Zentrum für Statistik
Center for Statistics

Replication Working Paper Series

No. 02/2012

July 2012

GEORG-AUGUST-UNIVERSITÄT
GÖTTINGEN

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# Replication in the narrow sense of Banzhaf/ Walsh (2008)

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July 13, 2012

**Abstract**

This is a partially successful replication of an empirical test on the Tiebout Hypothesis by Spencer Banzhaf and Randall Walsh (2008). Although I was not able to fully replicate their findings, Banzhaf and Walsh's conclusion is not called into question.

## Replication

This replication is part of a research project on the replicability of empirical articles in economics.[1] A replication in the narrow sense by our means is a repetition of empirical research, using the same datasets as well as the same program codes as in the original article.

Following the AER Data Availability Policy, Banzhaf/Walsh (BW) published data and code needed to replicate the main estimates. BW mentioned sensitivity analyses using one-mile diameters for circle communities, for which they only published descriptive statistics [1, p. 858]. Underlying data and program code are not available. Thus, I was not able to replicate their findings in regards to their sensitivity analyses. Also, I did not get access to all the necessary raw data. Although the authors kindly responded to my request, they were not able to provide a sufficient[2] description of how to get access to the kind of census data used for their analyses. A request to the census office from 08/02/2011 remained unanswered. As the authors only published merged data, consisting of the mentioned census data as well as data from the Toxic Release Inventory of the Evironmental Protection Agency (EPA), I was not able to verify the raw

[1] http://ineteconomics.org/grants/replication-economics

[2] According to the AER Data Availability Policy, authors "should include (...) a description of how previous intermediate data sets and programs were employed to create the final data set(s). Authors are invited to submit these intermediate data files and programs as an option; if they are not provided, authors must fully cooperate with investigators seeking to conduct a replication who request them." (American Economic Review (2003), Data Availability Policy http://www.aeaweb.org/aer/data.php). To our experience, few authors meet this requirement.

data. Nonetheless, main descriptive statistics regarding the final dataset could be replicated successfully. BW's analysis is based on simple OLS regressions as well as nearest neighborhood matching estimates. The former was straightforward to replicate. However, by estimating the matching coefficients, serious differences occurred. Regarding the matching estimates, the authors explained the errors upon request from 09/17/2011, and 09/30/2011 respectively, by misspecifications of the matching algorithm. It seems that errors occurred due to an older version of the program code, which had been used for the published results. Nonetheless, as the errors do not cause any changes in the directions of the effects and overall estimates remain significant, BWs conclusion is not affected. A complete comparison of our results with those of BW can be found in the appendix below.

# Appendix

## A Descriptive Statistics

Table 1 - Published Values for Table 1 Banzhaf/Walsh

| | Half-mile circles | One-mile circles |
|---|---|---|
| Count | 25,166 | 6,218 |
| Blocks per circle (1990) | | |
| 25th percentile | 4 | 11 |
| 50th percentile | 10 | 29 |
| 75th percentile | 19 | 55 |
| Max | 132 | 383 |
| Blocks per circle (2000) | | |
| 25th percentile | 6 | 17 |
| 50th percentile | 13 | 38 |
| 75th percentile | 22 | 64 |
| Max | 136 | 408 |
| Circles with TRI exposure | | |
| ¼-mile buffer | 3,109 | 1,295 |
| ½-mile buffer | 5,179 | 1,795 |
| TRI sites for exposed circles | | |
| ¼-mile buffer | | |
| 25th percentile | 1 | 1 |
| 50th percentile | 2 | 2 |
| 75th percentile | 3 | 4 |
| Max | 19 | 25 |
| ½-mile buffer | | |
| 25th percentile | 1 | 1 |
| 50th percentile | 2 | 2 |
| 75th percentile | 4 | 5 |
| Max | 27 | 34 |
| Circles per school district | | |
| 25th percentile | 45 | 14 |
| 50th percentile | 93.5 | 27 |
| 75th percentile | 169 | 47 |
| Max | 2,352 | 620 |
| Circles per zip code | | |
| 25th percentile | 11 | 3 |
| 50th percentile | 21 | 6 |
| 75th percentile | 35 | 9 |
| Max | 190 | 49 |

Source: Banzhaf/Walsh (2008) Table 1

Table 1-R: Replicated Value for Table 1 Banzhaf/Walsh

| | Half-mile circles | One-mile circles |
|---|---|---|
| Count | 26631 | NA |
| Blocks per circle (1990) | | |
| 25th percentile | 4 | NA |
| 50th percentile | 10 | NA |
| 75th percentile | 19 | NA |
| Max | 132 | NA |
| Blocks per circle (2000) | | |
| 25th percentile | 6 | NA |
| 50th percentile | 13 | NA |
| 75th percentile | 22 | NA |
| Max | 136 | NA |
| Circles with TRI exposure | | |
| 1/4-mile buffer | 2516 | NA |
| 1/2-mile buffer | NA | NA |
| TRI sites for exposed circles | | |
| 1/4-mile buffer | NA | |
| 25th percentile | NA | NA |
| 50th percentile | NA | NA |
| 75th percentile | NA | NA |
| Max | NA | NA |
| 1/2-mile buffer | | |
| 25th percentile | NA | NA |
| 50th percentile | NA | NA |
| 75th percentile | NA | NA |
| Max | NA | NA |
| Circles per school district | | |
| 25th percentile | NA | NA |
| 50th percentile | NA | NA |
| 75th percentile | NA | NA |
| Max | NA | NA |
| circles per zip code | | |
| 25th percentile | 11 | NA |
| 50th percentile | 21 | NA |
| 75th percentile | 35 | NA |
| Max | 190 | NA |

Notes: NA marks values which could not be replicated. Source: Own calculations, based on data and code of Banzhaf/Walsh 2008.

Table 2 of Banzhaf/Walsh (2008), containing descriptive statistics of the main dataset could be replicated succsessfully, meaning that replicated values are identical with those being published by BW. Consequently, it is not reported at this point.

# B Estimations

Table 3A: Published Results fot estimated Scale Effects Unweighted

| | Average effect of baseline TRI exposure | | Average effect of new TRI exposure | | Average effect of exiting TRI exposure | | $R^2$ |
|---|---|---|---|---|---|---|---|
| *Effect on population levels* | | | | | | | |
| No controls | −30 | (<0.01) | −13 | (0.37) | 43 | (<0.01) | 0.00 |
| Basic controls | −54 | (<0.01) | −35 | (<0.01) | 39 | (<0.01) | 0.07 |
| School district fixed effects | −59 | (<0.01) | −35 | (<0.01) | 42 | (<0.01) | 0.11 |
| Zip code fixed effects | −71 | (<0.01) | −36 | (<0.01) | 45 | (<0.01) | 0.26 |
| Matching estimator | −32 | (<0.01) | 27 | (0.16) | 31 | (<0.01) | — |
| *Effect on percentage change in population* | | | | | | | |
| No controls | −15.6 | (<0.01) | −5.3 | (0.29) | 7.1 | (0.04) | 0.00 |
| Basic controls | −10.7 | (<0.01) | −7.3 | (0.11) | 5.0 | (0.09) | 0.04 |
| School district fixed effects | −10.3 | (<0.01) | −8.3 | (0.07) | 6.1 | (0.04) | 0.09 |
| Zip code fixed effects | −12.0 | (<0.01) | −9.3 | (0.05) | 6.3 | (0.04) | 0.19 |
| Matching estimator | −10.7 | (<0.01) | −12.11 | (0.05) | 4.3 | (0.04) | — |

Source: [1, Banzhaf/Walsh (2008), Table 3A]; p-values in parantheses.

Table 3A-R: Replicated Results for Estimated Scale Effects Unweighted

| | Average effect of baseline TRI exposure | | Average effect of new TRI exposure | | Average effect of exiting TRI exposure | | $R^2$ |
|---|---|---|---|---|---|---|---|
| *Effect on population levels* | | | | | | | |
| No controls | 29.63 | (<0.01) | -12.62 | (0,4392) | 42.74 | (<0.01) | 0.00 |
| Basic controls | 53.80 | (<0.01) | -34.59 | (0.0469) | 38.93 | (0.0014) | 0.07 |
| School district fixed effects | -58.56 | (<0.01) | -35.50 | (0.0392) | 42.04 | (0.0005) | 0.11 |
| Zip code fixed effects | -71.41 | (<0.01) | -36.33 | (0.0284) | 44.64 | (<0.01) | 0.26 |
| Matching estimator | -22.12 | (0.080) | 16.66 | (0.437) | 24.71 | (0.021) | - |
| *Effect on percentage change in population* | | | | | | | |
| No controls | -15.63 | (<0.01) | -5.26 | (0.2061) | 7.06 | (0.0161) | 0.00 |
| Basic controls | -10.66 | (<0.01) | -7.32 | (0.0631) | 4.95 | (0.0725) | 0.04 |
| School district fixed effects | -10.34 | (<0.01) | -8.38 | (0.0310) | 6.12 | (0.0248) | 0.09 |
| Zip code fixed effects | -12.01 | (<0.01) | -9.35 | (0.0154) | 6.31 | (0.0198) | 0.19 |
| Matching estimator | -10.73 | (0.030) | -16.62 | (0.065) | 3.43 | (0.022) | - |

Significances published by BW are correct. Deviations that occured in this replication are due to missing robust options in the program code published in the AER archive. The authors stated they have submitted corrected code to the AER. As of 07/06/2012, it has not been uploaded to the AER website. Source: Own calculations, based on data and code of Banzhaf/Walsh (2008); p-values in parantheses.

Table 3B: Published Results for Estimated Scale Effects: Population-Weighted

| | Average effect of baseline TRI exposure | | Average effect of new TRI exposure | | Average effect of exiting TRI exposure | | $R^2$ |
|---|---|---|---|---|---|---|---|
| *Effect on population levels* | | | | | | | |
| No controls | –46 | (0.07) | –18 | (0.43) | 81 | (<0.01) | 0.00 |
| Basic controls | –81 | (<0.01) | –39 | (<0.01) | 71 | (<0.01) | 0.18 |
| School district fixed effects | –84 | (<0.01) | –31 | (0.13) | 78 | (<0.01) | 0.25 |
| Zip code fixed effects | –108 | (<0.01) | –42 | (0.07) | 78 | (<0.01) | 0.58 |
| Matching estimator | –43 | (<0.01) | 42 | (<0.01) | 46 | (<0.01) | — |
| *Effect on percentage change in population* | | | | | | | |
| No controls | –2.6 | (0.11) | 0.8 | (0.50) | 3.0 | (0.02) | 0.00 |
| Basic controls | –3.6 | (0.01) | –0.7 | (0.58) | 2.6 | (0.03) | 0.05 |
| School district fixed effects | –4.0 | (<0.01) | –1.0 | (0.38) | 3.0 | (0.01) | 0.10 |
| Zip code fixed effects | –4.7 | (<0.01) | –1.6 | (0.19) | 2.9 | (<0.01) | 0.24 |
| Matching estimator | –1.1 | (0.16) | –3.9 | (0.01) | 1.7 | (<0.01) | — |

Source: [1, Banzhaf/Walsh (2008), Table 3B]; p-values in parantheses.

Table 3B-R: Replicated Results for Estimated Sacle Effects: Population-Weighted

| | Average effect of baseline TRI exposure | | Average effect of new TRI exposure | | Average effect of exiting TRI exposure | | $R^2$ |
|---|---|---|---|---|---|---|---|
| *Effect on population levels* | | | | | | | |
| No controls | -46.27 | (0,07) | -18.20 | (0.4266) | 81.43 | (<0.01) | 0.00 |
| Basic controls | -80.52 | (<0.01) | -38.61 | (0.0687) | 70.96 | (<0.01) | 0.18 |
| School district fixed effects | -84.52 | (<0.01) | -30.90 | (0.1346) | 78.06 | (<0.01) | 0.25 |
| Zip code fixed effects | -107.51 | (<0.01) | -42.29 | (0.0660) | 78.35 | (<0.01) | 0.58 |
| Matching estimator | -50.76 | (<0.01) | 40.82 | (<0.01) | 53.72 | (<0.01) | - |
| *Effect on percentage change in population* | | | | | | | |
| No controls | -2.55 | (0.1081) | 0.82 | (0.5024) | 2.97 | (0.0193) | 0.00 |
| Basic controls | -3.64 | (0.0106) | -0.65 | (0.5812) | 2.58 | (0.0291) | 0.05 |
| School district fixed effects | -4.01 | (0.0067) | -1.04 | (0.3817) | 2.97 | (0.0144) | 0.10 |
| Zip code fixed effects | -4.71 | (<0.01) | -1.57 | (0.1895) | 2.93 | (0.0091) | 0.24 |
| Matching estimator | -1.26 | (0.01) | 01.04.86 | (0.0223) | 3.43 | (0.022) | - |

See footnote Table 3A-R.

Table 4A: Published Results for Estimated Income Effects: Unweighted

| | Average effect of baseline TRI exposure | | Average effect of new TRI exposure | | Average effect of exiting TRI exposure | | $R^2$ |
|---|---|---|---|---|---|---|---|
| No controls | –7,619 | (<0.01) | –7,652 | (<0.01) | 1,899 | (<0.01) | 0.01 |
| Basic controls | –2,618 | (<0.01) | 624 | (0.52) | 1,344 | (0.06) | 0.31 |
| School district fixed effects | –2,458 | (<0.01) | –277 | (0.75) | 1,693 | (0.01) | 0.41 |
| Zip code fixed effects | –2,194 | (<0.01) | –189 | (0.82) | 1,416 | (0.03) | 0.50 |
| Matching estimator | –3,182 | (0.01) | –6,115 | (<0.01) | 530 | (0.33) | — |

Source: [1, Banzhaf/ Walsh (2008), Table 4A]; p-values in parantheses.

Table 4A-R: Replicated Results for Estimated Income Effects: Unweighted

| | Average effect of baseline TRI exposure | | Average effect of new TRI exposure | | Average effect of exiting TRI exposure | | $R^2$ |
|---|---|---|---|---|---|---|---|
| *Effect on population levels* | | | | | | | |
| No controls | -7619.15 | (<0.01) | -7652.40 | (<0.01) | 1898.67 | (<0.01) | 0.01 |
| Basic controls | -2617.66 | (<0.01) | 623.87 | (0.5221) | 1344.25 | (0.0601) | 0.31 |
| School district fixed effects | -2457.86 | (<0.01) | -277.42 | (0.7457) | 1692.63 | (0.0124) | 0.41 |
| Zip code fixed effects | -2193.87 | (<0.01) | -188.73 | (0.8197) | 1416.13 | (0.0293) | 0.51 |
| Matching estimator | -3182.12 | (0.012) | -6144.59 | (<0.01) | 530.09 | (0.325) | - |

See footnote Table 3A-R.

Table 4B: Published Results for Estimated Income Effects: Weighted

| | Average effect of baseline TRI exposure | | Average effect of new TRI exposure | | Average effect of exiting TRI exposure | | $R^2$ |
|---|---|---|---|---|---|---|---|
| No controls | –3,951 | (<0.01) | –5,205 | (<0.01) | 784 | (0.18) | 0.01 |
| Basic controls | –362 | (0.33) | 216 | (0.77) | –35 | (0.94) | 0.42 |
| School district fixed effects | 179 | (0.62) | –937 | (0.18) | –22 | (0.96) | 0.51 |
| Zip code fixed effects | 222 | (0.55) | –795 | (0.23) | 126 | (0.76) | 0.60 |
| Matching estimator | –2,433 | (<0.01) | –2,015 | (<0.01) | 30 | (0.93) | — |

Source: [1, Banzhaf/ Walsh (2008), Table 4B]; p-values in paratheses.

Table 4B-R: Replicated Results for Estimated Income Effects: Weighted

| | Average effect of baseline TRI exposure | | Average effect of new TRI exposure | | Average effect of exiting TRI exposure | | $R^2$ |
|---|---|---|---|---|---|---|---|
| *Effect on population levels* | | | | | | | |
| No controls | -3950.86 | (<0.01) | -5205.01 | (<0.01) | 783.55 | (0.179) | 0.01 |
| Basic controls | -362.28 | (0.3329) | 215.92 | (0.77) | -35.22 | (0.9402) | 0.42 |
| School district fixed effects | 178.86 | (0.6188) | -937.41 | (0.182) | -21.85 | (0.9608) | 0.51 |
| Zip code fixed effects | 221.75 | (0.5458) | -794.64 | (0.2257) | 126.29 | (0.7654) | 0.60 |
| Matching estimator | -2432.85 | (<0.01) | -2015.13 | (<0.01) | 29.89 | (0.0930) | - |

See footnote Table 3A-R.

# References

[1] Spencer H. Banzhaf and Randall P. Walsh. Do people vote with their feet? an empirical test of tiebout's mechanism. *The American Economic Review*, 98(3):843–863, 2008.