Does democracy work better in smaller populations?

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Abstract

Does democracy work better in smaller populations? To answer this, we take advantage of the fact that Canada has remarkably large variation in the population of electoral districts. We provide three empirical tests of democratic representation using data from the Local Parliament Project, a study conducted during the 2015 election campaign over a very large sample (>36,000 respondents). We ask whether residents of less-populated electoral districts are better represented. In particular, we ask whether they are more likely to be represented by a Condorcet winner, by a politician they like, and by a legislator that votes consistent with their district's wishes. In all of our measures of the quality of democratic representation, we find no evidence that voters in smaller electoral districts are likely to be better represented. This has an important implication for lawmakers and democratic theorists: within limits, increases in population size need not necessarily degrade quality of democratic representation.

Does democracy work better in smaller populations?[1] In this paper, we take advantage of substantial variation in the population size of Canadian electoral districts to evaluate whether citizens in less-populated districts are better represented. To do so, we forward three tests. First, we examine whether less-populated districts are more likely to elect a member of Parliament (MP) who is the Condorcet winner. Second, we ask whether citizens in less-populated districts realize greater utility from the winning candidate. Finally, we ask whether citizens in less-populated districts elect MPs whose parliamentary voting records are more congruent with aggregate district preferences. We ultimately find that district population size does not have a significant impact on the quality of democratic representation: on all three measures, we find that citizens from more populated districts are just as well-represented as citizens from less-populated districts. While it is certainly reasonable for those designing democratic institutions to focus on constituency size and variance for normative reasons, our work clearly suggests that they have little reason to be concerned about a possible trade-off between population size and quality of democracy.

The paper proceeds as follows. First, we develop a theoretical account of why population size may influence the quality of democracy – drawing on both traditional democratic theory and contemporary empirical work. Second, we set out our three empirical tests: the presence of Condorcet winners, voters' utility levels, and representative policy congruence. Third, we describe the Canadian case and show why examining the impact of variation in the size of Canada's federal electoral districts can inform a broader understanding of the effects of population size on democratic quality. Fourth, we introduce our data, as well as our measures and estimation strategy. Finally, we present the results of our quantitative analysis and discuss the implications of our null findings.

Population Size and Democracy

Questions have long existed about the ideal population size of a democratic polity, both at the macro national level and the micro electoral district level. From a theoretical standpoint, there are two major reasons why we would expect to see better representation in smaller populations. The first is the level of contact between citizens and their local representatives. During the drafting of the American constitution, for example, Madison (1788) proposed a trade-off between efficacy and local accountability. Madison worried that elected officials tasked with representing such a large number of voters could lose their basic connection with the community. Electoral districts that were too large could lead to "confusion" and encourage the "intemperance of the multitude."

Contemporary research bears out Madison's concerns. Squire (1993) argues that less-populated electoral constituencies can at times be seen as preferable because of the simple reality of elected officials being unable to properly conduct constituency work in jurisdictions that are overwhelmingly large. Looking at seven US states, Squire finds that less-populated districts are associated with greater contact between legislators and their constituents. In a statistical comparison of constituent experiences in South Dakota and Illinois, Squire finds that contact is "enhanced…by the intimacy of small districts," as voter experiences in South Dakota with respect

[1] This research was approved by the Research Ethics Board at University XX, conducted under protocol number XXXXXX.

to state legislator contact were significantly stronger than voter experiences in Illinois. South Dakotans were nine percent more likely to contact their elected state representatives than residents of Illinois. Squire concludes that "smaller districts increase contacts with legislators and should provide legislators with a better sense of their constituents and their interests" (486).

Carey and Shugart (1995) note that in closed list electoral systems, historical evidence has shown that district size has an inverse relationship with pork barrel spending. Alluding to earlier work by Lancaster (1986), Carey and Shugart note that pork barrel spending activities tend to decline as district size increases. While in the modern era pork barrel spending has largely been criticized, the fact that pork barrel spending decreases as district size increases is a signal that elected officials begin to afford more attention to national and partisan issues rather than local concerns as their constituency size increases.

The second major theoretical reason that would lead us to expect better representation in smaller populations is heterogeneity in preferences. This has been addressed at both the national and local levels. Alesina (2003) and Dahl and Tufte (1973) have reflected on the desirable size of a democratic polity. According to Alesina, there is a basic trade-off between the benefits of population size (particularly the value of economies of scale) and the costs associated with greater preference heterogeneity among citizens. As Alesina notes, "as heterogeneity [in preferences] increases, then, more and more individuals…will be less satisfied by the central government policies" (305). Alesina and Spolaore (1997) make a similar argument: "beyond a certain point, the benefits of scale may be counter-balanced by congestion and coordination problems" (1029).

Willumsen et al. (2019) illustrate the same issue at the subnational level. Looking at the behaviour of Australian senators, Willumsen et al. find that senators with more populous and socio-economically diverse districts are less active in the legislative arena – specifically, in forwarding amendments and asking questions - than their colleagues with less diverse districts. The authors go on to note that, "while it may be feasible to cater to the views of a small number of voters with homogenous interests, more diverse and more numerous electorates complicate parliamentarians' representational activities." As "the diversity of an electorate increases, it becomes harder, if not impossible, to please all the voters as their diverging interests mean that any proposed policy change will lead to a significant portion of them losing out" (37). Beyond concerns about heterogeneity of citizens' policy preferences, Willumsen et al. echo the concerns articulated by Squire (1993) and Carey and Shugart (1995) about elected officials simply not having sufficient time to tend to constituents' needs when constituency populations become too numerous.

Differences in theoretical claims about the optimal size of democratic units have been mirrored by differences between countries. While there is some empirical regularity in the size of legislatures as a function of population (Taagepera 1972), the fit is far from perfect. Looking only to single-member plurality systems, we can see small countries such as Palau with an average population per constituency of 1,358, while Azerbaijan has an average population of 78,896. At the other end of the distribution, we see the United Kingdom with an average constituency population of 101,600, while the United States has an average population of 710,000. Different

countries have taken not only different paths in terms of population, but also in terms of how many politicians they elect to represent those citizens.

Three Tests of Democratic Representation

We forward three tests to assess whether less-populated districts are better represented than more populated districts. We have paid special attention to developing tests that have fidelity to the majoritarian logic of the first past the post system. In particular, we focus on the capacity of elections to choose majority-preferred candidates and to return representatives whose legislative behavior is congruent with their constituents' policy preferences. These are our first and third measures. Our second, which focuses on voter utility, is a more generic measure of satisfaction—though we adapt its measurement to the context of a system with candidates in single member districts.

In our first test, we ask if smaller districts are more likely to elect a Condorcet winner in their district. While the presence of a Condorcet winner is not assured in any race with more than two candidates and more than two voters (Riker 1982), a collective choice that recovers the Condorcet winner when one exists is more normatively desirable than one that does not. A Condorcet winner, by definition, is the preferred candidate of a given electorate: the candidate who would best all others in a head-to-head matchup. When a candidate wins an election with a plurality but was not majority preferred to all other candidates, the winner's legitimacy comes into question and voter dissatisfaction may increase. Recognizing these potential challenges, many countries have adopted alternative vote systems, including Australia in its House of Representatives - though even these systems do not ensure a Condorcet winner is elected (Maskin 1979). Ultimately, we might expect the likelihood of finding a Condorcet winner in smaller districts to increase, as population and heterogeneity are, in theory, tied together: more voters mean a greater diversity in preferences, and more difficulty in producing a single candidate preferred by a majority to all.

Our second test examines whether smaller districts are more likely to generate greater voter utility. We assume that voters are not indifferent between the representatives who are elected in their district, and that they likewise care about the parties that the candidates represent. We thus derive a measure of voters' utility over each candidate by observing the thermometer ratings voters give to each candidate and their party. We then assign a utility score according to the candidate elected. This further assumes that voters are not indifferent between parties other than their preferred party. Instead, voters who prefer Party A may nonetheless derive different utility from Party B than from Party C. Such assumptions are central to models of strategic voting, for example. Accordingly, we calculate average voter utility in a riding according to the average thermometer scores voters give to winning candidate and their party. If smaller districts are better represented, then we would expect that citizens in less populous districts to be more satisfied with the winner than their counterparts in more populous districts.

Our third test examines whether elected officials from smaller districts have parliamentary voting records that are more congruent with local policy preferences than lawmakers elected from more populous districts. Following Powell (2013), we are interested in "the fit between the preferences of citizens and the committed policy positions of their representatives" (10). Greater

congruence is normatively desirable. Previous researchers have used congruence to measure the quality of democratic representation (Stadelmann et al., 2014; Blais and Bodet 2006; Golder and Stramski 2010). As Blais et al. (2006) assert, "the objective [of congruence] is…to minimize the gap between policy makers and voters" (1244). This is also desirable for pragmatic reasons: as Converse and Pierce (1986) find in their study of democratic representation in France, lawmakers tend to reflect the will of constituents that voted for them rather than the will of a constituency writ large. Thus, if smaller districts have more homogeneity, which in turn may lead to greater congruence, we should expect stronger representation. In our case, we consider congruence on sixteen parliamentary votes, matched against the aggregate preferences in each constituency, as obtained from an unusually large survey sample, which we describe below.

The logic behind each of these three measurements of the quality of democratic representation rests in the logic of majoritarian systems. First, majoritarian systems elect an individual representative at the local level: because an electoral district only selects one candidate, understanding whether that candidate is majority-preferred is essential in seeking to understand the quality of democratic representation. Second, majoritarian systems are meant to encourage centrism. Based on both Duverger and Downs' Median Voter Theorem, the leading candidates running in a majoritarian system should tend toward the centre of the relevant dimension of competition in order to capture enough of the vote to win the election (Cox 2010; Riker 1982; Huber and Powell 1994; Downs 1957). Particularly an election within a single electoral district is a two-person race (Herron et al. 2018), candidates from both sides of the ideological spectrum will converge toward the centre (Downs 1957). Thus, the winning candidate in a majoritarian election will likely have run on a centrist platform, generating a higher average utility. Third, majoritarian systems prioritize local representation (Norris 1997). Because elected officials in majoritarian systems are directly connected to a local constituency, they should be much more knowledgeable about local preferences than elected officials in non-local systems. Therefore, it should be expected that locally elected lawmakers will be more aware of the preferences of their constituents, which in theory should encourage greater congruence between a representative's parliamentary votes and the aggregate preferences of their constituents.

The Case: Considerable variation in the population size of Canadian federal electoral districts

For two reasons, Canada presents as an ideal case to test the potential trade-off between population and democratic representation. First, the average federal electoral district population in Canada falls roughly in the middle of the average electoral district population in the set of democracies that employ a single-member district electoral system. The average population of a Canadian electoral district is roughly 104,000. The mean district population we observe across thirty-nine single member district systems is 157,748.[2] Second, Canada has an abnormally large

[2] We contextualized Canada's approximate average electoral district population with thirty-nine other nations with single member districts. Those countries include Antigua and Barbuda, Australia, Azerbaijan, Bahamas, Bangladesh,

degree of variation in the population size of its federal electoral districts. This means that we can observe variation—within the Canadian context—that covers the majority of the range of average constituency populations in these thirty-nine single-member-district democracies. This goes some way in allowing us to make inferences about democratic experiences in countries with average electoral district populations that fall within the range of Canada's single member district populations.[3] Table 2 in the Appendix presents the average constituency population in forty single member district systems, including Canada. The population range between the fifth and ninety-fifth percentile of Canadian electoral districts covers the fifty-sixth to eighty-seventh percentile of the average electoral district populations across the forty single member district democracies (see Table 2 in the Appendix). The wide range of constituency populations in Canada allows us to make some inferences about the effects of constituency population on democratic outcomes, holding national and political culture constant. Put differently, the within-country analysis presented here offers an important complement to cross-national analyses where unobserved variation in countries' political systems risks confounding the impact of population size.

The wide variation in the size of Canadian electoral districts is unusual by cross-national standards (Ward 1963). This variation is in large part the product of two constitutional rules that establish for each province a minimum number of seats in the House of Commons, the Canadian Parliament's elected lower house. The first rule, known as the grandfather clause, prescribes that each province is guaranteed at least as many seats in the House of Commons as it had in 1986. The second rule, known as the senatorial clause, mandates that no province have fewer seats in the House of Commons than it has in the Senate, Parliament's unelected upper chamber (Courtney 2004). These two rules were adopted to prevent slower-growing provinces from losing representation in the House of Commons. However, an important consequence of these rules has been to further increase variation in district population size between provinces as some provinces experience substantially faster population growth than others. For example, the average electoral district population in Canada's smallest province, Prince Edward Island, is 35,000. By contrast, the average electoral district population in Alberta - one of the country's fastest growing provinces - is 119,000. Both constitutional rules have been upheld by the courts (Sancton 1990; Thomas et al. 2013).

In addition to these two constitutional guarantees, there is a third source of variation: within each province, any given electoral district is allowed to deviate above or below the average district population size of each province by up to twenty-five percent, leading to even more drastic disparities in electoral district populations nationwide. Consider, for example, Ontario and Quebec - Canada's two most populous provinces. While some may argue that disparities in Canada are not

Barbados, Belarus, Belize, Bermuda, Bhutan, Botswana, Burma, Cayman Islands, Comoros, Ethiopia, France, Gambia, Ghana, Grenada, Haiti, India, Ivory Coast, Jamaica, Liberia, Malawi, Malaysia, Maldives, Federated States of Micronesia, Nigeria, Palau, Saint Kitts and Nevis, Saint Lucia, Sierra Leone, Solomon Islands, Trinidad and Tobago, Uganda, United Kingdom, United States, and Yemen. The average electoral district population across all thirty-nine nations is 157,748. Canada's approximate average electoral district population is close to the mean, indicating that Canada is an ideal test case. See Table 2 in the Appendix for an approximate electoral district population size average for all thirty-nine countries.

[3] The population of Canadian electoral districts ranges from 27,197 to 158,749. The average electoral district size among the comparison countries ranges from 1,358 in Palau to 2,454,930 in India.

as prevalent and dramatic as they may seem because over eighty percent of Canada's federal electoral districts are in heavily populated provinces like Ontario, Quebec, British Columbia, and Alberta, the reality is that even within a province like Ontario, electoral district populations vary considerably: ranging from 55,000 in Kenora to 125,000 in Oshawa. Dramatic differences can be seen in Quebec as well, ranging from 78,000 in Gaspésie - Les Îles-de-la-Madeleine to 112,000 in Bellechasse - Les Etchemins - Lévis.

If a larger population decreases the quality of democratic representation, this should be evident in the Canadian context - given its significant population disparities across districts. The smallest twenty percent of electoral districts in Canada (outside of its three northern territories) have an average population of roughly seventy-eight thousand, while the largest twenty percent have an average population of roughly one hundred and twenty-four thousand. If a larger population is tied to greater heterogeneity and less voter contact, and greater heterogeneity and less voter contact leads to a decrease in the quality of democratic representation, some Canadian electoral districts should, in theory, be much better represented than others.

After testing this expectation, our results are clear: using a variety of estimation strategies, we find that electoral districts with smaller populations are no more likely than electoral districts with larger populations to elect a Condorcet winner, to exhibit higher voter utilities, or to produce more congruence between voters' policy preferences and the votes of their Members of Parliament. We simply fail to find evidence that an electoral district's population size has an impact on the overall quality of democratic representation. We also provide a series of robustness checks, all of which suggest no substantive difference in the quality of democratic representation across district populations.

Data, Measures, and Estimation Strategy

All three of our quality of democracy tests - Condorcet winners, utility scores, and policy congruence - employ data from the Local Parliament Project (LPP), a survey of voters conducted in the 2015 Canadian federal election (Loewen et al., 2018). The LPP dataset is well-suited to construct our three tests. With over 36,000 respondents, it allows us to estimate district-level preferences with some precision. Among other standard election study items, participants in the LPP survey were asked for their evaluations of the party leaders and the candidates in their district, as well as their preferences on a wide range of public policy issues. In constructing our measures of democratic quality (described in further detail below), we aggregate these individual-level preferences to the district level.[4] The average number of survey respondents per electoral district is 109.[5] We control for party vote share, immigration, and language at the provincial level and age and gender at the electoral district-level.

To this dataset of survey-based estimates of district-level preferences, we add two other sources of data. The first concerns district population size. We obtained the population size of each

[4] Due to limited survey sampling in Canada's three northern territories (Yukon, the Northwest Territories, and Nunavut), we exclude the three electoral districts that make up the territories. We also excluded the speaker's electoral district because he does not vote.

[5] We used raked weights on a multi-level basis to ensure the representativeness of the data.

electoral district from the 2016 Canadian Census. The second source concerns MPs' voting records in the ensuing Parliament, as obtained from official records of the House of Commons (available at ourcommons.ca).

The key explanatory variable in our study is the population size for each electoral district. We use two measures of population size. The first is simply how many residents live in the district. In the analysis below, we refer to this as absolute population size. The second measure is calculated by taking the total population in each electoral district and dividing it by the mean electoral district population in the province. We refer to this as relative population size. Because the mean electoral district population varies so substantially between provinces, we used our second measure to contextualize the population of each electoral district by comparing it with the provincial population average rather than the national average.

We calculate three measures of democratic representation, which serve as our dependent variables: Condorcet winners, voter utility scores, and policy congruence (which we further break down into two complementary measures). The identification of Condorcet winners at the electoral district level is based on the individual-level utility scores described below. With the individual-level utility scores in hand, we proceeded to rank each voter's party-candidate preferences.[6] With these preferences for every sampled voter in a riding, we simulated each possible head-to-head match-up within an electoral district.[7] Once the head-to-head matchups were aggregated to the electoral district level, we identified the presence of a Condorcet winner by determining if a single party won a head-to-head matchup against every other party. We identify a Condorcet winner in 307 out of 334 constituencies (92%). The remaining 27 exhibited some form of a cycle. Within those 307 constituencies with a Condorcet winner, the winner was elected 193 times. For the purposes of our analysis, we include all 334 ridings, effectively grouping together the cases in which a Condorcet winner is not identified, or is identified but is not elected.

Utility scores were measured using feeling thermometers toward party leaders and local candidates. We create a score for each candidate-party combination by weighting scores for party leaders at 0.75, while feelings toward their local candidates were weighted 0.25.[8] Originally, each of these questions were asked from 0-100, from dislike to like. We recode scores from -1 to +1. We then average the scores across all voters in a constituency, resulting in a district-level score of voter utility for each candidate. We gave leadership scores more weight than those for the local candidates because previous work shows that vote choice in majoritarian systems, such as Canada,

[6] We restricted our analysis to concentrate on five parties in Quebec and four parties in the rest of Canada: Conservative, Liberal, NDP, Green, and—in Quebec only—the Bloc Quebecois.

[7] Based on the utility scores of each respondent, we calculated a ranking of the four main parties (five in Quebec) and then assigned a ranking profile to each individual (e.g., outside of Quebec, a respondent could have 1 of 24 possible profiles). We then computed the frequency of the 24 profiles (120 in Quebec) in each electoral district. Next, for each electoral district, we determined whether a given party beats each other parties in head to head match ups. A Condorcet winner exists if one party is preferred in every pairwise ranking between that party and others.

[8] We also create a utility index for each candidate-party combination by assigning different weighting scores for party leaders at 0.50 and 0.60, and feelings toward their local candidates at 0.50 and 0.40 respectively. This is to examine whether our original measure of utility has a consistent effect on representation irrespective of how we attach weights to party leaders and local candidates. The results are consistent and are demonstrated in Tables 6.1 and 6.2 in the Appendix respectively.

is strongly influenced by voters' evaluations of party leaders (Bittner 2011; Johnston 1992) and less so by local candidate considerations (Allen Stevens et al. 2019).

To establish the face validity of the utility scores of the winning candidates, consider to following two examples. In the electoral district of Bonavista-Burin-Trinity (Newfoundland and Labrador), where the winning candidate won eighty-two percent of the popular vote, we would expect a relatively high utility score - since most voters supported the winning candidate and party. By contrast, in the district of Elmwood-Transcona (Manitoba), where the winning candidate won less than thirty-five percent of the popular vote and the second and third place candidates won roughly thirty percent of the popular vote, we would expect a relatively low utility score. The mean utility score in Bonavista-Burin-Trinity is 0.22, while the mean utility score in Elmwood-Transcona is -0.13. The overall range of utility scores is from -0.4 to 0.4. We find that the average constituency utility score of voters is positively correlated with first place vote share ($r=.42$, $p<.01$), and negatively correlated with second place (($r=-.30$, $p<.01$) and third place ($r=-.29$, $p<.01$) vote share.

Our third measure is the congruence between voters' policy preferences and parliamentary voting by their representative. We compute two different measures of congruence between an MP's voting record and the aggregate preference of their district. We use the LPP data to measure the preferences of voters across various policy issues, and then match these against the voting records of MPs during the 42nd Parliament (2015 to 2019). The first measure of congruence is majority-based. To construct this measure, we first identified the majority position in each electoral district across sixteen different public policy issues. Specifically, we calculated whether more people in a given district favoured or opposed the policy statement in question -after setting aside respondents who indicated that they neither favoured nor opposed the policy.[9] We then determined whether the vote cast by MP in Parliament on this issue was congruent with the majority's position. For each issue, the district was coded as 1 if the MP was onside with the district majority and 0 otherwise. We then took the sum of the resulting sixteen majority-based congruence items and calculated the proportion of instances in which the MP was onside. For details on the survey questions and matching parliamentary votes selected, see Table 3 in the Appendix.

The second measure of congruence aims to capture the absolute difference between MPs' votes and their district aggregate preference. To begin, the policy survey items were rescaled from -1 to 1 and the constituency average for each issue is computed. MPs were then scored on the same scale (i.e., the MP's position is coded at either -1 or 1). We then calculated the absolute distance between the MP's vote from the constituency mean for each issue. Lastly, we took the average of these absolute distances across all votes to determine the average absolute distance.

We employ two estimation strategies to evaluate the relationship between population size and our measures of the quality of democratic representation. Our first strategy is to regress our

[9] The LPP response categories ranged from strongly agree to strongly disagree. In calculating whether more people favour or oppose the policy in question, we used only the strongly agree, agree, disagree and strongly disagree categories. We then added the two agree and the two disagree categories together and compared the majority position among respondents in the districts with the voting records of their representatives on similar issues in the House of Commons.

outcomes of interest on population size - controlling for a large number of other district characteristics. Given that our utility score and congruence outcomes are continuous, we use OLS to estimate the impact of population size. By contrast, the presence of a Condorcet winner is dichotomous; here the impact of population size is estimated using logistic regression. All of the models include province-level fixed effects. We control for a wide range of electoral district level characteristics that might be correlated with our key independent variables and dependent variables. The controls include average age, income, education, unemployment rate, ethnicity, immigration levels, left-right political alignment, election turnout, gender proportion, language, and party competitiveness (see Table 1 in the Appendix for summary statistics).[10]

Second, given that the selection of control variables may be arbitrary, we evaluated the robustness of our model results using specification curves. We do so by using a *speccurve* function, which is available in Stata 16.1. The full specification of each model includes eleven control variables - over and above the provincial fixed effects. Thus, for each model, we estimated an additional $2^{11} = 2048$ different versions – corresponding to all possible combinations of the control variables (with the exception of the province fixed effects, which were included in all versions of the specification analyses). We then plot the parameter estimate of interest (along with its 95% confidence interval) across all of these possible models. Put differently, we have two measures of population size and four measures of democratic representation. Hence, we regress each measure of democratic representation on each measure of population size with all possible combinations of the control variables. All together, we therefore estimated 16384 (2^{11} x 2 x 4) models. We present all regression and specification curve results based on both non-weighted and raked weighted data.

Empirical Results

We examine the impact of both measures of population size on our four measures of democratic representation separately. We present the results from our basic estimation strategy in Tables 5 to 8 in the Appendix. First, we examine the impact of population size on the presence of a Condorcet winner. Model 1 in Table 5 uses the absolute measure of population size without controls whereas Model 2 uses the relative measure of population size without controls. Models 3 and 4 separately use the absolute and the relative measures of population size - and incorporate the control variables. All of models include province-level fixed effects. Across all four estimations in Table 5, we find no evidence that constituency population is related to the likelihood of electing a Condorcet winner.[11]

Table 6 presents our estimates of the relationship between population size and voter utility. The four models follow the same substantive specification as in Table 5. In this case, only the relative measure of population size has a statistically significant effect on voter utility - and only at 90%

[10] We use the Herfindahl index, defined as the sum of the squares of the vote shares of the major parties within each electoral district, to calculate the relative party competitiveness in each electoral district.

[11] We present our main models in Tables 5 to 8 in the Appendix, which show the effects of both measures of population size on Condorcet winners, utility scores, and majority-based and absolute-based congruence respectively.

level. These results, when considered at traditional cut-off of 95%, are both statistically and substantively unimpressive.

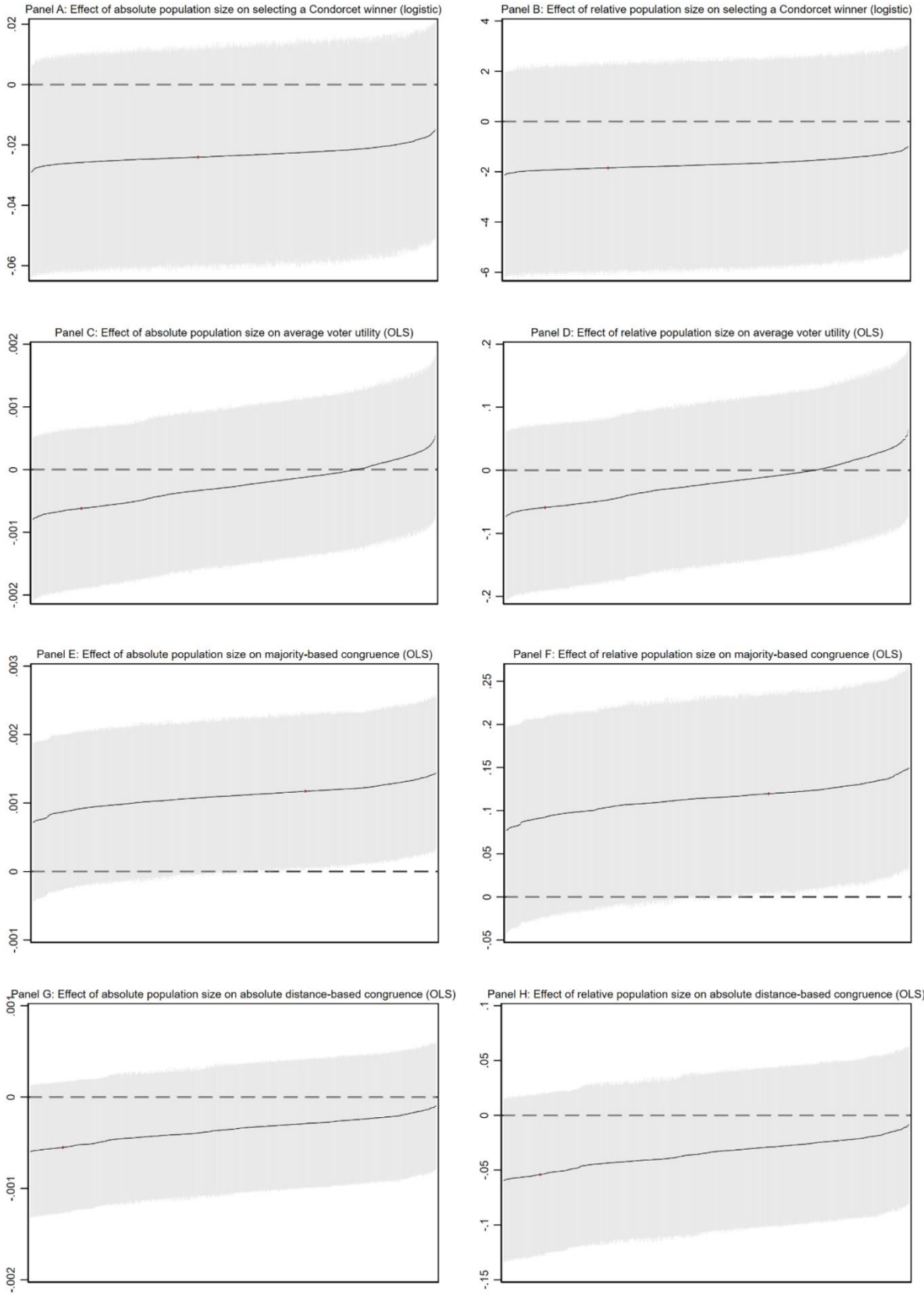
Turning to Tables 7 and 8 in the Appendix, we find no evidence of a negative relationship between greater constituency population and congruence in parliamentary voting. As we have two measures of congruence (majority-based and absolute distance), we separately estimate four models for each measure. In this case, neither measure of population size has a statistically significant negative effect on our two measures of congruence.

Our expectation was that smaller ridings would have greater congruence. Contrary to expectation, however, we find that population size is positively associated with majority-based congruence - although the effect is not large. Our majority-based measure of congruence ranges from 0.10 to 0.80 (suggesting MPs range between voting with the majority preference in their constituency 10% to 80% of the time). The estimated substantive effect of a one-unit/thousand increase in absolute population size on congruence in the main model, while controlling for no other variables, is 0.001 - meaning that an increase in twenty thousand voters is associated with an increase of 0.02 in majority congruence or, equivalently, being onside with the district two more times per 100 votes. This is simply not a large effect. We repeat the same estimation strategy for relative population size. The result substantively tells the same story as the absolute population size measure: larger ridings have more congruent representation. However, once again, the effect is quite small. Moreover, we find no statistically significant relationship between population and our absolute distance-based measure of congruence.

Taken together, we find no convincing evidence across multiple measures of representation that democratic quality is higher in less-populated constituencies.

Second, we are sensitive to the possibility that our null results may be a function of model selection. To guard against this possibility, we have conducted a number of specification curve analyses. In particular, we have conducted a specification curve analysis for each of our four outcomes with each of our measures of population. In Figure 1, Panels A and B respectively show the effect of absolute population size and relative population size on selecting a Condorcet winner. Each panel graphs the parameter of interest from $2^{11} = 2048$ different model specifications—that is, all possible combinations of the 11 control variables (fixed effects for province were included in all specifications). Consistent with our earlier findings, we find no evidence that district population is related to electing a Condorcet winter: the 95% confidence interval overlaps zero in all instances. Panels C and D repeat the process—this time for utility score outcome. Again, we find no evidence that population size is associated with the outcome.

Figure 1: Effects of Population Size on Democratic Representation



Panels E and F present the specification curves for the effect of population on majority-based congruence. Here we find a statistically significant positive effect between both measures of population size and majority-based congruence in 46% of models with non-weighted data and 90% of models with weighted data,[12] largely confirming our initial finding that as population size increases, so too does congruence between voter preferences and lawmakers' voting records. This certainly does not suggest that voters in smaller ridings have greater policy congruence with their representatives.

Finally, Panels G and H show the results from our second measure of legislator congruence, namely absolute distance, and here we find null effects across all models. There is no evidence that an increase in population size has a negative relationship with policy congruence between lawmakers and voters. All together, these findings support the contention that there is no clear negative relationship between constituency population and the quality of democratic representation.

Robustness checks

We employ two robustness checks. First, we employ propensity score matching to estimate the average treatment effect of being above the median district population in a province. Table 9 in the Appendix presents these results: we find no evidence that any of our outcome variables are systematically related to a constituency having a population above the median population in their province. Second, we performed a second set of matching analysis. To address the possibility that differences in population are confounded by differences in regional political cultures or differences in party practices across regions, we matched constituencies geographically. In particular, within each province we identified the most populated district, and matched it with the contiguous district with the smallest population, without replacement. We then repeated this for the second most populated district, matching it with the remaining contiguous district with the smallest population, and continued this until all districts had been matched - generating 165 pairings in all.[13] We then calculated the differences between the matched pairs on all variables, including the dependent variable, and re-estimated the models found in Tables 10 to 13 in the Appendix. We again recover null results: the effect of population size on the quality of democratic representation is indistinguishable from zero at the 95% level across all measures.

Discussion and Conclusion

[12] To ensure that the findings from our unweighted data are robust, we have also re-estimated 16, 384 (2^{11} x 2 x 4) models with raked weights. We used province-level vote share, immigration, and language targets within each province, and constituency-level age and gender targets within each electoral district. See Figure 2 in the Appendix for these weighted results.

[13] There are three provinces (Ontario, Nova Scotia and Newfoundland and Labrador) that have an odd number of districts. We removed the final unpaired riding from each of these three provinces. We also removed the three territories and the Speaker's riding. This leaves us with 165 pairings.

Democracies vary broadly in how many citizens are represented by a single politician. They likewise vary broadly in how much variation in district population they allow for within their country. Leveraging the wide variation in the population of Canadian federal electoral districts, we have explored whether democracy works better in less-populated versus more populated districts. We find little evidence that it does. Majority-preferred candidates are no more likely in less-populated districts, voter utility is not higher, and politicians do not display more congruence with their constituents.

There are important limitations to our findings, of course. While the range of populations in Canadian districts covers a very wide swath of countries with single member plurality systems, some countries remain obvious outliers—namely very large countries like the United States and India and smaller states such as the Bahamas or the Solomon Islands. It is difficult to say whether our findings would generalize to these sites. Second, our comparisons within Canada are constrained effectively by the national party system that is imposed upon them. Effectively, we make inferences over how well coordination can occur across different population sizes within a single party system. If the party system is endogenous to other features of the electoral system - and we have reason to believe it is (Cox 1997; Powell and Vanberg 2000; Powell 2006, 2013) - then we are more constrained in our inferences. Finally, while we have chosen a broad set of indicators of democratic performance, others exist - whether it is satisfaction with democracy (Loewen et al. 2013), MP service (Loewen and MacKenzie 2019; Butler and Nickerson 2011), other measures of congruence (Converse 1986), or even voter participation and other indicators of system satisfaction. Future work should explore other measures. Moreover, our work does not speak directly to measures of government performance and societal well-being, much of which concerned both Alesina (2003) and Madison (1788).

What our work does suggest is that while those designing democratic institutions may be concerned about constituency size and variance for normative reasons, such as equality between citizens, they have less reason to be concerned about the trade-off between population size and the quality of democracy. Policy makers then can perhaps consider other features when setting legislature sizes, such as minimum regional representation or legislative effectiveness. We simply find no persuasive evidence, across multiple tests and thousands of specifications, that the quality of democracy is higher in less-populated areas.

References

Alesina, Alberto. 2003. "The Size of Countries: Does it Matter?" *Journal of the European Economic Association* 1(2-3): 301-316.

Alesina, Alberto, and Enrico Spolaore. 1997. "On the Number and Size of Nations." *The Quarterly Journal of Economics* 112(4): 1027-1056.

Allen Stevens, Benjamin, Md Mujahedul Islam, Roosmarijn de Geus, Jonah Goldberg, John R. McAndrews, Alex Mierke-Zatwarnicki, Peter John Loewen, and Daniel Rubenson. 2019. “Local Candidate Effects in Canadian Elections.” *Canadian Journal of*

Political Science 52(1): 83–96.
Bittner, Amanda. 2011. *Platform or Personality? The Role of Party Leaders in Elections*. Oxford: Oxford University Press.
Blais, André and Marc André Bodet. 2006. “Does Proportional Representation Foster Closer Congruence Between Citizens and Policy Makers?” *Comparative Political Studies* 39(10): 1243-1262.
Butler, Daniel M., and David W. Nickerson. 2011. "Can Learning Constituency Opinion Affect how Legislators Vote? Results from a Field Experiment." *Quarterly Journal of Political Science* 6(1): 55-83.
Carey, John M., and Matthew Soberg Shugart. 1995. "Incentives to Cultivate a Personal Vote: A Rank Ordering of Electoral Formulas." *Electoral studies* 14(4): 417-439.
Converse, Philip E. and Roy Pierce. 1986. *Political Representation in France*. Cambridge: Belknap Press of Harvard University Press.
Courtney, John C. 2004. *Elections*. Vancouver: University of British Columbia Press.
Cox, Gary W. 1997. *Making Votes Count: Strategic Coordination in the World’s Electoral Systems.* Cambridge: Cambridge University Press.
Cox, Gary W. 2010. “Swing Voters, Core Voters, and Distributive Politics.” In *Political Representation,* edited by Ian Shapiro, Susan C. Stokes, Elisabeth Jean Wood, and Alexander S. Kirshner, 342–57. Cambridge: Cambridge University Press.
Dahl, Robert A. and Edward R. Tufte. 1973. *Size and Democracy.* Stanford: Stanford University Press.
Downs, Anthony. 1957. "An Economic Theory of Political Action in a Democracy." *Journal of Political Economy* 65(2): 135-150.
Golder, Matt, and Jacek Stramski. 2010. "Ideological Congruence and Electoral Institutions." *American Journal of Political Science* 54, No. 1, 90-106.
Herron, Erik, Robert Pekkanen and Matthew S. Shugart. 2018. “Terminology and Basic Rules of Electoral Systems.” In *The Oxford Handbook of Electoral Systems*, eds. Erik Herron, Robert Pekkanen and Matthew S. Shugart. New York: Oxford University Press.
Johnston, Richard. 1992. *Letting the People Decide: Dynamics of a Canadian Election*. Stanford: Stanford University Press.
Lancaster, Thomas D. 1986. "Electoral Structures and Pork Barrel Politics." *International Political Science Review* 7(1): 67-81.
Loewen, Peter John, and Michael Kenneth MacKenzie. 2019. "Service Representation in a Federal System: A Field Experiment." *Journal of Experimental Political Science* 6(2): 93-107.
Loewen, Peter, Daniel Rubenson and Royce Koop. 2018. Local Parliament Project 2015 Canadian Election Survey. Harvard Dataverse, http://dx.doi.org/10.7910/DVN/DACHKP, 2018.
Madison, James. 1788. *Federalist 55.*
Maskin, Eric. 1979. “Voting for Public Alternatives: Some Notes on Majority Rule.” *National*

Tax Journal 32(2): 105-108.
Norris, Pippa. 1997. “Choosing Electoral Systems: Proportional, Majoritarian, and Mixed Systems.” *International Political Science Review* 18(3): 297-312.
Powell Jr, G. Bingham and John D. Huber. 1994. “Congruence Between Citizens and Policy-Makers in Two Visions of Liberal Democracy.” *World Politics* 46(3): 291-326.
Powell Jr, G. Bingham, and Georg S. Vanberg. 2000. "Election Laws, Disproportionality and Median Correspondence: Implications for two Visions of Democracy." British Journal of Political Science 30(3): 383-411.
Powell Jr., G. Bingham. 2006. “Election Laws and Representative Governments: Beyond Votes and Seats.” *British Journal of Political Science* 36(2): 291-315.
Powell Jr., G. Bingham. 2013. “Representation in Context: Election Laws and Ideological Congruence Between Citizens and Government.” *Perspectives on Politics* 11(1): 9-21.
Riker, William. 1982. “The Two-Party System and Duverger’s Law: An Essay on the History of Political Science.” *American Political Science Review* 76(4): 753-766.
Sancton, Andrew. 1990. “Eroding Representation-by-Population in the Canadian House of Commons: The Representation Act, 1985.” *Canadian Journal of Political Science* 23(3): 441–57.
Squire, Peverill. 1993. "Professionalization and Public Opinion of State Legislatures." *The Journal of Politics* 55(2): 479-491.
Stadelmann, David, Marco Portmann, and Reiner Eichenberger. 2014. “The Law of Large Districts: How District Magnitude Affects the Quality of Political Representation.” *European Journal of Political* Economy 35(1): 128-140.
Taagepera, Rein. 1972. “The Size of National Assemblies.” *Social Science Research* 1(4): 385-401.
Thomas, Paul E.J., Peter John Loewen, Michael K. MacKenzie. 2013. “Fair Isn’t Always Equal: Constituency Population and the Quality of Representation in Canada.” *Canadian Journal of Political Science* 46(2): 273-293.
Ward, Norman. 1963. *The Canadian House of Commons: Representation*. Toronto: University of Toronto Press.
Willumsen, David M., Christian Stecker and Klaus H. Goetz. 2018. “Do Electoral District Size and Diversity Affect Legislative Behaviour?” *Australian Journal of Political Science.*

Appendix

Table 1: Summary Statistics of Covariates

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
Utility	334	0.05	0.14	-0.41	-0.05	0.15	0.41
Condorcet Winner	334	0.92	0.27	0	1	1	1
Majority-based congruence	334	0.47	0.11	0.12	0.38	0.56	0.75
Absolute distance-based congruence	334	0.61	0.08	0.38	0.55	0.66	0.80
Absolute population size	334	104.62	17.71	27.20	96.31	115.78	158.75
Relative population size	334	1.00	0.10	0.37	0.94	1.06	1.33
Age (mean)	334	48.70	4.72	35.77	45.26	52.09	66.62
Income (mean)	334	4.01	0.64	2.58	3.54	4.43	5.98
Education (mean)	334	3.23	0.51	2.42	2.84	3.57	4.98
Unemployment rate (mean)	334	6.85	4.39	0.00	3.69	9.49	30.39
Visible minority (mean)	334	25.47	16.91	0.00	11.50	36.12	81.95
Left-right alignment (mean)	334	0.50	0.03	0.41	0.49	0.52	0.58
Turnout rate (mean)	334	68.23	5.02	54.80	65.40	71.80	80.60
Female (proportion)	334	0.52	0.01	0.48	0.52	0.53	0.58
Language spoken, French (proportion)	334	0.21	0.36	0.001	0.004	0.24	1.00
Immigrant 2011 (percent)	334	19.64	17.29	0.70	5.23	30.23	68.40
Party competitiveness	334	0.99	0.02	1	1	1	1

Sources: Local parliament project (LPP); www.ourcommons.ca and 2016 Canadian census)

Table 2: Approximate Average Electoral District Population Across Countries

Country	Population	Seats[14]	Average
Antigua and Barbuda	102,012	19	5369
Australia	24,600,000	151	162914
Azerbaijan	9,862,000	125	78896
Bahamas	395,361	55	7188
Bangladesh	164,700,000	350	470571
Barbados	285,719	51	5602
Belarus	9,508,000	110	86436
Belize	374,681	31	12087
Bermuda	65,441	36	1818
Bhutan	807,610	47	17183
Botswana	2,292,000	57	40211
Burma	53,370,000	440	121295
Canada	37,060,000	338	109645
Cayman Islands	61,559	19	3240
Comoros	813,912	33	24664
Ethiopia	105,000,000	547	191956
France	66,990,000	577	116101
Gambia	2,101,000	58	36224
Ghana	28,830,000	275	104836
Grenada	107,825	15	7188
Haiti	10,980,000	119	92269
India	1,339,000,000	543	2,454,930
Ivory Coast	24,290,000	255	95255
Jamaica	2,890,000	63	45873
Liberia	4,732,000	73	64822
Malawi	18,620,000	193	96477
Malaysia	31,620,000	222	142432
Maldives	436,330	87	5015
Micronesia	105,544	14	7539
Nigeria	190,900,000	360	530278
Palau	21,729	16	1358
Saint Kitts and Nevis	55,345	15	3690
Saint Lucia	178,844	18	9936
Sierra Leone	7,557,000	146	51760
Solomon Islands	611,343	50	12227
Trinidad and Tobago	1,369,000	41	33390
Uganda	42,860,000	426	100610

[14] Lower house if bicameral.

UK	66,040,000	650	101600
US	327,200,000	435	752184
Yemen	28,250,000	301	93854

Table 3: Matching Survey Questions with Motion Text for Congruence

Survey Question	Description of Vote
pos_isis Canada should continue its military mission against ISIS.	The government should continue its mission against ISIS, including air-combat
pos_qb Quebec should be treated the same as every other province.	Quebec should have its own income tax arrangement with the federal government.
pos_trade There should be more free trade with other countries, even if it hurts some industries in Canada.	Implement free trade with the European Union.
pos_absay When economic development projects cross on Aboriginal land, Aboriginals should have the final say.	Aboriginals should have the final say about development projects that affect their traditional land.
pos_health How much should the federal government spend on health care? (coded as if the question was we should spend more on health care)	Introducing a national pharmacare program
pos_abort There should be more restrictions on abortion.	Pro-life groups/individuals should be able to access summer job programs.
pos_energy The federal government should do more to help Canada's energy sector, including building oil pipelines.	Approve the Kinder Morgan Pipeline Project
pos_envreg Environmental regulation should be stricter, even if it leads to consumers having to pay higher prices.	Declare climate change emergency, call on the House to support the Paris targets.
pos_carbon To help reduce greenhouse gas emissions, the federal government should institute a carbon tax.	There should be a pan-Canadian framework for addressing climate change
pos_fptp Canada should change its electoral system from "First Past the Post" to a "proportional representation" system.	Canada should change its electoral system to proportional representation.

pos_jobs When there is a conflict between protecting the environment and creating jobs, jobs should come first.	Introduces further regulation for energy projects
pos_life Individuals who are terminally ill should be allowed to end their lives with the assistance of a doctor.	Assisted suicide should be legalized in some circumstances.
pos_pot Possession of marijuana should be a criminal offence.	Marijuana should be legalized.
pos_refuge Canada should increase the number of refugees it admits each year.	A plan should be adopted to deal with illegal border crossings, and the Prime Minister's #WelcometoCanada support should be condemned.
pos_taxbus How much should small businesses pay in taxes? (coded as if small business should pay more taxes)	Small business taxes should be reduced
pos_terror The federal government should have more powers to combat terrorism, even if it means that citizens have to give up more privacy.	Privacy should be enhanced and government capacity to handle terrorism should be curtailed.

Table 4: Summary Statistics of the Covariates in Contiguous Electoral District Pairing

Summary statistics of the covariates

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
Diff.utility	165	0.03	0.16	-0.45	-0.05	0.14	0.43
Diff.condorcet winner	165	-0.03	0.37	-1	0	0	1
Diff.majority-based congruence	165	0.03	0.14	-0	-0.1	0.1	1
Diff.absolute distance based congruence	165	-0.01	0.09	-0.30	-0.07	0.05	0.26
Diff.absolute population size	165	11.52	9.50	-1.91	4.26	15.82	59.36
Diff.relative population size	165	0.11	0.10	-0.02	0.04	0.15	0.80
Diff.age (mean)	165	-0.14	5.38	-17.78	-3.37	3.65	13.91
Diff.income (mean)	165	0.12	0.63	-1.75	-0.31	0.58	1.65
Diff.education (mean)	165	0.10	0.55	-1.55	-0.22	0.39	1.80
Diff.unemployment rate (mean)	165	-0.09	6.27	-16.41	-4.35	3.83	25.83
Diff.visible minority (mean)	165	-0.51	15.13	-47.89	-8.98	7.49	64.47
Diff.left-right alignment (mean)	165	-0.003	0.03	-0.09	-0.03	0.02	0.09
Diff.turnout rate (mean)	165	0.49	5.23	-14.00	-2.60	3.80	16.60
Diff.female (prop.)	165	-0.0004	0.01	-0.05	-0.01	0.01	0.03
Diff.language spoken, French (prop.)	165	-0.01	0.12	-0.67	-0.003	0.003	0.53
Diff.immigrant 2011 (percent)	165	0.83	10.96	-39.00	-4.20	6.50	45.00
Diff.party competitiveness	165	0.002	0.03	-0	0	0	0
Province	165	7.37	3.78	1	3	11	12

Sources: Local parliament project (LPP); www.ourcommons.ca and 2016 Canadian census.

Table 5: Effect of population size on selecting a Condorcet winner (logistic)

	Dependent variable:			
	Condorcet winner			
	(1)	(2)	(3)	(4)
Absolute population size	-0.01 (0.02)		-0.02 (0.02)	
Relative population size		-1.22 (2.08)		-2.13 (2.17)
Age (mean)			-0.03 (0.06)	-0.03 (0.06)
Income (mean)			0.10 (0.53)	0.10 (0.53)
Education (mean)			0.50 (0.80)	0.51 (0.80)
Unemployment rate (mean)			-0.02 (0.05)	-0.02 (0.05)
Visible minority (mean)			-0.00 (0.03)	-0.01 (0.03)
Left-right alignment (mean)			-6.18 (9.08)	-6.21 (9.09)
Turnout rate (mean)			0.04 (0.07)	0.04 (0.07)
Female (proportion)			9.02 (27.35)	8.89 (27.36)
Language spoken, French (proportion)			2.70 (2.80)	2.72 (2.80)
Immigrant 2011 (percent)			0.01 (0.03)	0.01 (0.03)
Party competitiveness			-13.45 (26.07)	-13.43 (26.05)
British Columbia (Base is Alberta)	-1.26 (0.86)	-1.17 (0.84)	-1.82* (1.02)	-1.66* (1.01)
Manitoba	15.48 (1,742.77)	15.79 (1,742.54)	15.21 (1,705.15)	15.74 (1,703.15)
New Brunswick	-1.06 (1.55)	-0.57 (1.28)	-2.25 (1.86)	-1.41 (1.68)
Newfoundland	15.31 (2,457.86)	15.82 (2,449.92)	15.16 (2,397.91)	16.04 (2,382.25)
Nova Scotia	15.39 (2,061.37)	15.77 (2,060.41)	14.78 (2,034.91)	15.44 (2,031.52)
Ontario	-0.75 (0.80)	-0.65 (0.79)	-1.22 (0.94)	-1.07 (0.93)
PEI	14.88 (3,261.29)	15.79 (3,261.07)	13.29 (3,245.99)	14.83 (3,249.02)
Quebec	0.70 (1.06)	0.86 (1.02)	-1.91 (2.30)	-1.64 (2.30)
Saskatchewan	-1.43 (1.33)	-0.98 (1.06)	-1.81 (1.42)	-1.06 (1.20)
Constant	4.07* (2.44)	4.00* (2.22)	13.64 (29.92)	13.62 (29.88)
Observations	334	334	334	334
Log Likelihood	-85.94	-85.93	-82.08	-82.02
Akaike Inf. Crit.	193.88	193.85	208.15	208.03
Note:				*p<0.1; **p<0.05; ***p<0.01

Table 6: Effect of population size on average voter utility (OLS)

	Dependent variable:			
	Average Voter Utility			
	(1)	(2)	(3)	(4)
Absolute population size	0.00 (0.00)		-0.00 (0.00)	
Relative population size		0.06 (0.07)		-0.06 (0.07)
Age (mean)			-0.00 (0.00)	-0.00 (0.00)
Income (mean)			-0.01 (0.02)	-0.01 (0.02)
Education (mean)			0.02 (0.02)	0.02 (0.02)
Unemployment rate (mean)			-0.00 (0.00)	-0.00 (0.00)
Visible minority (mean)			-0.00 (0.00)	0.00 (0.00)
Left-right alignment (mean)			-0.95*** (0.30)	-0.95*** (0.30)
Turnout rate (mean)			0.00* (0.00)	0.00* (0.00)
Female (proportion)			-0.49 (0.79)	-0.49 (0.79)
Language spoken, French (proportion)			-0.07 (0.07)	-0.07 (0.07)
Immigrant 2011 (percent)			0.00*** (0.00)	0.00** (0.00)
Party competitiveness			0.72* (0.43)	0.72* (0.43)
British Columbia (Base is Alberta)	-0.05* (0.03)	-0.06* (0.03)	-0.13*** (0.03)	-0.13*** (0.03)
Manitoba	-0.03 (0.05)	-0.04 (0.04)	-0.07 (0.04)	-0.05 (0.04)
New Brunswick	0.08 (0.06)	0.06 (0.05)	0.02 (0.06)	0.04 (0.05)
Newfoundland	0.18*** (0.06)	0.16*** (0.05)	0.17*** (0.06)	0.20*** (0.06)
Nova Scotia	0.15*** (0.05)	0.13*** (0.05)	0.08 (0.05)	0.10** (0.05)
Ontario	-0.03 (0.03)	-0.03 (0.03)	-0.08*** (0.03)	-0.08*** (0.03)
PEI	0.16* (0.09)	0.12* (0.07)	0.04 (0.09)	0.09 (0.08)
Quebec	-0.00 (0.03)	-0.01 (0.03)	0.06 (0.06)	0.06 (0.06)
Saskatchewan	-0.15*** (0.05)	-0.17*** (0.04)	-0.18*** (0.05)	-0.16*** (0.04)
Constant	0.01 (0.08)	0.01 (0.07)	-0.07 (0.62)	-0.08 (0.62)
Observations	334	334	334	334
R^2	0.16	0.16	0.32	0.32
Adjusted R^2	0.13	0.13	0.27	0.27
F Statistic	5.98***	6.00***	6.93***	6.92***
Note:				*p<0.1; **p<0.05; ***p<0.01

Table 6.1: Effect of population size on average voter utility (OLS) (50/50)

	Dependent variable:			
	Average Voter Utility 50/50			
	(1)	(2)	(3)	(4)
Absolute population size	0.00 (0.00)		-0.00 (0.00)	
Relative population size		0.03 (0.06)		-0.05 (0.06)
Age (mean)			-0.00 (0.00)	-0.00 (0.00)
Income (mean)			-0.02 (0.02)	-0.02 (0.02)
Education (mean)			0.02 (0.02)	0.02 (0.02)
Unemployment rate (mean)			-0.00 (0.00)	-0.00 (0.00)
Visible minority (mean)			0.00 (0.00)	0.00 (0.00)
Left-right alignment (mean)			-0.79*** (0.29)	-0.79*** (0.29)
Turnout rate (mean)			0.00 (0.00)	0.00 (0.00)
Female (proportion)			-0.72 (0.76)	-0.73 (0.76)
Language spoken, French (proportion)			-0.12* (0.07)	-0.12* (0.07)
Immigrant 2011 (percent)			0.00 (0.00)	0.00 (0.00)
Party competitiveness			0.71* (0.41)	0.71* (0.41)
British Columbia (Base is Alberta)	-0.05* (0.03)	-0.06** (0.03)	-0.12*** (0.03)	-0.11*** (0.03)
Manitoba	-0.02 (0.04)	-0.03 (0.04)	-0.06 (0.04)	-0.04 (0.04)
New Brunswick	0.05 (0.05)	0.04 (0.04)	0.02 (0.06)	0.04 (0.05)
Newfoundland	0.16*** (0.06)	0.15*** (0.05)	0.15** (0.06)	0.17*** (0.06)
Nova Scotia	0.12** (0.05)	0.11** (0.04)	0.06 (0.05)	0.08 (0.05)
Ontario	-0.03 (0.02)	-0.03 (0.02)	-0.07** (0.03)	-0.06** (0.03)
PEI	0.14* (0.08)	0.11* (0.06)	0.05 (0.09)	0.09 (0.07)
Quebec	-0.02 (0.03)	-0.02 (0.02)	0.07 (0.06)	0.07 (0.06)
Saskatchewan	-0.14*** (0.05)	-0.15*** (0.04)	-0.16*** (0.04)	-0.14*** (0.04)
Constant	0.05 (0.08)	0.05 (0.07)	0.06 (0.59)	0.06 (0.59)
Observations	334	334	334	334
R^2	0.14	0.14	0.27	0.27
Adjusted R^2	0.12	0.12	0.22	0.22
F Statistic	5.35***	5.35***	5.45***	5.45***
Note:				*p<0.1; **p<0.05; ***p<0.01

Table 6.2: Effect of population size on average voter utility (OLS) (60/40)

	Dependent variable:			
	Average Voter Utility (60/40)			
	(1)	(2)	(3)	(4)
Absolute population size	0.00 (0.00)		-0.00 (0.00)	
Relative population size		0.04 (0.06)		-0.05 (0.06)
Age (mean)			-0.00 (0.00)	-0.00 (0.00)
Income (mean)			-0.02 (0.02)	-0.02 (0.02)
Education (mean)			0.02 (0.02)	0.02 (0.02)
Unemployment rate (mean)			-0.00 (0.00)	-0.00 (0.00)
Visible minority (mean)			0.00 (0.00)	0.00 (0.00)
Left-right alignment (mean)			-0.85*** (0.29)	-0.86*** (0.29)
Turnout rate (mean)			0.00* (0.00)	0.00* (0.00)
Female (proportion)			-0.63 (0.76)	-0.63 (0.76)
Language spoken, French (proportion)			-0.10 (0.07)	-0.10 (0.07)
Immigrant 2011 (percent)			0.00** (0.00)	0.00** (0.00)
Party competitiveness			0.72* (0.42)	0.71* (0.42)
British Columbia (Base is Alberta)	-0.05* (0.03)	-0.06** (0.03)	-0.12*** (0.03)	-0.12*** (0.03)
Manitoba	-0.03 (0.04)	-0.04 (0.04)	-0.06 (0.04)	-0.05 (0.04)
New Brunswick	0.06 (0.05)	0.05 (0.04)	0.02 (0.06)	0.04 (0.05)
Newfoundland	0.17*** (0.06)	0.15*** (0.05)	0.16*** (0.06)	0.18*** (0.06)
Nova Scotia	0.13** (0.05)	0.12*** (0.04)	0.07 (0.05)	0.09* (0.05)
Ontario	-0.03 (0.02)	-0.03 (0.02)	-0.07*** (0.03)	-0.07** (0.03)
PEI	0.15* (0.08)	0.12* (0.07)	0.05 (0.09)	0.09 (0.07)
Quebec	-0.01 (0.03)	-0.02 (0.03)	0.06 (0.06)	0.07 (0.06)
Saskatchewan	-0.14*** (0.05)	-0.16*** (0.04)	-0.17*** (0.05)	-0.15*** (0.04)
Constant	0.03 (0.08)	0.04 (0.07)	0.01 (0.60)	0.00 (0.60)
Observations	334	334	334	334
R^2	0.15	0.15	0.29	0.29
Adjusted R^2	0.12	0.12	0.24	0.24
F Statistic	5.68***	5.68***	6.09***	6.08***
Note:				*p<0.1; **p<0.05; ***p<0.01

Table 7: Effect of population size on majority-based congruence (OLS)

	Dependent variable:			
	Majority-based congruence			
	(1)	(2)	(3)	(4)
Absolute population size	0.00** (0.00)		0.00** (0.00)	
Relative population size		0.12** (0.06)		0.12** (0.06)
Age (mean)			-0.00 (0.00)	-0.00 (0.00)
Income (mean)			-0.03** (0.01)	-0.03** (0.01)
Education (mean)			0.02 (0.02)	0.02 (0.02)
Unemployment rate (mean)			-0.00 (0.00)	-0.00 (0.00)
Visible minority (mean)			-0.00 (0.00)	-0.00 (0.00)
Left-right alignment (mean)			-0.60** (0.27)	-0.60** (0.27)
Turnout rate (mean)			0.00 (0.00)	0.00 (0.00)
Female (proportion)			1.44** (0.71)	1.45** (0.71)
Language spoken, French (proportion)			-0.01 (0.06)	-0.01 (0.06)
Immigrant 2011 (percent)			-0.00 (0.00)	-0.00 (0.00)
Party competitiveness			-0.10 (0.39)	-0.10 (0.39)
British Columbia (Base is Alberta)	0.01 (0.03)	-0.00 (0.03)	-0.06* (0.03)	-0.07** (0.03)
Manitoba	0.04 (0.04)	0.00 (0.04)	-0.02 (0.04)	-0.05 (0.04)
New Brunswick	0.06 (0.05)	0.00 (0.04)	-0.05 (0.05)	-0.11** (0.05)
Newfoundland	0.02 (0.05)	-0.04 (0.05)	-0.03 (0.06)	-0.08 (0.05)
Nova Scotia	0.14*** (0.04)	0.10** (0.04)	0.03 (0.05)	-0.01 (0.05)
Ontario	0.02 (0.02)	0.01 (0.02)	-0.04 (0.02)	-0.05* (0.02)
PEI	0.10 (0.07)	0.00 (0.06)	-0.05 (0.08)	-0.15** (0.07)
Quebec	0.03 (0.02)	0.02 (0.02)	-0.02 (0.05)	-0.04 (0.05)
Saskatchewan	-0.02 (0.04)	-0.07** (0.04)	-0.06 (0.04)	-0.11*** (0.04)
Constant	0.33*** (0.07)	0.34*** (0.06)	0.03 (0.56)	0.04 (0.56)
Observations	334	334	334	334
R^2	0.06	0.06	0.14	0.14
Adjusted R^2	0.03	0.03	0.09	0.09
F Statistic	1.96**	1.98**	2.48***	2.48***
Note:				*p<0.1; **p<0.05; ***p<0.01

Table 8: Effect of population size on absolute distance-based congruence (OLS)

	Dependent variable:			
	Absolute distance-based congruence			
	(1)	(2)	(3)	(4)
Absolute population size	-0.00 (0.00)		-0.00 (0.00)	
Relative population size		-0.01 (0.04)		-0.05 (0.04)
Age (mean)			-0.00 (0.00)	-0.00 (0.00)
Income (mean)			0.00 (0.01)	0.00 (0.01)
Education (mean)			-0.01 (0.01)	-0.01 (0.01)
Unemployment rate (mean)			0.00 (0.00)	0.00 (0.00)
Visible minority (mean)			-0.00 (0.00)	-0.00 (0.00)
Left-right alignment (mean)			-0.03 (0.17)	-0.03 (0.17)
Turnout rate (mean)			0.00*** (0.00)	0.00*** (0.00)
Female (proportion)			-0.08 (0.44)	-0.08 (0.45)
Language spoken, French (proportion)			-0.08* (0.04)	-0.08* (0.04)
Immigrant 2011 (percent)			0.00 (0.00)	0.00 (0.00)
Party competitiveness			0.60** (0.24)	0.60** (0.24)
British Columbia (Base is Alberta)	0.04** (0.02)	0.04** (0.02)	0.03 (0.02)	0.03* (0.02)
Manitoba	0.03 (0.02)	0.04 (0.02)	0.03 (0.02)	0.04* (0.02)
New Brunswick	0.07** (0.03)	0.07*** (0.02)	0.05 (0.03)	0.08** (0.03)
Newfoundland	0.10*** (0.03)	0.11*** (0.03)	0.12*** (0.04)	0.15*** (0.03)
Nova Scotia	0.08*** (0.03)	0.09*** (0.03)	0.06** (0.03)	0.08*** (0.03)
Ontario	0.07*** (0.01)	0.07*** (0.01)	0.06*** (0.02)	0.07*** (0.02)
PEI	0.11** (0.05)	0.12*** (0.04)	0.04 (0.05)	0.09** (0.04)
Quebec	0.00 (0.02)	0.00 (0.01)	0.10*** (0.03)	0.11*** (0.03)
Saskatchewan	0.01 (0.03)	0.01 (0.02)	-0.01 (0.03)	0.01 (0.02)
Constant	0.58*** (0.04)	0.57*** (0.04)	-0.16 (0.35)	-0.17 (0.35)
Observations	334	334	334	334
R^2	0.18	0.18	0.26	0.26
Adjusted R^2	0.16	0.16	0.21	0.21
F Statistic	7.11***	7.11***	5.30***	5.28***
Note:				*p<0.1; **p<0.05; ***p<0.01

Table 9: Average treatment effect of population size on three measures of democratic representation

	Dependent variables:			
	(Utility)	(Condorcet Winner)	(Majority-based congruence)	(Absolute distance-based congruence)
Population size (1 = Above provincial median)	-0.00 (0.02)	-.04 (.04)	-.01 (.01)	-.01 (.01)
Estimator	PSM	PSM	PSM	PSM
Outcome model	Matching	Matching	Matching	Matching
Treatment model	Logit	Logit	Logit	Logit
Z	-0.25	-1.16	-0.42	-0.64
P>|Z|	0.80	0.25	0.69	0.52
Observations	334	334	334	334

Note: Propensity-score matching (PSM). AI Robust Std. Err. in parenthesis
*p<0.1; **p<0.05; ***p<0.01 Estimated using teffects in STATA.

Table 10: Effect of Population Size on Condorcet Winner in Contiguous Electoral District Pairing

	Dependent variable:			
	Diff.condorcet winner			
	(1)	(2)	(3)	(4)
Diff.absolute population size	0.00 (0.00)		0.00 (0.00)	
Diff.relative population size		0.08 (0.33)		0.06 (0.34)
Diff.age (mean)			-0.00 (0.01)	-0.00 (0.01)
Diff.income (mean)			-0.04 (0.06)	-0.04 (0.06)
Diff.education (mean)			-0.05 (0.09)	-0.05 (0.09)
Diff.unemployment rate (mean)			-0.01 (0.01)	-0.01 (0.01)
Diff.visible minority (mean)			-0.00 (0.00)	-0.00 (0.00)
Diff.left-right alignment (mean)			-0.53 (1.06)	-0.52 (1.06)
Diff.turnout rate (mean)			0.01 (0.01)	0.01 (0.01)
Diff.female (proportion)			1.12 (2.94)	1.12 (2.94)
Diff.language spoken, French (proportion)			0.17 (0.32)	0.17 (0.32)
Diff.immigrant 2011 (percent)			0.00 (0.00)	0.00 (0.00)
Diff.party competitiveness			-0.11 (1.20)	-0.11 (1.20)
British Columbia (Base is Alberta)	0.26** (0.12)	0.26** (0.12)	0.26* (0.13)	0.25* (0.13)
Manitoba	0.12 (0.17)	0.12 (0.17)	0.10 (0.18)	0.10 (0.18)
New Brunswick	-0.08 (0.19)	-0.09 (0.19)	-0.06 (0.21)	-0.07 (0.21)
Newfoundland	0.10 (0.24)	0.10 (0.25)	0.08 (0.25)	0.07 (0.26)
Nova Scotia	0.12 (0.21)	0.12 (0.21)	0.12 (0.22)	0.12 (0.22)
Ontario	0.07 (0.10)	0.07 (0.10)	0.06 (0.11)	0.06 (0.11)
PEI	0.13 (0.28)	0.12 (0.28)	0.12 (0.30)	0.12 (0.29)
Quebec	0.07 (0.11)	0.07 (0.11)	0.07 (0.12)	0.07 (0.12)
Saskatchewan	0.13 (0.17)	0.12 (0.17)	0.11 (0.19)	0.10 (0.18)
Constant	-0.13 (0.10)	-0.13 (0.10)	-0.12 (0.11)	-0.12 (0.10)
Observations[15]	165	165	165	165
R^2	0.04	0.04	0.07	0.07
Adjusted R^2	-0.02	-0.02	-0.07	-0.07
F Statistic	0.69	0.68	0.51	0.51

[15] As noted before, there are three provinces (Ontario, Nova Scotia and Newfoundland and Labrador) that have an odd number of districts. We removed the final unpaired riding from each of these three provinces. We also removed the three territories and the Speaker's riding. This leaves us with 165 pairings (observations).

Note: *p<0.1; **p<0.05; ***p<0.01

Table 11: Effect of Population Size on Utility in Contiguous Electoral District Pairing

	Dependent variable:			
	Diff.utility			
	(1)	(2)	(3)	(4)
Diff.absolute population size	-0.00 (0.00)		-0.00 (0.00)	
Diff.relative population size		-0.01 (0.14)		-0.02 (0.14)
Diff.age (mean)			0.00 (0.00)	0.00 (0.00)
Diff.income (mean)			-0.00 (0.02)	-0.00 (0.02)
Diff.education (mean)			0.03 (0.03)	0.03 (0.03)
Diff.unemployment rate (mean)			-0.00** (0.00)	-0.00** (0.00)
Diff.visible minority (mean)			0.00 (0.00)	0.00 (0.00)
Diff.left-right alignment (mean)			-1.21*** (0.42)	-1.21*** (0.42)
Diff.turnout rate (mean)			-0.00 (0.00)	-0.00 (0.00)
Diff.female (proportion)			0.98 (1.17)	0.97 (1.17)
Diff.language spoken, French (proportion)			-0.13 (0.13)	-0.13 (0.13)
Diff.immigrant 2011 (percent)			0.00 (0.00)	0.00 (0.00)
Diff.party competitiveness			1.09** (0.48)	1.09** (0.48)
British Columbia (Base is Alberta)	0.02 (0.05)	0.02 (0.05)	-0.00 (0.05)	-0.00 (0.05)
Manitoba	0.01 (0.07)	0.01 (0.07)	0.05 (0.07)	0.05 (0.07)
New Brunswick	0.08 (0.08)	0.08 (0.08)	0.04 (0.08)	0.04 (0.08)
Newfoundland	-0.04 (0.10)	-0.04 (0.11)	-0.09 (0.10)	-0.09 (0.10)
Nova Scotia	0.07 (0.09)	0.07 (0.09)	0.05 (0.09)	0.05 (0.09)
Ontario	0.02 (0.04)	0.02 (0.04)	0.01 (0.04)	0.01 (0.04)
PEI	-0.09 (0.12)	-0.09 (0.12)	-0.10 (0.12)	-0.10 (0.12)
Quebec	0.02 (0.05)	0.02 (0.05)	0.01 (0.05)	0.01 (0.05)
Saskatchewan	0.01 (0.07)	0.01 (0.07)	-0.08 (0.07)	-0.07 (0.07)
Constant	0.01 (0.04)	0.01 (0.04)	0.02 (0.04)	0.02 (0.04)
Observations	165	165	165	165
R^2	0.02	0.02	0.19	0.19
Adjusted R^2	-0.05	-0.05	0.07	0.07
F Statistic	0.28	0.28	1.55*	1.55*

Note: *p<0.1; **p<0.05; ***p<0.01

Table 12: Effect of Population Size on Majority-Based Congruence in Contiguous Electoral district Pairing

	Dependent variable:			
	Diff.majority-based congruence			
	(1)	(2)	(3)	(4)
Diff.absolute population size	0.00 (0.00)		0.00 (0.00)	
Diff.relative population size		0.12 (0.13)		0.12 (0.13)
Diff.age (mean)			-0.00 (0.00)	-0.00 (0.00)
Diff.income (mean)			-0.01 (0.02)	-0.01 (0.02)
Diff.education (mean)			0.02 (0.03)	0.02 (0.03)
Diff.unemployment rate (mean)			-0.00 (0.00)	-0.00 (0.00)
Diff.visible minority (mean)			0.00 (0.00)	0.00 (0.00)
Diff.left-right alignment (mean)			-0.50 (0.40)	-0.50 (0.40)
Diff.turnout rate (mean)			-0.00 (0.00)	-0.00 (0.00)
Diff.female (proportion)			2.93*** (1.10)	2.94*** (1.10)
Diff.language spoken, French (proportion)			0.00 (0.12)	0.00 (0.12)
Diff.immigrant 2011 (percent)			-0.00 (0.00)	-0.00 (0.00)
Diff.party competitiveness			0.77* (0.45)	0.77* (0.45)
British Columbia (Base is Alberta)	-0.02 (0.05)	-0.02 (0.05)	-0.02 (0.05)	-0.02 (0.05)
Manitoba	-0.02 (0.07)	-0.03 (0.07)	0.02 (0.07)	0.02 (0.07)
New Brunswick	0.04 (0.07)	0.03 (0.07)	0.02 (0.08)	0.01 (0.08)
Newfoundland	0.05 (0.09)	0.03 (0.10)	0.04 (0.09)	0.03 (0.10)
Nova Scotia	0.06 (0.08)	0.05 (0.08)	0.05 (0.08)	0.05 (0.08)
Ontario	0.01 (0.04)	0.01 (0.04)	0.01 (0.04)	0.00 (0.04)
PEI	0.06 (0.11)	0.05 (0.11)	0.04 (0.11)	0.03 (0.11)
Quebec	0.01 (0.04)	0.01 (0.04)	0.01 (0.04)	0.01 (0.04)
Saskatchewan	0.03 (0.07)	0.03 (0.07)	-0.00 (0.07)	-0.01 (0.07)
Constant	0.00 (0.04)	0.01 (0.04)	0.01 (0.04)	0.01 (0.04)
Observations	165	165	165	165
R^2	0.02	0.02	0.11	0.11
Adjusted R^2	-0.04	-0.04	-0.02	-0.02
F Statistic	0.38	0.36	0.87	0.86
Note:				*p<0.1; **p<0.05; ***p<0.01

Table 13: Effect of Population Size on Absolute Distance-Based Congruence in Contiguous Electoral district Pairing

	Dependent variable:			
	Diff.absolute distance based congruence			
	(1)	(2)	(3)	(4)
Diff.absolute population size	-0.00 (0.00)		-0.00 (0.00)	
Diff.relative population size		-0.02 (0.08)		-0.02 (0.09)
Diff.age (mean)			-0.00* (0.00)	-0.00* (0.00)
Diff.income (mean)			-0.01 (0.02)	-0.01 (0.02)
Diff.education (mean)			-0.01 (0.02)	-0.01 (0.02)
Diff.unemployment rate (mean)			0.00 (0.00)	0.00 (0.00)
Diff.visible minority (mean)			-0.00 (0.00)	-0.00 (0.00)
Diff.left-right alignment (mean)			0.15 (0.26)	0.15 (0.27)
Diff.turnout rate (mean)			0.01** (0.00)	0.01** (0.00)
Diff.female (proportion)			-0.14 (0.73)	-0.14 (0.73)
Diff.language spoken, French (proportion)			0.03 (0.08)	0.03 (0.08)
Diff.immigrant 2011 (percent)			0.00** (0.00)	0.00** (0.00)
Diff.party competitiveness			0.38 (0.30)	0.38 (0.30)
British Columbia (Base is Alberta)	-0.02 (0.03)	-0.02 (0.03)	-0.02 (0.03)	-0.02 (0.03)
Manitoba	0.01 (0.04)	0.01 (0.04)	-0.02 (0.05)	-0.02 (0.05)
New Brunswick	-0.02 (0.05)	-0.02 (0.05)	-0.00 (0.05)	-0.00 (0.05)
Newfoundland	-0.01 (0.06)	-0.01 (0.06)	0.01 (0.06)	0.01 (0.06)
Nova Scotia	0.02 (0.05)	0.02 (0.05)	0.02 (0.05)	0.02 (0.05)
Ontario	0.00 (0.03)	0.00 (0.03)	0.00 (0.03)	0.00 (0.03)
PEI	-0.00 (0.07)	0.00 (0.07)	-0.02 (0.07)	-0.01 (0.07)
Quebec	0.01 (0.03)	0.01 (0.03)	-0.00 (0.03)	-0.00 (0.03)
Saskatchewan	-0.02 (0.04)	-0.02 (0.04)	-0.01 (0.05)	-0.01 (0.05)
Constant	-0.00 (0.03)	-0.01 (0.03)	-0.01 (0.03)	-0.01 (0.03)
Observations	165	165	165	165
R^2	0.01	0.01	0.11	0.11
Adjusted R^2	-0.05	-0.05	-0.02	-0.02
F Statistic	0.21	0.20	0.83	0.83
Note:				*p<0.1; **p<0.05; ***p<0.01

Figure 2: Effects of Population Size on Democratic Representation (raked weighted)