Drawing from survey research on clientelism and corruption showing citizen's distrust of politicians who engage in non-programmatic politics and corruption (Boas, Hidalgo & Melo 2019, Pereira & Melo 2015, Weitz-Shapiro 2012), I expect that citizens will be less likely to trust politicians who use patronage.

In order to test this hypothesis, I use a question from the LAPOP survey asking citizens, "to what extent do you have confidence in your mayor?". The respondents answer on

a scale from 1 to 7, where 1 is no confidence and 7 is the most confidence. Using a bivariate ordered logit regression, I find that at higher levels of patronage, citizens are less likely to trust their elected officials.⁸ This finding is in line with my expectation and highlights how patronage may negatively affect the relationship between politicians and citizens, even if patronage politicians continue to win elections.

6 Discussion

In this paper, I present a novel application of a mixed-membership model as a tool to estimate clientelism at the local level. Using data from Colombia in 2013, I find that the mixed-membership approach is able to identify which municipalities have a higher relative use of clientelism vis-a-vis patronage. This measure is validated using survey questions from the Latin American Public Opinion Project on corruption during the same mayoral period.

Having a method to estimate local-level clientelism greatly contributes to our ability to answer questions about the effect of clientelism on politics. For example, with information about clientelism at the local-level, we can better evaluate how the use of patronage effects the probability of reelection or how the use of patronage correlates with politician's margins of victory. These advances will bring scholars of clientelism closer to estimating the direct effects of clientelism on electoral outcomes.

This model can easily be applied in additional contexts. The same strategy can be used in any country that uses patronage to target voters. When there is available data on temporary hires, it is possible to apply a mixed membership model estimation strategy in order to estimate relative levels of patronage across geographic units. Similarly, this estimation strategy can be used to evaluate how the use of patronage varies across public sectors. Using data from other sectors, scholars can answer questions about how variation in the use of patronage across public services affects service delivery. Finally, this strategy can be used

⁸See Appendix for regression table and graph of the predicted probability of responding no confidence, moderate confident, and the most confidence.

to observe how the use of patronage has changed over time in the same geographic unit. Using a mixed-membership model to estimate clientelism opens a new avenue for clientelism research. With an estimation strategy for observing variation in the use of clientelism across geographic units, scholars can better analyze the extent to which clientelism affects elections and redistribution.

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Appendices

A Descriptive Statistics

First, I present the descriptive statistics for each of the variables included in the municipal demographic matrix in Table A.1. These variables are then mean-scaled before being used to generate estimations of patronage.

	Min	Mean	Max	Standard Deviation
Fiscal Responsibility	31.82	67.28	90.73	7.74
Need (SISBEN Homes)	38	8181	1031416	37668.88
Population (School Aged)	273	11766	1860862	63660.69

Table A.1: Descriptive Statistics for the Municipal Demographics Variables

Next, I present the summary statistics for each of the employee characteristics in the employee characteristic matrix used to fit the model. Since these variables are counts of employees who share a characteristic in a municipality, I include the minimum count, mean count, maximum count, and standard deviation.

	Min	Mean	Max	Standard Deviation
Educated for Position	8	272.6	30666	1074.21
Assigned to School	8	286.5	31174	1097.42
Assigned to District	0	0.44	148	5.25
Floating Position	0	0.58	77	4.13
Urban School	0	192.47	30243	1054.90
Rural School	0	94.03	999	108.81
“Other” School	0	1.024	207	8.58
Paid through SGP	8	284.2	29038	1036.38
Tenured Position	3	241.42	28789	983.50
Definite Vacancy	0	35.47	2646	115.40
Temporary Vacancy	0	5.72	525	19.05
Trial Vacancy	0	2.87	1691	52.03
Temporary Position	0	2.04	42	3.85
Classroom Teacher	7	263.26	28211	999.82
Support Teacher	0	0.89	369	11.40
Guidance Position	0	2.95	985	30.47
Coordinator	0	10.88	1443	51.17
Rural Director	0	1.64	47	3.34
Rector	0	5.37	335	14.02
Tutor	0	2.11	62	4.26
Not Commissioned	8	284.9	31233	1098.32
Unpaid	0	0.04	21	0.88
Services	0	2.48	147	6.94
No Bonus	7	268.76	29599	1038.57
10 % Bonus	0	1.64	47	3.34
20 % Bonus	0	10.73	1415	50.36
25 % Bonus	0	0.18	5	0.61
30 % Bonus	0	5.05	329	13.64
35% Bonus	0	0.40	18	1.40
No Ethnic Distinction	5	272.2	31381	1100.49
Mixed Race	0	5.99	317	22.52
Afro-Colombian	0	6.23	1617	70.26
Indigenous	0	3.07	186	14.95
Number of Total Employees	72	2568	279521	9840.74

Table A.2: Descriptive Statistics for the Municipal

B Sensitivity Analysis

In Table B.1, I highlight the changes to estimates when modifying a variety of the model assumptions and included variables. In the first column, I highlight the change to the model variables. In each column I include whether the qualitative test for Córdoba still is statistically significant in the same direction, whether the new estimate passes each of the two corruption validity checks, whether the direction of the relationship is the same as the clientelism validity test, and the relationship between the original estimates and the new estimates.

Variation	Qualitative	Government Control Corruption	Public Corruption	Clientelism	Relationship
Ethnicity Omitted	Yes	No	No	Yes	Flat
Proportion Rural ^a	No	No	No	No	Positive
No Rural Schools ^b	No	Yes	Yes	No	Positive
Only Temporary Employees	No	No	No	Yes	Flat ^c
Temporary Employees and Percent Temporary	Yes	No	No	No	Positive ^d
Municipal Capacity ^e	No	Yes	Yes	Yes	Flat
No Municipal Variables	No	Yes	Yes	Yes	Positive ^f
Lagged Municipal Variables	Yes	Yes	Yes	Yes	Positive

^a Due to missing data on the proportion rural, the number of municipalities included in this estimation model drops from 1098 to 938.

^b This model includes the proportion rural variable in the municipal demographic matrix, and as a result only estimates 938 municipalities.

^c This analysis is notable because it highlights the limitations in only considering temporary employees since they are easier to use as temporary hires. Without including the characteristics of non-temporary hires, we see very different, and less reliable, estimates of patronage.

^d As when only considering temporary employees, controlling for the proportion of total employees who are temporary is less effective than including the features of tenured employees.

^e In this version, I replace the fiscal responsibility score with a measure of the surplus/ deficit per capita and add a variable for tax income/ capita in order to better capture municipal-level state capacity.

^f Notably, results are largely consistent even without municipal variables. However, including municipal information refines the estimates, particularly when considering regional variation.

Table B.1: Summary of Sensitivity Analysis

In order to build a visual representation, I graph each of the variations with the new estimates on the x axis and the original estimates on the y axis.

C Regression Results for Validity Checks

Ordered Logit: Government Combats Corruption	
Municipal Patronage	-1.33*** (0.37)
1 2	-2.18*** (0.18)
2 3	-1.35*** (0.17)
3 4	-0.47** (0.17)
4 5	0.36* (0.17)
5 6	1.39*** (0.18)
6 7	2.68*** (0.19)
AIC	10871.70
BIC	10913.60
Log Likelihood	-5428.85
Deviance	10857.70
Num. obs.	2939

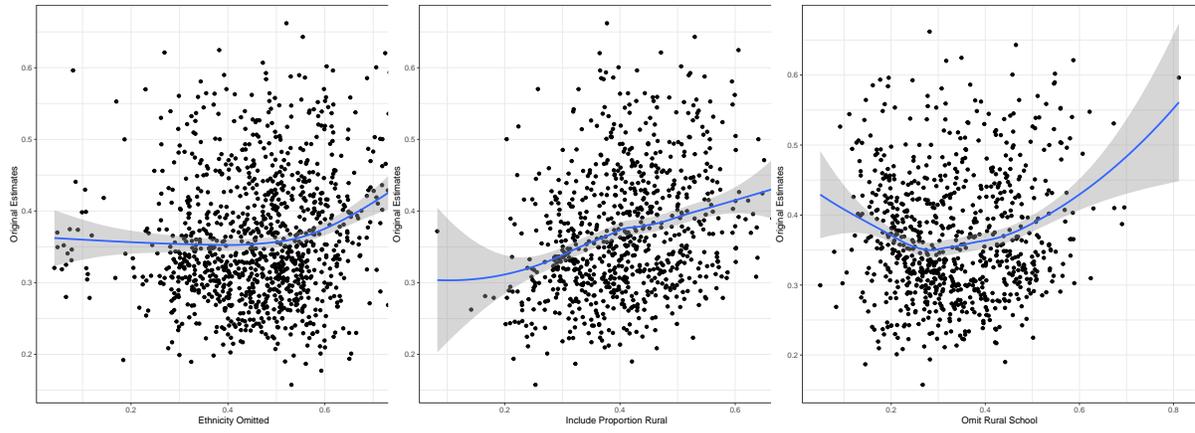
*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

Table C.1: To what extent does the government combat corruption?

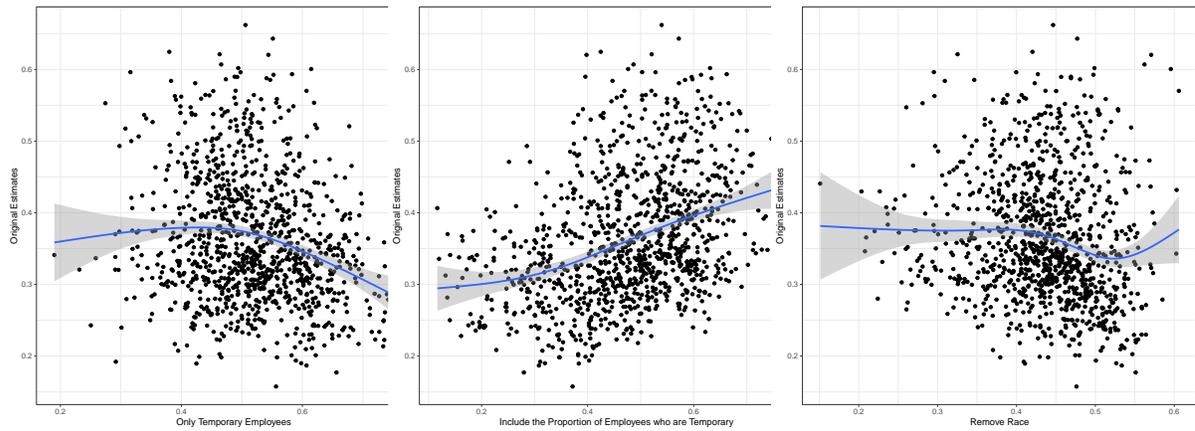
Ordered Logit: Corruption in Public Officials	
Municipal Patronage	1.86*** (0.41)
1 2	-2.82*** (0.22)
2 3	-1.12*** (0.20)
3 4	0.50** (0.19)
AIC	5616.63
BIC	5640.43
Log Likelihood	-2804.32
Deviance	5608.63
Num. obs.	2834

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

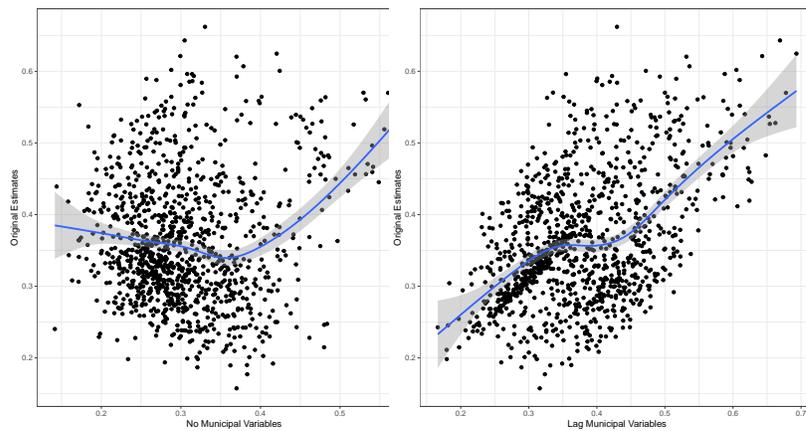
Table C.2: How widespread is corruption in public officials?



(a) Comparison of Estimates when Ethnicity is Omitted (b) Comparison of Estimates when the Proportion of the Municipality Classified as Rural is Included (c) Compare Estimates when the School is Rural



(d) Compare Estimates Only Including Temporary Employees (e) Compare Estimates Including the Proportion of Employees who are Temporary (f) Compare Estimates With Variables for Municipal Capacity



(g) Compare Estimates When Municipal Variables are Omitted (h) Compare Estimates When Municipal Variables Lagged One Year

Figure B.1: Sensitivity Analysis

D Results for Model Application

	Ordered Logit: Trust in Mayor
Municipal Patronage	-1.260*** (0.367)
1 2	-2.270*** (0.178)
2 3	-1.536*** (0.175)
3 4	-0.839*** (0.173)
4 5	0.004 (0.172)
5 6	0.991*** (0.174)
6 7	2.069*** (0.182)
AIC	11124.686
BIC	11166.579
Log Likelihood	-5555.343
Deviance	11110.686
Num. obs.	2936

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Table D.1: To what extent do you have confidence in your mayor?

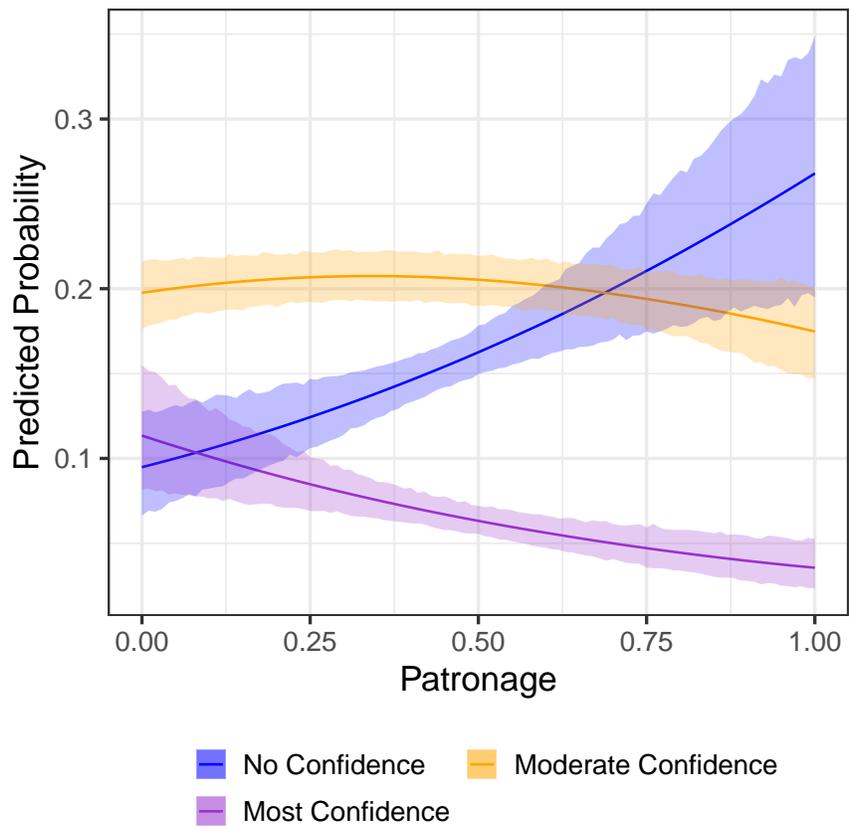


Figure D.1: To what extent do you have confidence in your mayor?

E Imputation Results for Municipalities Without Hires

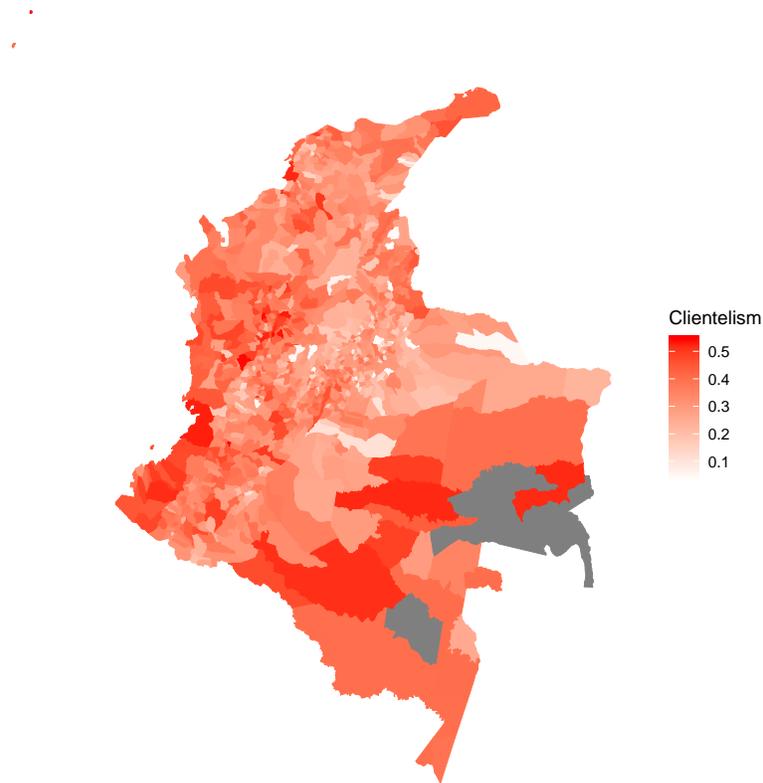


Figure E.1: Patronage Map with Imputations