Rethinking Detroit

Supplementary Material and Data Appendices*

Raymond Owens III Esteban Rossi-Hansberg
Pierre-Daniel Sarte

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1 History and Census Data

This section provides additional data, tables and figures, with respect to the history of Detroit discussed in Section 2 of the main text. The details of the data sources underlying the tables and figures are described in the next subsection.

In 1950 the city of Detroit had 1,849,568 residents and was the fifth most populous city in the United States. By 2010 only 713,777 residents still lived in Detroit, and in

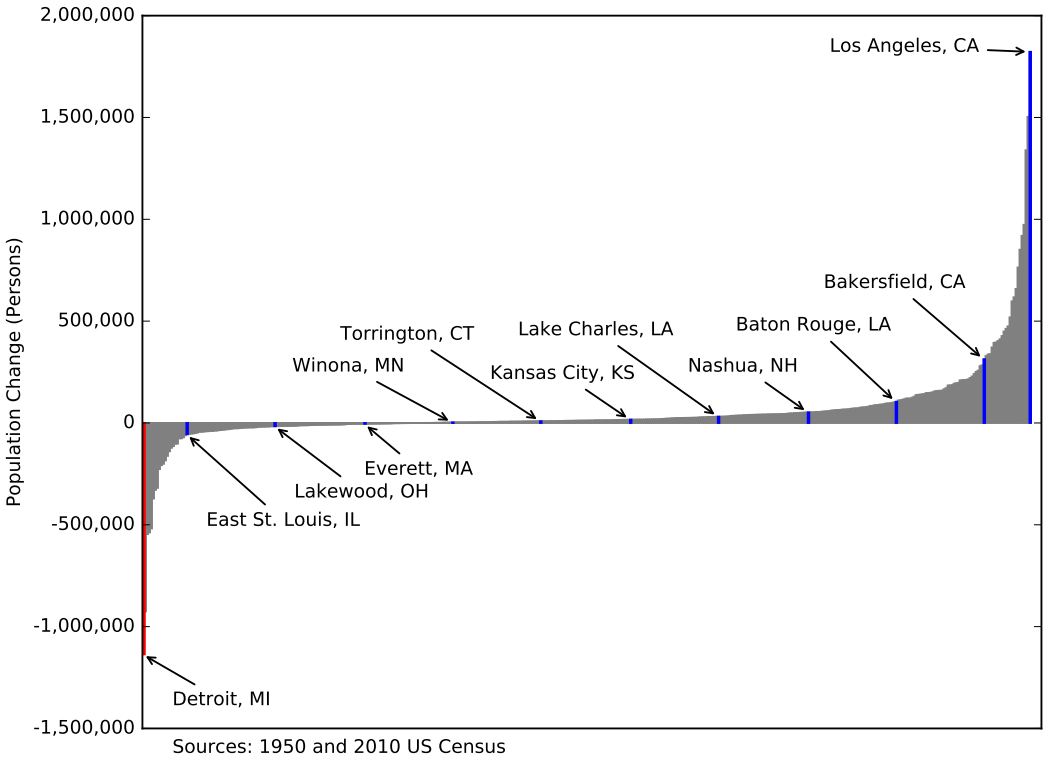

Figure 1: Population Change by City, 1950 to 2010

the ranking of population it had fallen to 18th. Much of the infrastructure of Detroit was built for a population more than 2.5 times its current number of residents. This is the largest population loss seen over this time period by a significant margin, and the decay of Detroit's infrastructure following this exodus has made Detroit the most famous declining American city.

Figure (1) shows the distribution of population changes by city from 1950 to 2010. Detroit is highlighted in red, and the midpoint of each decile (as well as the fastest growing city) are highlighted in blue.

Detroit's rapid rise in population associated with the explosive growth in the automobile industry is shown in Table 1 and Figure 2. Population rose rapidly from 1900 through 1930 and then grew more slowly, as the great depression dampened demand for both automobiles and workers. Detroit reached a population peak in the years around 1950, before beginning the decline that characterizes the city more recently. The number of people that have left Detroit since 1970 totals just over 800,000—enough to comprise the sixteenth largest city in the U.S.

Increased population through 1930 located primarily in areas adjacent to Detroit's core that existed in 1900. The set of maps displayed in Figure 3 illustrate the population

Year	Population	Level Change	Percent Change
1900	285,704		
1910	465,766	180,062	63.02%
1920	993,678	527,912	113.34%
1930	1,568,662	574,984	57.86%
1940	1,623,452	54,790	3.49%
1950	1,849,568	226,116	13.93%
1960	1,670,144	-179,424	-9.70%
1970	1,514,063	-156,081	-9.35%
1980	1,203,368	-310,695	-20.52%
1990	1,027,974	-175,394	-14.58%
2000	951,270	-76,704	-7.46%
2010	713,777	-237,493	-24.97%

Source: U.S. Census Bureau, Census of Population and Housing.

Table 1: Detroit: Total Population

density of the city. In 1920, the densest areas are concentrated tightly around the core. By 1930 and 1940, the pattern is similar, though the densest areas naturally expand outward as population grows. Note that the 1930 pattern of population density corresponds well with the spatial pattern of housing built before 1930 in Figure 2 and the vacant areas displayed in Figure 3 in the main text. From the maps, we see that density lessens adjacent to the core area in 1960 and dissipates notably after 1970. By 1980 the area is dominated by the low density categories, with only scattered areas of moderately higher densities.

The correspondence between population densities and manufacturing worker densities, defined as concentrations of non-farm, non-service workers, is shown in Figure 4. The densest categories are again tightly packed adjacent to the core in 1920, spread out in 1930, and lessen in intensity but remain geographically similar in 1940 and 1950. By 1960, this measure of worker density lessens notably.[1]

Total manufacturing employment in Detroit fell sharply from 1947 through 1954, as shown in Table 2. The decline from 1947 through 1954 was partly a result of the cessation of World War II-related production. Manufacturing employment was relatively stable from 1958 through 1967, but declined rapidly from 1967 through 1977.

[1]Data are unavailable after 1960.

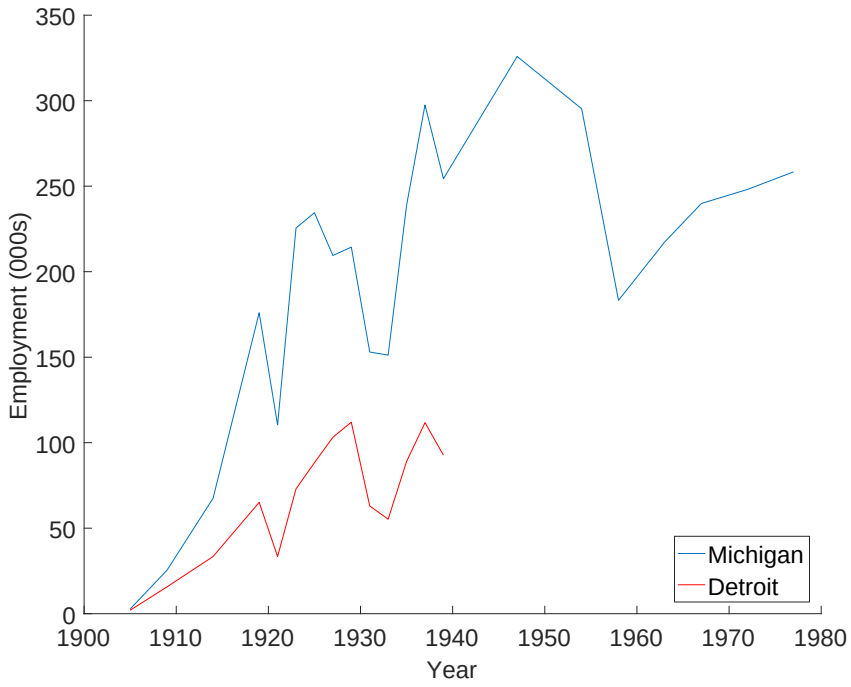

Figure 2: Detroit: Motor Vehicle and Equipment Employment

To get a sense of the impact of job losses on Detroit, it is useful to view the employment-to-population ratio of the city, shown in Figure 5. In 1950, when Detroit's population was near its peak, the employment-to-population ratio in the city generally ranged from 32 percent to 67 percent with only a few scattered census tracts below those levels. By 1960, tracts near the core of the city mostly ranged from 22 to 32 percent. By 1970, ratios in these tracts were relatively stable, though some expansion of lower-ratio tracts to the east of the core city was evident. A substantial decline in ratios across tracts was in place by 1980. In this period, the reach of low employment-to-population tracts expanded notably and a number of tracts in the 0 to 22 percent range appeared. These low-ratio tracts spread further by 1990.

1.1 Construction of Historical Census Variables

1.1.1 Manufacturing-Related Employment

Detailed employment microdata are available only for 1920 and 1930 as these Census records have been completely digitized. We consider manufacturing-related employment to be workers in the following industry categories: fact or factory; plant; foundry; works; mfg (i.e. manufacturing); machine; and auto. Using industry descriptions, as

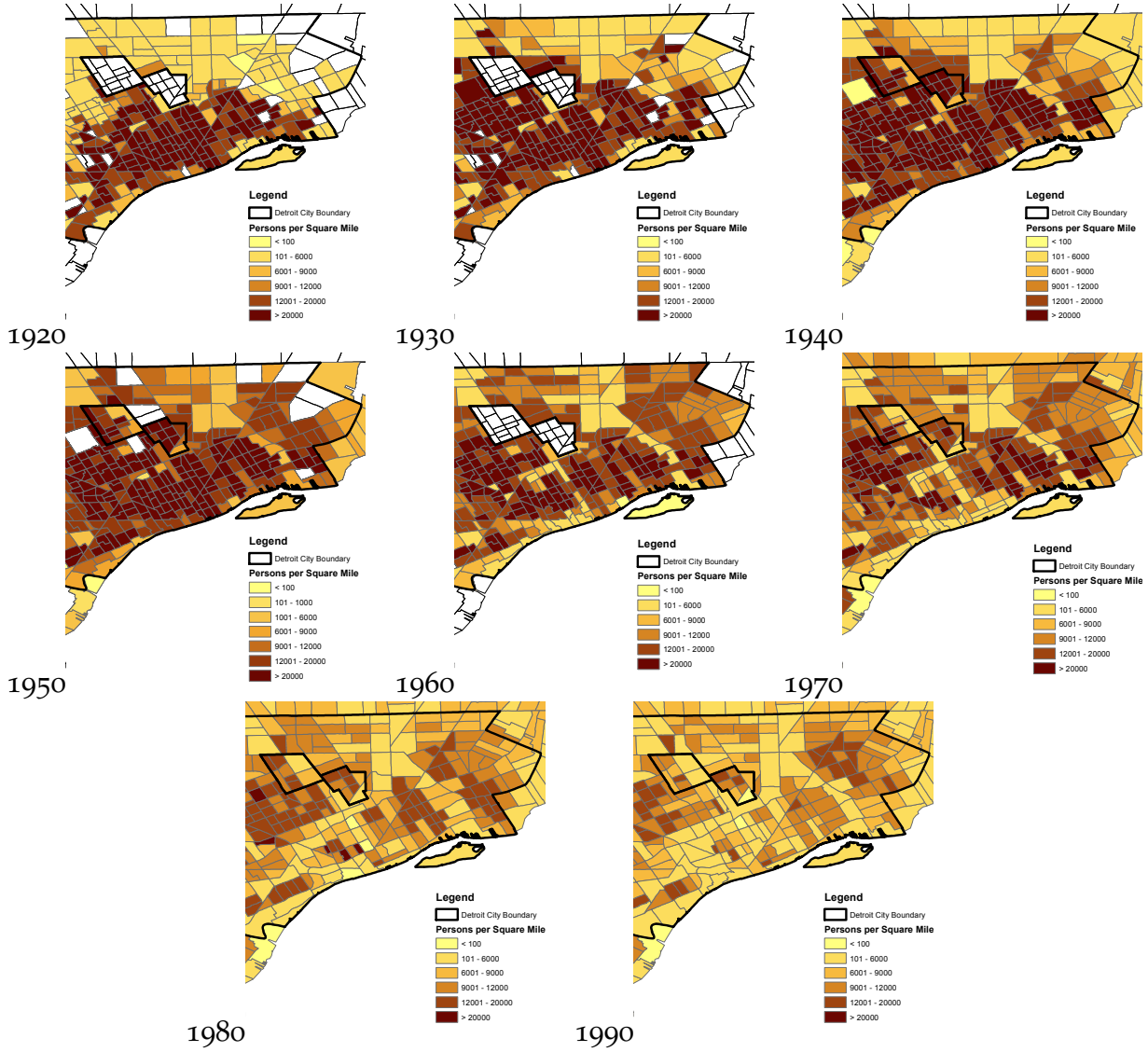

Figure 3: Detroit Population Density

opposed to occupation descriptions, gives us a larger number of individuals employed in Detroit during the time frame considered. Data after 1930 have not been digitized and made available to the public. Thus, for decades after 1930, we use aggregate measures of occupational status as a proxy for manufacturing-related employment, which we refer to as "non-farm, non-service" employment in the associated maps.

Data is initially collected at the enumeration district (ED) level in the U.S. Census records. Because digital maps are not available for EDs in 1920, 1930, and 1940, we convert this data into 1940 census tracts using Morse and Weitraub's (2011) ED crosswalks, and map the data using shapefiles provided by the National Historical Geographic Information System (NHGIS). For example, ED 8 in 1920 becomes EDs 907 and 908 in

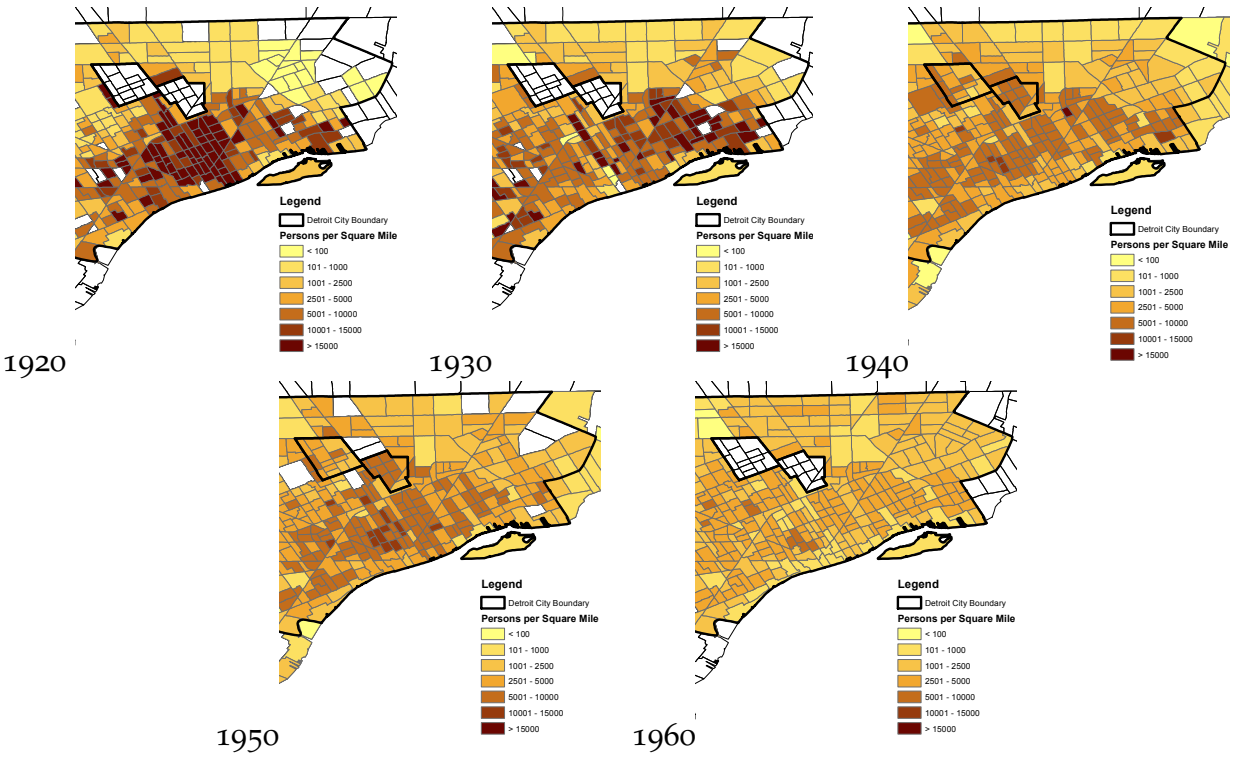

Figure 4: Detroit Non-Service, Non-Farm Employment

the 1930 Census. Therefore, we distribute the population of ED 8 in 1920 into those of EDs 907 and 908 in 1930 in equal proportion. We repeat this procedure, distributing the population of 1930 EDs into 1940 EDs, and then again the population of 1940 EDs into 1940 census tracts.

Using the Census aggregates compiled and aggregated by Bogue (2000), we rely on occupation status since no consistent industry classification exist across the three decades provided. However, consistent occupation status is available for the years 1940, 1950, and 1960. For 1940, we consider manufacturing-related employment to be the total number individuals employed as craftsmen, operatives, and laborers. For 1950, we define manufacturing-related employment as the total number individuals employed as craftsmen, foremen, operatives and kindred workers, and laborers, except for mine. Similar to 1950, for 1960 we consider manufacturing-related employment to be the total number individuals employed as craftsmen, foremen, operatives and kindred workers, and laborers, except farm and mine.

Year	Employment	Level Change	Percent Change
1947	338.4		
1954	296.5	-41.9	12.4%
1958	213.5	-83	-28.0%
1963	200.6	-12.9	-6.04%
1967	209.7	9.1	4.54%
1972	180.4	-29.3	-14.0%
1977	153.3	-27.1	-15.0%

Source: County and City Data Book Consolidated File: City Data 1944-1977 and Sugrue (1996). Manufacturing Employment measured in thousands.

Table 2: Detroit: Manufacturing Employment

1.1.2 Population Density and Employed-to-Population Ratio

For 1920 and 1930, we apply the procedure described above with respect to manufacturing-related employment to total population counts. To arrive at total population density, we divide the resulting population counts in 1940 census tracts by the corresponding square miles of each tract as reported in the NHGIS shapefiles.

For the decades following 1930, we use the Bogue and NHGIS Census population aggregates by census tract, and divide by the square miles of each tract in the corresponding NHGIS shapefile (e.g. 1950 Bogue Census corresponds to 1950 NHGIS shapefile, etc.).

The Bogue and NHGIS Census aggregates similarly report employment totals by census tract. Therefore, we simply divide total employment by total population to create the maps presented in Figure 5.

2 Benchmark Data

This section provides a description of all variable constructions and data sources for "Rethinking Detroit," Owens, Rossi-Hansberg, Sarte (2017). In this paper, we study the economic geography of Detroit and its surrounding counties: Macomb, Oakland, and Wayne Counties. Our unit of analysis is the census tract, with centroids taken from the 2015 U.S. Census Bureau Gazetteer files. Summary statistics pertaining to the land area covered by the different census tracts are described in Table 3.

The data originally contains 1,163 census tracts, 12 of which are excluded from our

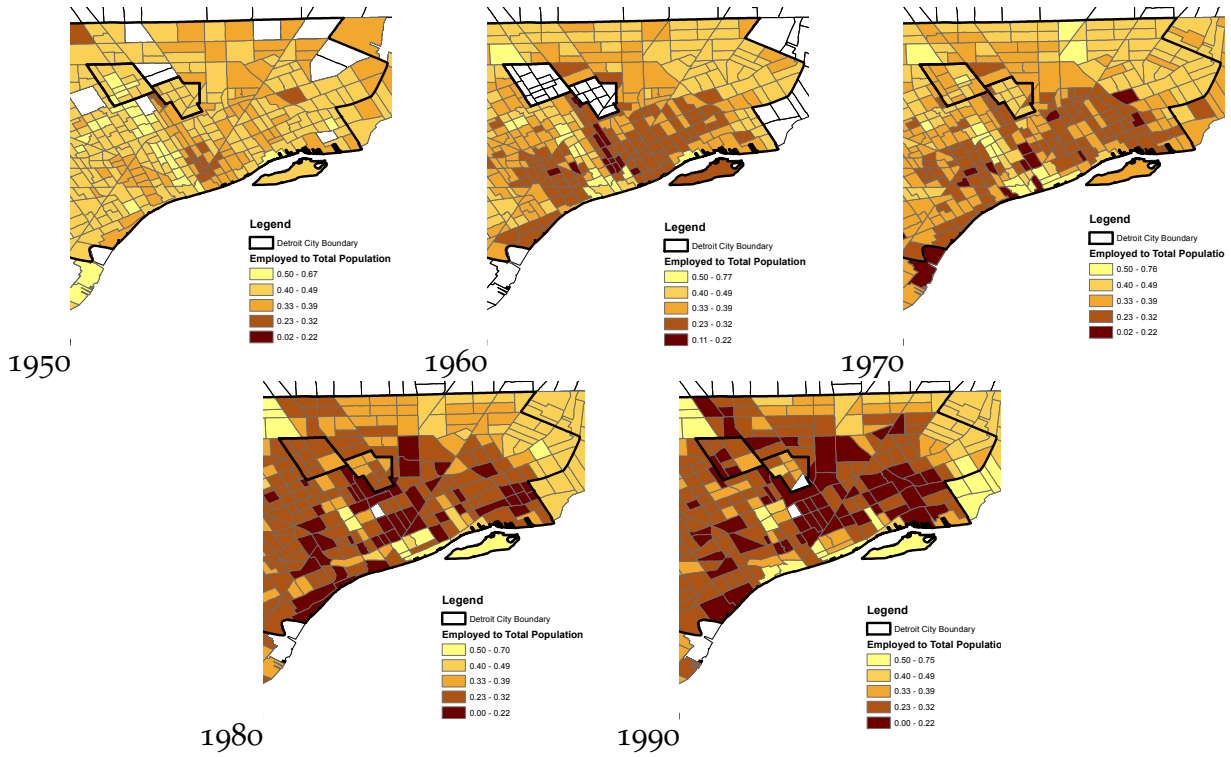

Figure 5: Detroit, Employed to Total Population Ratio

	Mean	Median	Std. Dev.	Min	Max	Number of Tracts
Detroit City	0.47	0.46	0.23	0.087	1.95	297
Whole Sample	1.68	0.83	3.30	0.087	38.12	1,163

Table 3: Land area of census tracts (in square miles)

analysis because of missing or inconsistent assessment data. This leaves us with 1,151 tracts for our analysis.

2.1 Commuting (π_{ij}), Employment (L_j), Residents (R_j), and Wages $(w_i, \overline{w}_j)$

The data on residents, workers, commute flows, and wages are obtained from the Longitudinal Employer-Households Dynamics (LEHD) Origin-Destination Employment Statistics (LODES) for the year 2014.[2] Data are provided according to several different classifications of job types including: All Jobs; All Primary Jobs; All Private Jobs; Pri-

[2]lehd.ces.census.gov/data. See Couture and Handbury (2016) for a description of how the LODES data is imputed.

vate Primary Jobs; All Federal Jobs; and Federal Primary Jobs. We use the universe of "all primary jobs," jobs that earned the most earnings of all jobs held during the reference period (Graham, Kutzbach, and McKenzie, 2014). Doing so allows us to avoid double-counting individuals in measures of aggregate population.

The LODES data are reported at the Census Block level; we aggregate to the census tract level, which corresponds to the first 12 digits of the reported Federal Information Processing Standard (FIPS) code, as recommended by LEHD (Abowd, Stephens, Vilhuber, Andersson, McKinney, Roemer, and Woodcock, 2005). Individuals that live within the census tracts we are analyzing but commute to a census tract outside our geographic space (and vice versa) are excluded from measurement.

The flows data are converted into a full 1151×1151 matrix, where the row index represents the place of employment, generally indexed as i in the paper, and the column index the place of residence, indexed as j. Suppose, for example, the element $(21, 612)$ of this matrix is equal to 25. This implies there are 25 individuals that commute bilaterally between their place of residence, census tract 612, and their place of employment, census tract 21, in 2014.

To calculate the total number of residents, denoted R_j in the paper, (workers, L_i), we simply sum the vertical (horizontal) elements of the flows matrix. Next, we compute commuting percentages using an element-wise operation, dividing the flows matrix by a repeated row vector of the number of residents. This yields a 1151×1151 matrix, $\{\pi_{ij}\}$, whose elements represents the percentage of residents of census tract j that commute to census tract i. The columns of the commuting percentage matrix, therefore, sum to one, $\sum_i \pi_{ij} = 1$.

The LODES data also report commuting by subcategories (e.g. wage bins, industry, age, etc.). We calculate an employment-weighted average of workplace wages using the following formula:

$$w_i = \frac{12 * \left(\left[N_1 * \frac{(LB_1 + UB_1)}{2} \right] + \left[N_2 * \frac{(LB_2 + UB_2)}{2} \right] + \left[N_3 * \frac{(LB_3 + UB_3)}{2} \right] \right)}{N_1 + N_2 + N_3}, \tag{1}$$

where LB_i and UB_i are the lower and upper bounds of the wage bins provided in the LODES data, and N_i is the number of workers in each wage bin. The ranges for the wage bins are as follows:

1. $[0,\ 15,000]$ dollars per year
2. $(15,000,\ 39,996]$ dollars per year
3. $(39,996,\ \infty)$ dollars per year

	Mean	Median	Standard Deviation
ZIP Business Patterns	36283	34256	13105
LODES (UB_3 = 87,522)	33955	33506	8320

Table 4: Comparison of Wage Distributions (annual)

The upper wage bin (UB_3) in the LODES data reports jobs with a monthly income of greater than $39,996$ dollars. In order to obtain an upper bound on this bin, we make use of the ZIP Business Patterns employment data for Zip Codes in the year 2014.[3] We must allocate the Zip Code-level data to census tracts, and do so by using the Department of Housing and Urban Development's Zip-to-Tract crosswalk for the fourth quarter of 2015.[4][5] The crosswalk data reports the percentage of addresses (i.e. residential, business, other) in a Zip Code that belong to a specific census tract. Ignoring tracts with missing data, we allocate total employment (reported for March of 2014) and annual payroll based on a re-normalized distribution of business addresses and sum by census tracts. We divide total annual payroll by the number of employees, and take the maximum average monthly wage and treat this as our upper bound. Following these steps, we obtain an upper wage bin of $87,522$ dollars per year.

With workplace wages in hand, we can obtain average residential wages by census tract as follows:

$$\overline{w}_j = \sum_{i=1}^{I} \pi_{ij} * w_i, \tag{2}$$

where π_{ij} is the percentage of census tract j workers who commute to census tract i, and w_i is the vector of workplace wages.

2.2 Commuting Costs (κ_{ij})

Data on commuting costs are obtained from the Google Maps Distance Matrix Application Program Interface (Google Maps API) and is measured as the distance reflecting the optimal travel route (in miles) and the estimated travel time (in minutes) between census tract centroids.[6] Google's API allows the user to specify one-among-many different possible travel methods. For example, the user may wish to know the difference in time it takes to travel between Seattle and Tacoma WA taking public transportation

[3]Table: CB1400CZ11, Total for Zip Code

[4]https://www.huduser.gov/portal/datasets/usps_crosswalk.html

[5]This is also consistent with Couture and Handbury (2016).

[6]The Google Maps data was collected between October 7, and October 23, 2016.

instead of driving while avoiding tolls. In the paper, we consider the fastest driving route between census tracts in Detroit and surrounding areas, and do not impose any restrictions such as avoiding major highways or tolls. Because our analysis began with 1,163 census tracts, we collected data for 1,352,569 bilateral routes using the Googleway package (Cooley and Barcelos, 2016) for R.

To check for robustness with respect to time of day and day of week for driving, we compare two identical sets of coordinate pairs collected at different times of day (i.e. AM and PM) and on different days of the week (i.e. weekday and weekend). When comparing time to commute in the AM vs. PM, the R-squared for that relationship is 0.94, and for distance 0.98. Regarding weekend and weekday commutes, the data is similarly robust with an R-squared for time to commute on weekdays vs. weekends of 0.95, and 0.98 for distance.

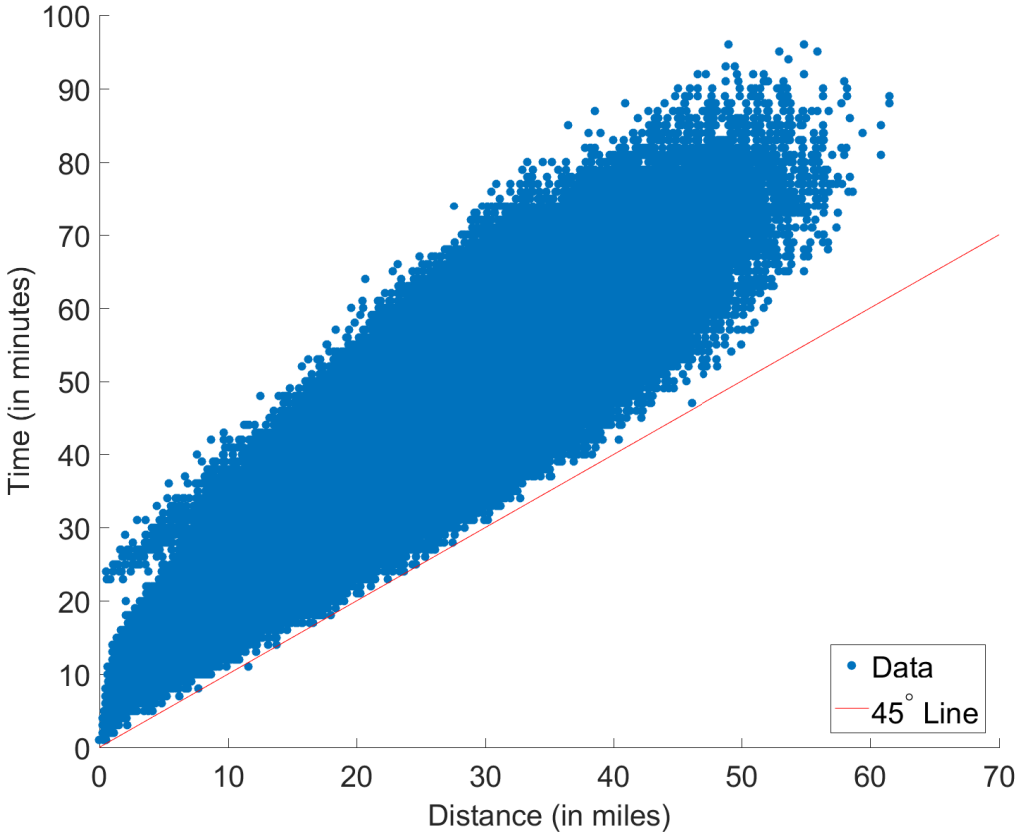

Figure 6: Google Time vs. Straight Line Distance (all census tract pairs)

Another way to measure commuting costs is using distance "as the crow flies" (or straight-line distance). This measure of commute is calculated using the arctan2 version

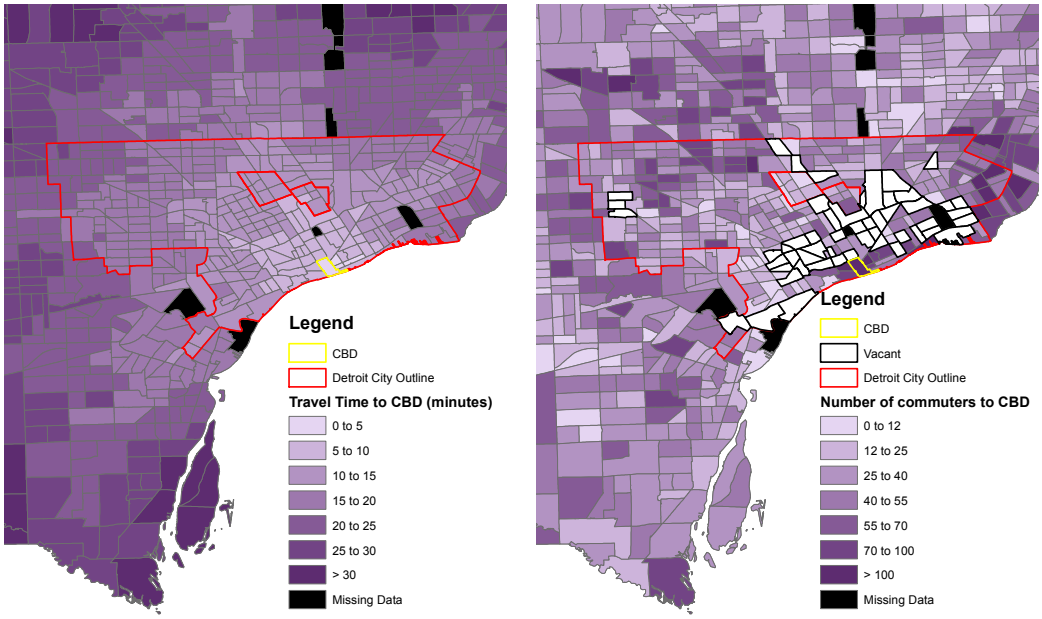

Figure 7: Travel Time and Number of Commuters to the Central Business District

of the Haversine formula (Sinnott, 1984) for great-circle distances between centroids, also used by the NBER, in miles. When using distance "as the crow flies," we add one mile to account for a "fixed" cost of commuting, which ensures a minimum positive commute cost. Within a city, the Google Maps data is preferable to distance "as the crow flies" since it allows us to account for historical traffic patterns and geography by way of existing road networks. The relationship between Google times to commute and straight line distance is illustrated in Figure 6. Figure 7 shows travel time (in minutes) to the CBD from different census tracts, as well as the number of commuters from those tracts.

2.3 Parcels Data in Detroit and Surrounding Counties

Our model uses information on residential prices as well as commercial land and potential residential land use in a benchmark year, 2014. It also requires that census tracts be classified as vacant, partially developed or fully developed. As explained in the text, these classifications and the variables we seek at the census tract level are in part determined according to the characteristics of parcels within these tracts.

To make use of parcels data in the analysis requires that we condense and make consistent various recommended property code classifications used by the state of Michi-

gan. Data may be obtained from several different sources of microdata that provide extensive detail on current use, vacancy status, and construction. The sources include Detroit's Assessors Office, Wayne County's Office of Equalization and Assessment, Oakland County's Office of Economic Affairs and Community Development, the Southeast Michigan Council of Governments (SEMCOG), CoreLogic, the Motor City Mapping (MCM) project, the ZIP Business Patterns, and the US Gazetteer files. We construct variables for Detroit City, Wayne County (excluding Detroit City), Oakland County, and Macomb County independently of one another because variable definitions are not uniform across each subgeography's primary dataset.

There are several distinctions that need to be made when measuring both developed residential and commercial land. First, assessment data provides extensive detail on residential parcels and includes measurements for the land area (i.e. surface area) of the parcel and the living area (i.e. the heated portion of a building or structure) of any structures maintained on the parcel. This allows us to construct an accurate measure of building intensity for residential zoning, which will play a role in establishing the upper bound on potential residential development we need, $\overline{T}_j^r$ (to be discussed below), in counterfactual exercises. Second, data on commercial structures is considerably more incomplete across different data sources, and as a result we are restricted to only measuring land area of commercially-zoned parcels. Third, apartment buildings are traditionally treated as commercial properties in assessment data. However, because we are unable to parse out the market value attributable to the independent residential and commercial areas, and because we consider apartments to be a significant component of future residential development in Detroit, we treat the entire unit as residential. By doing so, we also introduce the possibility of Detroit building upward as opposed to outward which, as laid out in Section 2 of the main text, was a component of the city's decline.

Parcel-level data from the Wayne County Office of Equalization and Assessment and Economic Development and Community Affairs of Oakland County contain only location addresses and, therefore, must be geocoded using ArcGIS, the summary of which is provided below.

In Table 5, "Matched" means that there is a unique location matching the address, "Unmatched" means that there are no locations that correspond to the address, and "Tied" implies that ArcGIS has found more than one location for a given address. In the analysis, we only consider matched parcels.

Below we discuss primary data sources for each subgeography of Greater Detroit (i.e. Detroit City, Wayne County excluding Detroit, Oakland County, and Macomb County)

Geographic Area	Matched	Tied	Unmatched	Total
Oakland County	383,171	342	96,164	479,677
Percent	79.88	0.07	20.05	
Wayne County (excluding Detroit)	658,849	6,959	52,288	718,096
Percent	91.75	0.97	7.28	

Note: Detroit City and Macomb County not geocoded because census tracts are provided in data sets.

Table 5: Geocoding Summary

and the method for calculating potential residential land. For all areas (Detroit City, Wayne, Oakland, and Macomb Counties), we remove residential observations with land area less than 500 square feet or greater than $2,000,000$ square feet, or observations that have a reported assessment value of greater than one billion dollars, as these likely represent measurement or coding errors. Our unit of area in the model is "square miles," but we occasionally present our findings in term of square feet to follow convention, for example dollars per square foot when referring to land rents.

Detroit City, Michigan - The data for Detroit City, Michigan combines data from the Detroit Assessor's Office, MCM, SEMCOG, and CoreLogic. We create a new use classification variable using the following definitions:

- A property is "residential" if it is classified as residential by Detroit's Assessors Office[7] and not classified as public by MCM.
- A property is "commercial" if it is classified as commercial or industrial by Detroit's Assessors office and not classified as public by MCM.
- A property is "public" if it is classified as a tax exempt property by Detroit's Assessors Office or it is classified as public by MCM.
- A property is "vacant" if it is classified as vacant by Detroit's Assessors Office or the parcel does not have a structure and is also not classified as public by MCM. Note that "vacant" here refers to a parcel. Recall that vacant tracts in the analysis take this information into account but adds other considerations from MCM as described in the text.

[7]See Michigan's State Tax Commission Recommended Classification Codes, adopted in 2011.

Property Classification	Number of Parcels	Percent of Total	Total Land Area (Square Miles)
Commercial	9,240	2.52	7.56
Public	10,846	2.96	6.81
Residential	195,353	53.36	35.21
Vacant	150,663	41.15	28.02
Total	366,102	100	77.76

Table 6: Detroit: Property Classification

In order to ensure accurate specification, we must manually redefine some specific property types to a particular classification. For example, apartments, multi-family houses, and town/row houses fall into the commercial property classification. To correct for this, we can make use of additional text variables to redefine these property types as residential. For consistency, we reclassify properties where use is not related to a residential purpose (e.g. restaurant/snack bar, dental clinic, etc.) as commercial using the same text variable referenced above.

Our classification definitions yield the distribution of parcel types for the city of Detroit, presented in Table 6.

In all, we cover 97 percent of the $377,602$ parcels contained in MCM. Our classification of vacant parcels matches well with that of the Detroit Future City (DFC) Strategic Framework, which reports an estimated $150,000$ vacant properties, with two-thirds identified as vacant parcels and the remaining one-third identified as vacant buildings. Of our $150,663$ parcels classified as vacant, $103,097$ are vacant parcels, or approximately 68 percent.

Having classified the parcels, we use the following data sources, according to most recently available, for information on land area pertaining to residential properties in Detroit:

- Detroit's Assessors Office, variable $totsqft$ (Parcel Point Ownership).
- CoreLogic, variable $land\_sqft$ (if $totsqft$ does not exist or $totsqft$ is less than 500 square feet).
- Detroit's Assessors Office 2010, variable $squarefeet$ (if $totsqft$ and $land\_sqft$ do not exist or are less than 500 square feet).

  As explained below, this classification also allows us to cross-reference market values for these parcels.

Oakland County, Michigan - The data for Oakland County are obtained from the office of Economic Development and Community Affairs, SEMCOG, and CoreLogic. We remove observations with missing use classifications or use classifications of "Equalization," "Conservation," or "Farm," and create a new use classification variable with the following parcel specification:

- A property is "residential"if it is labeled as residential improved, lake improved, condominium improved, or apartments improved by Economic Affairs and Community Development of Oakland County.
- A property is "commercial" if it is labeled as business improved, utility improved, industrial improved, or miscellaneous business by Economic Affairs and Community Development of Oakland County.
- A property is "vacant" if it is labeled as residential vacant, lake vacant, condominium vacant, apartments vacant, business vacant, utility vacant, or industrial vacant by Economic Affairs and Community Development of Oakland County.

Properties listed as "Lake" in their use description are considered residential under the Michigan State Tax Commission's definition of residential real property (pp. 3-4). Following the assignment of a parcel classification, we assign land and living area as follows:

Land area and market values are assigned as reported by the Assessor's office, unless equal to zero in which case it is substituted with information from the American Housing Survey.

Wayne County, Michigan - Data for Wayne County are obtained from the Wayne County Office of Equalization and Assessment, SEMCOG, and CoreLogic. We create a new use classification variables with the following parcel specifications:

- A property is "residential" if it is classified as residential by the Wayne County Assessors Office.
- A property is "commercial" if it is classified as commercial or industrial by the Wayne County Assessors Office.
- A property is "vacant" if it is classified as vacant by the Wayne County Assessors Office.

Similar to Detroit, we treat apartment buildings, multi-family houses, and town/row houses as residential property by replacing their newly specified use classification with "residential" and perform similar changes to "commercial" for properties where use is not related to a residential purpose.

Macomb County, Michigan - The data for Macomb County, Michigan are obtained from CoreLogic and SEMCOG. A property is "residential" if it is a single-family residence, a condominium, a duplex/triplex/quadplex, or an apartment building.

Land area for parcels specified as condominiums is listed as the total area of the development, so that we divide the total up evenly amongst similarly specified condominiums properties in order to prevent overestimating total developed land. Market values are assigned as reported by CoreLogic in our benchmark year.

2.3.1 Commercial Land $\left(T_j^b\right)$

Commercial land is calculated as the sum of the land area of parcels designated commercial under the new use classification within a census tract. For some census tracts (notably those in Macomb County, but not necessarily unique to them) data are only available from CoreLogic, which covers residential properties; these census tracts are therefore missing data to compute T_j^b.

The LODES data establish that there are workers commuting to work in Macomb county census tracts, so that we make use of the ZIP Business Patterns data on the number of commercial establishments by Zip Code, and use the Zip-to-Tract crosswalk from the Department of Housing and Urban Development, to impute the number of commercial establishments by census tract. To do so, we calculate the average land area per parcel (assuming one establishment per parcel) and take a weighted average of the eight nearest neighbors. We multiply this area per parcel by the number of establishments from the ZIP Business Patterns to arrive at an imputed area for commercial land. For Macomb County, we use an average for the MSA.

2.3.2 Total Potential Residential Development $\left(\overline{T}_j^r\right)$

The model and geography of Detroit naturally impose an upper bound on total residential development in a census tract. Moreover, this upper bound must be taken into account in any counterfactual exercises that involve vacant or partially developed tracts. Thus, we need to know how much land remains after accounting for all parcels with an

identifiable use (i.e. residential, commercial, and public). To this end, we start by calculating total potential residential land as the total land area of a census tract less land not suited for residential development (i.e. commercial and public summed across parcels). The total land area of each census tract is given by the U.S. Gazetteer files (U.S. Census Bureau, 2015) and is computed using the following definitions:

$$T_j^A = T_j - T_j^b - T_j^p,$$

where T_j is the total land area of a census tract, T_j^A is total land suitable for residential purposes (i.e. includes developed and undeveloped land), T_j^b is total commercial land (as measured above), and T_j^p is total public land (mentioned above). Because the surface area of residential development can be built upwards, T_j^A is at best a lower bound for $\overline{T}_j^r$. Therefore, we adjust T_j^A by a factor that accounts for the ratio of living area to land area in a given census tract,

$$\overline{T}_j^r = T_j^A(1+x),$$

where x denotes an allowance for vertical development. In particular, x is the maximum ratio of living to land area within the tract and nearest three neighboring tracts. Taking into account the nearest three neighboring tracts allows us to ensure that tracts with relatively low development, but next to developed tracts with tall buildings, are not assigned an artificially low $\overline{T}_j^r$. In 114 census tracts, out of 1151, the total land area of parcels measured in the data exceeded that of the area published by the U.S. Census Bureau. In these cases, we decrease each type of land by an equivalent proportion so that our measure of land is consistent with that of the Census.

2.3.3 Residential Prices $\left(q_j^r\right)$

We sum market values of all residential parcels, obtained from the data sources described above, in a given census tract, which we refer to as the market value of that tract. Because residential prices in the model reflect the value of housing services within a given period, which we take to be a year in the analysis, we then convert census tract market values into annual rent equivalents using the present-value formula for an annuity-due,

$$\text{Annual Rent Equivalent}_j = \frac{r}{1+r}\frac{\text{Market Value}_j}{(1-(1+r)^{-T})}, \tag{3}$$

where r is a discount rate and T is the life of the asset. We let $r = 0.06$, and interpret the unusually low rents observed in Detroit as reflecting in part an aged housing stock often left abandoned with relatively low remaining useful life, $T = 20$. In particular, the

calculation in (3) with these parameters match well with other information on Detroit rents, for instance from Zillow and the American Community Survey. Consistent with the model, q_j^r is measured as these annual equivalent rents per unit area, following convention dollars per square foot in the main text.

2.4 Contractors (n_j)

The data on residential contractors are obtained from Detroit's Demolition Program and the Detroit's Buildings, Safety Engineering and Environmental Department's Building Permits. We make use of data on active building and demolition permits in order to identify the number of unique contractors, n_j, currently working in Detroit. Specifically, any permit issued up through 2014 and still active from 2014 onward is considered an active permit. If contractors have more than one contract active in a particular Census Tract, we only count them once.

3 Robustness

This section contains a series of robustness exercises, organized as follows: first, we consider counterfactuals based on the different land-use typologies of Detroit Future City. Second, since each typology considers a subset of tracts identified in the Detroit Future City counterfactual, we consider a series of 'optimal' counterfactuals with a number of tracts equivalent to that of each typology. Third, we compute a measure of wages controlling for demographics, education, and occupation, and use this measure to recompute the benchmark and counterfactuals presented in the main text. Fourth, we consider counterfactuals analogous to those presented in the main text but where the total population of greater Detroit is held fixed. Fifth, we reproduce Tables 4 and 5 from the main text for both cases where variations in residential amenities partly reflect local tract characteristics; in the first case the elasticity of amenities with respect to the number of residents is estimated using cross-sectional data, and in the other case the elasticity is estimated using the change in amenities over time. Finally, we revisit our findings in the main text but for the entire area of greater Detroit.

3.1 Detroit Future City Typologies

The Detroit Future City (DFC) Strategic Framework includes 17 land use typologies, 9 of which mention residential components. Of these 9, 6 typologies are suggested for

currently vacant tracts. We compute and present a counterfactual for each such land use typology. Figure 8 shows the locations of these land use typologies in Detroit while table 7 summarizes how tracts are selected. Following this setup a series of tables and maps present the results of these counterfactuals.

3.1.1 Land Use Typology Descriptions

DFC identifies 6 land-use typologies that made natural choices for counterfactuals.

District Center: These areas would be developed for medium-to-high density mixed use, including both residential and employment. Examples include universities or medical centers.

Green Mixed-Rise: These areas are imagined to be residential neighborhood of varying density and heights built into a landscape setting.

Traditional Low-Density: Common in Detroit, these are wealthier neighborhoods of detached single-family houses on large parcels.

Live + Make: Live + Make neighborhoods would consist of both new buildings and re-purposed historic structures and are used for both small scale production and residential spaces.

Traditional Medium-Density: The most prominent pattern currently seen in Detroit, Traditional Medium-Density neighborhoods consist of a grid of single-family houses on moderate sized parcels.

Neighborhood Center: Neighborhood centers are meant to be just that; commercial, retail, and recreational areas exist alongside diverse housing options, from single- and multi- family houses to townhouses.

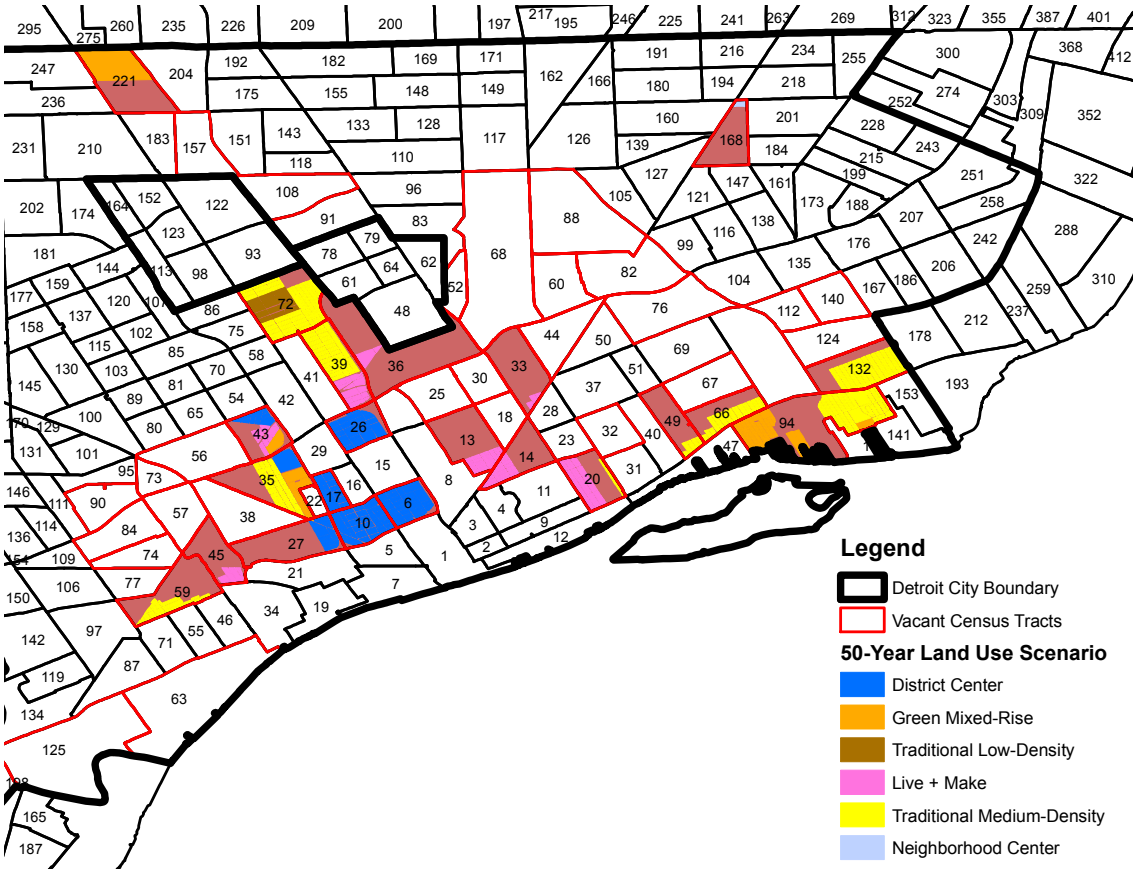

Figure 8: Detroit Future City Residential Land-Use Typologies

Full Name	Abbreviation	6	10	13	14	17	20	26	27	33	35	36	39	43	45	49	59	66	72	94	132	168	221
Detroit Future City	DFC	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
District Center	DC	✓	✓			✓		✓	✓		✓			✓									
Live + Make	LM			✓	✓		✓			✓		✓	✓	✓	✓								
Green Mixed-Rise	GMR										✓			✓						✓			✓
Traditional Medium-Density	TMD						✓				✓		✓			✓	✓	✓	✓	✓	✓		
Traditional Low-Density	TLD																		✓				
Neighborhood Center	NC																					✓	

Table 7: Tract Identifiers by Detroit Future City Residential Land-Use Typology

Detroit	Benchmark	DFC	DC	LM	GMR	TMD	TLD	NC
Residents	126,430	131,466	128,258	127,981	127,776	128,491	126,509	126,762
Mean Wages, $	31,996	31,922	31,977	31,976	31,980	31,961	31,995	31,989
S.D. Wages, $	10,137	10,099	10,126	10,126	10,131	10,120	10,136	10,129
Mean Res. Rents, $/Sq. Ft.	1.47	1.43	1.46	1.45	1.46	1.45	1.47	1.47
S.D. Res. Rents, $/Sq. Ft.	0.64	0.65	0.64	0.65	0.64	0.65	0.64	0.64
Total Res. Rent, Mill. $	1,223	1,270	1,241	1,238	1,236	1,242	1,224	1,226
Total Bus. Rent, Mill. $	2,181	2,205	2,190	2,188	2,187	2,191	2,182	2,182

Table 8: Detroit Proper Outcomes for Detroit Future City Typologies

	DFC	DC	LM	GMR	TMD	TLD	NC
Dev. Guarantee, Mill. $	41.057	15.200	12.960	11.112	17.437	0.597	2.773
Detroit Proper:							
Δ in Res. Rent, Mill.							
Total	47.451	17.576	15.211	12.771	19.376	0.738	3.118
Treated Tracts	45.796	17.093	14.786	12.353	18.725	0.713	3.006
Other Tracts	1.656	0.484	0.425	0.418	0.651	0.025	0.112
Δ in Bus. Rent, Mill.							
Total	23.502	9.248	7.132	6.077	9.764	0.434	1.234
Treated Tracts	9.857	4.052	2.814	1.388	2.934	0.303	0.000
Other Tracts	13.645	5.196	4.319	4.689	6.830	0.131	1.234
Δ in Population							
Total	5,036	1,828	1,550	1,346	2,061	79	332
Treated Tracts	4,746	1,725	1,466	1,269	1,942	73	314
Other Tracts	290	104	84	78	119	6	19
Greater Detroit:							
Δ in Res. Rent, Mill. $	58.675	21.361	18.223	15.817	23.911	0.895	3.955
Δ in Biz. Rent, Mill. $	61.111	22.243	18.974	16.467	24.899	0.924	4.109
Δ in Population	7,043	2,540	2,155	1,893	2,870	107	476

Table 9: Dev. Guarantees, Policy Outcomes in Detroit Proper and Greater Detroit for Detroit Future City Typologies

3.1.2 Counterfactual Maps: Detroit Future City

Similarly to the maps depicting changes resulting from coordination in all 52 vacant tracts, the maps below illustrate our findings for coordination in the tracts identified by DFC.

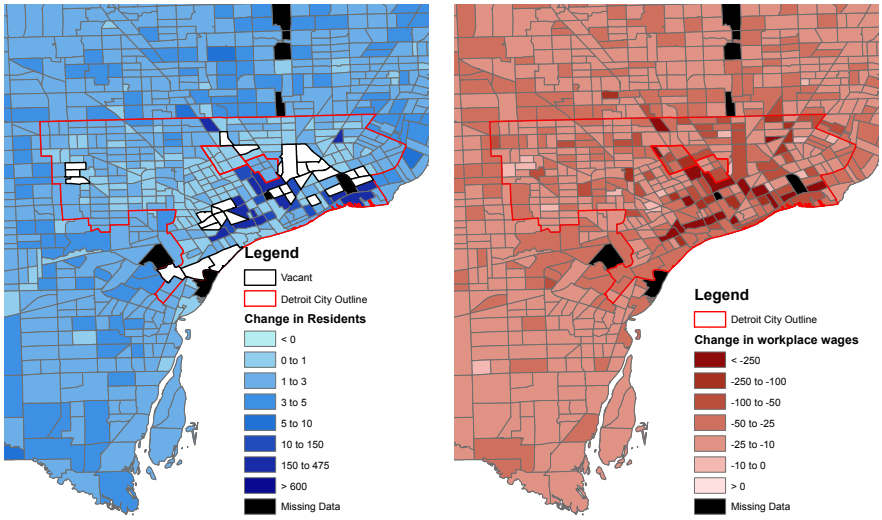

Figure 9: Detroit Future City, Change in Residents and Workplace Wages

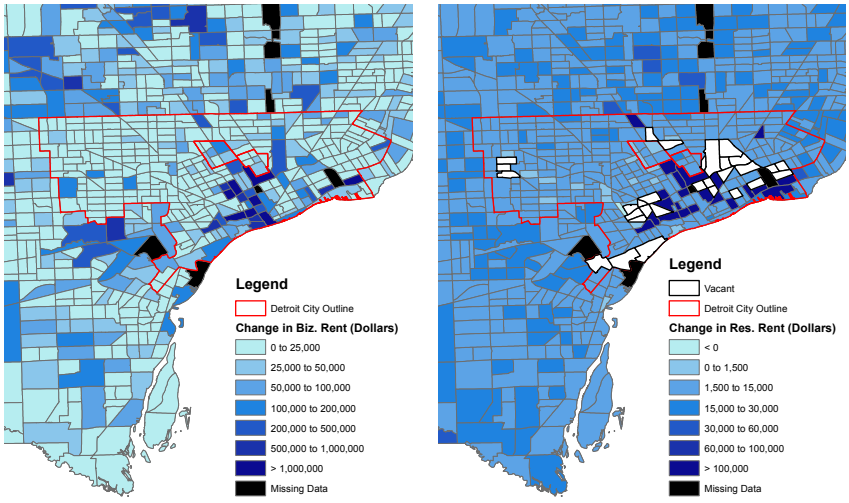

Figure 10: Detroit Future City, Change in Business and Residential Rents

3.2 'Best Tracts' Counterfactuals

In the main text, one quantitative exercise compares Detroit Future City's selection of 22 tracts to alternative selections of 22 tracts that yield better outcomes in terms of increases to business rents, residential rents, or population gain. We can carry out similar exercises with respect to Detroit Future City's individual typologies. For example, the Traditional Medium-Density land use typology identified 9 tracts; we can choose the 9 tracts that individually most increase citywide business rents, residential rents, or population when an equilibrium with coordination. Having identified these 9 individual tracts, we then compute the counterfactual where all 9 tracts have simultaneously switched to an equilibrium with coordination. The results are presented in the following tables:

3.2.1 District Center and Best 7

Detroit	Benchmark	DC	Best 7 Bus.	Best 7 Res.	Best 7 Pop.
Residents	126,430	128,258	130,070	129,952	130,076
Mean Wages, $	31,996	31,977	31,934	31,952	31,932
S.D. Wages, $	10,137	10,126	10,141	10,130	10,143
Mean Res. Rents, $/Sq. Ft.	1.47	1.46	1.47	1.46	1.47
S.D. Res. Rents, $/Sq. Ft.	0.64	0.64	0.64	0.64	0.64
Total Res. Rent, Mill. $	1,223	1,241	1,256	1,256	1,255
Total Bus. Rent, Mill. $	2,181	2,190	2,196	2,195	2,196

Table 10: Detroit Proper Outcomes for District Center and 7-tract Alternatives

	DC	Best 7 Bus.	Best 7 Res.	Best 7 Pop.
Dev. Guarantee, Mill. $	15.200	29.611	31.239	29.137
Detroit Proper:				
Δ in Res. Rent, Mill.				
Total	17.576	32.714	33.439	32.336
Treated Tracts	17.093	31.417	32.405	30.905
Other Tracts	0.484	1.297	1.034	1.430
Δ in Bus. Rent, Mill.				
Total	9.248	14.936	14.041	14.363
Treated Tracts	4.052	2.737	0.053	2.776
Other Tracts	5.196	12.200	13.988	11.587
Δ in Population				
Total	1,828	3,640	3,522	3,646
Treated Tracts	1,725	3,438	3,328	3,441
Other Tracts	104	202	194	206
Greater Detroit:				
Δ in Res. Rent, Mill. $	21.361	41.460	41.711	41.498
Δ in Biz. Rent, Mill. $	22.243	43.179	43.440	43.219
Δ in Population	2,540	5,108	4,998	5,139

Table 11: Dev. Guarantees, Policy Outcomes in Detroit Proper and Greater Detroit for District Center and 7-tract Alternatives

3.2.2 Live + Make and Best 8

Table 12: Detroit Proper Outcomes for Live + Make and 8-tract Alternatives

Detroit	Benchmark	LM	Best 8 Bus.	Best 8 Res.	Best 8 Pop.
Residents	126,430	127,981	130,475	130,386	130,487
Mean Wages, $	31,996	31,976	31,930	31,946	31,929
S.D. Wages, $	10,137	10,126	10,141	10,127	10,142
Mean Res. Rents, $/Sq. Ft.	1.47	1.45	1.46	1.46	1.46
S.D. Res. Rents, $/Sq. Ft.	0.64	0.65	0.64	0.64	0.64
Total Res. Rent, Mill. $	1,223	1,238	1,260	1,260	1,259
Total Bus. Rent, Mill. $	2,181	2,188	2,198	2,198	2,198

	LM	Best 8 Bus.	Best 8 Res.	Best 8 Pop.
Dev. Guarantee, Mill. $	12.960	33.348	34.186	32.969
Detroit Proper:				
Δ in Res. Rent, Mill.				
Total	15.211	36.644	37.245	36.447
Treated Tracts	14.786	35.253	36.016	34.949
Other Tracts	0.425	1.390	1.229	1.498
Δ in Bus. Rent, Mill.				
Total	7.132	16.697	16.339	16.396
Treated Tracts	2.814	2.770	1.480	3.021
Other Tracts	4.319	13.927	14.859	13.375
Δ in Population				
Total	1,550	4,045	3,956	4,057
Treated Tracts	1,466	3,821	3,734	3,829
Other Tracts	84	224	222	228
Greater Detroit:				
Δ in Res. Rent, Mill. $	18.223	46.233	46.640	46.333
Δ in Biz. Rent, Mill. $	18.974	48.151	48.575	48.255
Δ in Population	2,155	5,674	5,604	5,706

Table 13: Dev. Guarantees, Policy Outcomes for Live + Make and 8-tract Alternatives

3.2.3 Green Mixed-Rise and Best 4

Table 14: Detroit Proper Outcomes for Green Mixed-Rise and 4-tract Alternatives

Detroit	Benchmark	GMR	Best 4 Bus.	Best 4 Res.	Best 4 Pop.
Residents	126,430	127,776	128,733	128,744	128,784
Mean Wages, $	31,996	31,980	31,950	31,963	31,946
S.D. Wages, $	10,137	10,131	10,148	10,132	10,146
Mean Res. Rents, $/Sq. Ft.	1.47	1.46	1.47	1.47	1.47
S.D. Res. Rents, $/Sq. Ft.	0.64	0.64	0.64	0.64	0.64
Total Res. Rent, Mill. $	1,223	1,236	1,243	1,245	1,243
Total Bus. Rent, Mill. $	2,181	2,187	2,190	2,190	2,190

	GMR	Best 4 Bus.	Best 4 Res.	Best 4 Pop.
Dev. Guarantee, Mill. $	11.112	17.360	20.237	18.640
Detroit Proper:				
Δ in Res. Rent, Mill.				
Total	12.771	19.778	21.592	20.460
Treated Tracts	12.353	18.844	20.833	19.533
Other Tracts	0.418	0.935	0.759	0.928
Δ in Bus. Rent, Mill.				
Total	6.077	9.106	8.574	8.814
Treated Tracts	1.388	1.368	0.002	1.305
Other Tracts	4.689	7.738	8.572	7.508
Δ in Population				
Total	1,346	2,303	2,314	2,354
Treated Tracts	1,269	2,176	2,187	2,225
Other Tracts	78	127	127	129
Greater Detroit:				
Δ in Res. Rent, Mill. $	15.817	25.731	27.477	26.442
Δ in Biz. Rent, Mill. $	16.467	26.795	28.614	27.535
Δ in Population	1,893	3,238	3,315	3,314

Table 15: Dev. Guarantees, Policy Outcomes for Green Mixed-Rise and 4-tract Alternatives

3.2.4 Traditional Medium Density and Best 9

Table 16: Detroit Proper Outcomes for Traditional Medium-Density and 9-tract Alternatives

Detroit	Benchmark	TMD	Best 9 Bus.	Best 9 Res.	Best 9 Pop.
Residents	126,430	128,491	130,869	130,802	130,892
Mean Wages, $	31,996	31,961	31,926	31,941	31,923
S.D. Wages, $	10,137	10,120	10,140	10,128	10,142
Mean Res. Rents, $/Sq. Ft.	1.47	1.45	1.46	1.46	1.46
S.D. Res. Rents, $/Sq. Ft.	0.64	0.65	0.64	0.64	0.64
Total Res. Rent, Mill. $	1,223	1,242	1,263	1,264	1,263
Total Bus. Rent, Mill. $	2,181	2,191	2,200	2,199	2,199

	TMD	Best 9 Bus.	Best 9 Res.	Best 9 Pop.
Dev. Guarantee, Mill. $	17.437	36.781	37.545	36.217
Detroit Proper:				
Δ in Res. Rent, Mill.				
Total	19.376	40.453	40.980	40.069
Treated Tracts	18.725	38.951	39.550	38.367
Other Tracts	0.651	1.502	1.430	1.702
Δ in Bus. Rent, Mill.				
Total	9.764	18.373	17.798	17.875
Treated Tracts	2.934	2.822	1.770	3.041
Other Tracts	6.830	15.551	16.028	14.834
Δ in Population				
Total	2,061	4,439	4,372	4,462
Treated Tracts	1,942	4,192	4,125	4,209
Other Tracts	119	246	248	253
Greater Detroit:				
Δ in Res. Rent, Mill. $	23.911	50.857	51.513	51.086
Δ in Biz. Rent, Mill. $	24.899	52.968	53.651	53.207
Δ in Population	2,870	6,225	6,201	6,290

Table 17: Dev. Guarantees, Policy Outcomes for Traditional Medium-Density and 9-tract Alternatives

3.2.5 Traditional Low Density, Neighborhood Center, and Best Single Tract

Table 18: Detroit Proper Outcomes for Single-tract Alternatives

Detroit	Benchmark	TLD	NC	Best Tract Bus.	Best Tract Res.	Best Tract Pop.
Residents	126,430	126,509	126,762	127,253	127,253	127,253
Mean Wages, $	31,996	31,995	31,989	31,982	31,982	31,982
S.D. Wages, $	10,137	10,136	10,129	10,139	10,139	10,139
Mean Res. Rents, $/Sq. Ft.	1.47	1.47	1.47	1.48	1.48	1.48
S.D. Res. Rents, $/Sq. Ft.	0.64	0.64	0.64	0.64	0.64	0.64
Total Res. Rent, Mill. $	1,223	1,224	1,226	1,230	1,230	1,230
Total Bus. Rent, Mill. $	2,181	2,182	2,182	2,184	2,184	2,184

	TLD	NC	Best Tract Biz.	Best Tract Res.	Best Tract Pop.
Dev. Guarantee, Mill. $	0.597	2.773	6.796	6.796	6.796
Detroit Proper:					
Δ in Res. Rent, Mill.					
Total	0.738	3.118	7.511	7.511	7.511
Treated Tracts	0.713	3.006	7.269	7.269	7.269
Other Tracts	0.025	0.112	0.243	0.243	0.243
Δ in Bus. Rent, Mill.					
Total	0.434	1.234	2.737	2.737	2.737
Treated Tracts	0.303	0.000	0.000	0.000	0.000
Other Tracts	0.131	1.234	2.737	2.737	2.737
Δ in Population					
Total	79	332	823	823	823
Treated Tracts	73	314	782	782	782
Other Tracts	6	19	41	41	41
Greater Detroit:					
Δ in Res. Rent, Mill. $	0.895	3.955	9.883	9.883	9.883
Δ in Biz. Rent, Mill. $	0.924	4.109	10.288	10.288	10.288
Δ in Population	107	476	1,202	1,202	1,202

Table 19: Dev. Guarantees, Policy Outcomes for Single-tract Alternatives

3.3 Demographic, Education, and Occupation-Controlled Wages

The model assumes that all individuals are identical up to some idiosyncratic preference for where to live and work. In practice, individuals also differ in their demographics, level of education, and occupation which is reflected in their wages. In this section we consider a Mincer-like regression on wages to control for these additional differences. We use the resulting wages to compute an alternative benchmark and counterfactuals analogous to those in the main text.

The LODES data includes the number of individuals working in a census tract by wage bin, education level, occupation, and various demographics, but does not include values and characteristics by individual worker. Under some assumptions, clarified below, this data can still be used to obtain the average wage by census tract controlled for characteristics of the individuals earning those wages.

Let education level be indexed by k, occupation by p, work location by l, and race by r. Suppose the true model of wage for individual i, was given by

$$w_i = \alpha + \sum_{k=1}^{K-1} d_k C_{k,i} + \sum_{p=1}^{P-1} \beta_p O_{p,i} + \sum_{l=1}^{L-1} \ell_l L_{l,i} + \sum_{r=1}^{R-1} \rho_r R_{r,i} + \phi F_i + \varepsilon_i$$

where $\{C_k\}$ is a set of education level dummies, $\{O_p\}$ is a set of occupation dummies, $\{L_l\}$ is a set of work location dummies, $\{R_r\}$ is a set of race dummies, and F_i is a dummy for female. Let $n_l = \sum_{i \in l} L_l$ be the number of people working in location l. Summing over locations and dividing by the number of people working in each location gives

$$\begin{aligned}
\frac{1}{n_l} \sum_{i \in l} w_i = \alpha &+ \sum_{k=1}^{K-1} d_k \frac{\sum_{i \in l} C_{k,i}}{n_l} + \sum_{p=1}^{P-1} \beta_p \frac{\sum_{i \in l} O_{p,i}}{n_l} + \ell_l \\
&+ \sum_{r=1}^{R-1} \rho_r \frac{\sum_{i \in l} R_{r,i}}{n_l} + \phi \frac{\sum_{i \in l} F_i}{n_l} + \frac{1}{n_l} \sum_{i \in l} \varepsilon_i \\
\bar{w}_l = \alpha &+ \sum_{k=1}^{K-1} d_k \left(\% \ C_k \text{ in location } l\right) + \sum_{p=1}^{P-1} \beta_p \left(\% \ O_p \text{ in location } l\right) \\
&+ \sum_{r=1}^{R-1} \rho_r \left(\% \ R_r \text{ in location } l\right) + \phi \left(\% \text{ female in location } l\right) + u_l \\
&\text{where } u_l = \ell_l + \frac{1}{n_L} \sum_{i \in l} \varepsilon_i.
\end{aligned}$$

Therefore,

$$\begin{aligned}\alpha + u_l = \bar{w}_l &- \sum_{k=1}^{K-1} d_k \left(\%\ C_k \text{ in location } L_l\right) - \sum_{p=1}^{P-1} \beta_p \left(\%\ O_p \text{ in location } L_l\right) \\ &- \sum_{r=1}^{R-1} \rho_r \left(\%\ R_r \text{ in location } l\right) - \phi \left(\%\ \text{female in location } l\right) \\ &= \frac{1}{n_l} \sum_{i \in l} \left(\alpha + \ell_l + \varepsilon_i\right),\end{aligned}$$

is the average wage of a male in location l with the omitted education level, occupation, and race.

In the paper, wages by census tract are constructed from the count of individuals whose wage falls into one of three bins:

$$\begin{aligned} b_1 &= [0,\ \ 15,000], && \text{midpoint: } m_1 = 7,500 \\ b_2 &= (15,000,\ \ 39,996], && \text{midpoint: } m_2 = 27,498 \\ b_3 &= (39,996,\ \ 87,522], && \text{midpoint: } m_3 = 63,759 \end{aligned}$$

we assign the midpoint of each wage bin to the individuals in that bin and take a population weighted average by location to arrive at wages:

$$\tilde{w}_l = m_1 \frac{n_{1,l}}{n_l} + m_2 \frac{n_{2,l}}{n_l} + m_3 \frac{n_{3,l}}{n_l}$$

where $n_{1,l}$ is the number of individuals in location l, wage bin b_1, etc.. Assuming $\tilde{w}_l = \bar{w}_l$ is equivalent to assuming that the midpoint is the average wage of the individuals in that bin.[8]

The regression we run is $\tilde{w}_l$ on the controls listed in the regression summary table on the next page. The adjusted wages ($\alpha + u_l$) represent the wage of a white male with a high school degree working in the transportation sector in location l, a reasonable population reference for Detroit.

[8] Let $\{w_1, \ldots, w_{j_1}, \ldots, w_{j_2}, \ldots, w_{n_l}\}$ be the wages of individuals living in location l ordered so that $\{w_1, \ldots, w_{j_1}\}$ are the individuals whose wage falls in b_1, $\{w_{j_1+1}, \ldots, w_{j_2}\}$ fall in b_2, etc. Then

$$\begin{aligned}\frac{1}{n_l} \sum_{i=1}^{n_l} w_i &= \frac{1}{n_l} \left[\sum_{i=1}^{j_1} w_i + \sum_{i=j_1+1}^{j_2} w_i + \sum_{i=j_2+1}^{n_l} w_i \right] \\ &= \frac{1}{n_l} \left[\frac{n_{1,l}}{n_{1,l}} \sum_{i=1}^{j_1} w_i + \frac{n_{2,l}}{n_{2,l}} \sum_{i=j_1+1}^{j_2} w_i + \frac{n_{3,l}}{n_{3,l}} \sum_{i=j_2+1}^{n_l} w_i \right] \\ &= \frac{n_{1,l}}{n_l} \left(\frac{1}{n_{1,l}} \sum_{i=1}^{j_1} w_i \right) + \frac{n_{2,l}}{n_l} \left(\frac{1}{n_{2,l}} \sum_{i=j_1+1}^{j_2} w_i \right) + \frac{n_{3,l}}{n_l} \left(\frac{1}{n_{3,l}} \sum_{i=j_2+1}^{n_l} w_i \right)\end{aligned}$$

VARIABLES	(1) Wj
Constant	36,907***
	(4,056)
Agriculture, Forestry, Fishing, and Hunting	-16,802**
	(8,526)
Mining, Quarrying, and Oil and Gas Extraction	17,947**
	(7,022)
Utilities	13,760*
	(7,107)
Construction	-7,015*
	(4,083)
Manufacturing	3,904
	(3,557)
Wholesale Trade	1,981
	(3,978)
Retail Trade	-19,822***
	(3,529)
Information	3,789
	(4,646)
Finance and Insurance	-700.6
	(5,083)
Real Estate	-1,833
	(5,131)
Professional, Scientific, and Technical Services	1,303
	(4,037)
Managment of Companies	6,754
	(6,135)
Admin/Support and Waste Management	-12,967***
	(3,919)
Educational Services	-4,393
	(3,853)
Health Care and Social Assistance	-5,279
	(3,715)
Arts, Entertainment, and Recreation	-18,847***
	(4,379)
Accomodation and Food Services	-24,292***
	(3,574)
Other Except Public Admin	-16,319***
	(4,229)
Public Administration	-650.0
	(3,861)

VARIABLES	(1) Wj
Less than High School	-15,607**
	(6,158)
Some college or associate degree	19,901***
	(5,545)
Bachelor's or Advanced degree	27,758***
	(4,303)
Black/African American	-594.1
	(1,291)
American Indian/Native Alaskan	60,162*
	(31,664)
Asian	-10,626
	(8,436)
Native Hawaiin/Pacific Islander	-15,471
	(74,500)
Two or More	-38,032*
	(22,090)
Female	-11,772***
	(2,876)
Observations	1,150
R-squared	0.689

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

We use the resulting adjusted average wage by census tract ($\alpha + u_l$) to recompute the benchmark and the counterfactuals presented in the main text. Tables summarizing the results are below:

Table 20: Detroit Proper Outcomes with Adjusted Wages

Detroit	Benchmark	DFC	Best 22 Bus.	Best 22 Res.	Best 22 Pop.	All 52
Residents	126,430	131,450	134,765	135,254	135,277	139,416
Mean Wages, $	37,034	36,952	36,880	36,883	36,884	36,805
S.D. Wages, $	6,400	6,380	6,380	6,393	6,393	6,366
Mean Res. Rents, $/Sq. Ft.	1.47	1.42	1.43	1.43	1.43	1.37
S.D. Res. Rents, $/Sq. Ft.	0.64	0.65	0.64	0.64	0.64	0.64
Total Res. Rent, Mill. $	1,197	1,244	1,273	1,277	1,277	1,316
Total Bus. Rent, Mill. $	2,044	2,066	2,079	2,078	2,077	2,097

	DFC	Best 22 Bus.	Best 22 Res.	Best 22 Pop.	All 52
Dev. Guarantee, Mill. $	41.395	69.397	74.143	74.192	106.111
Detroit Proper:					
Δ in Res. Rent, Mill.					
Total	46.524	76.335	80.300	80.400	118.622
Treated Tracts	45.375	74.349	78.016	78.095	115.439
Other Tracts	1.148	1.986	2.283	2.305	3.183
Δ in Bus. Rent, Mill.					
Total	22.788	35.183	34.097	33.520	53.081
Treated Tracts	9.905	9.137	5.505	5.528	22.784
Other Tracts	12.884	26.046	28.592	27.991	30.296
Δ in Population					
Total	5,020	8,335	8,824	8,847	12,986
Treated Tracts	4,745	7,893	8,346	8,368	12,295
Other Tracts	274	442	478	478	691
Greater Detroit:					
Δ in Res. Rent, Mill. $	56.579	93.611	99.527	99.854	146.091
Δ in Biz. Rent, Mill. $	58.927	97.502	103.664	104.006	152.168
Δ in Population	6,978	11,609	12,384	12,432	18,141

Table 21: Development Guarantees and Policy Outcomes with Adjusted Wages

Comparing these tables to those in the main text, it is apparent that adjusting wages for additional controls is relatively immaterial for our main findings.

3.4 Closed City Counterfactuals

As described in section 3.5.1 of the paper, we also consider counterfactuals where total population of Greater Detroit is held constant. More specifically, the population being held constant is that of our entire sample, including both the 297 tracts inside Detroit's political boundaries as well as the 866 additional tracts in the surrounding adjacent metro area. Unlike the counterfactuals described in the main text, in the counterfactuals carried out in this section, any population gain within Detroit must necessarily be offset by an equivalent population loss in areas outside Detroit. This feature reflects an implicit assumption of essentially infinite moving costs at the border of Greater Detroit, and therefore place a lower bound on potential changes resulting from any policy proposal.

We first describe the changes to our solution algorithm needed to compute these counterfactuals. We then present the results for the closed city case version of the counterfactuals corresponding to Detroit Future City, 'best 22', and 'all 52' presented in the main text.

3.4.1 Change to the Algorithm

Step 4 of our solution algorithm described in Appendix A of the main text computes residential population across tracts, R_j, at $\boldsymbol{w}^0$, using $\pi_{ij}(w_i = w_i^0)$ and $T_j^r(w_i = w_i^0)$. For a closed city counterfactual, we compute instead at $\boldsymbol{w}^0$ an alternative residential population across tracts, R_j, along with utility, $\bar{u}$, such that total population in Greater Detroit is left unchanged, $\bar{P} = \sum_j R_j$. Thus, step 4 in Appendix A of the main text changes as follows:

4. Find $\bar{u}$ such that

$$P(\bar{u}) = \sum_j R_j - \bar{P} = \sum_j \left(\frac{\bar{u}(1-\gamma)^{1-\gamma} \left\{ \sum_{i=1}^J \pi_{ij}(w_i = w_i^0) w_i \right\}^{1-\gamma}}{\Gamma\left(\frac{\theta-1}{\theta}\right) \left(T_j^r(w_i = w_i^0) \right)^{1-\gamma} \left[\sum_{i=1}^J \lambda_{ij} (w_i/\kappa_{ij})^\theta \right]^{\frac{1}{\theta}}} \right)^{\frac{1}{\sigma_j + \gamma - 1}} - \bar{P} = 0.$$

Here, we use Newton's method where, starting from a guess, $\bar{u}_0$, we iterate

$$\bar{u}_{n+1} = \bar{u}_n - \frac{P(\bar{u}_n)}{P_u(\bar{u}_n)},$$

where

$$P_u(\bar{u}) = \frac{\partial P}{\partial \bar{u}} = \sum_j \frac{1}{\sigma_j + \gamma - 1} \bar{u}^{\frac{1}{\sigma_j+\gamma-1}-1} \left(\frac{(1-\gamma)^{1-\gamma} \left\{ \sum_{i=1}^J \pi_{ij}(w_i = w_i^0) w_i \right\}^{1-\gamma}}{\Gamma\left(\frac{\theta-1}{\theta}\right) \left(T_j^r(w_i = w_i^0) \right)^{1-\gamma} \left[\sum_{i=1}^J \lambda_{ij} (w_i/\kappa_{ij})^\theta \right]^{\frac{1}{\theta}}} \right)^{\frac{1}{\sigma_j + \gamma - 1}},$$

until $P(\bar{u}_n) < \varepsilon$ for some small $\varepsilon > 0$.

3.4.2 Detroit Future City, Best 22, and All 52, Closed City Results

Table 22: Detroit Proper Outcomes for Fixed Population Counterfactuals

Detroit	Benchmark	DFC (Fix Pop.)	Best 22 Bus. (Fix Pop.)	Best 22 Res. (Fix Pop.)	Best 22 Pop. (Fix Pop.)	All 52 (Fix Pop.)
Residents	126,430	130,890	133,384	134,164	134,258	137,898
Mean Wages, $	31,996	31,945	31,907	31,920	31,918	31,862
S.D. Wages, $	10,137	10,106	10,126	10,139	10,146	10,102
Mean Res. Rents, $/Sq. Ft.	1.47	1.42	1.43	1.43	1.43	1.37
S.D. Res. Rents, $/Sq. Ft.	0.64	0.65	0.64	0.64	0.64	0.64
Total Res. Rent, Mill. $	1,223	1,266	1,289	1,296	1,295	1,331
Total Bus. Rent, Mill. $	2,181	2,194	2,200	2,198	2,196	2,208

	DFC	Best 22 Bus.	Best 22 Res.	Best 22 Pop.	All 52
Dev. Guarantee, Mill. $	41.057	65.040	73.313	72.805	106.001
Detroit Proper:					
Δ in Res. Rent, Mill.					
Total	42.865	65.764	72.551	72.144	108.012
Treated Tracts	45.687	70.165	77.281	76.726	115.175
Other Tracts	-2.822	-4.401	-4.730	-4.582	-7.163
Δ in Bus. Rent, Mill.					
Total	13.102	18.960	16.697	15.154	27.159
Treated Tracts	9.165	10.419	5.214	4.123	18.815
Other Tracts	3.938	8.541	11.483	11.031	8.344
Δ in Population					
Total	4,460	6,954	7,734	7,828	11,468
Treated Tracts	4,731	7,389	8,223	8,320	12,195
Other Tracts	-271	-435	-489	-492	-727
Greater Detroit:					
Δ in Res. Rent, Mill. $	-0.029	-0.930	-1.357	-1.986	-1.594
Δ in Biz. Rent, Mill. $	-0.037	-0.971	-1.418	-2.073	-1.664
Δ in Population	0	0	0	0	0

Table 23: Dev. Guarantees, Policy Outcomes in Detroit Proper and Greater Detroit for Fixed Population Counterfactuals

3.4.3 Counterfactual Maps: Detroit Future City, Closed City Results

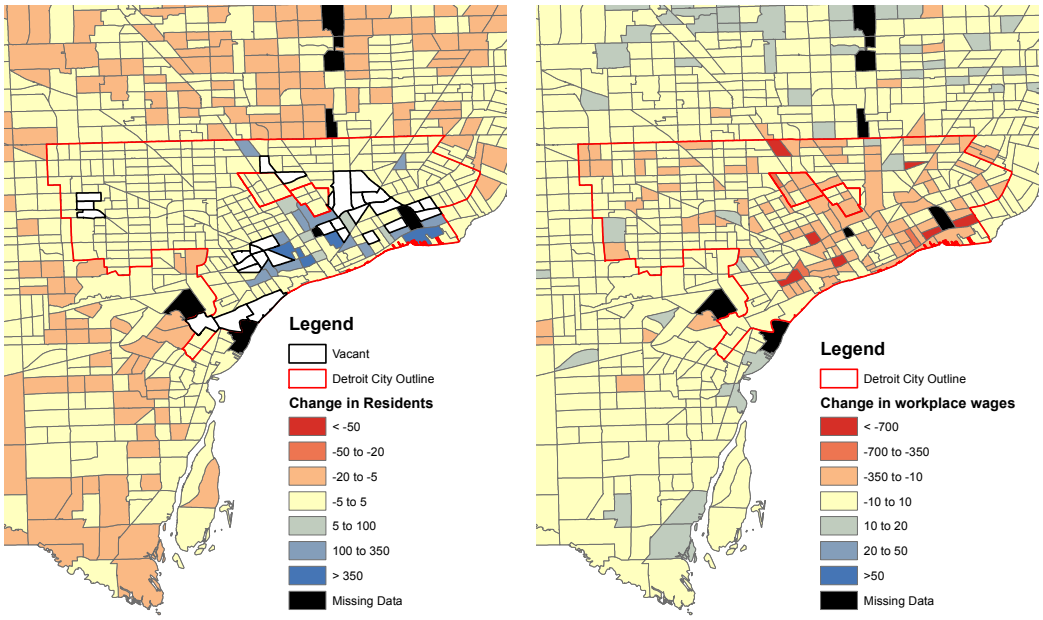

Figure 11: Detroit Future City, Change in Residents Workplace Wages, Closed City Results

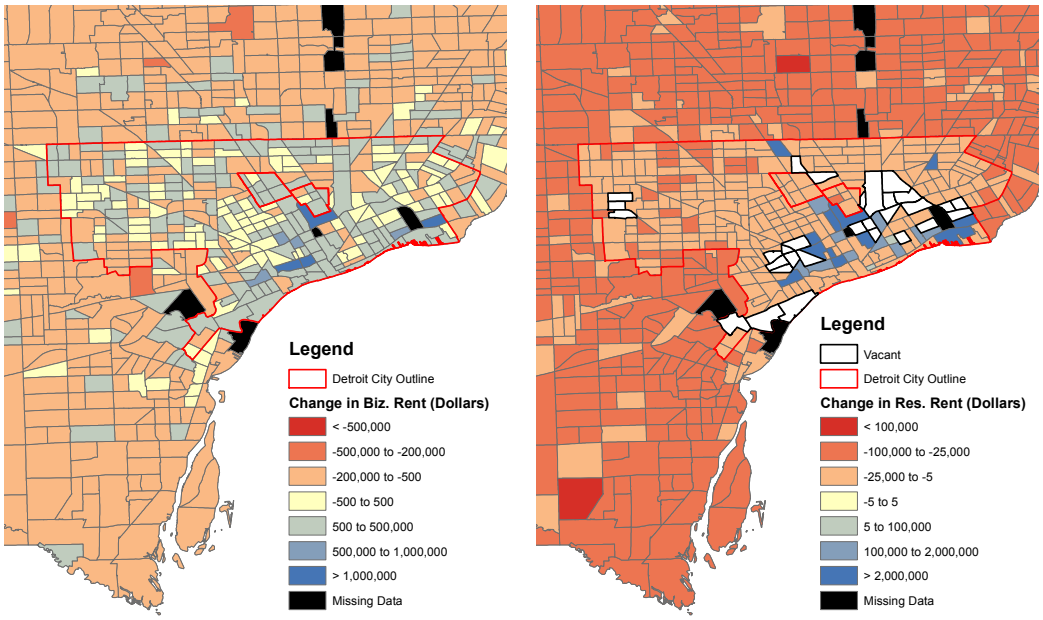

Figure 12: Detroit Future City, Change in Business and Residential Rents, Closed City Results

3.5 Residential Amenities Reflecting Local Tract Characteristics, Using Cross-Sectional Data

As discussed in the main text, we explore an alternative case in which variations in local amenities in part reflect exogenous attributes of each location. In this case, our measure of neighborhood amenities is $B(R_j; j) = B_j R_j^{\sigma}$. Here we estimate the elasticity of amenities with respect to the number of residents, σ, using cross-sectional data. In this case, the equation that we estimate takes the form

$$\ln\left(\overline{B}_j\right) = b + \sigma \ln\left(R_j\right) + \varphi X_j + e_j,$$

where X_j is a vector of tract controls consisting of each tract's distance to sets of various fixed amenities in the Greater Detroit area. All distances are measured in driving time using the Google Maps API, in order to maintain consistent measures with our values of κ_{ij}. In particular, X_j consists of (the natural log of) the following controls:

- A tract's minimum distance to one of the tracts bordering the Detroit River or Lake St. Clair.
- A tract's distance to the census tract closest to Detroit Metropolitan Wayne County Airport.
- A tract's minimum distance to a tract containing or bordering a limited-access highway. This includes all segments of the interstate highways I-75, I-94, I-96, I-275, I-375, and I-696; all segments of the state highways M-14 and M-8; and certain segments of the state highways M-5, M-10, M-39, M-53, and M-59.
- A tract's minimum distance to a tract containing a Michigan state park or a Huron-Clinton Metropark. This consists of the following state parks: Belle Isle, Dodge No. 4, Maybury, Seven Lakes, and William G. Miliken. This measure also includes the following Huron-Clinton Metroparks: Indian Springs, Kensington, Lake Erie, Lower Huron, Lake St. Clair, Oakwoods, Stony Creek, Willow, and Wolcott Mill.
- A tract's minimum distance to a census tract containing one of the following four-year colleges and universities: Lawrence Technological University (founded in 1932), Madonna University (1937), Marygrove College (1927), Oakland University (1957), Rochester College (1959), the University of Detroit Mercy (1927), the University of Michigan-Dearborn (1959), and Wayne State University (1868).

As discussed in the main text, because R_j is endogenous in the above equation we use neighborhood productivity, A_i, as an instrument for R_j. Specification (1) of Table 3 in the main text shows that using A_i as an instrument and including all five controls in X_j gives an estimated σ of 0.635.

The tables below reproduce Tables 4 and 5 in the main text according to specification (1), with the sets of Best 22 tracts being recalculated under this specification. The main difference between the results shown below and the results shown in Table 4 in the main text is that the response in the number of residents is now slightly less pronounced and wages are in turn slightly higher under some of these policy experiments. Turning to policy outcomes, aggregate changes within Detroit proper in the table below are very similar to outcomes in Table 5 across specifications, although changes are slightly more pronounced in the treated tracts. In Greater Detroit, the effects of the policies are now less marked since there are smaller general equilibrium effects, but outcomes generally remain within 10 percent of our benchmark results.

Detroit	Benchmark	DFC	Best 22 Bus.	Best 22 Res.	Best 22 Pop.	All 52
Residents	126,430	131,506	134,821	135,200	135,276	139,448
Mean Wages, $	31,996	31,922	31,871	31,881	31,879	31,806
S.D. Wages, $	10,137	10,098	10,111	10,127	10,133	10,083
Mean Res. Rents, $/Sq. Ft.	1.47	1.42	1.43	1.43	1.43	1.37
S.D. Res. Rents, $/Sq. Ft.	0.64	0.65	0.64	0.64	0.64	0.64
Total Res. Rent, Mill. $	1,223	1,271	1,301	1,304	1,303	1,344
Total Bus. Rent, Mill. $	2,181	2,204	2,216	2,215	2,213	2,234

Table 24: Summary Statistics for Detroit Proper with $\sigma = 0.635$

	DFC	Best 22 Bus.	Best 22 Res.	Best 22 Pop.	All 52
Dev. Guarantee, Mill. $	41.735	71.170	73.556	72.805	107.199
Detroit Proper:					
Δ in Res. Rent, Mill.					
Total	47.980	78.409	81.009	80.282	120.604
Treated Tracts	46.665	76.299	78.493	77.474	117.050
Other Tracts	1.314	2.109	2.516	2.808	3.554
Δ in Bus. Rent, Mill.					
Total	23.054	34.958	33.689	32.199	52.343
Treated Tracts	10.231	8.991	5.984	4.536	22.530
Other Tracts	12.824	25.967	27.705	27.663	29.813
Δ in Population					
Total	5,076	8,391	8,770	8,846	13,018
Treated Tracts	4,828	8,000	8,352	8,413	12,402
Other Tracts	248	391	419	432	616
Greater Detroit:					
Δ in Res. Rent, Mill. $	53.991	88.345	92.599	93.267	137.378
Δ in Biz. Rent, Mill. $	56.232	92.018	96.449	97.145	143.094
Δ in Population	6,477	10,697	11,271	11,433	16,677

Table 25: Policy Outcomes with $\sigma = 0.635$

3.6 Residential Amenities Reflecting Local Tract Characteristics, Using Changes Over Time

As in the preceding section, our measure of neighborhood amenities is $B(R_j; j) = B_j R_j^{\sigma}$. Here we estimate the elasticity of amenities with respect to the number of residents, σ, using changes in amenities over time. This allows us to estimate the following equation:

$$\ln\left(\frac{\overline{B}_{j,t}}{\overline{B}_{j,t-1}}\right) = \tilde{b} + \sigma \ln\left(\frac{R_{j,t}}{R_{j,t-1}}\right) + \tilde{e}_j,$$

where t denotes 2014, our benchmark year, and $t-1$ denotes 2004, the earliest year for which data on residents, R_j, wages, w_i, and residential prices, q_j^r, are available. Using these variables (after adjusting wages and prices in 2004 for inflation), we can compute total amenities in 2004 using equation (26) in the main text.

Data on residents, R_j, and wages, w_i, in 2004 are obtained from the same sources as the corresponding data in 2014. In particular, the data on residents is available from the Longitudinal Employer-Household Dynamic (LEHD), Origin-Destination Employment

Statistics (LODES). Data on wages are determined primarily using the LODES data and also complemented with data from the ZIP Business Patterns.

In our benchmark, residential prices, q_j^r, in 2014 are determined using a variety of data sources, including CoreLogic and local assessors offices. However, for 2004 the only available data is from CoreLogic's Tax History database, and thus we calculate prices in 2004 using only CoreLogic data. In order to maintain consistent measures of prices, we recalculate 2014 residential prices using only CoreLogic price data, and then recalculate our measure of amenities, $\overline{B}_{j,t}$, for 2014 using these prices. In section 3.5.1, we show that recomputing the benchmark and the counterfactuals presented in the main text using CoreLogic prices for 2014 is relatively inconsequential for our main findings. In general, CoreLogic does not have price data available for all parcels in a tract, and of the non-vacant census tracts, 40 do not have any price data available for either 2004 or 2014 (or both). We exclude these census tracts when estimating equation (28) in the main text.

As mentioned in the main text, in order to instrument for changes in R_j we identify four auto plants that closed during the Great Recession: Chrysler's Detroit Axle Plant (closed in 2010), GM's Pontiac Assembly Center (2009), GM's Powertrain Livonia Engine Plant (2010), and Ford's Wixom Assembly Plant (2007). For each tract, we then calculate the log of its mean distance to the 4 census tracts containing those plants. Using only this mean distance as an instrument for changes in R_j gives the results displayed in the third column of Table 3 in the main text and produces an estimated σ of 0.531. As a second instrument we include the log change in neighborhood productivity, A_i, between 2004 and 2014, with A_i in 2004 calculated using our measures of wages, w_i, and workers, L_i, in 2004. Including both the mean distance to closed plants and the change in neighborhood productivity as instruments gives an estimated σ of 0.519, as seen in specification (4) of Table 3.

The tables below reproduce Tables 4 and 5 in the main text according to specification (4), with the sets of Best 22 tracts being recalculated under this specification. The gains to Detroit, in population and rents, are slightly smaller here than in the equivalent tables in the main text, and the gains are less concentrated in the treated tracts. Likewise, the sizes of the required development guarantees are somewhat smaller. Overall, however, the outcomes are very similar.

Detroit	Benchmark	DFC	Best 22 Bus.	Best 22 Res.	Best 22 Pop.	All 52
Residents	126,430	131,168	134,753	135,209	135,258	138,965
Mean Wages, $	31,996	31,926	31,869	31,874	31,875	31,809
S.D. Wages, $	10,137	10,102	10,117	10,130	10,132	10,089
Mean Res. Rents, $/Sq. Ft.	1.47	1.43	1.44	1.43	1.43	1.38
S.D. Res. Rents, $/Sq. Ft.	0.64	0.65	0.64	0.64	0.64	0.65
Total Res. Rent, Mill. $	1,223	1,268	1,300	1,303	1,303	1,339
Total Bus. Rent, Mill. $	2,181	2,203	2,217	2,216	2,215	2,233

Table 26: Summary Statistics for Detroit Proper with $\sigma = 0.519$

	DFC	Best 22 Bus.	Best 22 Res.	Best 22 Pop.	All 52
Dev. Guarantee, Mill. $	38.508	68.459	72.131	71.936	102.195
Detroit Proper:					
Δ in Res. Rent, Mill.					
Total	44.611	76.828	79.996	80.000	115.539
Treated Tracts	42.431	72.942	75.581	75.453	109.627
Other Tracts	2.180	3.886	4.416	4.548	5.912
Δ in Bus. Rent, Mill.					
Total	22.111	35.476	34.732	34.151	52.206
Treated Tracts	8.638	7.568	4.293	4.332	20.132
Other Tracts	13.473	27.908	30.440	29.819	32.074
Δ in Population					
Total	4,738	8,323	8,779	8,828	12,535
Treated Tracts	4,397	7,744	8,150	8,194	11,659
Other Tracts	340	579	628	635	877
Greater Detroit:					
Δ in Res. Rent, Mill. $	57.429	99.875	105.996	106.724	151.076
Δ in Biz. Rent, Mill. $	59.814	104.028	110.404	111.163	157.362
Δ in Population	6,893	12,125	12,925	13,040	18,332

Table 27: Policy Outcomes with $\sigma = 0.519$

3.6.1 Benchmark Tables Using CoreLogic Residential Prices

Below we reproduce Tables 4 and 5 in the main text recalculating residential prices, q_j^r, in 2014 using only CoreLogic data and using our benchmark measure of amenities, $B(R_j; j) = R_j^{\sigma_j}$. For the 20 tracts that do not have CoreLogic data on residential prices available for 2014, we use the same measures of residential prices calculated in the benchmark calculation of prices. Here, we do not change the sets of Best 22 tracts from the sets used in creating the main text tables. The mean residential rents per square foot

in Detroit are about 20% higher here than in the main text, reflecting the fact that residential prices calculated solely using CoreLogic data are generally higher in most tracts in Detroit than prices calculated using data from the Detroit Assessor's Office, MCM, SEMCOG, and CoreLogic. Otherwise, the results are remarkably similar.

Detroit	Benchmark	DFC	Best 22 Bus.	Best 22 Res.	Best 22 Pop.	All 52
Residents	126,430	131,467	134,783	135,282	135,308	139,460
Mean Wages, $	31,996	31,921	31,869	31,875	31,875	31,801
S.D. Wages, $	10,137	10,098	10,111	10,130	10,132	10,082
Mean Res. Rents, $/Sq. Ft.	1.79	1.72	1.73	1.73	1.73	1.65
S.D. Res. Rents, $/Sq. Ft.	0.83	0.84	0.83	0.83	0.83	0.84
Total Res. Rent, Mill. $	1,223	1,270	1,301	1,304	1,303	1,343
Total Bus. Rent, Mill. $	2,181	2,205	2,217	2,216	2,215	2,236

Table 28: Summary Statistics for Detroit Proper with CoreLogic Residential Prices

	DFC	Best 22 Bus.	Best 22 Res.	Best 22 Pop.	All 52
Dev. Guarantee, Mill. $	40.608	68.534	71.352	70.915	103.993
Detroit Proper:					
Δ in Res. Rent, Mill.					
Total	47.463	77.821	80.709	80.449	120.404
Treated Tracts	45.855	75.230	77.482	77.100	116.077
Other Tracts	1.608	2.591	3.227	3.349	4.327
Δ in Bus. Rent, Mill.					
Total	23.549	35.976	34.558	33.823	54.376
Treated Tracts	9.890	8.682	4.473	4.509	22.451
Other Tracts	13.659	27.294	30.085	29.314	31.925
Δ in Population					
Total	5,037	8,353	8,852	8,878	13,030
Treated Tracts	4,752	7,900	8,351	8,373	12,312
Other Tracts	286	453	501	505	718
Greater Detroit:					
Δ in Res. Rent, Mill. $	58.834	96.573	102.954	103.345	151.258
Δ in Biz. Rent, Mill. $	61.277	100.589	107.236	107.643	157.552
Δ in Population	7,061	11,689	12,564	12,641	18,348

Table 29: Policy Outcomes with CoreLogic Residential Prices

3.7 Beyond Detroit: Results for Greater Detroit

While in the main text we present findings for how Detroit proper responds to different counterfactuals, these findings are in part driven by data from the surrounding counties to more accurately capture, among other factors, workers commuting in and out of Detroit proper. We here present our findings as they apply to greater Detroit. Because individuals who live inside the counties of Macomb, Oakland, and Wayne but commute outside these areas (or vice-versa) are necessarily excluded from our data, results for areas close to these counties' borders are approximate.

Greater Detroit	Benchmark	DFC	Best 22 Bus.	Best 22 Res.	Best 22 Pop.	All 52
Residents	1,245,418	1,252,461	1,257,081	1,257,958	1,258,035	1,263,719
Mean Wages, $	33,834	33,799	33,775	33,773	33,773	33,742
S.D. Wages, $	8,182	8,171	8,175	8,181	8,181	8,167
Mean Res. Rents, $/Sq. Ft.	5.50	5.41	5.42	5.42	5.42	5.30
S.D. Res. Rents, $/Sq. Ft.	3.79	3.81	3.81	3.81	3.81	3.84
Total Res. Rent, Mill. $	1,223	1,270	1,301	1,304	1,303	1,343
Total Bus. Rent, Mill. $	2,181	2,205	2,217	2,216	2,215	2,235

Table 30: Greater Detroit Outcomes

	DFC	Best 22 Bus.	Best 22 Res.	Best 22 Pop.	All 52
Dev. Guarantee, Mill. $	41.057	70.367	73.243	72.805	106.001
Whole Sample:					
Δ in Res. Rent, Mill.					
Total	58.675	96.348	102.751	103.142	150.846
Treated Tracts	45.796	75.158	77.443	77.064	115.893
Other Tracts	12.879	21.190	25.307	26.078	34.953
Δ in Bus. Rent, Mill.					
Total	61.111	100.355	107.024	107.431	157.123
Treated Tracts	9.857	8.656	4.469	4.505	22.370
Other Tracts	51.254	91.698	102.555	102.926	134.753
Δ in Population					
Total	7,043	11,663	12,540	12,617	18,301
Treated Tracts	4,746	7,893	8,347	8,369	12,296
Other Tracts	2,297	3,770	4,193	4,248	6,005

Table 31: Development Guarantees and Policy Outcomes, Greater Detroit Results

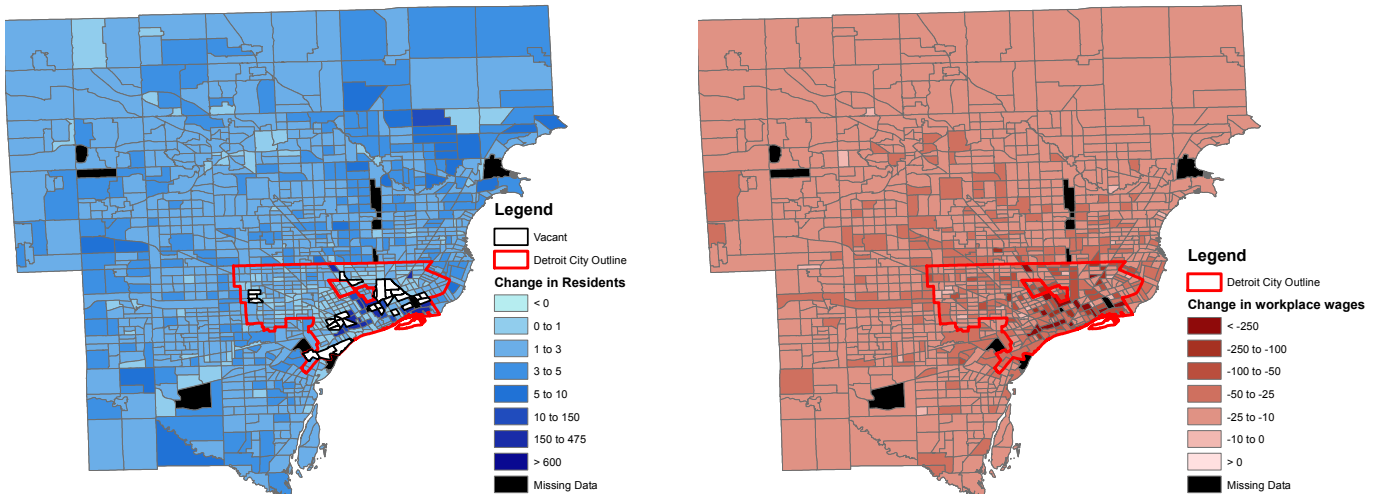

Figure 13: DFC, Change in Residents and Workplace Wages in Greater Detroit

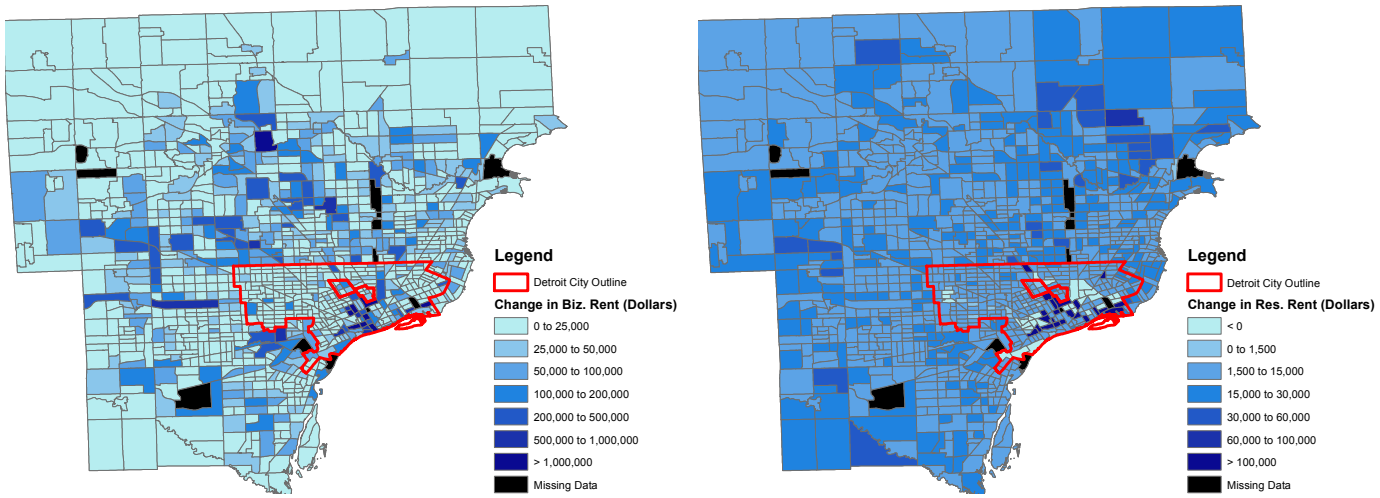

Figure 14: DFC, Change in Business and Residential Rent in Greater Detroit

4 Glossary

4.1 Buildings, Safety Engineering and Environmental Department

The Buildings, Safety Engineering and Environmental Department (BSEED) of Detroit, Michigan is responsible for enforcing permits filed with the city government. BSEED maintains an extensive database of permits, containing data for over 45,000 permits. BSEED contains information on location, date issued, date completed/expired, legal

use, price, parcel size, and the contractor executing the permit. Examples of permit types include, alterations, repairs, and new construction. Visit https://data.detroitmi.gov/ for access to publicly available data.

4.2 CoreLogic

CoreLogic, Inc. is a private company that collects public and proprietary data from local assessment offices, tax collectors, state agencies, etc., geocodes, and packages the information for a variety of interested parties. Specifically, we use data from their Tax and Tax History database, which contains information from local governments used for calculating property taxes. The data is reported at the parcel level, and contains information on location, assessment value, number of bathrooms, and most recent sales price.

4.3 Detroit Demolition Program

The Detroit Demolition Program is a government initiative to remove publicly-owned (and in some cases privately-owned) residential, commercial, or vacant structures, that pose a significant risk to public safety and have a negative impact on the surrounding community. Demolitions are primarily funded using the federal Hardest Hit Funds, with the current total number of demolitions exceeding $10,000$, $3,271$ of which occurred during 2016. There are currently another $2,500$ demolitions under way, with an average cost of residential demolition being approximately $12,600$ dollars in 2016. The city of Detroit provides an interactive mapping tool and an extensive database concerning each demolition project. The database includes information on location, the contractor performing the demolition, the price, and the date of demolition. Visit http://www.detroitmi.gov/demolition for more information.

4.4 Detroit Future City

Detroit Future City (DFC), launched in 2010, is an amalgamation of visions for the city of Detroit. The DFC Strategic Framework provides guidance for achieving short- and long-term policy objectives "inviting diverse input from technical experts within Detroit and around the world and, most importantly, the community experts and everyday citizens who would be most affected by its recommendations." In particular, DFC provides guidelines for five pillars of Detroit's economic resurgence: economic

growth; land use; city systems; neighborhoods; and land and building assets. Visit https://detroitfuturecity.com/framework/ for access to the full report.

4.5 Elizabeth Mullen Bogue files

The Elizabeth Mullen Bogue files were created by key punching the original Census records, done by Elizabeth Mullen Bogue, under the direction of Dr. Donald Bogue. The punchcards were converted into data files and obtained by the Inter-university Consortium for Political and Social Research (ICPSR) from the National Archives and Records Administration (NARA).

4.6 HUD-USPS Zip Crosswalk files

The US Department of Housing and Urban Development (HUD) provides a crosswalk that allows the user to convert data between Zip Codes, established by the United States Postal Service (USPS), and Census geographies (e.g. census tracts, counties). The crosswalk contains information on the distribution of addresses in a Zip Code that belong to a particular census tract, by property type (i.e. residential or commercial). The crosswalks are derived by the USPS and updated every quarter, starting in 2010. According to HUD, "by using an allocation method based on residential addresses rather than by area or by population, analysts can take into account not only the spatial distribution of population, but also the spatial distribution of residences. This enables a slightly more nuanced approach to allocating data between disparate geographies."

4.7 Minnesota Population Center

The Minnesota Population Center (MPC), through their partnership with Ancestry.com, are responsible for the digitizing and availability of historical census data prior to 1940. Furthermore, MPC makes available aggregated census data for census records not currently made available to the public at various geographical units. MPC's National Historical Geographic Information System (NHGIS) provides historical GIS shapefiles that allow us to map the data in ArcGIS.

4.8 Motor City Mapping Project

"In November 2013, the Detroit Blight Removal Task Force, in partnership with Michigan Nonprofit Association, Data Driven Detroit, and Loveland Technologies, conducted

a physical survey that gathered property condition data for all 380,000 parcels in the Detroit." The Motor City Mapping (MCM) survey created a comprehensive database of detailed information on the occupancy status and condition of all properties and parcels in Detroit. One of the key contributions of the MCM survey is to identify properties and parcels that meet the legal definition of "blighted," or are likely to become blighted over the next few years. In general, a property or parcel is considered "blighted" if it meets at least one of the following criteria: is a public/attractive nuisance; is a fire hazard or otherwise dangerous; has had utilities and other public services removed; is tax-reverted; owned or under control of a land bank; has been vacant for five consecutive years; poses an immediate health or safety threat. Additionally, any property that is open to the elements or on BSEED's demolition list is also considered to be blighted. Visit http://report.timetoendblight.org/ for the full report on the MCM survey.

4.9 Southeast Michigan Council of Governments

The Southeast Michigan Council of Governments (SEMCOG), formed in 1968, is a regional planning partner that supports technical and data analysis to promote economic development to its local member governments. SEMCOG provides support in a wide range of areas including water quality, transportation system efficiency, and community revitalization. SEMCOG provides numerous datasets and GIS shapefiles on soil quality, building footprints, traffic volumes, and more. Specifically, we use the building footprints dataset, which "represents the digital footprint of each building in Southeast Michigan, as of April 2015, along with associated attributes of each building. The building footprints were originally compiled using heads-up digitizing of 2010 aerial photography, and then attributed with additional information on their location and physical characteristics using a variety of sources." Visit http://maps-semcog.opendata.arcgis.com/ for access to publicly available data.

4.10 ZIP Business Patterns

"Business Patterns is an annual series that provides subnational economic data by industry. This series includes the number of establishments, employment during the week of March 12, first quarter payroll, and annual payroll."

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