Economic Effects of Environmental Crises: Evidence from Flint, Michigan

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Online Appendix

A Data Appendix

A.1 Google Trends and Grocery Sales Data

We use two metrics to understand residents' knowledge of the Flint water crisis. First, we use Google Trends data, summarizing water-quality-related search behavior among Flint residents. Second, we use consumer purchases of bottled water and Pur water filters.

Google Trends data are monthly, public measures of internet search behavior, and are available nationally and for some regions. Google Trends data summarize search intensity for different search queries. Google normalizes its measures to represent the relative search intensity for a term or set of terms over user-specified time-frames and geographic areas. For example, our data downloaded from Google Trends scales all entries from 0 to 100, where 100 indicates the city-month when searches for our specified terms were highest.

We downloaded Google Trends data for the four metropolitan areas closely associated with Flint, MI, and the top 3 matched control cities.[1] We focus on searches closely related to water quality issues related to the Flint water crisis.[2] Given its arbitrary scale, we standardize the data so that each series represents a z-score. Figure 1 graphs search behavior in Flint-Saginaw-Bay City. For comparison, Figure A.1 shows the differential search behavior in Flint relative to our control cities.[3] While all cities show increased interest in water-related-searches around the Flint water crisis, none increase at the scale seen in Flint. The one exception is the Pontiac/Detroit area, where water-quality searches increased nearly five

[1] The finest geographic level allowed in Google Trends data are metropolitan areas, often Designated Market Areas (DMAs). In our case, the closest metropolitan areas to our study cities available were Flint-Saginaw-Bay City, MI; Youngstown, OH; Detroit, MI; and Philadelphia, PA. Pontiac, MI, and Camden, NJ are suburbs of Detroit and Philadelphia, respectively. We cannot include search behavior results for receivership cities due to the geographic constraints in Google Trends.

[2] Specifically, our search terms included: "Flint water + brown water + drinking water + water testing + lead + boil advisory + Legionella."

[3] Searches in Flint are on a different scale than Figure 1 because we standardized the search intensities for Figure A.1 using the average and standard deviation of all cities rather than only Flint.

standard deviations around the state and federal emergency health declarations.

Consumer purchase data are from the Nielsen Retail Scanner and Consumer Panel data provided by the Kilts Center for Marketing at the University of Chicago. The Retail Scanner data include UPC-level, weekly volume, price, and product characteristics from more than 35,000 grocery, drug, and mass merchandising stores from January 2006 to August 2019. The data cover more than half the total sales volume of grocery and drug stores in the U.S. The Consumer Panel data consist of a representative, longitudinal panel of U.S. households that report product-level purchase and price data for all shopping trips over their participation in the program. The panel includes 40,000 to 60,000 households per year.

Using the Retail Scanner data, we compile monthly, city-level sales volume data for bottled water and in-home water filters in Flint. Bottled water includes branded (e.g., Dasani) and generic non-flavored water. We focus on Pur water filter systems because state and federal officials endorsed them after the emergency declarations. Further, there was confusion about other filter systems' efficacy due to misleading social media posts regarding whether Brita and other water filters removed lead from water (Schuch, 2015). The finest geographic unit available in the Retail Scanner data is the county and three-digit zip code. The Consumer Panel data, however, identifies households' five-digit zip code. We take advantage of this feature of the Consumer Panel data to refine our definitions of stores in Flint. Specifically, we designate a store as being a Flint store if it is located in Flint's three-digit zip code and if any household living in a Flint five-digit zip code shopped at that store between 2004 and 2018.[4] After identifying Flint stores, we sum all bottled water and Pur water filter system sales by month and standardize the sales data, producing Figure 1, Panels B and C.

A.2 Matched City Details

We collect city-level population, labor force, and demographic data from the U.S. Census and American Community Survey to construct our matched city control groups (Ruggles et al., 2015). We limit the data to cities with populations greater than 50,000 and less than 200,000 to ensure our sample is composed of cities similar in size to Flint. We choose several city-level statistics to construct our matched control group. From the 2010 Census, we match on city population, the percent of vacant households, and the percent of the population that is Black or African American. From the 2012 ACS, we match on median household income and the

[4] The Nielsen Consumer Panel data are representative only for broader U.S. regions. Therefore, we do not use the Consumer Panel to infer Flint-level outcomes.

unemployment rate. We also construct variables to capture city demographics changes over time to ensure our control sample cities experienced similar economic declines as Flint since the mid-20th century. Specifically, we create variables for the difference in median household income from 1980 to 2012 and the population change from 1970 to 2010.[5]

We define the distance between the vector of other cities' and Flint's covariates as the vector norm of the covariate differences, $||\mathbf{z}-\mathbf{x}|| = [(\mathbf{z}-\mathbf{x})'V(\mathbf{z}-\mathbf{x})]^{\frac{1}{2}}$, where V is specified as the diagonal of the inverse variances for each element in $(\mathbf{z}-\mathbf{x})$. After computing the differences in pre-treatment covariates, we construct our matched control samples using the top 3 city matches. We include robustness checks for up to the top 10 matched cities.

Table A.1 reports the match distance (normalized between zero and one) and statistics for Flint and the top matched control cities. Youngstown, OH, Pontiac, MI, and Camden, NJ constitute our top 3 control cities. All three saw substantial population declines since the 1970s, have low median incomes with only modest income growth rates over three decades, have high unemployment, and large African American or Black populations. As expected, matched cities are less comparable to Flint on our baseline characteristics when we include more cities in the sample.[6] We are unable to include Saginaw, MI in our top 5 and top 10 control samples because, after extracting transactions for the city, we discovered that there were no reported transactions for multiple years.[7]

A.3 ZTRAX Data Cleaning

Housing sales data were provided by Zillow via the ZTRAX database. Zillow aggregates more than 400 million public real estate transactions across over 2,750 U.S. counties. Below we highlight key steps taken to produce our final database. Zillow provides all data zipped in files that contain all historical transactions by state. We extract transaction data for all relevant cities, including Flint, all matched U.S. cities, and all receivership cities.[8] After merging the data with the relevant census, lead testing, lead-line replacement data, and other data, we compile all transactions. We then clean the transactions data to ensure all data

[5]Median income statistics at the city level are unavailable for 1970. The statistics report median income over the previous year.

[6]A few of the cities in the top 10 matched control sample are Indiana Townships. Townships often include areas of multiple cities. For example, Calumet Township, IN consists of the cities Lake Station and Gary. Center Township (Marion County) includes portions of Indianapolis and Beech Grove.

[7]Top 5 control sample results are similar to our top 3 control sample results when we include the limited Saginaw data and exclude Dayton, OH.

[8]We extract Indiana Townships by including only transactions that occur in the cities and zip codes located within each respective township.

included in the final analysis are for single-family homes sold in arms-length transactions from 2006 through the third quarter of 2019.[9]

We drop transactions that: (i) are flagged as an intra-family transfer; (ii) are flagged as tax-exempt; (iii) are not single-family homes (e.g., condos, townhouses, etc.); (iv) include deed transfers after a death or corporate deeds; (v) are flagged as non-arms length or homes sold for tax redemption purposes; or (vi) are for homes we observe selling more than 15 times in our dataset. We further identify and exclude outlier transactions as follows: (i) we calculate two-year (2006-07, 2008-09, etc.) rolling average house prices for every census block group in our data;[10] (ii) we flag a transaction as an outlier if the reported price is more than 10 (or less than $\frac{1}{10}$) of the rolling average price for that Census Block Group.[11]

A.4 Heterogeneity by Tract Area

We explore heterogeneous impacts of the water crisis within Flint by interacting the post-emergency indicators with census tract-area indicators. Our data contain transactions from 41 census tracts in Flint. Many tracts include few single-family homes, and we observe only a few sales in those tracts, particularly after the emergency crisis declarations. This makes tract-by-tract estimates infeasible. To account for this feature of the data, we combine many tracts into tract-areas. We include observations in neighboring tracts that have few observations into the areas shown in Figure A.2. When creating the areas, we combined tracts with neighboring tracts if we observed very few post-emergency sales to ensure each tract-area contained at least 25 post-emergency transactions. For example, tract-area 1 includes eight census tracts that had 45 sales after October 2015. We keep ten single tracts that have more single-family homes and corresponding sales. For example, the tract labeled 10 in the Figure had 336 single-family home sales in our data after the emergency crisis declarations.

[9] Current data coverage beyond the third quarter of 2019 is sparse.

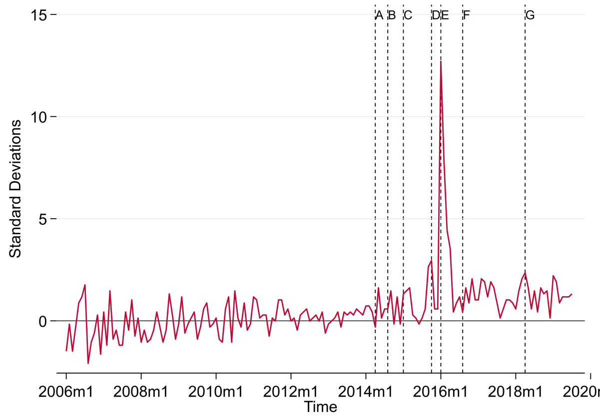
[10] Census block groups are statistical divisions of census tracts, containing between 600 and 3,000 people. We observe transactions in 132 distinct block groups in Flint, MI.

[11] Results are robust to including outlier transactions prices.

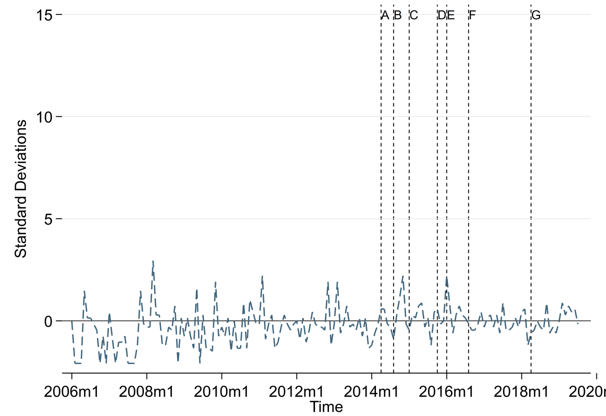
Table A.1: Matched Sample

City	Match Distance	Population (2010)	Population Δ (1970-2010)	Med. Income (2012)	Med. Income Δ (1970-2012)	Vacant Houses (%, 2010)	Unemploy. Rate 2012	Black Population (%, 2010)
Flint, MI	–	102,434	-90,883	26,339	9,158	0.211	0.255	0.566
Youngstown, OH	0.304	66,971	-72,788	24,421	10,981	0.190	0.195	0.452
Pontiac, MI	0.396	59,515	-25,764	28,825	12,643	0.180	0.214	0.521
Camden, NJ	0.396	77,344	-25,207	26,705	17,420	0.137	0.238	0.481
Calumet Twp, IN	0.413	104,258	-11,1682	30,983	12,554	0.178	0.170	0.696
Saginaw, MI	0.429	51,508	-40,341	27,658	13,116	0.160	0.219	0.461
Dayton, OH	0.470	141,527	-102,074	28,595	16,536	0.211	0.172	0.429
Center Twp, IN	0.503	142,787	-130,811	27,930	16,602	0.241	0.187	0.372
Hartford, CT	0.602	124,775	-33,242	28,931	17,418	0.129	0.193	0.387
Trenton, NJ	0.697	84,913	-19,725	36,727	24,545	0.135	0.179	0.520
Portage, IN	0.825	93,063	-36,210	33,791	18,524	0.149	0.167	0.262
Wayne, IN	0.964	103,803	-45,713	32,951	17,816	0.154	0.150	0.225

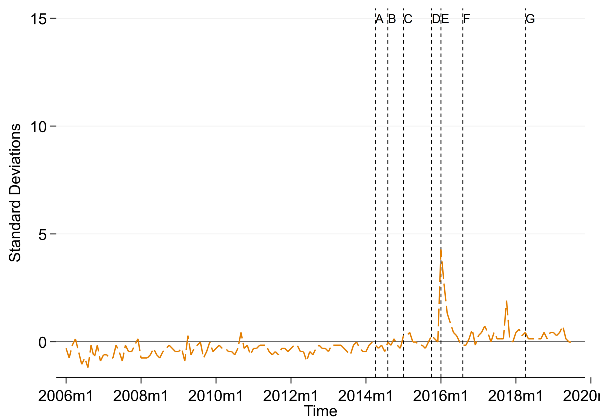
Figure A.1: Google Trends Searches: Flint vs. Matched Control Cities



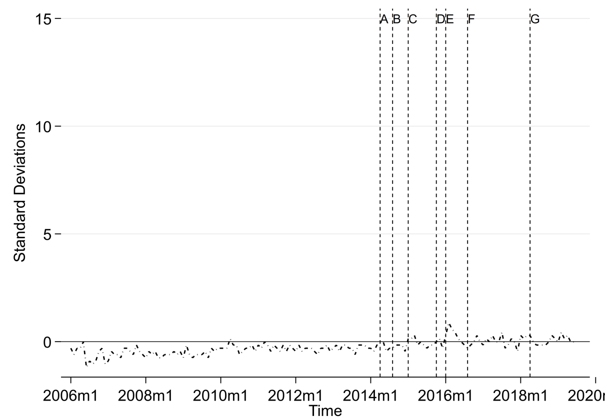
(a) Flint, MI (Flint-Saginaw-Bay City, MI)



(b) Youngstown, OH



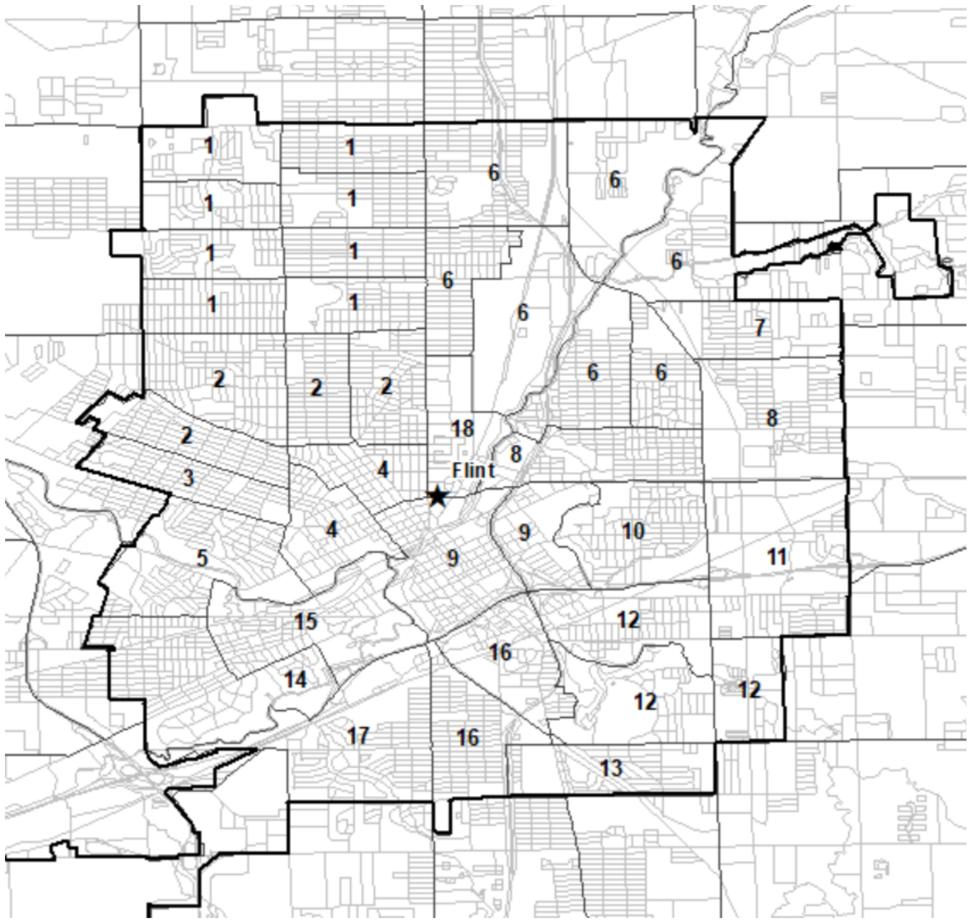
(c) Pontiac, MI (Detroit, MI)



(d) Camden, NJ (Philadelphia, PA)

Notes: Figure A.1 graphs monthly Google search behavior for water quality related searches in Flint and three metropolitan areas closely associated with the top 3 matched control cities and from January 2006 through August 2019. Descriptions in parentheses indicate the exact metropolitan areas used when downloading the data from Google Trends. All data are scaled so that a one unit change in each z-score represents a one-standard deviation shock for all cities and all periods. A indicates the month of the switch to the Flint River; B indicates the first of three boil advisories in 2014; C indicates TTHM violations and the town hall meeting; D indicates the Genesee Public Health Emergency; E indicates the state and federal public health emergencies; F indicates the end of the federal public health emergency and beginning of the lead line replacements; G indicates the end of the free bottled water program.

Figure A.2: Census Tract Areas



Notes: This map displays groupings of census tracts into areas of Flint. The groupings were done based on location. Groups contain approximately 30 housing transactions or more that occurred after the public health emergencies.

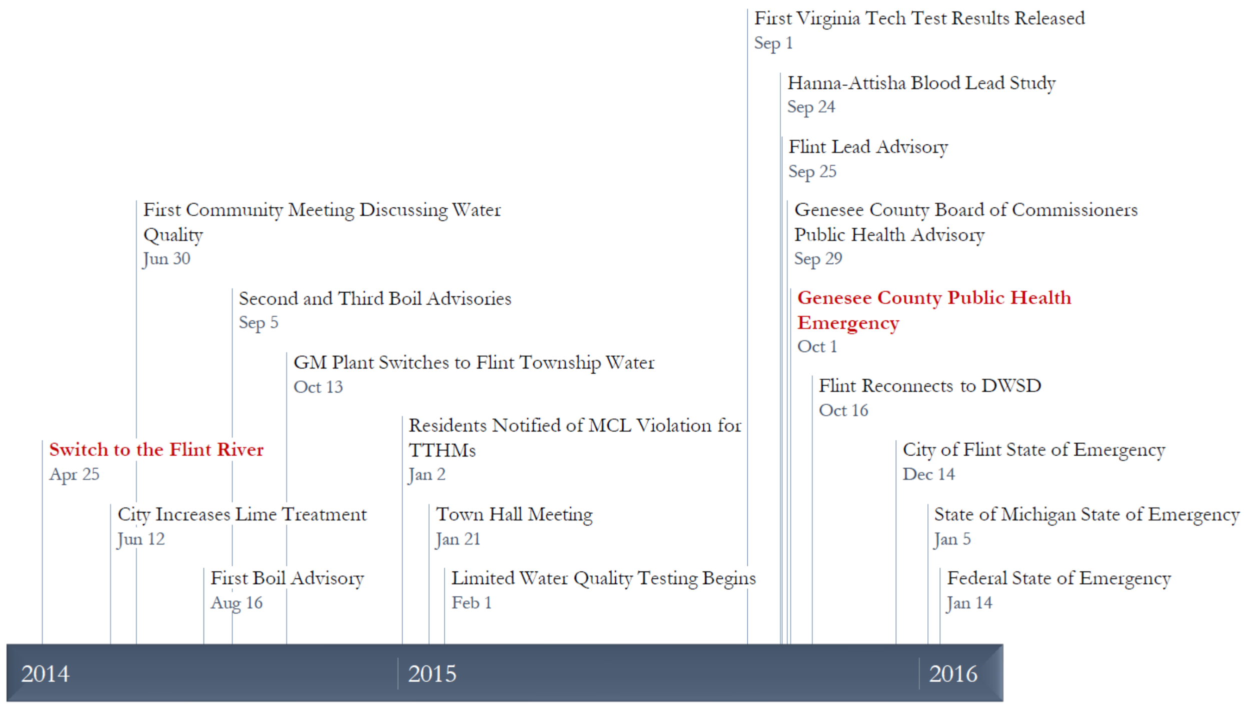
B Additional Background

B.1 Timeline

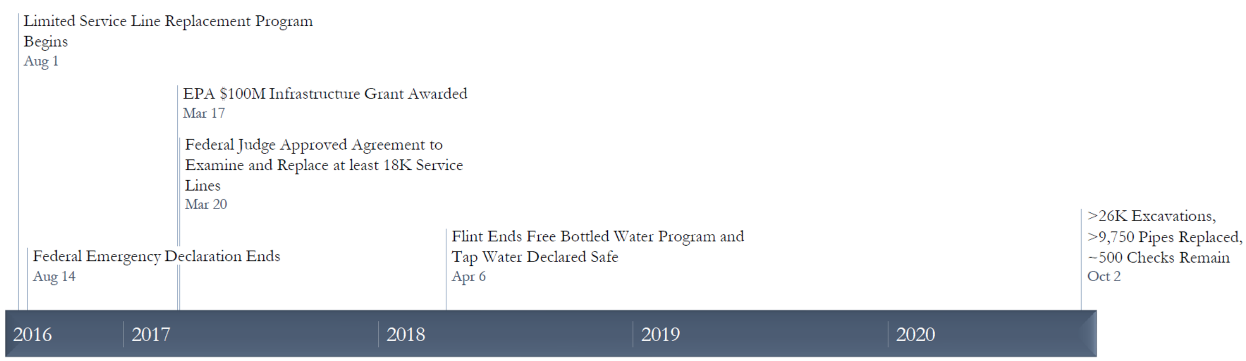
Figure B.1 provides a more detailed timeline of the events described in Section I.B. Panel (a) focuses on events between the switch to the Flint River and the state and federal emergency crisis declarations in January 2016. The timeline highlights adverse public signals related to the impacts of the switch in the city's water source on citizens' water quality. Early signals include increases in lime treatment in June 2014 and three boil advisories in Fall 2014. While some citizens raised concerns in a town hall meeting in January 2015, the extent of the crisis and widespread awareness of its potential impacts did not become clear until Fall 2015 as in-home lead test and blood-lead test results became public.

Panel (b) highlights progress to remediate the water crisis. The service line replacement program began in August 2016, though it was not fully underway until late 2016 and early 2017. Financial settlements and judicial rules paid for and expanded the efforts to inspect all service lines in the city and replace all non-copper service line portions from the water main to the meter. The program was set to be completed by the end of 2019, though delays have pushed back completion. As of October 2020, over 26,000 homes have had their service lines inspected, with over 9,750 lines having some portion of their service line replaced. Around 500 inspections remained. Although the program was still incomplete, Governor Rick Snyder declared that water quality testing indicated that tap water was safe for human consumption and ended the free bottled water program in April 2018.

Figure B.1: Timeline of Important Events (April 2014 to October 2020)



(a) April 2014 - January 2016



(b) August 2016 - October 2020

C Robustness Checks

C.1 Robustness: Matched City Design

Alternative Control Cities: Table C.1 shows results using alternative control groups. Panel A uses the top matched control city, Panel B uses the top 2 matched control cities, Panel C the top 5 matched control cities, and Panel D the top 10 matched control cities. Control cities are listed, in order, in Table A.1. When comparing Flint to only Youngstown, none of the specifications show pre-trends in the receivership period. Further, all coefficients for after the water supply switch and post-emergency declarations are stable across all three specifications. Overall impacts are similar to those in the top 3 control design. The top 2 results are again similar to our primary results. Coefficients for post-emergency declarations are smaller when we consider the top 5 and top 10 control samples. The receivership period coefficients, however, show potential differential pre-trends across most specifications, suggesting the broader control group definitions are inappropriate.

Alternative Control Variables: Tables C.2 and C.3 presents results using the same samples as Table 2 but with alternative control variables. Table C.2 Panel A presents the results that include home characteristics as control variables.[12] Home prices correlate with home characteristics in predictable ways, and our coefficients of interest are larger than our main specifications. Tables C.2 Panel B shows results with property instead of census block group fixed effects. The specification in column (1) suffers from similar pre-trend concerns as our main specification. Columns (2) and (3) show that including city labor market controls or city linear trends controls for these concerns. The crisis's overall impacts are larger than our main findings, and the specifications suggest larger home value losses after the switch to the Flint River. Table C.3 Panel A and B show results with more flexible temporal controls. Panel A shows results using year-month, in place of year and month, fixed effects. Panel B shows results with linear and quadratic trend controls. Results are very similar to our main specifications in both cases.

Alternative Price Restrictions: Table C.4 explores the impacts of using alternative price restrictions across all three of our empirical specifications. Panel A focuses on low-valued homes that sold for between \$500 and \$25,000. Panel B limits the upper bound of our price range, estimating each specification for homes that sold for between \$25,000 and \$1M. Panel

[12] Home characteristics are not included in our main specification since we do not observe all characteristics for over 7,000 transactions. We include as controls lot size, total bedrooms, full and half bathrooms, as well as home age and home age squared. Home age is defined as 2019 minus the year the home was built or remodeled.

C considers our widest price range, \$500 to \$10M. Very low-valued home prices in Flint fell substantially more after the water supply switch. They experienced no further losses and perhaps even a slight gain in the periods after the emergency crisis declarations. We highlight how these low-valued homes impact our analysis in Panel C and Table 4, where we also see larger impacts of the switch than the emergency crisis declarations across all specifications. Panel B shows very similar results to our main specifications, suggesting our upper-price threshold choice does not impact our results.

C.2 Robustness: Emergency Manager Design

Alternative Control Cities: Table C.5 presents results using alternative control groups. In the first panel, we limit the control to Hamtramck, MI. Like Flint, Hamtramck's finances were placed under the control of an emergency manager twice. Further, Hamtramck's latest receivership came after 2012 when Michigan strengthened the authority of emergency managers. Results remain significant and very similar to our main emergency manager design results. Panel B presents results excluding Pontiac, MI, from the control group. We do this because Pontiac, MI also serves as a control in our matched city design. The table confirms that the receivership design results remain similar to our matched design findings, even excluding the common city to the two groups.

Alternative Control Variables: Tables C.6 and Table C.7 presents results using the same alternative controls as we explored for the previous design. Table C.6 Panel A includes housing controls for housing characteristics for the sub-sample of houses for which we observe them. We lose a significant number of observations in this sample. Results remain significant, though slightly smaller than our primary results. Panel B includes property fixed effects. The sample size appreciably declines, though we continue to find large home value declines after the switch to the Flint River and after emergency management ended. Table C.7 Panel A includes year-month fixed effects, and Panel B includes quadratic controls. All results are very similar to our main specifications, however, we find slightly smaller impacts of the switch and end of emergency management when we include city event time quadratic trends. Overall impacts still exceed 23%.

Alternative Price Restrictions: Table C.8 presents results for alternative price restrictions. Panel A shows results for low-valued homes that sold for between \$500 and \$25,000. As with the matched city design, we find the largest and most statistically significant impacts on these homes after the switch to the Flint River across all specifications. We estimate that these very low-priced homes saw no further declines, or even a slight increase, in value after the end of emergency management. Panel B narrows the home values to between \$25,000 and \$1M. Results are nearly identical to our main regression results. Panel C considers our largest price range of \$500 to \$10M. As in the matched city design, we find the largest percentage change impacts after the switch, with further smaller impacts after the end of emergency management. Results, however, are more sensitive to the included controls, and low-valued home sales show strong differential pre-trends in two of the three specifications.

C.3 Robustness: Flexible Difference-in-Differences

Figure C.1a compares our year-quarter estimates from our preferred specification with those using labor market controls. Panel (a) shows results for the matched city design and Panel (b) shows results for the emergency manager design. Consistent with the results in Tables 2 and 3, the labor market controls flatten potential pre-trends that are apparent when we only include year and month fixed effects. Results with labor market controls are nearly identical to those with city-year trends in Panel A, especially after the switch to the Flint River. The coefficients leading up to emergency management are also almost identical to our preferred specification in Panel B. We find larger impacts of the water crisis when we use labor controls instead of city-year trends.

C.4 Robustness: Housing Value Losses and Alternative Price Ranges

Table C.9 Panel A presents regression results and estimated housing value losses in Flint for the matched city design. For clarity, we reproduce results from Table 2. We calculate a consistent estimate of the average percentage change effect of each event on home prices using the formula derived by Kennedy (1981). For example, we calculate the percentage change impact of the water supply switch for the matched city design as $\exp(\hat{\gamma}_2 - \frac{1}{2}\hat{V}(\hat{\gamma}_2))$ where $\hat{\gamma}_2$ is the coefficient estimate for the variable [Water Supply Switch X Flint] in equation (1) and $\hat{V}(\hat{\gamma}_2)$ is its estimated variance. We multiply the total percentage change in housing values, the sum of the adjusted [Water Supply Switch X Flint] and [Emergency X Flint] coefficients, by the average home price in our sample to calculate average home value losses.

We estimate aggregate housing value losses by multiplying average household losses by the estimated number of detached, occupied housing units whose value was above \$25,000 in

[13] The 2014 American Community Survey estimated 39,125 occupied housing units in Flint in 2014. Of those, 79.1% were detached homes. Using home price ranges reported in the ACS, we estimate that 61.4% of homes had values greater than \$25,000. Thus, the total number of affected homes in our sample is around 19,000. We only adjust the 79.1% of detached homes for the extended sample (\$500 to \$10M), estimating that around 31,000 owner-occupied homes had a value of at least \$500.

2014.[13] The matched city home value loss estimates for our main sample range from around \$21,000 to \$29,000 per house, or \$401 to \$559M citywide.

Panel B reports results for our largest price range, including homes that sold for between \$500 and \$10M. Average home value losses are largely similar for this extended sample, around \$21,000 per house across all specifications. Total losses are larger, ranging from \$658M to \$670M, since we scale up by a larger housing stock.

Table C.10 presents corresponding home value loss estimates using the emergency manager design. Panel A shows results for our main price sample. Damage estimates do not vary much across specifications. Average total home value losses range from \$27,000 to \$31,000 per household, or \$521M to \$593M in citywide losses. Average total home value losses of the crisis are lower in the extended sample, ranging from \$19,000 to \$23,000 per household. After we account for the larger housing stock represented by the sample, however, citywide losses are generally higher, between \$587M and \$720M.

Table C.1: Flint Housing Price Impacts - Matched City Design (Alternative Control Cities)

	(1)	(2)	(3)
Panel A: Top 1 Matched Control City			
Emergency X Flint	-0.173	-0.173	-0.196
	(0.041)	(0.039)	(0.051)
Water Supply Switch X Flint	-0.146	-0.146	-0.150
	(0.035)	(0.036)	(0.036)
Receivership X Flint	-0.005	-0.005	-0.028
	(0.026)	(0.025)	(0.040)
Observations	21,788	21,788	21,788
N (Houses)	17,537	17,537	17,537
Panel B: Top 2 Matched Control Cities			
Emergency X Flint	-0.215	-0.241	-0.295
	(0.041)	(0.042)	(0.059)
Water Supply Switch X Flint	-0.072	-0.062	-0.113
	(0.032)	(0.032)	(0.035)
Receivership X Flint	0.139	0.041	0.008
	(0.028)	(0.027)	(0.035)
Observations	31,246	31,246	31,246
N (Houses)	23,592	23,592	23,592
Panel C: Top 5 Matched Control City			
Emergency X Flint	-0.108	-0.112	-0.140
	(0.036)	(0.036)	(0.050)
Water Supply Switch X Flint	-0.121	-0.113	-0.134
	(0.030)	(0.030)	(0.031)
Receivership X Flint	0.060	0.037	0.007
	(0.025)	(0.027)	(0.030)
Observations	76,550	76,550	76,550
N (Houses)	60,450	60,450	60,450
Panel D: Top 10 Matched Control Cities			
Emergency X Flint	-0.064	-0.074	-0.089
	(0.036)	(0.036)	(0.047)
Water Supply Switch X Flint	-0.143	-0.135	-0.141
	(0.030)	(0.030)	(0.031)
Receivership X Flint	0.094	0.052	0.073
	(0.024)	(0.027)	(0.027)
Observations	133,286	133,286	133,286
N (Houses)	105,944	105,944	105,944
Census Block Group FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Month FE	Yes	Yes	Yes
Labor Force Controls	No	Yes	No
City-Year Linear Trends	No	No	Yes

Notes: The dependent variable is the log of home sales prices in Flint and the specified control cities (2019 $). All regressions include weather controls. Standard errors are clustered at the census block group.

Table C.2: Flint Housing Price Impacts - Matched City Design
(Alternative Controls 1)

	(1)	(2)	(3)
Panel A: House Characteristic Controls			
Emergency X Flint	-0.225	-0.248	-0.304
	(0.041)	(0.042)	(0.060)
Water Supply Switch X Flint	-0.080	-0.071	-0.122
	(0.033)	(0.033)	(0.037)
Receivership X Flint	0.129	0.039	0.001
	(0.029)	(0.027)	(0.035)
Lot Size (Acres)	0.108	0.107	0.107
	(0.017)	(0.017)	(0.017)
Total Bedrooms	0.052	0.052	0.052
	(0.005)	(0.005)	(0.005)
Full Bathrooms	0.160	0.159	0.159
	(0.012)	(0.012)	(0.012)
Half Bathrooms	0.134	0.132	0.132
	(0.012)	(0.012)	(0.011)
Home Age	-0.006	-0.006	-0.006
	(0.001)	(0.001)	(0.001)
Home Age Squared	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Observations	29,548	29,548	29,548
N (Houses)	22,202	22,202	22,202
Census Block Group FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Month FE	Yes	Yes	Yes
Labor Force Controls	No	Yes	No
City-Year Linear Trends	No	No	Yes
Panel B: Property Fixed Effects			
Emergency X Flint	-0.125	-0.141	-0.205
	(0.066)	(0.066)	(0.083)
Water Supply Switch X Flint	-0.189	-0.187	-0.247
	(0.058)	(0.058)	(0.064)
Receivership X Flint	0.154	0.058	-0.004
	(0.054)	(0.051)	(0.050)
Observations	15,857	15,857	15,857
N (Houses)	6,848	6,848	6,848
Property FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Month FE	Yes	Yes	Yes
Labor Force Controls	No	Yes	No
City-Year Linear Trends	No	No	Yes

Notes: The dependent variable is the log of home sales prices in Flint and the top 3 matched control cities (2019 $). All regressions include weather controls. Standard errors are clustered at the census block group.

Table C.3: Flint Housing Price Impacts - Matched City Design (Alternative Controls 2)

	(1)	(2)	(3)
Panel A: Year-Month Fixed Effects			
Emergency X Flint	-0.179	-0.197	-0.257
	(0.039)	(0.040)	(0.055)
Water Supply Switch X Flint	-0.088	-0.072	-0.125
	(0.032)	(0.032)	(0.034)
Receivership X Flint	0.126	0.038	0.014
	(0.028)	(0.027)	(0.033)
Observations	37,318	37,318	37,318
N (Houses)	28,309	28,309	28,309
Census Block Group FE	Yes	Yes	Yes
Year-Month FE	Yes	Yes	Yes
Labor Force Controls	No	Yes	No
City-Year Linear Trends	No	No	Yes
Panel B: Quadratic City Trends			
Emergency X Flint	-0.257	-0.203	-0.200
	(0.055)	(0.042)	(0.042)
Water Supply Switch X Flint	-0.128	-0.111	-0.108
	(0.034)	(0.034)	(0.034)
Receivership X Flint	0.013	0.038	0.038
	(0.034)	(0.032)	(0.032)
Observations	37,318	37,318	37,318
N (Houses)	28,309	28,309	28,309
Census Block Group FE	Yes	Yes	Yes
Year FE	Yes	Yes	No
Month FE	Yes	Yes	No
Year-Month FE	No	No	Yes
City-Year Linear Trends	Yes	Yes	Yes
City-Year Quadratic Trends	No	Yes	Yes

Notes: The dependent variable is the log of home sales prices in Flint and the top 3 matched control cities (2019 $). All regressions include weather controls. Standard errors are clustered at the census block group.

Table C.4: Flint Housing Price Impacts - Matched City Design (Alternative Price Ranges)

	(1)	(2)	(3)
Panel A: Home Prices $500 to $25,000			
Emergency X Flint	-0.001	0.016	0.137
	(0.045)	(0.045)	(0.055)
Water Supply Switch X Flint	-0.409	-0.393	-0.310
	(0.049)	(0.048)	(0.051)
Receivership X Flint	0.021	0.121	0.201
	(0.035)	(0.042)	(0.054)
Observations	32,418	32,418	32,418
N (Houses)	23,531	23,531	23,531
Panel B: Home Prices $25,000 to $1,000,000			
Emergency X Flint	-0.178	-0.194	-0.258
	(0.038)	(0.039)	(0.054)
Water Supply Switch X Flint	-0.087	-0.072	-0.126
	(0.033)	(0.032)	(0.034)
Receivership X Flint	0.125	0.041	0.008
	(0.028)	(0.027)	(0.034)
Observations	37,297	37,297	37,297
N (Houses)	28,295	28,295	28,295
Panel C: Home Prices $500 to $10,000,000			
Emergency X Flint	-0.074	-0.064	-0.086
	(0.041)	(0.040)	(0.047)
Water Supply Switch X Flint	-0.449	-0.452	-0.423
	(0.045)	(0.044)	(0.050)
Receivership X Flint	-0.064	-0.005	-0.031
	(0.038)	(0.041)	(0.044)
Observations	69,765	69,765	69,765
N (Houses)	41,855	41,855	41,855
Census Block Group FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Month FE	Yes	Yes	Yes
Labor Force Controls	No	Yes	No
City-Year Linear Trends	No	No	Yes

Notes: The dependent variable is the log of home sales prices in Flint and the top 3 matched control cities (2019 $). All regressions include weather controls. Standard errors are clustered at the census block group.

Table C.5: Flint Housing Price Impacts - Emerg. Man. Design (Alternative Control Cities)

	(1)	(2)	(3)
Panel A: Hamtramck Controls Only			
EM Ends X Flint	-0.298	-0.281	-0.250
	(0.050)	(0.048)	(0.051)
EM Starts X Flint x Switch	-0.080	-0.091	-0.061
	(0.046)	(0.047)	(0.050)
EM Starts X Flint	-0.091	-0.072	0.050
	(0.057)	(0.056)	(0.069)
EM Ends	0.104	0.109	0.095
	(0.039)	(0.039)	(0.039)
EM Starts	0.127	0.101	0.046
	(0.056)	(0.054)	(0.058)
Observations	10,208	10,208	10,208
N (Houses)	8,465	8,465	8,465
Panel B: No Pontiac Controls			
EM Ends X Flint	-0.285	-0.262	-0.277
	(0.042)	(0.043)	(0.045)
EM Starts X Flint x Switch	-0.148	-0.158	-0.149
	(0.037)	(0.037)	(0.038)
EM Starts X Flint	-0.030	-0.030	-0.018
	(0.031)	(0.031)	(0.037)
EM Ends	0.057	0.055	0.061
	(0.024)	(0.024)	(0.024)
EM Starts	0.109	0.102	0.074
	(0.028)	(0.028)	(0.027)
Observations	20,500	20,500	20,500
N (Houses)	15,417	15,417	15,417
Census Block Group FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Month FE	Yes	Yes	Yes
Labor Force Controls	No	Yes	No
City Event Time Linear Trends	No	No	Yes

Notes: The dependent variable is the log of home sales prices in Flint and the emergency manager control cities (2019 $). All regressions include weather controls. Standard errors are clustered at the census block group.

Table C.6: Flint Housing Price Impacts - Emerg. Man. Design (Alternative Controls 1)

	(1)	(2)	(3)
Panel A: House Characteristic Controls			
EM Ends X Flint	-0.214	-0.250	-0.183
	(0.048)	(0.050)	(0.058)
EM Starts X Flint x Switch	-0.089	-0.097	-0.081
	(0.037)	(0.036)	(0.050)
EM Starts X Flint	0.155	0.044	0.107
	(0.028)	(0.034)	(0.046)
EM Ends	-0.009	0.003	-0.003
	(0.034)	(0.034)	(0.035)
EM Starts	-0.097	-0.015	-0.067
	(0.033)	(0.037)	(0.041)
Lot Size (Acres)	0.046	0.045	0.045
	(0.005)	(0.005)	(0.005)
Total Bedrooms	0.033	0.033	0.034
	(0.007)	(0.007)	(0.007)
Full Bathrooms	0.150	0.150	0.149
	(0.019)	(0.019)	(0.019)
Half Bathrooms	0.117	0.117	0.116
	(0.020)	(0.020)	(0.020)
Home Age	-0.004	-0.004	-0.004
	(0.001)	(0.001)	(0.001)
Home Age Squared	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Observations	16,775	16,775	16,775
N (Houses)	12,478	12,478	12,478
Census Block Group FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Month FE	Yes	Yes	Yes
Labor Force Controls	No	Yes	No
City Event Time Linear Trends	No	No	Yes
Panel B: Property Fixed Effects			
EM Ends X Flint	-0.253	-0.292	-0.172
	(0.080)	(0.082)	(0.094)
EM Starts X Flint x Switch	-0.123	-0.110	-0.205
	(0.071)	(0.070)	(0.077)
EM Starts X Flint	-0.021	-0.069	0.037
	(0.058)	(0.059)	(0.073)
EM Ends	0.064	0.082	0.037
	(0.041)	(0.042)	(0.042)
EM Starts	0.102	0.116	0.080
	(0.040)	(0.040)	(0.041)
Observations	13,066	13,066	13,066
N (Houses)	5,616	5,616	5,616
Property FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Month FE	Yes	Yes	Yes
Labor Force Controls	No	Yes	No
City Event Time Linear Trends	No	No	Yes

Notes: The dependent variable is the log of home sales prices in Flint and the emergency manager control cities (2019 $). All regressions include weather controls. Standard errors are clustered at the census block group.

Table C.7: Flint Housing Price Impacts - Emerg. Man. Design (Alternative Controls 2)

	(1)	(2)	(3)
Panel A: Year-Month Fixed Effects			
EM Ends X Flint	-0.256	-0.356	-0.253
	(0.044)	(0.045)	(0.049)
EM Starts X Flint x Switch	-0.149	-0.084	-0.138
	(0.036)	(0.033)	(0.038)
EM Starts X Flint	0.068	-0.053	-0.020
	(0.027)	(0.026)	(0.035)
EM Ends	-0.045	0.009	-0.024
	(0.023)	(0.022)	(0.022)
EM Starts	0.100	0.149	0.074
	(0.025)	(0.024)	(0.023)
Observations	28,058	28,058	28,058
N (Houses)	20,608	20,608	20,608
Census Block Group FE	Yes	Yes	Yes
Year-Month FE	Yes	Yes	Yes
Labor Force Controls	No	Yes	No
City Event Time Linear Trends	No	No	Yes
Panel B: Quadratic City Trends			
EM Ends X Flint	-0.250	-0.187	-0.080
	(0.046)	(0.040)	(0.048)
EM Starts X Flint x Switch	-0.114	-0.100	-0.150
	(0.035)	(0.036)	(0.039)
EM Starts X Flint	-0.004	-0.028	0.025
	(0.032)	(0.032)	(0.034)
EM Ends	-0.008	-0.019	-0.055
	(0.020)	(0.020)	(0.022)
EM Starts	0.055	0.049	0.027
	(0.023)	(0.022)	(0.026)
Observations	28,058	28,058	28,058
N (Houses)	20,608	20,608	20,608
Census Block Group FE	Yes	Yes	Yes
Year FE	Yes	Yes	No
Month FE	Yes	Yes	No
Year-Month FE	No	No	Yes
City Event Time Linear Trends	Yes	Yes	Yes
City Event Time Quadratic Trends	No	Yes	Yes

Notes: The dependent variable is the log of home sales prices in Flint and the emergency manager control cities (2019 $). All regressions include weather controls. Standard errors are clustered at the census block group.

Table C.8: Flint Housing Price Impacts - Emerg. Man. Design (Alternative Price Ranges)

	(1)	(2)	(3)
Panel A: Home Prices \$500 to \$25,000			
EM Ends X Flint	0.051	0.115	0.106
	(0.046)	(0.048)	(0.057)
EM Starts X Flint x Switch	-0.306	-0.295	-0.218
	(0.042)	(0.041)	(0.053)
EM Starts X Flint	0.072	0.227	0.007
	(0.038)	(0.044)	(0.071)
EM Ends	0.019	-0.002	0.003
	(0.042)	(0.040)	(0.042)
EM Starts	0.015	-0.086	0.072
	(0.037)	(0.040)	(0.047)
Observations	31,819	31,819	31,819
N (Houses)	22,844	22,844	22,844
Panel B: Home Prices \$25,000 to \$1,000,000			
EM Ends X Flint	-0.278	-0.349	-0.250
	(0.041)	(0.042)	(0.046)
EM Starts X Flint x Switch	-0.118	-0.082	-0.109
	(0.032)	(0.030)	(0.035)
EM Starts X Flint	0.059	-0.037	-0.004
	(0.026)	(0.025)	(0.033)
EM Ends	-0.027	0.012	-0.008
	(0.020)	(0.019)	(0.020)
EM Starts	0.087	0.124	0.055
	(0.024)	(0.023)	(0.023)
Observations	28,050	28,050	28,050
N (Houses)	20,602	20,602	20,602
Panel C: Home Prices \$500 to \$10,000,000			
EM Ends X Flint	-0.195	-0.159	-0.177
	(0.048)	(0.049)	(0.053)
EM Starts X Flint x Switch	-0.436	-0.443	-0.314
	(0.043)	(0.042)	(0.050)
EM Starts X Flint	-0.053	0.012	-0.155
	(0.039)	(0.045)	(0.056)
EM Ends	-0.001	-0.016	0.054
	(0.043)	(0.043)	(0.042)
EM Starts	0.127	0.094	0.120
	(0.034)	(0.034)	(0.038)
Observations	59,884	59,884	59,884
N (Houses)	34,637	34,637	34,637
Census Block Group FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Month FE	Yes	Yes	Yes
Labor Force Controls	No	Yes	No
City Event Time Linear Trends	No	No	Yes

Notes: The dependent variable is the log of home sales prices in Flint and the emergency manager control cities (2019 \$). All regressions include weather controls. Standard errors are clustered at the census block group.

Table C.9: Damage Estimates - Matched City Design

	(1)	(2)	(3)
Panel A: Main Price Sample ($25K to $10M)			
Emergency X Flint	-0.179	-0.194	-0.257
	(0.039)	(0.039)	(0.055)
Water Supply Switch X Flint	-0.090	-0.074	-0.128
	(0.032)	(0.032)	(0.034)
Receivership X Flint	0.127	0.043	0.013
	(0.028)	(0.027)	(0.034)
Observations	37,318	37,318	37,318
Avg. Home Value Losses ($ 2019)	$21,201	$21,081	$29,412
Citywide Losses (M$ 2019)	$403	$401	$559
Panel B: Extended Price Sample ($500 to $10M)			
Emergency X Flint	-0.074	-0.064	-0.086
	(0.041)	(0.040)	(0.047)
Water Supply Switch X Flint	-0.449	-0.452	-0.423
	(0.045)	(0.044)	(0.050)
Receivership X Flint	-0.064	-0.005	-0.031
	(0.038)	(0.041)	(0.044)
Observations	69,765	69,765	69,765
Avg. Home Value Losses ($ 2019)	$21,635	$21,260	$21,365
Citywide Losses (M$ 2019)	$670	$658	$661
Census Block Group FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Month FE	Yes	Yes	Yes
Labor Force Controls	No	Yes	No
City-Year (City-Event) Linear Trends	No	No	Yes

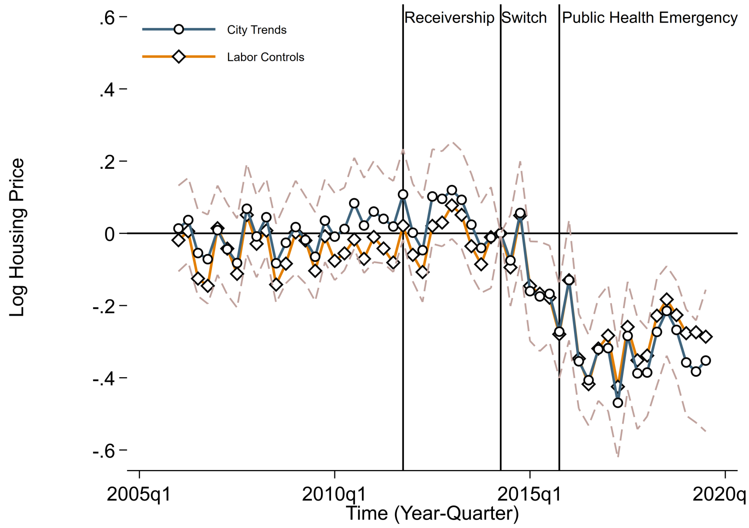
Notes: The dependent variable is the level of home sales prices in Flint and the top 3 matched control cities (2019 $). All regressions include weather controls. Standard errors are clustered at the census block group.

Table C.10: Damage Estimates - Emerg. Man. Design

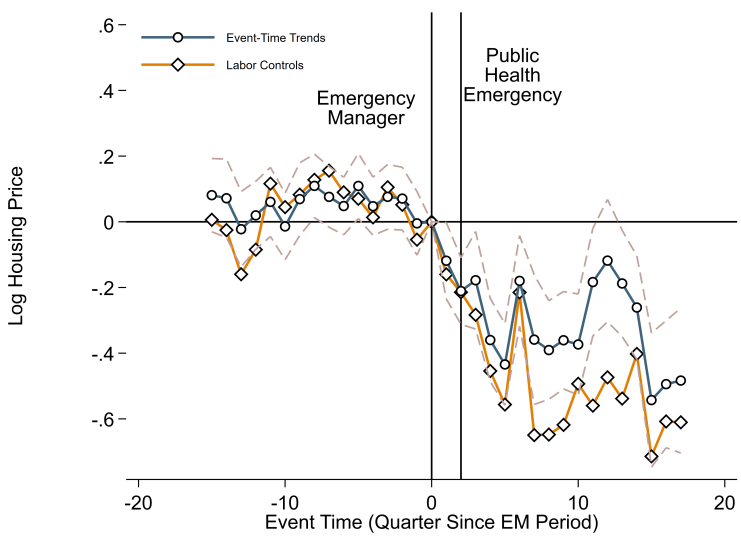
	(1)	(2)	(3)
Panel A: Main Price Sample ($25K to $10M)			
EM Ends X Flint	-0.275	-0.346	-0.250
	(0.041)	(0.043)	(0.046)
EM Starts X Flint x Switch	-0.123	-0.087	-0.114
	(0.032)	(0.030)	(0.035)
EM Starts X Flint	0.062	-0.035	-0.004
	(0.026)	(0.025)	(0.032)
EM Ends	-0.027	0.012	-0.008
	(0.020)	(0.019)	(0.020)
EM Starts	0.086	0.123	0.055
	(0.024)	(0.023)	(0.023)
Observations	28,058	28,058	28,058
Avg. Home Value Losses ($ 2019)	$29,568	$31,191	$27,397
Citywide Losses (M$ 2019)	$562	$593	$521
Panel B: Extended Price Sample ($500 to $10M)			
EM Ends X Flint	-0.195	-0.159	-0.177
	(0.048)	(0.049)	(0.053)
EM Starts X Flint x Switch	-0.436	-0.443	-0.314
	(0.043)	(0.042)	(0.050)
EM Starts X Flint	-0.053	0.012	-0.155
	(0.039)	(0.045)	(0.056)
EM Ends	-0.001	-0.016	0.054
	(0.043)	(0.043)	(0.042)
EM Starts	0.127	0.094	0.120
	(0.034)	(0.034)	(0.038)
Observations	59,884	59,884	59,884
Avg. Home Value Losses ($ 2019)	$23,275	$22,155	$18,965
Citywide Losses (M$ 2019)	$720	$686	$587
Census Block Group FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Month FE	Yes	Yes	Yes
Labor Force Controls	No	Yes	No
City-Year (City-Event) Linear Trends	No	No	Yes

Notes: The dependent variable is the level of home sales prices in Flint and the emergency manager control cities (2019 $). All regressions include weather controls. Standard errors are clustered at the census block group.

Figure C.1: Home Price Event Studies: Labor Controls



(a) Matched City Design



(b) Emergency Manager Design

Notes: These figures graph year-quarter coefficients from the matched city and emergency manager empirical design. For both designs, we plot year-quarter home price estimates from the preferred model and corresponding 95% confidence intervals in blue with circles and the dashed gray lines, respectively. Orange lines with diamonds show year-quarter estimates from our specifications with labor market controls.

D Additional Analyses

D.1 Post-April 2018 Analysis

On April 6, 2018, Governor Snyder declared that the city's water quality was 'well within the standards' set by EPA for safe human consumption (Chavez, 2018). Our flexible difference-in-differences approach shows the evolution of home prices in Flint over time. Here, we formally test whether housing prices recovered after the period. Specifically, we extend our difference-in-differences designs for both empirical designs to include indicators for after April 6, 2018. Table D.1 Panel A presents results for the matched city design. In all three specifications, the estimated post-emergency declaration impacts increase, while we find suggestive evidence of a slight recovery after the water was deemed safe, with statistically significant but small improvements in columns (1) and (2). When we sum all coefficient estimates since the switch, total impacts of the switch and subsequent crisis are 3% to 5% lower than specifications that do not include the post April 6, 2018 indicator.

Table D.1 Panel B present corresponding results for the emergency manager design. Here, we find the opposite impacts. In columns (1) and (2), we see further, statistically significant declines in home values after the water was declared safe, while in column (3) we see no further change in home values after April 2018. Overall impacts are generally larger in these specifications. Taken together, the matched city and emergency manager results show no clear evidence of a recovery after the water was deemed safe.

D.2 Honest Difference-in-Differences

We construct Honest Difference-in-Differences (Honest DiD) estimates to evaluate the sensitivity of estimated treatment effects to assumptions about parallel pre-trends. The Honest DiD estimator provides a method for constructing robust confidence sets under varying assumptions about possible violations of parallel trends (Rambachan and Roth, 2021). The estimator uses variance in pre-period trends to estimate uniform asymptotic bounds on estimated treatment effects. We construct a set of Honest DiD estimates that provides aymptotic bounds allowing for linear pre-trends in home prices leading up the switch. This analysis allows us to examine the impact of differential pre-period price trends on the estimates reported in specification (1) of Tables 2 and 3 and illustrated in Figures 4b and 5b.

Figure D.1 Panel (a) plots our results from the Honest DiD exercise for the matched city design. The Honest DiD confidence sets are plotted with solid red lines. For comparison, the confidence intervals from our specification with no labor force or city linear time trends are displayed in dashed grey lines. Mean estimates are connected with the solid blue line. The Honest DiD confidence sets indicate that a linear violation of the parallel pre-trends assumption implies our preferred estimates are conservative, with the confidence sets in the later periods being lower than our coefficient estimates. Figure D.1 Panel (b) plots similar results for the emergency manager city design. While the robust confidence sets all include our point estimates in this design, they are typically centered lower than our 95% confidence intervals, again suggesting our results are conservative.

D.3 Heterogeneous Impacts

Figure 6 maps coefficient estimates from our interacted difference-in-differences model. The results are from a regression that interacts the Flint-by-Emergency Declaration or Flint-by-End of EM period coefficients with tract-area indicators, allowing the crisis to have differential impacts across different Flint neighborhoods.[14] Tract estimates range from -14% to -43% for the matched city design and -11% to –39% for the emergency manager design.[15]

Figures D.2 and D.3 correlate the estimated effects with tract-area demographic characteristics in Panel (a) for the matched city design and emergency manager design, respectively. Census data are from the 2010-14 5-year American Community Service estimates. The Figures include a scatter-plot and best-fit line. Panel (b) of Figures D.2 and D.3 shows similar correlations with measures of lead risk and amount of lead remediation observed in tract-areas.

D.4 Impacts on Home Sales

Testing for Sales Impacts of the Crisis: We test whether the crisis impacted home sales in Flint using similar research designs. We count the number of sales in every census block group and year-month for every city in our sample. Our outcome variable is an indicator of whether any sale occurred in a census block group and month.[16] We estimate a regression

[14]Tract-areas are mapped in Figure A.2. In total, we estimate separate coefficients for eighteen areas of Flint.

[15]The tract-area estimates are highly correlated across the two designs with a correlation coefficient of 0.8.

[16]We observe 408 census block groups in Flint that had a housing sale over our sample. The average number of sales in a block-group in a year-month is 0.55. The 90th percentile of sales in a block-group and year-month is 2. As such, we prefer specifications using indicators for any sales over continuous sales measures.

similar to equations (1) and (3). Table D.2 presents the results for both the matched city and emergency manager designs. In all specifications, we see a decrease in the probability of a sale between the switch to the Flint River and the emergency declarations. The decrease ranges from 8% to 14%. We find no further impact of the emergency crisis declaration on the probability of observing a sale in Flint in any specifications. This suggests that the largest price decreases we find after the emergency declaration are not due to changes in sales.

Testing for Compositional Changes: We also explore whether the probability of a sale varied within Flint by interacting the post-emergency indicator with the census tract-area indicators. Figures D.4 and D.5 correlate the tract-area estimates with the same demographic as well as lead risk and remediation characteristics we used to explore price heterogeneity. The matched city tract-area estimates range from -11% to 21%. The emergency manager estimates range from -14% to 13%.[17] The figures show little systematic correlations between neighborhood demographics or lead risk and a change in the probability of a sale. The one exception across both research designs is a positive correlation between neighborhoods with higher 2010/14 median home values and the probability of a sale in that neighborhood. Changes in composition to this effect would attenuate our estimates of the water crisis's impact on home prices.

Share of Low-Valued Home Sales: Figure D.6 compares sales of low-value homes to homes in our main price sample. We show low-value home sales for two price ranges given our findings in Table 4: (i) \$500 to \$5K and (ii) \$5K to \$25K. Low-value home sales increased from the beginning of our sample through 2009, but remain relatively steady through the rest of the sample. Importantly, we observe no notable increases or decreases in sales of low-value homes around the switch to the Flint River or the emergency crisis declarations.

Testing for Changes in Buyer Characteristics: As an additional check on compositional changes resulting from the crisis, we conduct a separate analysis using mortgage data across Flint from the Home Mortgage Disclosure Act (HMDA). HMDA data report the data on borrowers and loans initialized from 2007 to 2016. We observe approximately 30,500 new loans initialized in Flint during our study period. Figure D.7 graphs changes in buyer characteristics for homeowners who applied for a home loan in Flint from 2008 to 2016. All estimates report differences relative to the first year, 2007. These display the changes in Flint over time, not relative changes to control cities. Buyers' incomes decreased by 10% to 15% in the two years following the financial crisis, but mostly recovered by 2014 and improved slightly from 2015 to 2016. We observe changes over time in other characteristics

[17] Again, the correlation between tract-area effects is strong across the two empirical designs. The correlation coefficient, in this case, is 0.97.

as well (probability of a co-applicant, denial rates, race, and gender). We see a slight increase in incomes of those filing for mortgages after 2014. Otherwise, we see little change in an outcomes from 2014 to 2016, suggesting a limited role of changes in buyer characteristics.[18]

D.5 Population Declines

Testing for Overall Population Changes:

We compare Flint to our top matched control cities to test whether the crisis deferentially affected Flint's population. We collect annual population data for each city from 2010 to 2019.[19] Figure D.8 plots the population estimates. Flint's population declines over the entire sample while most of the other cities had relatively stable populations. There is little visual evidence that the population declines sped up post-2014. We formally test whether Flint's population losses are differential after the emergency by regressing the log of each city's annual population on year indicators and year-by-Flint indicators. Table D.3 presents the results. Focusing on the indicators for post-2014, we see no differential change in Flint's population for 2014 through 2016. After 2017, Flint's population declined by 1.3% to 2.3% more than the matched control cities. The result suggests that some of our estimated treatment effect after the emergency crisis declaration may be due to out-migration, though the relative magnitues are small compared to our estimated impacts. For example, (Glaeser and Gyourko, 2005) find a price elasticity with respect to population decline of 1.8. This estimate would suggest that 2.3% to 4.1% of the price impact in Flint may be due to population declines.

Testing for Impacts on Out-Migration from Flint: We use data from InfoUSA to identify patterns of out-migration of homeowners and renters in Flint and our control cities. InfoUSA collects household-level address history data covering 2006 to 2017.[20] The data include indicators for whether households rent or own their home, as well as unique identifiers

[18] Gorton and Pinkovskiy (2021) examine changes in Flint households' financial well-being after the switch. The authors focus on households with lead or galvanized service lines and find modest impacts of the switch and crisis on households' loan balances and the probability of missed repayments. Consistent with our findings, they find that the events had little impact on mobility out of the state or county.

[19] Annual population estimates for many emergency manager cities are unavailable given their small size.

[20] Access to InfoUSA data is limited through 2017.

[21] InfoUSA tracks movers using a combination of utility data, deed transfers (homeowners), a Fair Credit Reporting Act compliant magazine, and credit sources. The entire database contains information on around 120 million households (292 million individuals) in the U.S. InfoUSA validates the database every 12 to 24 months, and the company records approximately 1 million moves per month. The company identifies 90% to 95% of movers from deed transfers. The data include information on ownership status, household head ethnicity, estimated household income, age, marital status, and the presence and number of children in the home.

that allow us to construct Flint and control city cohorts over time.[21] Figure D.9 plots changes in moving behavior of owners and renters using the 2012 household cohort. To create the figure, we follow all households living in Flint and our top 3 matched control cities in 2012 and estimate the likelihood that Flint households move in 2013 to 2016 relative to control households. We define a move as a change of address to a location outside of their original city.

Again, we find evidence of small declines in the likelihood of Flint households moving in 2014 and 2015. The coefficient is largest among renters, with a large standard error in 2015 due to a small number of observed moves. The 2016 coefficients indicate that the probability of a move in 2016 is not statistically different from 2012. The results support our other findings that, to date, the crisis had limited impacts on out-migration and population declines in Flint.

Table D.1: Extended Housing Price Impacts

	(1)	(2)	(3)
Panel A: Matched City Design			
Post Safety Declaration	0.062	0.082	0.034
	(0.030)	(0.030)	(0.036)
Emergency X Flint	-0.207	-0.231	-0.268
	(0.037)	(0.037)	(0.050)
Water Supply Switch X Flint	-0.089	-0.073	-0.125
	(0.032)	(0.032)	(0.035)
Receivership X Flint	0.127	0.042	0.019
	(0.028)	(0.028)	(0.035)
Observations	37,318	37,318	37,318
N (Houses)	28,309	28,309	28,309
Panel B: Emergency Manager Design			
Post-Safety Declaration X Flint	-0.123	-0.110	0.025
	(0.038)	(0.037)	(0.044)
EM Ends X Flint	-0.242	-0.317	-0.252
	(0.038)	(0.040)	(0.046)
EM Starts X Flint x Switch	-0.124	-0.087	-0.112
	(0.032)	(0.030)	(0.035)
EM Starts X Flint	0.065	-0.032	0.001
	(0.026)	(0.025)	(0.032)
EM Ends	-0.029	0.009	-0.007
	(0.020)	(0.020)	(0.020)
EM Starts	0.086	0.123	0.054
	(0.024)	(0.023)	(0.023)
Observations	28,058	28,058	28,058
N (Houses)	20,608	20,608	20,608
Census Block Group FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Month FE	Yes	Yes	Yes
Labor Force Controls	No	Yes	No
City-Year (City-Event) Time Linear Trends	No	No	Yes

Notes: The dependent variable is the log of home sales prices (2019 $) in Flint and the specified control cities from January 2006 to August 2019. All regressions include weather controls. Labor force controls are the log of each city's monthly labor force. Standard errors are clustered at the census block group.

Table D.2: Flint Housing Sales Impacts

	(1)	(2)	(3)
Panel A: Matched City Design			
Emergency X Flint	-0.016	-0.025	0.044
	(0.013)	(0.013)	(0.016)
Water Supply Switch X Flint	-0.139	-0.123	-0.105
	(0.015)	(0.015)	(0.016)
Receivership X Flint	-0.123	-0.164	-0.017
	(0.014)	(0.014)	(0.016)
Observations	67,732	67,732	67,732
Panel B: Emergency Manager Design			
EM Ends X Flint	-0.010	-0.013	-0.001
	(0.015)	(0.016)	(0.017)
EM Starts X Flint x Switch	-0.112	-0.111	-0.079
	(0.016)	(0.016)	(0.020)
EM Starts X Flint	-0.046	-0.051	-0.076
	(0.016)	(0.016)	(0.019)
EM Ends	0.006	0.007	0.018
	(0.013)	(0.013)	(0.013)
EM Starts	0.010	0.012	0.007
	(0.014)	(0.014)	(0.015)
Observations	39,874	39,874	39,874
Census Block Group FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Month FE	Yes	Yes	Yes
Labor Force Controls	No	Yes	No
City-Year (City-Event) Linear Trends	No	No	Yes

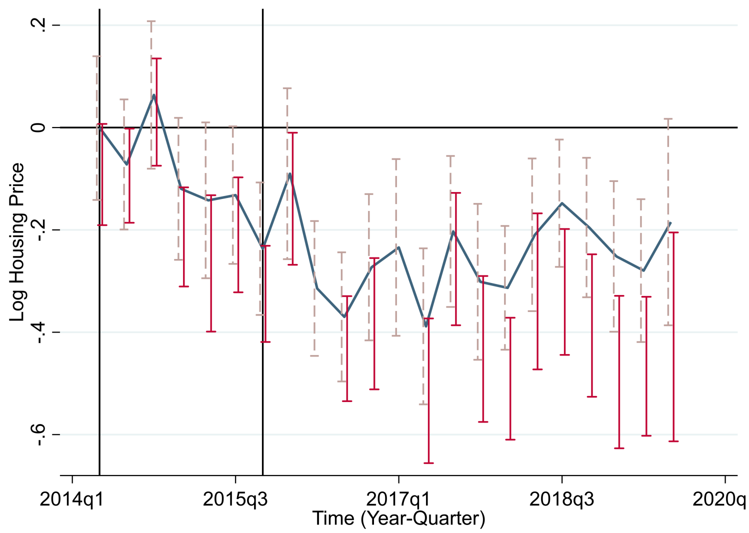
Notes: The dependent variable is an indicator for a home sale in a census block group in Flint and the specified control cities from January 2006 to August 2019. All regressions include census block fixed effects, year fixed effects, month fixed effects, and weather controls. Labor force controls are the log of each city's monthly labor force. Standard errors are clustered at the census block group.

Table D.3: Population Changes

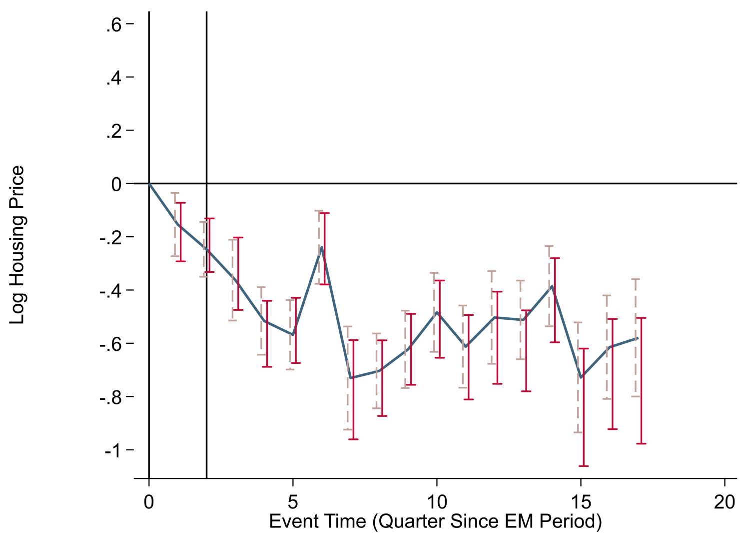
	(1)
Flint X 2010	0.020
	(0.012)
Flint X 2011	0.012
	(0.011)
Flint X 2012	0.004
	(0.007)
Flint X 2014	-0.004
	(0.006)
Flint X 2015	-0.007
	(0.007)
Flint X 2016	-0.006
	(0.009)
Flint X 2017	-0.013
	(0.009)
Flint X 2018	-0.018
	(0.007)
Flint X 2019	-0.023
	(0.009)
Observations	40

Notes: The dependent variable is the log of annual population in Flint and the top 3 matched control cities from 2010 to 2019. All regressions include city and year fixed effects. Standard errors are robust to heteroskedasticity.

Figure D.1: Honest Difference-in-Differences Results



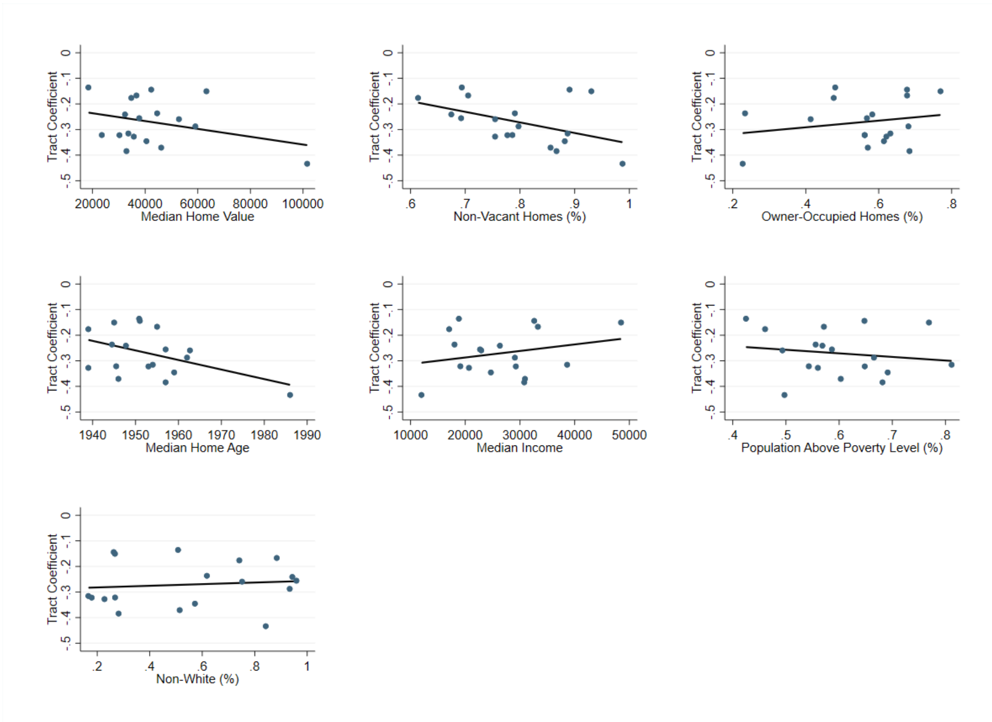
(a) Match City Design - No Labor/Trend Controls



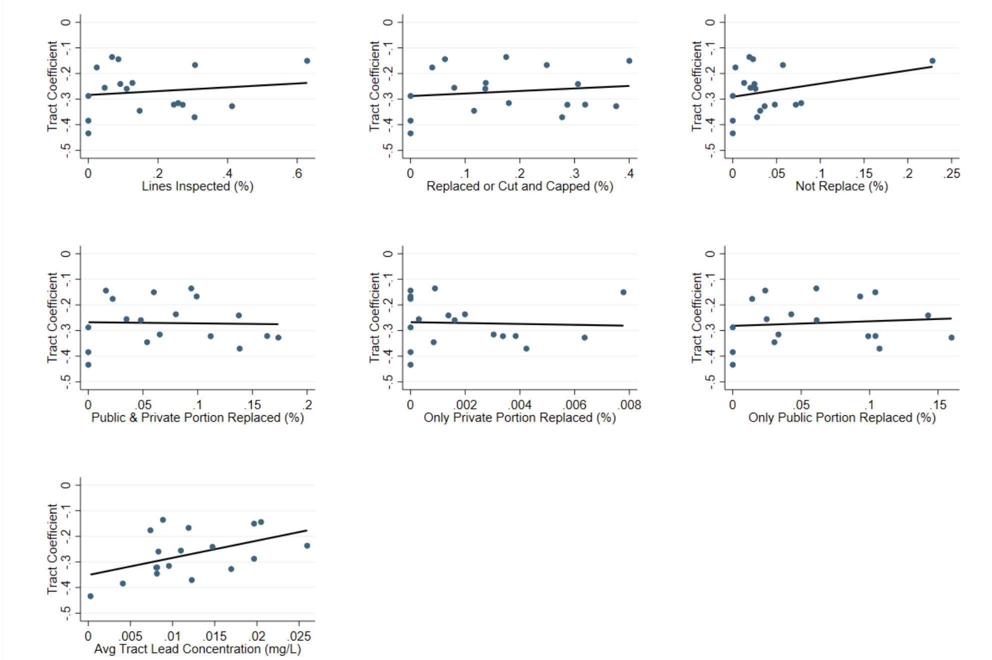
(b) Emergency Manager Design - No Labor/Trend Controls

Notes: The figures graph post-switch quarterly coefficients (blue line) with conventional 95% confidence intervals (gray dashed lines) and Honest DiD confidence sets (red solid lines). Results are from flexible DD regressions with no labor force or city-trend controls.

Figure D.2: Price Heterogeneity: Matched City Design



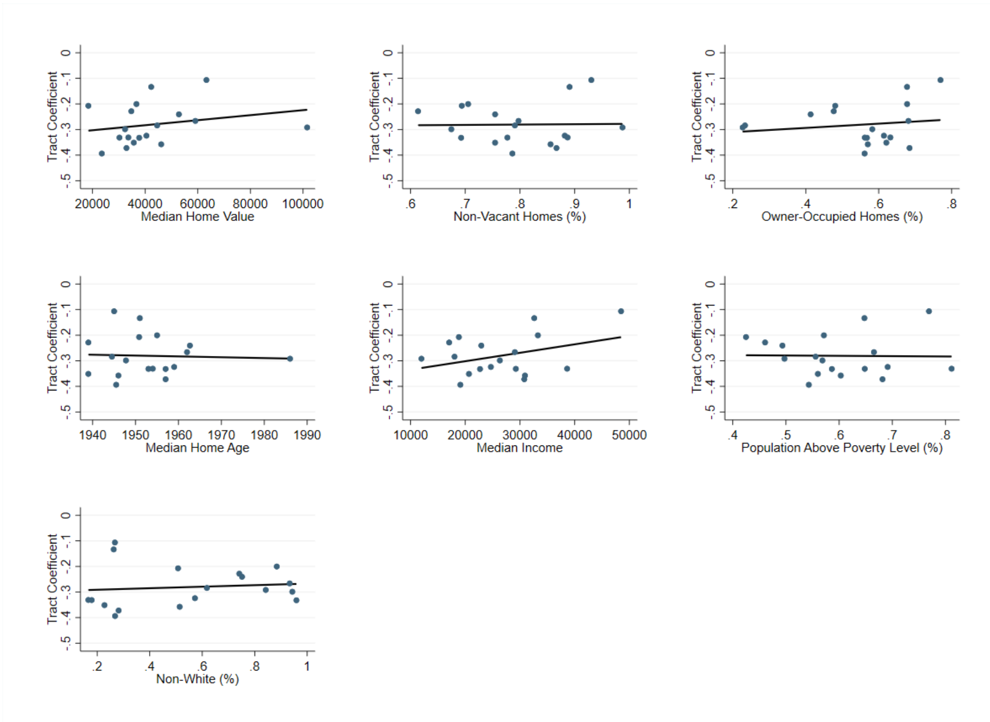
(a) Demographics



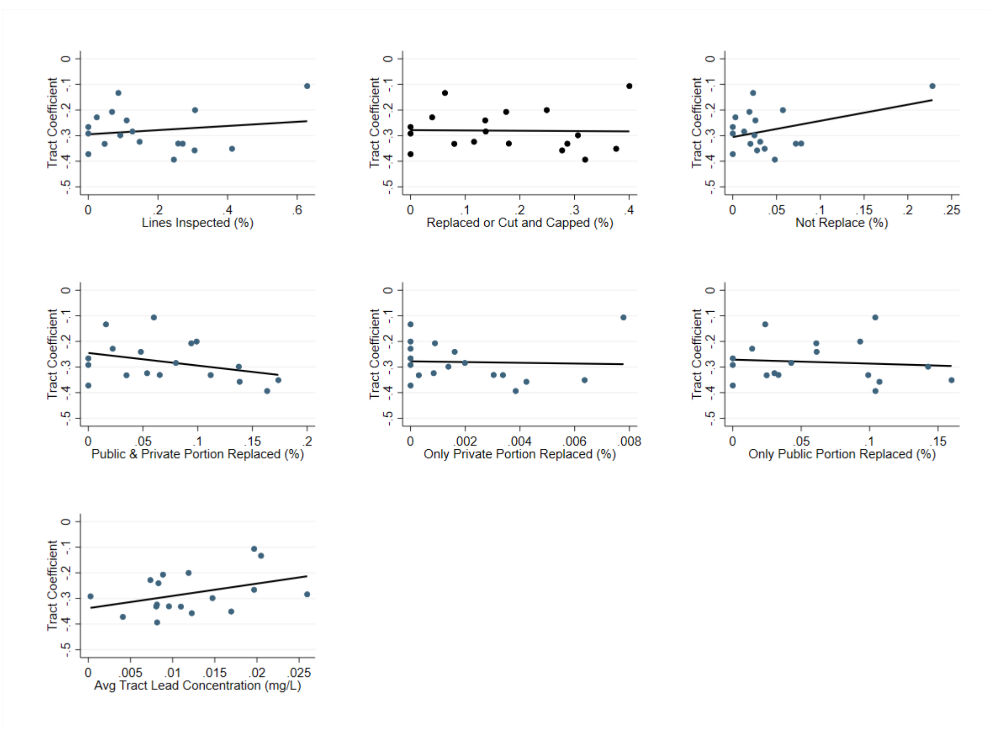
(b) Lead Risk and Remediation

Notes: The figure plots census tract area price coefficient estimates against tract demographics from the 2010/14 ACS 5-year average in Panel (a) and measures of lead risk and remediation in Panel (b). Price estimates are from the top 3 matched city sample with census block fixed effects, year fixed effects, city linear time trends, month fixed effects, and weather controls.

Figure D.3: Price Heterogeneity: Emergency Manager Design



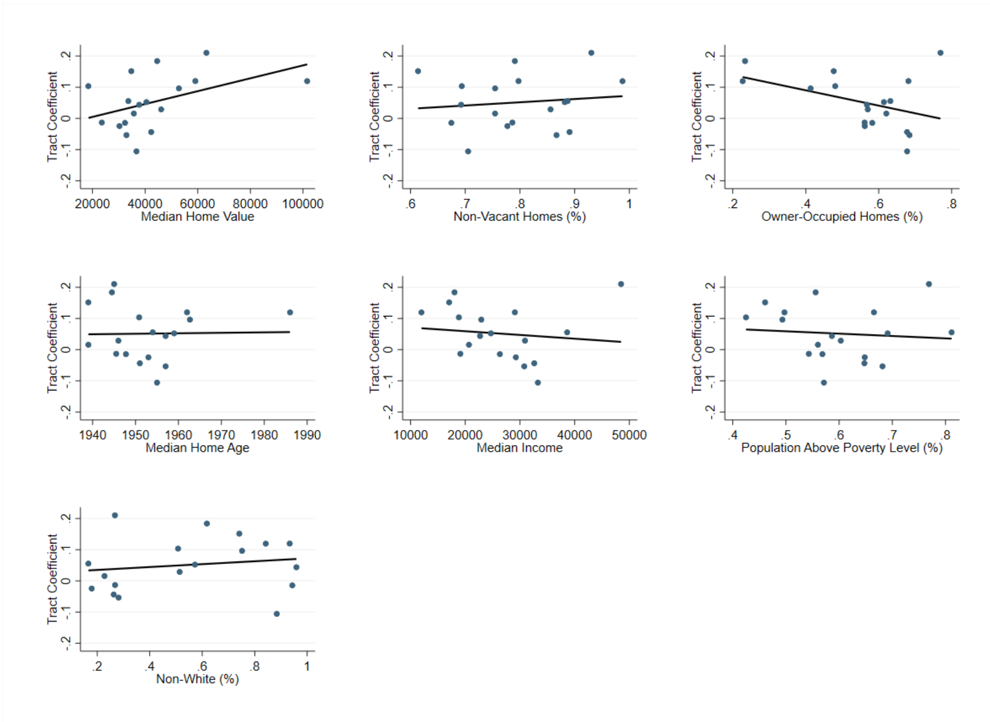
(a) Demographics



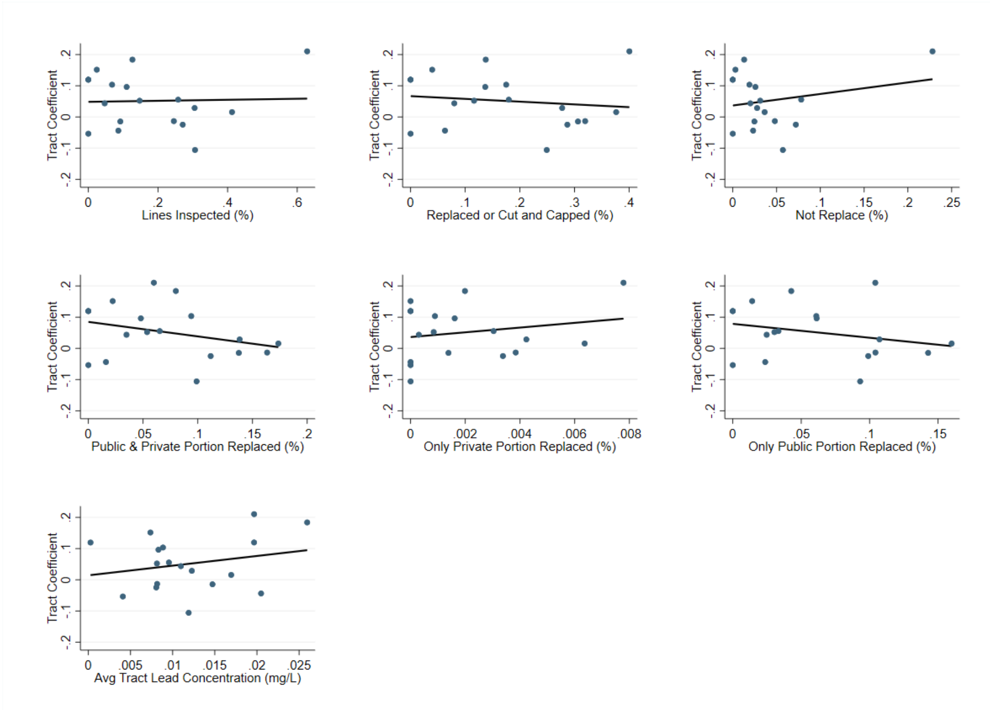
(b) Lead Risk and Remediation

Notes: The figure plots census tract area price coefficient estimates against tract demographics from the 2010/14 ACS 5-year average in Panel (a) and measures of lead risk and remediation in Panel (b). Price estimates are from the emergency manager design with census block fixed effects, year fixed effects, city even-time linear trends, month fixed effects, and weather controls.

Figure D.4: Sales Probability Heterogeneity: Matched City Design



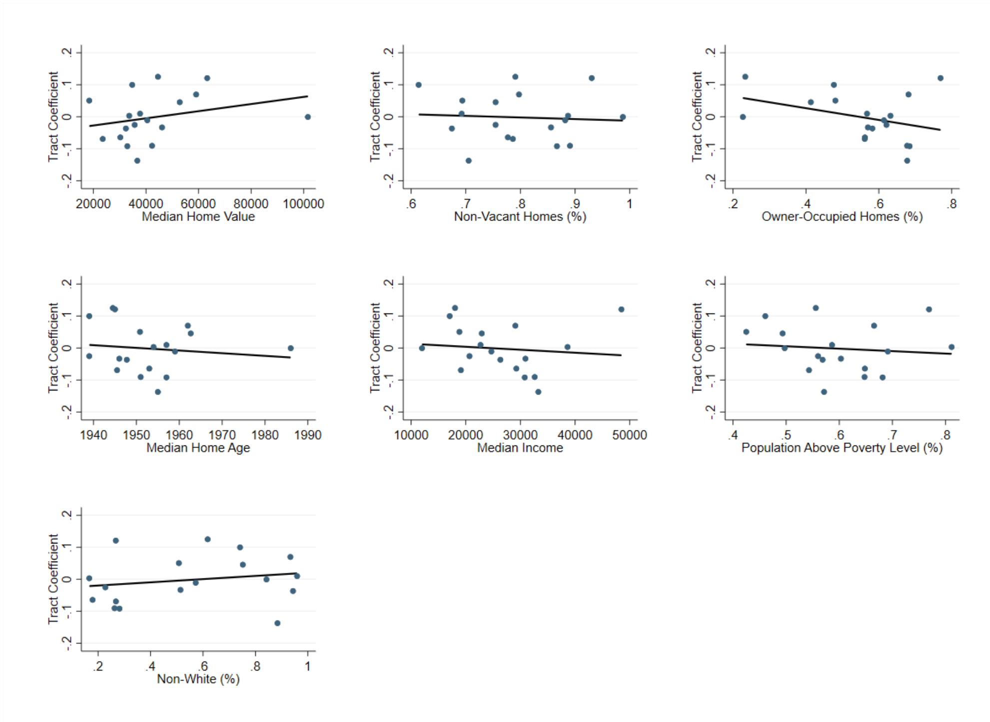
(a) Demographics



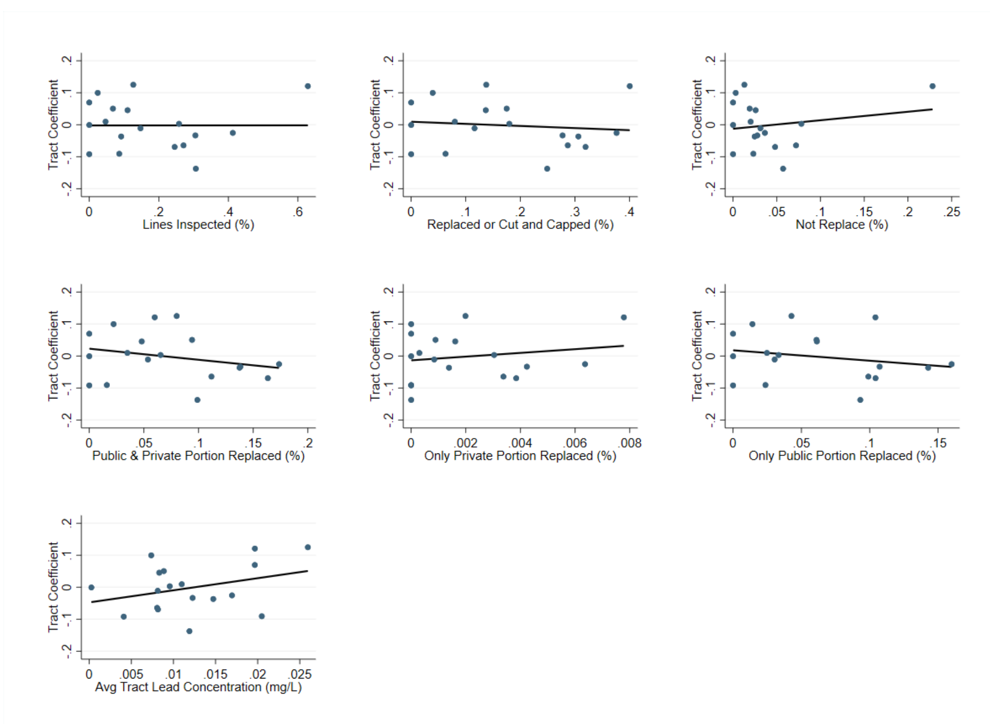
(b) Lead Risk and Remediation

Notes: The figure plots census tract area sales probability coefficient estimates for the post public health emergency period against measures of average census tract demographics from the 2014 ACS 5-year average. Price estimates are from the top 3 matched control city sample with census block fixed effects, year fixed effects, city linear time trends, month fixed effects, and weather controls.

Figure D.5: Sales Probability Heterogeneity: Emergency Manager Design



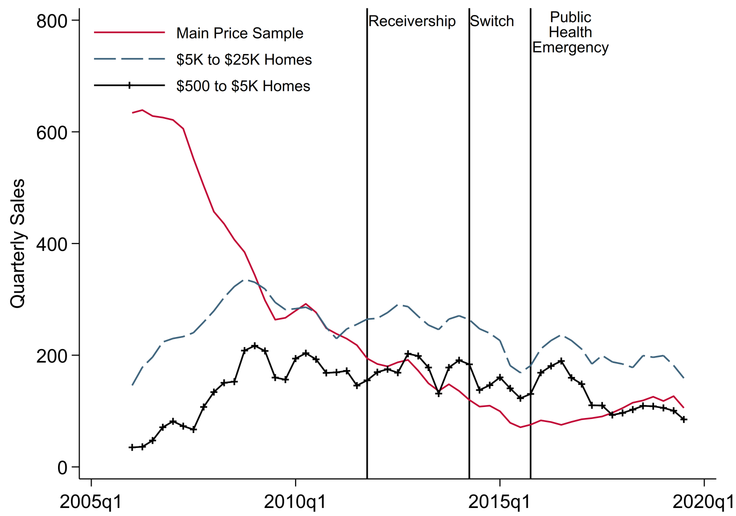
(a) Demographics



(b) Lead Risk and Remediation

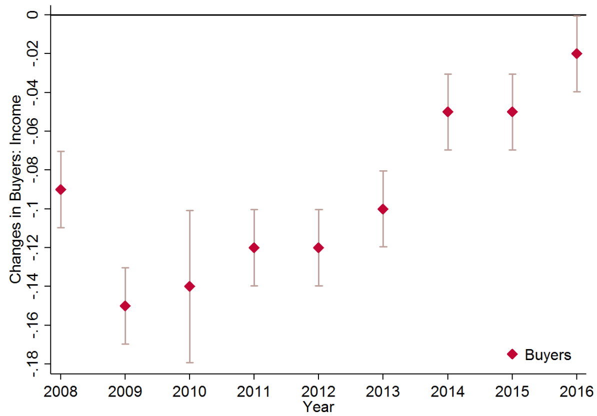
Notes: The figure plots census tract area sales probability coefficient estimates for the post emergency manager period against measures of average census tract demographics from the 2014 ACS 5-year average. Price estimates are from the emergency manager design with census block fixed effects, year fixed effects, city even-time linear trends, month fixed effects, and weather controls.

Figure D.6: Low-Value Homes Sales in Flint

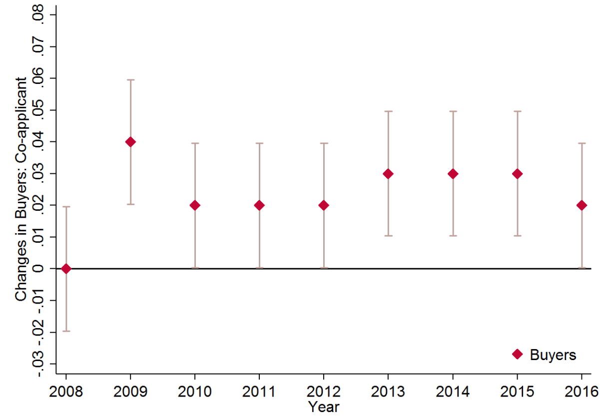


Notes: The figure compares observed low-value home sales versus sales in our main price sample ($25K to $10M). We split low-value homes sales into two price ranges: $500 to $5K and $5K to $25K.

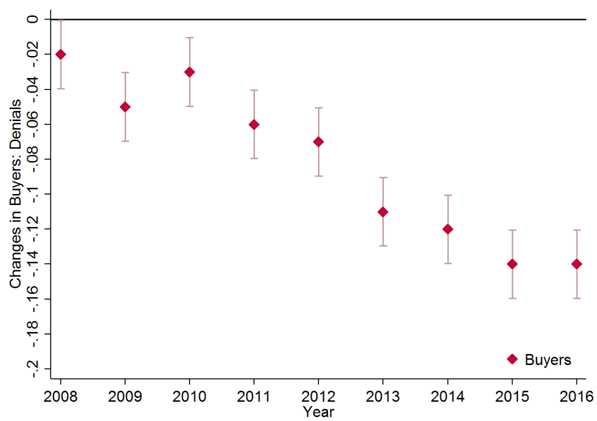
Figure D.7: Changes in Mortgage Applicants



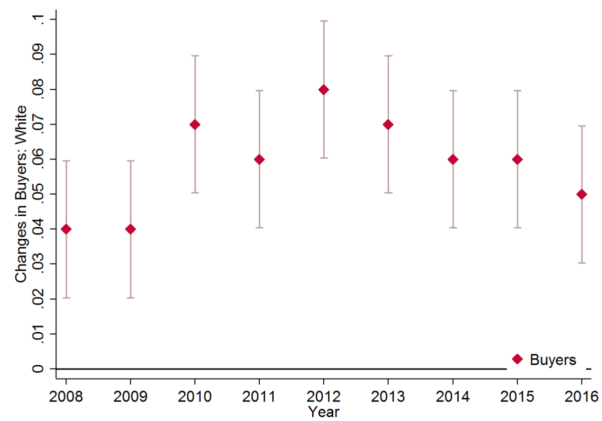
(a) Income of Applicants



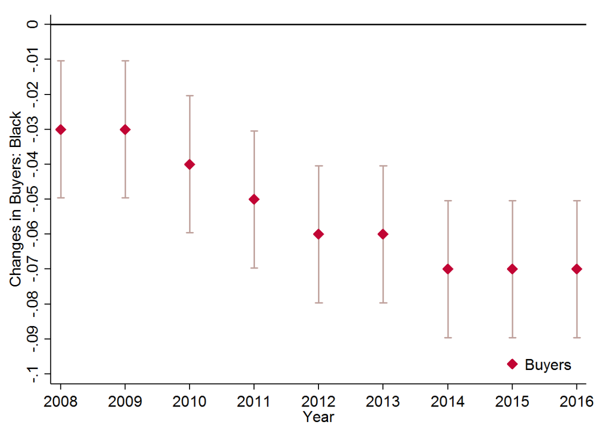
(b) Applications with Co-applicants



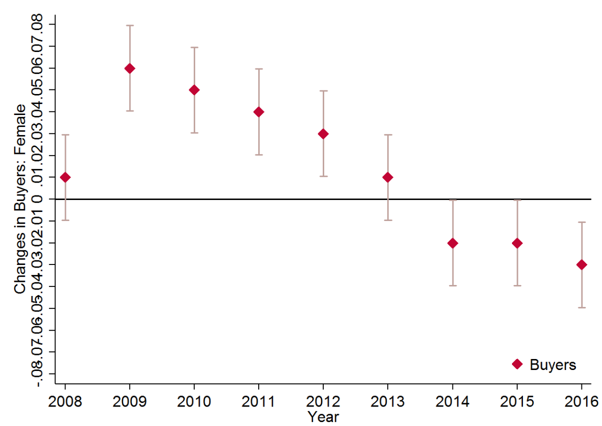
(c) Application Denials



(d) White Applicants



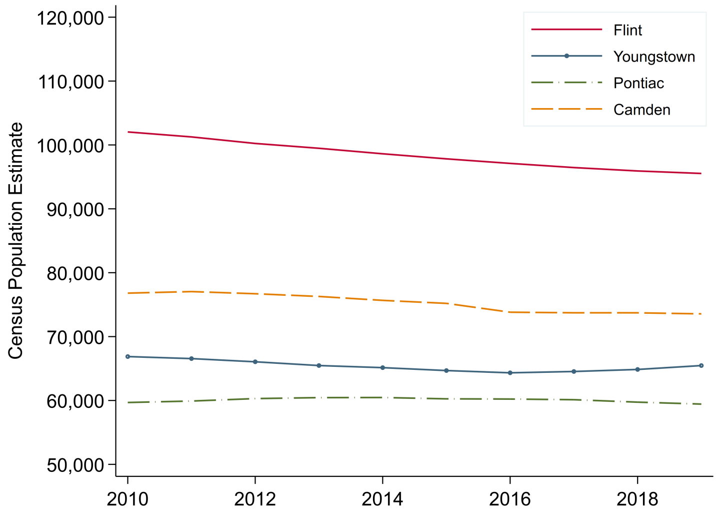
(e) African American or Black Applicants



(f) Female Applicants

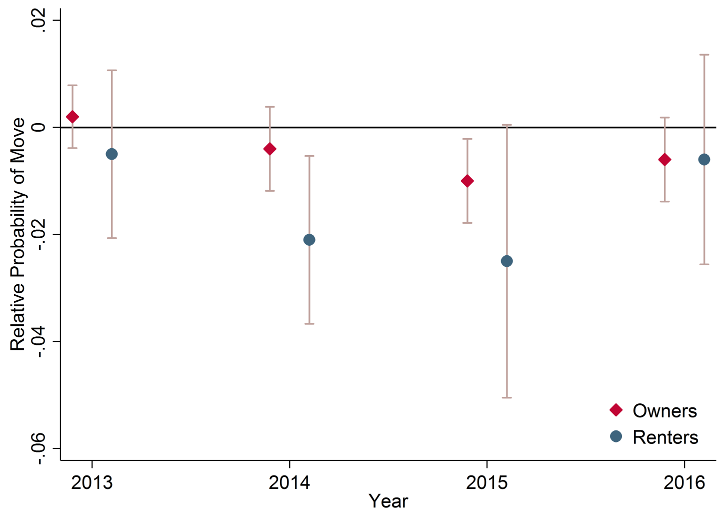
Notes: The figure reports estimates from a model of annual changes in the loan applicants characteristics reported by financial institutions as part of the Home Mortgage Disclosure Act (HMDA). All figures report estimates of changes relative to the base year, 2007.

Figure D.8: Population: Flint versus Matched Cities



Notes: The figure plots annual population estimates from the census for Flint and the top 3 matched control cities.

Figure D.9: Migration: Flint versus Matched Control Cities



Notes: The figure plots estimates from a panel model of the 2012 cohort in InfoUSA. Estimates represent differences in the probability of a move for Flint households relative to households in our top 3 matched control cities. All models includes controls for household estimated income, household marital status, number of children in the household and household wealth. Error bars report standard errors.

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