

Supplementary Materials

November 21, 2013

1 Ballot Language

The exact language on the ballot in Milwaukee was as follows:

Shall the City of Milwaukee adopt Common Council File 080420, being a substitute ordinance requiring employers within the city to provide paid sick leave to employees?

2 Voter History Measure

In the text, we noted that we exactly matched on a five category measure of turnout history for each voter. Here, we outline how we created this measure. The first category is for voters that registered between the 2006 midterm election and the 2008 election in which the treatment occurs and therefore do not have a longer voter history. Two other categories reflect whether the voter either failed to vote in both 2004 and 2006 or voted in both elections. Many voters regularly vote in presidential elections but not in midterm elections, and it is rare to observe voters that only vote in midterm elections. Thus, we wish to distinguish the regular presidential voter from the somewhat unusual midterm-only voter. Therefore, another category of the voting history indicator denotes only voting in the 2004 presidential election while the final category denotes only voting in 2006, a midterm election.

3 Legislative District Exact Matches Maps

Here, we include maps of the legislative districts in Milwaukee county that overlap. Figure 2 shows the areas where all three districts intersect. All matches occur within these areas in orange in Figure 2.

4 Additional Balance Results

4.1 Balance From Legislative Exact Matches

Table 1 reports pre-matching covariate balance between treated and control units in the full dataset, and in the *Legislative District Exact Match I* and *Legislative District Exact Match II* subsets. In the full unmatched data, the treatment group includes all citizens in the city of Milwaukee and the control group is comprised of the all citizens in the adjacent suburbs. As shown in the first panel of Table 1, the differences between voters in the city and those

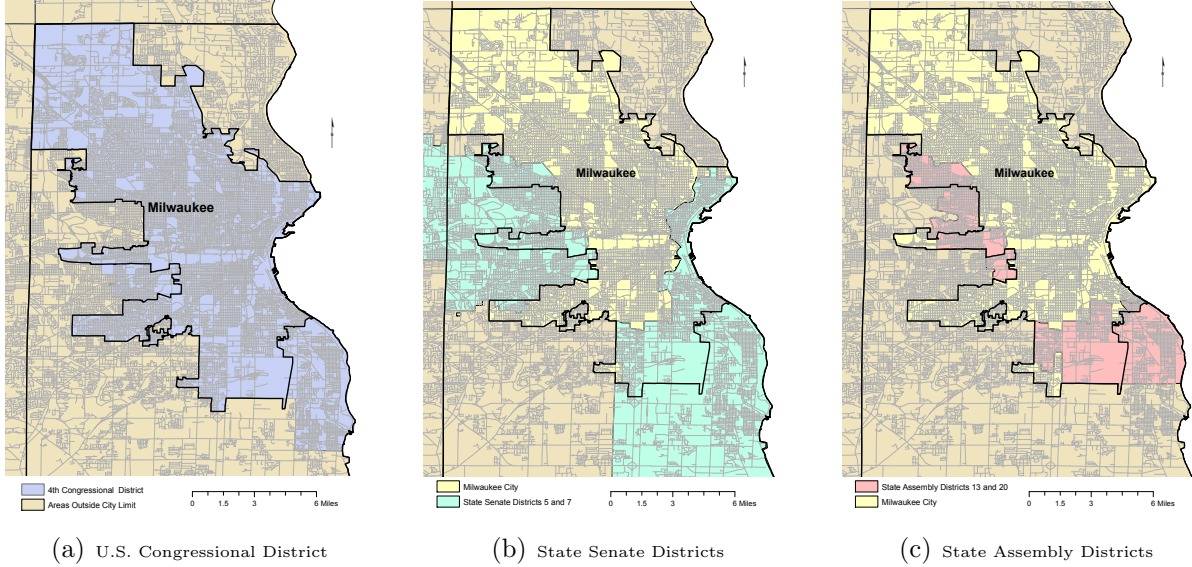


Figure 1: State Assembly, State Senate, and U.S. Congressional Districts in Milwaukee County that Overlap.

in the suburbs are large. Voters in the city are younger, more likely to be male, voted less often in prior elections and have houses that cost less. The two lower panels of the table show that matching exactly on legislative districts is extremely successful in removing age, gender, turnout, and housing price mean differences in the *Legislative District Exact Match I* subset, but less successful in the *Legislative District Exact Match II* subset.

4.2 Balance Results for Age

In the main text, we do not report how the various designs altered the balance in age. We omit age since housing value is a more important covariate and the patterns in balance are the same. Instead we report the age balance results in Table 2.

4.3 Fine Balance on Housing Values

As we mentioned in the text, for housing values we might prefer to not only have similar mean matches but that the distribution of housing values across the treated and control groups to be similar. To enforce a distributional constraint, we use fine balance and required that house prices have the same distribution in treated and control groups without constraining how units are matched (Rosenbaum et al. 2007; Rosenbaum 1989, §3.2). We matched with fine balance for seven categories of housing price. Tables 3 and 4 show the distribution of the seven category measure before matching as well as with and without fine balance. All the results in the main text except for matches on distance alone include fine balance.

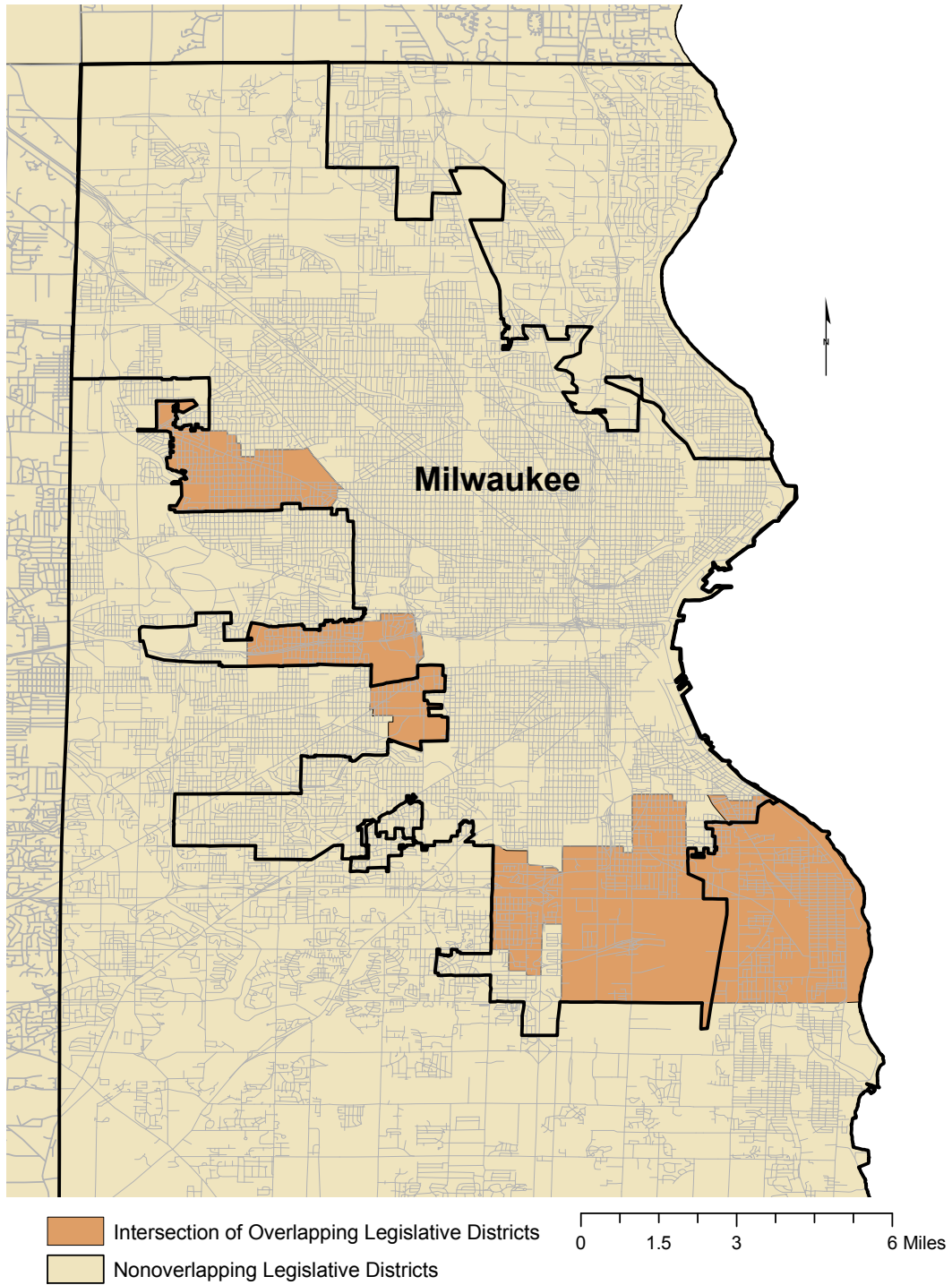


Figure 2: Intersection of State Assembly, State Senate, and U.S. Congressional Districts in Milwaukee County.

Table 1: Change in balance as a function of exact matching on legislative districts.

| Milwaukee County | | | |
|-------------------------------------|--------------|--------------|-----------------|
| | Mean Treated | Mean Control | Abs. Std. Diff. |
| Age | 38.0 | 45.7 | 0.36 |
| Male | 0.80 | 0.57 | 0.15 |
| Turnout 2006 | 0.46 | 0.61 | 0.29 |
| Turnout 2004 | 0.69 | 0.77 | 0.18 |
| Housing Value | 154605 | 218870 | 0.34 |
| Legislative District Exact Match I | | | |
| | Mean Treated | Mean Control | Std. Diff. |
| Age | 49.8 | 50.3 | 0.03 |
| Male | 0.48 | 0.47 | 0.01 |
| Turnout 2006 | 0.64 | 0.60 | 0.10 |
| Turnout 2004 | 0.84 | 0.81 | 0.07 |
| Housing Value | 164302 | 160801 | 0.16 |
| Legislative District Exact Match II | | | |
| | Mean Treated | Mean Control | Abs. Std. Diff. |
| Age | 48.0 | 47.2 | 0.05 |
| Male | 0.45 | 0.51 | 0.12 |
| Turnout 2006 | 0.64 | 0.52 | 0.25 |
| Turnout 2004 | 0.83 | 0.73 | 0.23 |
| Housing Value | 158736 | 144570 | 0.70 |

Note: In *Legislative District Exact Match I*, all voters are in the 4th Congressional district, the 7th State Senate district, and the 20th State Assembly district. In *Legislative District Exact Match II*, all voters are in the 4th Congressional district, the 5th State Senate district, and the 13th State Assembly district. Std. Diff.= absolute standardized difference.

Table 2: Balance Results for Age Across All Matched Designs

| Age | | | | |
|-------------------------------------|--------------|--------------|----------------|-------|
| | Mean Treated | Mean Control | Abs. Std. Diff | Pairs |
| Legislative District Exact Match I | | | | |
| Unmatched | 53.83 | 54.33 | 0.03 | – |
| Design 1 | 53.26 | 53.47 | 0.01 | 2704 |
| Design 2 | 52.65 | 54.41 | 0.10 | 2524 |
| Design 3 | 52.93 | 53.90 | 0.06 | 1939 |
| Legislative District Exact Match II | | | | |
| Unmatched | 51.9 | 51.1 | 0.05 | – |
| Design 1 | 51.6 | 51.1 | 0.02 | 1667 |
| Design 2 | 50.1 | 51.1 | 0.06 | 1663 |
| Design 3 | 50.2 | 50.9 | 0.04 | 536 |

Note: Covariate balance in three matched comparisons. For all designs, exact matching was done on sex, Congressional district, State Senate district, and State Assembly district, and only for observations within 750 meters from the border of each legislative district triplet. Design 1 additionally matches exactly on voting history and minimizes the total sum of covariate distances based on a rank-based Mahalanobis distance; it also constrains the means of age and housing price to be less or equal than 1 year and \$1000, respectively, and matches with fine balance for seven categories of housing price. Design 2 minimizes the total sum of geographic distances between matched pairs. Design 3 additionally matches exactly on voting history, and minimizes the total sum of geographic distances between matched pairs plus simultaneously matching on the same covariates as in Design 2. In *Legislative District Exact Match I*, all voters are in the 4th Congressional district, the 7th State Senate district, and the 20th State Assembly district. In *Legislative District Exact Match II*, all voters are in the 4th Congressional district, the 5th State Senate district, and the 15th State Assembly district. Abs. Std. Diff.= absolute standardized difference. Distance is measured in kilometers from control voter to treated voter residence. In the unmatched designs, *Pairs* shows the original number of treated observations; original number of controls is 7396 in Legislative District Exact Match I and 9089 in Legislative District Exact Match II.

Table 3: Fine Balance for Seven Categories of Housing Value in Thousands of Dollars Legislative District Exact Match I

| | [0, 140) | [140, 150) | [150, 160) | [160, 175) | [175, 195) | [195, 220) | [220, 324] |
|-------------------------|----------|------------|------------|------------|------------|------------|------------|
| Treated Before Matching | 250 | 1313 | 850 | 485 | 314 | 22 | 96 |
| Control Before Matching | 156 | 992 | 3064 | 951 | 1013 | 1201 | 19 |
| Treated no Fine Balance | 149 | 1281 | 717 | 265 | 128 | 0 | 0 |
| Control no Fine Balance | 13 | 910 | 1428 | 177 | 12 | 0 | 0 |
| Treated Fine Balance | 13 | 911 | 719 | 255 | 126 | 0 | 0 |
| Control Fine Balance | 13 | 911 | 719 | 255 | 126 | 0 | 0 |

Table 4: Fine Balance for Seven Categories of Housing Value in Thousands of Dollars Legislative District Exact Match II

| | [0, 140) | [140, 150) | [150, 160) | [160, 175) | [175, 195) | [195, 220) |
|-------------------------|----------|------------|------------|------------|------------|------------|
| Treated Before Matching | 949 | 4787 | 791 | 275 | 0 | 0 |
| Control Before Matching | 245 | 58 | 887 | 677 | 399 | 191 |
| Treated no Fine Balance | 0 | 509 | 239 | 67 | 0 | 0 |
| Control no Fine Balance | 245 | 44 | 303 | 221 | 0 | 2 |
| Treated Fine Balance | 0 | 50 | 231 | 67 | 0 | 0 |
| Control Fine Balance | 0 | 50 | 231 | 67 | 0 | 0 |

5 Balance tests in geographic buffers

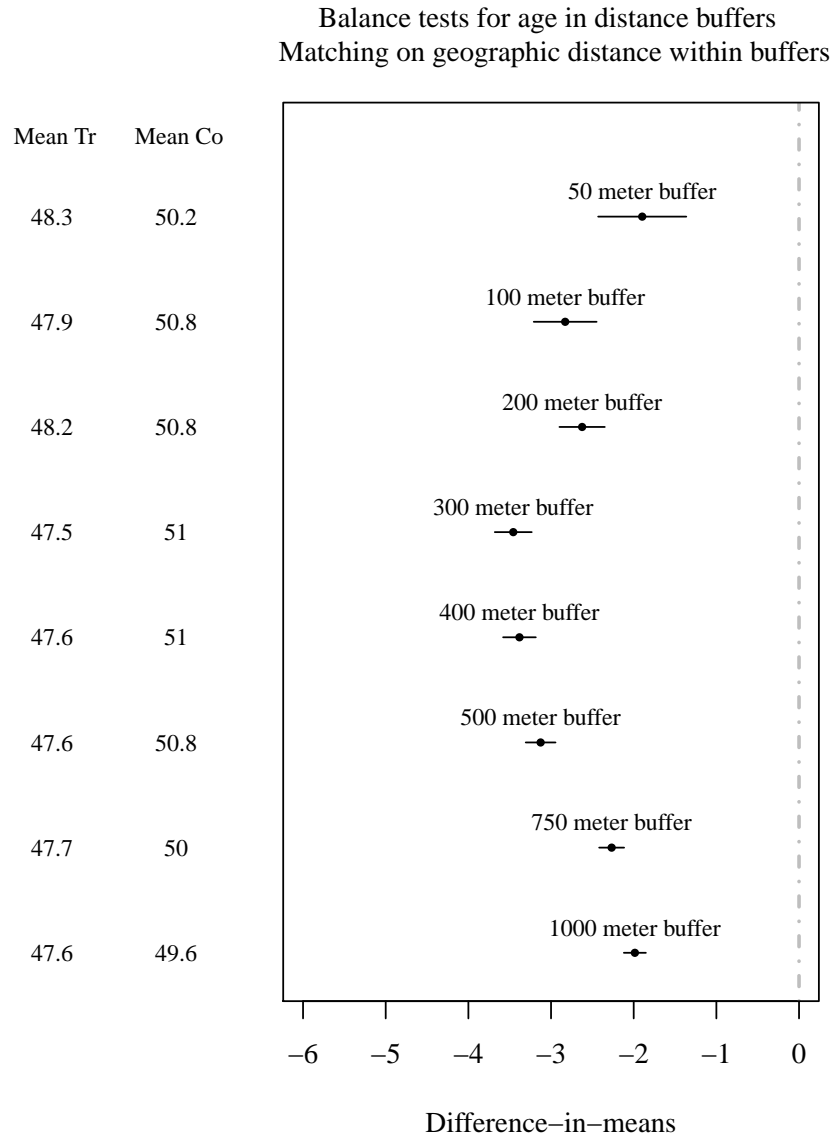


Figure 3: Difference-in-means in age at individual level between treatment and control groups for different buffers around the Milwaukee city limit, matching on geographic distance within each buffer. Unit is years. Dots are difference-in-means and bars are 95% confidence intervals based on paired t-tests.

References

- Rosenbaum, P. R. (1989), “Optimal Matching for Observational Studies,” *Journal of the American Statistical Association*, 84, 1024–1032.
- Rosenbaum, P. R., Ross, R. N., and Silber, J. H. (2007), “Minimum Distance Matched Sampling with Fine Balance in an Observational Study of Treatment for Ovarian Cancer,” *Journal of the American Statistical Association*, 102, 75–83.