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BRIGHT MINDS, BIG RENT: GENTRIFICATION AND THE RISING RETURNS TO SKILL

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Bright Minds, Big Rent: Gentrification and the Rising Returns to Skill
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ABSTRACT

In 1980, housing prices in the main US cities rose with distance to the city center. By 2010, that relationship had reversed. We propose that this development can be traced to greater labor supply of high-income households through reduced tolerance for commuting. In a tract-level data set covering the 27 largest US cities, years 1980-2010, we employ a city-level Bartik demand shifter for skilled labor and find support for our hypothesis: full-time skilled workers favor proximity to the city center and their increased presence can account for the observed price changes, notably the rising price premium commanded by centrality.

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I know things will get better
You'll find work and I'll get promoted
We'll move out of the shelter
Buy a bigger house and live in the suburbs

Tracy Chapman, Fast Car, 1988

The truth is that we are living at a moment in which the massive outward migration of the affluent that characterized the second half of the twentieth is coming to an end.

Ehrenhalt, The Great Inversion, 2013

1 Introduction

In 1980, US central-city residential real estate carried only a slight price premium. In fact, prices were higher beyond than within 10 miles of city centers. Fast forward 20 years and the center commands the highest prices, whence they fall sharply with distance for the first five miles and then flat lines. This pattern remains in 2010, unscathed by the 2007 housing market correction (Figure 1).

What lies behind this urban renewal, or "gentrification"? The literature has noted a number of signature features, such as depressed initial prices; and proximity to mass transportation and amenities [Kahn, 2007, Glaeser et al., 2008, 2012, Guerrieri et al., 2013].

Remains the question why centrality has increasingly come to be *the* local amenity. Gyourko et al. [2013] tied gentrification to a growing number of high-income households combined with inelastic housing supply, the case in city centers by necessity but also elsewhere courtesy of ordinances and the like [Ortalo-Magne and Prat, 2014]. However, the US economy grew at a healthy clip throughout the 1950s and 1960s, a time of urban decline and expansion of the suburbs [Jackson, 1985]. Granted, income growth was more evenly distributed, but the top 5 percent of earners have been increasing

their share of income since the early-1950s and the top 1 percent since the mid-1960s [Kopczuk et al., 2008, figure 2B].

The premium on central location seems to reflect more than a filling-up of scarce space by high-income households. City-dwellers that ten, twenty years ago would have headed straight for the suburbs at the first sign of baby now stay put despite cramped living and high rents.[1]

This paper proposes that the roots of gentrification can be found in the shrinking leisure of high-income households. This time scarcity, we hypothesize, has propelled centrality to the top of the local amenities list.

Between 1965 and 2005, leisure grew but not for the college educated. In the 1985-2005 period, the contraction in leisure among college men was substantial enough to result in an overall reduction for men (leisure grew among non-college men); for women, leisure contracted across the board but at the twice the rate for college women compared to non-college women [Aguiar and Hurst, 2009, table 2-2].

Aguiar and Hurst [2007, 2009] identified rising labor supply of the skilled to lie at the core of this development. Census data bear this out. The fraction college graduates who worked full time started to rise in the 1970s after three decades of barely moving, Figures 2 and 3. Unsurprisingly, the increase was more pronounced for women. Since 1990, there has also been a notable increase in the fraction (men and women) working 50+ hours per week (or "long hours" to use the terminology of Kuhn and Lozano [2006]).[2]

Long hours render non-work time scarce, planting low-utility activities such as commuting in the cross-hairs. One of the simplest ways to control commuting is to live close to work, which for skilled workers may mean the city center. There, by definition, land is scarce and higher demand translates into higher land rents. In time, local amenities adjust, boosting the attractiveness of the locality, further fueling the gentrification process. The core driver, however, we propose, can be found in the labor

[1] The October 23 2015 *New York Times* article "Growing Families That Stay Put" perhaps ironically gave "children" as the reasons for why New York City families choose to not move out of cramped apartments.

[2] Use of the Current Population Surveys (CPS) allows for finer education categories (but limits the time period). Distinguishing between just college and a graduate degree, the skill-hours gradient still holds. For men, the difference is particularly pronounced at the 50+ hour margin, while for women it is evident also at the 40+ hour margin, Appendix Figures A1 and A2.

market processes that have produced a corps of high-income-low-leisure individuals who live as singles or through assortative matching form dual-earner households.

Greater labor supply of the skilled is plausibly related to rising returns to skill [Katz and Murphy, 1992, Juhn et al., 1993, Autor et al., 2008], a development linked to the arrival of microprocessors in the early 1970s [Greenwood and Jovanovic, 1999, Hobijn and Jovanovic, 2001]. The ensuing Information Technology Revolution has been a boon to skilled employment growth in cities that were initially skilled [Berry and Glaeser, 2005, Moretti, 2013], a path dependency consistent with rapid technological change [Beaudry et al., 2010].

Like a number of recent papers, e.g., Diamond [Forthcoming], Moretti [2013], we will use college-employment demand shifters in combination with the 1970 city-level industry structure to generate an arguably exogenous, city-level, skilled labor demand shifter. The so called Bartik demand shifter helps us isolate our proposed labor-market driven explanation from alternative explanations. For instance, high-income households may always have valued central city living but in the past they were deterred by racial antagonism or high crime [Glaeser et al., 2001]. Another possibility is reverse causality, higher rents prod households to supply more labor [Johnson, 2012]).

Our hypothesis concerns the within-city distance-gradient of housing prices and our empirical analysis will be performed at the tract level. To create create tract-level variation we interact the city-level Bartik measure with the tract's (population weighted centroid) distance to the city center. In other words, we allow the city-specific demand growth to propagate differentially according to the tract's distance to the center.

Our main data set is a tract-level data set constructed from restricted-use US Census micro-data covering the period 1980-2010. We use tract geocodes to calculate (centroid) distance to a point in the central business district, and we will refer to this point as the CBD. Geographically, we limit our sample to cities that were in the top-20 (population wise) either in 1970 or 2010. There were 27 such cities[3] which for simplicity we will refer to as "top-20." We include tracts within 35 miles of the CBD regardless of whether

[3]They are: Austin, Baltimore, Boston, Charlotte, Chicago, Cleveland, Columbus, Dallas, Detroit, El Paso, Fort Worth, Houston, Indianapolis, Jacksonville, Los Angeles, Memphis, Milwaukee, New Orleans, New York, Philadelphia, Phoenix, San Antonio, San Diego, San Francisco, San Jose, St. Louis and Washington DC. Their respective center points are detailed in Appendix Table A2.

they were in the same same city (or state) as the CBD. For the purpose of this paper, the terms cities or metropolitan areas will be used interchangeably to refer to these geographic entities.

To capture the rise of the high-income-low-leisure demographic, we focus on full-time workers with a college degree among ages 25 to 55. This age group was chosen to capture prime working ages, the years after college completion but before retirement concerns. These ages are also key home buying ages.[4]

Throughout, we will control for a battery of fixed effects. Our preferred specification has city-year fixed effects and city-specific distance controls. City-year fixed effects absorbs any city-wide changes, including city-level labor demand shifts or credit expansion (for a recent paper on the role of the latter, see Favara and Imbs [2015]). City-specific distance controls stand in for tract fixed effects (but we will see that our findings hold in a constructed tract panel data set that allows for tract fixed effects).

Allowing the Bartik demand shifter to have a differential impact on tracts 0-3 miles, 3-10 miles, 10-20 miles or 20-35 miles from the CBD we find the effect to be concentrated near the center: almost three times stronger in the 0-3 mile core compared to the contiguous 3-10 mile ring and almost seven times stronger than in the more distant 10-20 mile ring (the 20-35 mile ring served as the reference area). The implied price changes from the reduced form estimates replicate very closely the actual level and distance gradient of housing price increases.

First stage regressions reveal a strong relationship between full-time skilled workers and the Bartik demand shifter. The relationship is strongest close to the CBD, and then attenuates, the exact shape of the decline varying somewhat with the set of fixed effects.

Turning to the relationship between full-time skilled workers and housing prices, we find empirical support both in OLS regression analysis and in instrumented results using the Bartik demand shifters. Full-time skilled workers not only chose to locate close to the CBD, their presence there has a positive impact on prices. The implied price changes from the IV analysis suggest that the growth of full-time skilled workers can capture the 1980-2010 housing price changes (Figures 11-12).

[4]National Association of Realtors [2014].

Some of the cities with the steepest price increases have also seen the largest declines in crime, New York City being a case in point with crime levels down by two-thirds from their late-1980s levels. To investigate the role of improved public safety, we split our cities into two equal sized groups, one with cities that saw large declines in crime and one with cities that saw modest declines or increases over the 1985-2012 period.[5] Qualitatively, results hold in both groups. Quantitatively, the effects were also similar when fulltime was measured at 50 hours, but at the weaker measure of 40 hours, the high-decline cities saw a stronger effect than the low-decline cities. As a last robustness check, we cross walk tracts to create a tract-level panel data set, allowing us to include tract fixed effects, an inclusion that yields results similar to those obtained using city-distance fixed effects. Further, we split tracts according to their percent black population in 1980 (above or below the 1980 median) and find results to be similar in the two samples, suggesting that the found results are not predicated on a particular racial composition.

Finally, Census data allow us check our premise that skilled jobs are disproportionately located in the central city, and we confirm this to be the case. Unskilled jobs, on the other hand, are more dispersed and increasingly so. As a corollary, we expect commuting time, especially for the skilled, to increase with residence distance to the central city. We find that to be the case for men throughout the studied period and increasingly also for women, consistent with the latter's greater labor force attachment.

The remainder of the paper is organized as follows. Section 2 gives further background and literature review. Section 3 describes our empirical strategy and data set. Section 4 presents the descriptives and results. Section 5 concludes.

2 Background and Existing Literature

This paper's hypothesis turns on the increasing hours worked by high-income households, which, to paraphrase Ehrenhalt [2013], has given rise to an affluent class who treat leisure as their most prized commodity.

[5]The years for which crime statistics are readily available. `http://www.ucrdatatool.gov/Search/Crime/Local/TrendsInOneVarLarge.cfm`

Individual v. Household Labor Supply We have chosen to focus on individual rather than household labor supply. Obviously, labor supply is a household decision. However, the trends in household formation and labor supply behavior mean that the distinction between individual and household labor supply behavior is fading.

First, there are more single headed households also among the skilled. While the skilled tend to marry, they do so later. The median age of first marriage among college educated was 28 in 2008, up from 23 in 1970; an additional five cohorts of college educated singles.[6]

Second, among couples, the cross-wage elasticity of women's labor supply is shrinking [Heim, 2007]. That is, married women are increasingly behaving as if they were single. Later marriage and higher risk of divorce [Edlund and Pande, 2002, Fernndez and Wong, 2014] have reduced the economic value of marriage to women pushing women into the labor force. Rising returns to skill figure prominently among pull factors.

As skilled women have become more attractive on the labor market, their currency on the marriage market has also appreciated, at least that is one reading of the greater degree of positive assortative mating evident in US data [Greenwood et al., 2014]. Positive assortative mating can boost married women's labor supply since the women who can most afford to stay home are also the ones leaving the most money on the table.

In other words, the increase in women's labor supply is mainly driven by married women, e.g., Juhn and Murphy [1997], DiCecio et al. [2008], McGrattan and Rogerson [2008], Schwartz [2010]. Married women's working has given rise to more dual-earner households. Although high-income dual-earner households are part of the demographic change we hypothesize have fed gentrification, the rise in high-income dual-earner households is one that is captured by the rise in skilled individuals' labor supply. High-income dual-earner households have interesting implications for the types of apartments in demand (larger) and amenities sought after (family friendly?) and thus bears on urban development. However, as far as housing prices are concerned, their impact may be captured by individual-level measures of labor supply.

[6] `http://www.pewsocialtrends.org/2010/10/07/the-reversal-of-the-college-marriage-gap/`

Drive 'Til You Qualify Our paper is in the spirit of what Mieszkowski and Mills [1993] called the "natural evolution theory of urban development" augmented with labor supply and household commuting decisions [White, 1977, Madden and White, 1980, Madden, 1980]. Rappaport [2014] explicitly considered utility from leisure, thereby sharpening the attention on commuting time. Empirically, his study made the case for the relevance of the monocentric city model for mid-sized US cities, focusing on Portland, Oregon.

While our paper stresses labor market changes, it is also quite possible that commuting itself has become onerous. On average, travel time for workers in the US increased by 20 percent between 1980 and 2009, or eight minutes per day [McKenzie and Rapino, 2011].

Rail transportation avoids traffic congestion, and can be combined with working. Interestingly, Kahn [2007] found proximity to "walk-and-ride" stations to be particularly conducive to gentrification in his 14-city study using tract level panel data.

Centrality and Other Amenities Jacobs [1961] drew attention to the economies of scale and scope offered by the city center and their importance for human capital intensive activities. Positive externalities in the "knowledge economy" create centrality and thus land scarcity around central points. Restriction on construction and the durable nature of real estate further contributes to steepen the housing supply curve in the center.

Davis and Heathcote [2007] decomposed housing prices into two components, the replacement cost of the structure and the land rent. They found that since the 1950s, residential land prices have grown at twice the rate of per capita income and (because of its low supply elasticity compared to structures) can account for most of the variation in housing prices; findings consistent with demand for residential real estate being increasingly center focused.

Thus semi-fixed supply of housing and non-zero transportation time link the housing market to the labor market. As wages have seen increased dispersion, so have housing prices [Van Nieuwerburgh and Weill, 2010]. Further, the increase in the wage dispersion has been driven by the right tail, which can lead to runaway price growth

in areas with particularly inelastic housing supply, viz. city centers [Gyourko et al., 2013]. A difference with Gyourko et al. [2013] however, is our focus on the importance of centrality. In other words, our hypothesis does not predict "superstar" suburbs.

Rents tend to be higher in high-wage cities, a fact that compresses real-wage inequality [Moretti, 2013]; although the possibilities of better amenities (including more skill building jobs [Glaeser and Mare, 2001], better partner search or co-location possibilities [Costa and Kahn, 2000, Compton and Pollak, 2007]) work in the opposite direction. Diamond [Forthcoming] quantified these effects by estimating a structural model of endogenous location choice and amenities.

While the prototypical gentrified neighborhood was wanting in most amenities save centrality, e.g., McDonald [1986], centrality is clearly not the sole amenity of importance. Guerrieri et al. [2012, 2013]'s model of gentrification turned on proximity to rich neighborhoods. As a city experience a positive labor demand shock, poor neighborhoods close to rich neighborhoods gentrify. Conversely, a negative labor demand shock (viz. Detroit) leads to a de-gentrification of marginal neighborhoods (those in between rich and poor neighborhoods). The proposed project complements this narrative by tying ground-zero to commuting time. Further, the suburbanization of the 1960s, a time of growing affluence, pose a challenge to Guerrieri et al. [2012, 2013] but is consistent with ours (female labor-force participation among high-income households was low in that period, rendering suburban residence ideal).

Monocentricity need not be based on concentration of economic activity. The city center could be thus because of public sector administration, educational or cultural institutions. Cities have seen a revival in Europe as well and in a recent paper Saint-Paul [2015] argued that gentrification can be tied to the knowledge economy which has moved skilled jobs to the city center.

Families and Public Schools During the study period, several policies aimed at facilitating school choice (and quality) such as charter schools and vouchers were introduced, which may have helped tip the balance in favor of city location.

However, one reason school quality may be secondary for gentrification is the high land rents in the central city. This cost disadvantage combined with the unfavor-

able dependency ratio of families with young children suggest that the city would be unattractive to large families. In other words, the childlessness that characterized early gentrifiers (e.g. yuppies or gays [Black et al., 2002]) may continue to dominate gentrification, quite independently of the quality of public schools.[7]

Another reason is that public school quality may be endogenous to the local demographics.

One way for us to examine the importance of public school quality is to study the age distribution. To preview results, we find that the CBD is no country for the young. These statistics suggest a limited role of the quality of public schools in gentrification.

Crime A local amenity of particular interest is crime. Violent crime rose between 1960 and 1990, and then declined.[8]

Does the decline in crime confound our explanation of gentrification? Clearly, the reduction in lawlessness has made US cities immeasurably more livable. On the other hand, from gentrification alone we would expect a reduction in crime, both because of a less crime prone demographic and higher demand for law and order; Diamond [Forthcoming] found that greater city level demand for skilled labor reduced crime.

We also note that European cities did not experience a level or concentration of crime in the inner cities anywhere near that of the US in the 1970s or 1980s but have experienced similar, core-centered, urban renewal, e.g., Carpenter and Lees [1995], Boterman et al. [2010], Saint-Paul [2015].

Still, the crime question is hard to ignore. To somewhat address this question we split our sample cities into two groups according to whether above or below the (population weighted) median crime reduction over the 1985-2012 period. To anticipate results, our main findings hold in both samples (Table 8).

[7] Incidentally, in a survey of home buyers, quality of schools came in only 5th among factors influencing neighborhood choice, after quality of neighborhood; *convenient to job; overall affordability*; convenient to friends/family [National Association of Realtors, 2014, exhibit 2-7, emphasis added].

[8] The origins of its rise and fall are debated. A non-exhaustive list includes the removal of school prayers, abortion legalization [Donohue and Levitt, 2001, Foote and Goetz, 2008], more aggressive and targeted policing, greater incarceration rates, electronic surveillance, ATMs and credit cards, the crack epidemic, and environmental factors such as lead exposure [Reyes, 2007].

Race Residential location patterns in the recent past have evidenced a high degree of taste for racial segregation, especially along the white-black demarcation line [Schelling, 1969, Cutler et al., 1999, Card et al., 2008]. Card et al. [2008] documented thresholds for minorities beyond which white flight took place, so called tipping points, and Aaronson [2001] found high racial persistence. This literature suggests that gentrification may be slower in areas with a large initial black population. Therefore, we construct a panel data set and split tracts by their 1980-level percentage black. We find similar results in the two samples (Table 8), suggesting that our proposed mechanism is not predicated on any particular racial composition.

3 Data and Empirical Strategy

Our primary data set is drawn from the decennial censuses of 1980, 1990 and 2000, and the American Community Survey (ACS) pooled 2008-2012 sample (which offers sufficient sample size). The chosen level of aggregation is the census tract. The Census writes: "Census tracts generally have a population size between 1,200 and 8,000 people, with an optimum size of 4,000 people."[9] For each tract, we aggregate individual- or household-level information and calculate the distance to the city center (by matching the tract to its centroid latitude and longitude).

Measures of housing prices are generated using self-reported estimates for owner-occupied single-family homes with two or three bedrooms. We use households no more than ten years in the current residence on the assumption that owners of more recently transacted units would be more knowledgeable about going market price.[10] The restriction to two- or three-bedroom single-family homes was done in order to obtain a price that refers to comparable units while preserving sample size.

We focus on ages 25-55, ages often used delineate the prime-age population.

Further details on data set and variable construction are in the Data Appendix.

[9] `http://www.census.gov/geo/reference/gtc/gtc_ct.html`

[10] Including all households yield similar results.

3.1 Cities

We focused on the 27 cities which were in the top-20 either in 1970 or 2010. The list is topped by New York City in both years and the number 20 spot is taken by Phoenix and Memphis in 1970 and 2010 respectively.

We limit our sample to tracts within 35 miles of the city center point or "CBD" (detailed in Table A2). This restriction is arbitrary but arguably delineates a commutable area, the outer reaches of which would be about an hour away from the center For our city sample and the years 1980, 1990, 2000 and 2010, we have about 65 thousand tract-year observations, or an average of 600 tracts per city and year.[11]

For details on how city centers were picked, please see the Appendix.

3.2 Bartik demand shifter

We used the public use version of the decennial censuses (IPUMS) to calculate the city-specific demand shifter for skilled employment from the national growth rates of employment of college workers in industry h, excluding the city in question, $-j$, weighted by each industry's employment share in city j in 1970. The base year 1970 was chosen because the IT revolution and the rise in wage inequality (returns to skill) date to the ensuing decade [Beaudry et al., 2010].

Specifically, focusing on ages 25-55, we construct our Bartik demand shifter for skilled labor demand for city j and year t as:

$$Z_{jt} = \frac{1}{N_{j,1970}} \sum_{h}^{41} n_{h,j,1970} \times (\ln n_{h,-j,t} - \ln n_{h,-j,1970}), \tag{1}$$

where

$N_{j,t}$ is the number of workers in city j and year $t = 1980, 1990, 2000, 2010$,

$n_{h,j,t}$ is the number of college educated workers in industry h, city j, year t,

$n_{h,-j,t}$ is the number of college workers in industry h and year t, excluding city j. In words, the first factor is the 1970 city specific industry share in 1970; the second factor is the logged national growth, excluding city j, for that industry in terms of college

[11] For disclosure reasons, the sample size is rounded.

workers. Thus, Z_{jt} can be interpreted as the share of employment in city j predicted to be held by college educated workers.

Throughout the studied period, Z_{jt} is book-ended by San Antonio and Washington DC. In 1980, San Antonio had a predicted share of college educated workers of 9 percent compared with DC's 23 percent. Thirty years later, 2010, those numbers were 18 and 46 percent respectively.

The Bartik measure is city specific and detailed in Table A2.[12] We allow the city-specific demand shifter to propagate differentially through the city by interacting it with a function of distance to the city-center. We expect the demand shift to operate more strongly close to the CBD, where jobs are concentrated (an assumption we will confirm) and decline thence.

4 Analysis

We start by presenting descriptive statistics (means) for each year by distance categories 0-3, 3-10, 10-20, and 20-35 miles from the CBD, and in a series of graphs showing smoothed polynomials based on 1-mile distance intervals. We will employ the following notation: BA- for less than four-year college, BA for at least four-year college but no advanced degree, MA+ for advanced degree, and BA+ for BA and MA+.

House prices Between 1980 and 2010, housing prices in the top-20 cities rose by 30 percent from 92.5 to 120.5 thousand 1980 constant dollars for a two-or-three bedroom one-family home. Turning to price changes by distance to the CBD and we see that price increases were higher in more centrally located tracts. In the core (0-3 miles), prices more than doubled. In tracts 3-10 miles out, prices rose by 60 percent, whereas price increases were a mere 10 and 6 percent in tracts 10-20 and 20-35 miles out, respectively. In fact, the price profile flips. In 1980, prices in the periphery are 50 percent higher than in the center. By 2010, prices in the center are 40 percent higher than in the periphery, Table 1 and Figure 1.

[12] Except Dallas-Fort Worth, coded as one city in the IPUMS.

Full-time skilled workers We let $FT(h, e)$ denote the fraction of adults 25-55 who worked more that $h, h = 40, 50$ hours per week and had education $e, e = BA+, MA+$.

The fraction of adults 25-55 who worked full-time and had college degree increased in our top-20 cities throughout the period, a development driven by women, Table 1 and Figures 4 and 5.[13]

As for location, in 1980, $FT(40, BA+)$ rose with distance to the city center, while $FT(40, MA+)$ declined slightly. In 2010, the population in the center was significantly higher in the city center than the periphery, by 24 and 50 percent for $FT(40, BA+)$ $FT(40, MA+)$ respectively. The growing proclivity to favor the city center is even more pronounced among those working long (50+) hours, Table 1.[14]

Breaking down residence location by gender, we see that BA men working full time were more likely to live away from the center than either skilled women or MA+ men, Figures 4 and 5.

Location of jobs, distance to the CBD To investigate our premise that the skilled work in the city center, we graph the distribution of jobs held by adults 25-55 (not conditional on hours) by the education level of the worker, Figure 6. We see that all jobs are concentrated in the city core, but more so for the skilled than the unskilled. Further, while there has been a "suburbanization" of jobs, it is particularly pronounced for the unskilled: unskilled jobs decreased within 7 miles of the city center and grew outside of that ring. Skilled jobs grew throughout.

Commuting time Average time spent commuting rose by 15 percent over the study period [McKenzie and Rapino, 2011, figur 3]. Urban sprawl may be a factor. However, as Figures 7-8 show, commuting time for workers at any given distance to the CBD has increased, and the increase is in the range seen for the nation as a whole.

Turning to commuting patterns by distance to the CBD, we see that the BA+ group spend more time commuting than the BA- group, suggestive of the importance of skill match and concentration of skilled jobs in the CBD, Figure 9. Men spend more time commuting than women, but the difference narrowed over the period. The greatest

[13] Also true nationally for MA+ women working 40+ hours, see Appendix Table A1.
[14] Meanwhile, unskilled full-time workers moved away from the center, Figure A3.

increase in commuting time is seen for BA women living at the outskirts. In 1980, they seem to work locally, whereas by 2010 the catchment area appears to have widened, consistent with a greater weight given to the skill match, Figure 8.

Age composition We now turn to the age distribution by distance. We find that although urban revival has been tied to hipsters and empty nesters, the prime age population dominates the city core, a tendency that increased over the study period, Figure 10. In 1980, their share of the population was j-shaped, bottoming out around 4 miles from the CBD. In 2010, the j had fallen on its back – the share decreased monotonically with distance, the sharpest decline being within the first five miles of the CBD.

While young adults, 19 to 24 years old, have long favored the central city, their presence decreased over the study period. Thus, this demographic does not seem to be a prime driver of gentrification, perhaps not surprising considering their limited purchasing power compared to the 25-55 age group.

As for ages 56 and above, this group has increased its presence in the population overall but the growth in this demographic is concentrated 10 miles out of the CBD. Within 10 miles of the CBD, there is a decrease. This was true of both the 56-65, and the 66+ population, Table 1.

As regards children 0 to 18 years old, their share has declined nationally and in our sample. The declined is particularly pronounced close to the city center, suggestive of a limited role for the quality of public schools in shaping gentrification.

Turning to the fraction children in private school and we find that a higher fraction of children attend private school in tracts close to the CBD and there was an increased between 1990 and 2000, but declined between 2000 and 2010 (Figures A4-A5). Two countervailing forces are likely at play. From a more affluent demographic close to the CBD we would expect a higher fraction of children attending private schools. On the other hand, the same demographic changes likely result in improved public schools.

The most striking change, however, is the erosion of the hump in private school enrollment about 10 miles out of from the CBD evident in 1980. Since there are few reasons to believe suburban public schools improved over the period, this change likely

reflects a poorer suburban demographics.

Other demographics Table 1 also report tract means for income (total personal, 1980$), percent non-Hispanic white, black, and married. Over the period, income rose by 25 percent, and as expected the gains were concentrated in tracts close to to the CBD. In the 0-3 mile core, income rose by almost 80 percent.

The percent non-Hispanic white declined by 12 percentage points for our sample, whereas the percent blacks increased only slightly (from 19.4 to 19.6 percent). In the central city, however, the pattern was reversed: percent black declined while percent non-Hispanic white held steady. As for marital status, marriage decline during the study period, and in percentage terms the decline was steeper within 10 miles of the city center (25 v. 15 percent).

4.1 Regression Analysis

Reduced form We start by investigating the reduced form effect of a demand shock on housing prices by estimating the following regression:

$$PRICE_{ijt} = Z_{jt} + f(dist_{ij})Z_{jt} + f(dist_{ij}) + \alpha_j + \alpha_t + \epsilon_{ijt}, \tag{2}$$

where $PRICE_{ijt}$ is the housing price in tract i in city j and year t, Z_{jt} is the exogenous labor demand shock in city j in year t (cf. Equation 1) and $f(dist_{ij})$ is a flexible function of $dist_{ij}$, the tract distance in miles to the CBD. The regression also includes year and city fixed effects, α_t and α_j, or, alternatively, city-year fixed effects, α_{jt}. We control for distance specific characteristics through $f(dist_{ij})$ and allow for distance differential impacts of Z_{jt} through $f(dist_{ij}) \times Z_{jt}$. Throughout, standard errors are clustered at the city level, and tracts are weighted by their population size.

Table 2 presents the results. The first column shows the results from a bare-bones version of Equation 2, where

$$f(dist_{ij}) = d1_{ij} + d2_{ij} + d3_{ij} \tag{3}$$

where $d1_{ij}$, $d2_{ij}$, and $d3_{ij}$ are three distance indicator variables for the 0-3 mile core,

the 3-10 mile radius ring, and the 10-20 mile ring respectively. (The 20-35 mile ring is the reference area.)

We see that the effect of demand for skilled labor as measured by the Z_{jt} instrument is stronger close to the CBD, the estimated impact being 2.5 times larger in the core than 3-10 miles out (588.9/234.5), and 6.7 times larger than in the 10-20 mile ring (588.9/88.25).

Between 1980-2010, Z increased by about 13 percentage points,[15] implying house price changes of 75, 29 and 11 thousand 1980 USD in the 0-3 mile core, 3-10 mile, and 10-20 mile rings respectively (relative to the 20-35 mile ring). The predicted price changes line up closely with the observed price changes of 82, 30 and 4.5 thousand 1980 USD, respectively.

Results remain virtually unchanged when adding city-year fixed effects (column 2), indicating common price responses to demand for skilled labor for the cities in our sample over the study period.

Columns 3 and 4 us a quadratic or cubic specifications for $f(dist_{ij})$. While more parametric, these polynomials capture a similar effect of the demand shock: positive but fading with distance.

Ideally, we would like to control for tract fixed effects but tracts change between the censuses. We will construct a tract panel data set using cross-walk files but the fidelity to the underlying tract characteristics is lower and therefore we favor results from the repeated cross sectional sample.[16] As a step towards tract fixed effects, we add vector of city-specific distance fixed effects $g(dist_{ij})$ to Equation 2, that is, for columns 5-8 we estimate

$$PRICE_{ijt} = Z_{jt} + f(dist_{ij})Z_{jt} + f(dist_{ij}) + g(dist_{ij}) + \alpha_j + \alpha_t + \epsilon_{ijt}, \qquad (4)$$

[15] Table A2

[16] Results were similar in the constructed tract panel data set and the cross sectional sample, see Tables 6 and 8.

where for each city j we let:

$$g(dist_{ij}) = \sum_{k=1}^{21} \beta_{kj} dk_{ij} \tag{5}$$

where $d1 - d20$ are indicator variables for the tract being [0,1), [1,2),...,[19-20) miles away from the CBD ($d21$ indicates distance in the [20-35) mile range).

Results remain similar with this inclusion of "ring fixed effects," columns 5-8.

First stage – T1st Table 3, shows the direct effect of Z_{jt} on $FT(h,e)_{ijt}$ – the fraction adults 25-55 in tract i, city j, year t who worked more that $h = 40, 50$ hours per week and had education $e = BA+, MA+$. We estimate a variant of Equation 2 where $f(\cdot)$ is given by Equation 3 and the following three, successively more demanding, sets of fixed effects: (1) city-year fixed effects; (2) city-distance fixed effects and year fixed effects; and (3) city-distance fixed effects and city-year fixed effects.

Columns 1-3, upper panel, show the results for $FT(40, BA+)$. We see a strong positive effect of Z close to the CBD. The magnitude is reduced once city-specific distance fixed effects are included (columns 2-3), but the qualitative flavor remains. The point estimate from the third specification says that a 0.10 increase in Z leads to a 3.3 percentage point higher increase in $FT(40, BA+)$ in tracts 0-3 miles within the CBD compared to tracts 20-35 miles out.

The results from the three other full-time measures are qualitatively similar results.

We now turn to other demographics that may change with the Bartik demand shifter and plausibly influence housing prices. We estimate the same set of specifications as in Table 3 but substitute the percent black, married, and personal income for the full-time measure as the dependent variable.

Since these variables are correlated with the educational and employment status of the population we expect to find a relationship. The reason we favor $FT(\cdot)$ over these other variables is the direct causal link from growth in a skill intensive industry to a more skilled and employed population. We view other demographic changes to be incidental or derived from the primary relationship. Be that as it may, Table 4 presents the results for these other demographics.

Starting with the percent black, we see that in the first specification (including city-year fixed effects but not city-distance fixed effects), a higher Bartik reduces the fraction blacks in tracts close to the city center. Adding city-distance fixed effects (specifications two and three) halves the effect size but leaves the qualitative result unchanged, Table 3, Columns 1-3.

Turning to non-Hispanic whites, we see a pronounced positive effect of the Bartik demand shifter close to the CBD, Columns 4-6.

As for the percent married, in the first specification, we find no significant effect of the Bartik demand shifter, Column 1, lower panel. Adding city-distance controls, we find a small positive effect close to the CBD and a reduction in tracts 3-20 miles out, Columns 2-3, lower panel.

Lastly, for personal income the estimated relationship is u-shaped with respect to distance, with a trough in the 3-10 mile interval, Columns 4-6, lower panel.

OLS We can now engage our hypothesis that the emergence of centrality as a top amenity is linked to high-income households being time starved. We focus on our preferred specification which controls for city-year and city-specific distance fixed effects:

$$PRICE_{ijt} = FT(h,e)_{ijt} + f(dist_{ij})FT(h,e)_{ijt} + g(dist_{ij}) + \alpha_{jt} + \epsilon_{ijt}, \qquad (6)$$

where as before $f(dist_{ij})$ allows for the effect of $FT(h,e)_{ijt}$ to vary with tract distance to the CBD, and $g(dist_{ij})$ is as in Equation 5.

We present three variations on Equation 6: (1) $f(dist_{ij})FT(h,e)_{ijt}$ is omitted; (2) $f(\cdot) = dist_{ij}$; and (3) $f(\cdot) = dist_{ij} + dist_{ij}^2$. The OLS results from these three specifications estimated for our four full-time measures are presented in Table 5. We see that that the fraction full-time skilled workers in the tract and the tract's housing prices are positively related and the effect fades with distance to the CBD.

There are many reasons to question the interpretation of these OLS results, however. Higher housing prices could prompt greater labor supply or the association could be spurious. The central city could have been more attractive to the high-skill-low-leisure population for reasons unrelated to commuting. Their presence could be driven by the cultural amenities on offer in the city center or simply be part of a *zeitgeist* in

which an urban aesthetics is embraced perhaps as a reaction against subdivisions and cul-de-sacs.

IV We now turn to our IV estimates where we instrument our full-time skilled worker measure by the Bartik demand shifter described in Section 3.2. Our identifying assumption is that the Bartik demand shifter affects housing prices only through the posited channel of raising the fraction of the population that is skilled and works full time. The effect could stem directly from the purchasing power of a skilled, steadily employed population, or may be through the mores and preferences of this segment (e.g., regarding issues such as policing, liquor permits, bike lanes, etc.).

More worrying would be if demand growth for skilled labor affected other dimensions that in turn moved housing prices. For instance, a higher Bartik may result in higher tax revenues which in turn allow for better policing, infrastructure, or civic initiatives that improve quality of life, and possibly more so close to the city center.

Pure racism presents another challenge. Consider the case of tipping points. It is possible that a higher Bartik changes the demographics of a tract enough to make it tip. For instance, prices in a centrally located tract may be low because its high proportion blacks deters whites. As centrality gains salience, more whites move in, eventually bringing the proportion blacks below the tipping point. Thence, white reservation vanishes and prices take off. Note, however, that for the outlined mechanisms to be a threat to our identification strategy, we need pure racism. Racial stereotypes that merely reflect generalities regarding the behavior and preferences of a group based on their education level, income, or employment status do not suffice.

With these caveats in mind, we now turn to our findings from estimating Equation 6 where $FT(h,e)_{ijt}$ and $f(dist_{ij})FT(h,e)_{ijt}$ are instrumented by $Z_{jt}(1 + d1_{ij} + d2_{ij} + d3_{ij})$. As in the case of the OLS regressions, we present three specifications: (1) $f(dist_{ij})FT(h,e)_{ijt}$ is omitted; (2) $f(\cdot) = dist_{ij}$; and (3) $f(\cdot) = dist_{ij} + dist_{ij}^2$.

Throughout, the rudimentary specification in which $FT(\cdot)$ is hypothesized to have a uniform effect on housing prices regardless of distance to the CBD (and thus land availability) fails the over-identification test (JP) and therefore we focus on specifica-

tions two and three.[17] Both specifications estimate a positive effect of the fraction of full-time skilled workers among the prime-age population (statistically significant at the 0.1 percent level), and the effect is more pronounced closer to the CBD.

To gauge the economic significance of our proposed explanation for gentrification, Figures 11 and 12 show the predicted housing price increases for the linear and square specifications respectively. We see that both specification do a good job replicating the actual price changes.

Robustness We now show the results from estimating the second specification in a series of alternative samples as a robustness test (the first specification fails the overidentification test, the third specification gives very similar results as the second but the added interaction with distance squared is insignificant at conventional levels).

Motivated by the significant reduction in crime over the study period, we split the cities according to the decline in crime (see Table A1). It is reassuring that our results go through in both samples, although the strength of the first stage is somewhat weakened. For the 40+ full-time measures, the effect size is noticeably smaller in the low (crime reduction) sample, whereas for the 50+ full-time measures, the estimated coefficients are similar in the two samples, Table 8, Columns 1 and 2 samples.

New York City is the largest US city, and may be exceptional in other ways too, be it from the particularities forced geography, Manhattan Island in particular, the concentration of the finance industry, the substantive presence of foreign buyers, or the fact that it has a midtown and a downtown center. In order to gauge the extent to which our results are driven by the presence of New York City, Column 3 presents results from a sample where it has been excluded. Again, the results for the 50+ hours full-time measures are very similar to those of the whole sample, while the estimated effect size for our 40+ hours measure is reduced in magnitude (but remains statistically very significant).

In the last three columns we present results from a tract panel data set constructed using cross walk files from US2010.[18] The thus constructed tracts, however, reflect the

[17] The p-value of the Kleibergen-Paap LM test is below 1.7% throughout, rejecting the null that the model is underidentified.

[18] `http://www.s4.brown.edu/us2010/Researcher/Bridging.htm`

underlying demographics with less fidelity (for further details, see the Appendix).

Column 4 presents results from including tract fixed effects and we find results to be quite similar to the cross sectional sample (suggesting that the city-specific distance fixed effects are passable substitutes for tract fixed effects).

Our main interest in a tract-level panel data set derives from the possibility that initial conditions (other than distance) influence gentrification. In particular, we are interested in the role of the initial racial composition of the tract.

To that end, we divide our panel data set according to whether the (constructed) tract was above or below the median in terms of percent black in 1980 (the mean and median values were 18.7 and 2.5 percent respectively, reflecting a high degree of residential segregation).

We find results to be very similar in the two samples, Columns 5 and 6. That is, once tract fixed effects and city-year fixed effects are controlled for, the effect of full-time skilled workers on housing prices are estimated to be similar in tracts that had few blacks (below 2.5 percent) and tracts that had a high fraction blacks (the implied mean being close to 40 percent).

5 Discussion

For most of the 20th Century, suburbanization dominated the US urban landscape. However, as the century drew to a close it was clear that a counter movement was afoot. Today, gentrification has grown out of its erstwhile niche status to epitomize a broad based rehabilitation of the central city as the place to work, live, and play.

The driving factor, we have proposed, can be found in a growing corps of high-income-low-leisure households who by virtue of being time starved seek to locate close to work. Thus, our paper adds urban renewal to the list of time-saving machinations of modern life.

The ideas collated in this paper are by no means new. They hew closely to the canonical models of urban development, and labor supply. The employment of a Bartik demand shifter also follows a well-beaten path. To the best of our knowledge, however, ours is the first paper to emphasize the time scarcity of high-income households as *the*

explanation for the reversal of suburbanization and to present comprehensive empirical evidence to that effect.

We have focused on individual labor supply and lumped men and women together. In the preliminary analysis we looked at men and women separately and found them to yield similar results, possibly because the expansion of hours have been qualitatively similar for skilled men and women. It is conceivable, however, that had the ever harder working skilled men been paired with full time housewives, the situation would have been wholly different.

The Suburbs Are Dead – Long Live the Suburbs Gentrification is about price growth and changes to the housing stock, not population growth. Plenty of people will find enduring value in the affordability and leafiness of the suburbs. However, other aspects of suburban life may change.

For instance, between 2000 and 2010, Manhattan and Brooklyn poverty rates declined by 10 percent, but rose on Staten Island (the most suburban of New York City's five boroughs).[19] While more notable recently, poverty has been rising faster in suburbs than cities since the 1980s [Kneebone and Berube, 2013].

To its critics, gentrification signifies the displacement of lower income households. As the term suggests, displaced people show up somewhere else. The inner city, even at its nadir, always had centrality going for it [Glaeser et al., 2000]. How do low-wage workers, single-parents in particular, manage in suburban locations, areas built with car ownership in mind and targeted to middle-class families with a stay-at-home wife?

Beyond the Burbs A topic of less social urgency but possibly affected by gentrification is the secondary home market. Gentrification may breath new life into towns two or three hours away from the city. Too remote to be commuter towns, such places can be desirable weekend destinations. As more high-income families live in apartments rather than free standing houses, demand for second homes may pick up.

The only way is up? Urban sprawl had cheap housing going for it. Is the future one of ever rising land rents?

[19] By 18 percent, *New York Times* "Suburbs' Share of Poor has Grown Since 2000," May 20, 2013.

East Asia may offer guidance. Japan and South Korea are both developed industrialized countries, but gentrification appears to have been largely absent [Waley, 1997]. Several factor may account for this, including close to zero population growth and low labor force participation of married women. More replicable, however, is the vertical urban landscape built around mass transportation, notably trains. High density and rail connectedness ease the pressure on land rents both by packing in and transporting more people within any given area and by allowing for multiple centers within the urban core. While the sky may not be the limit, US cities still have a lot of head room.

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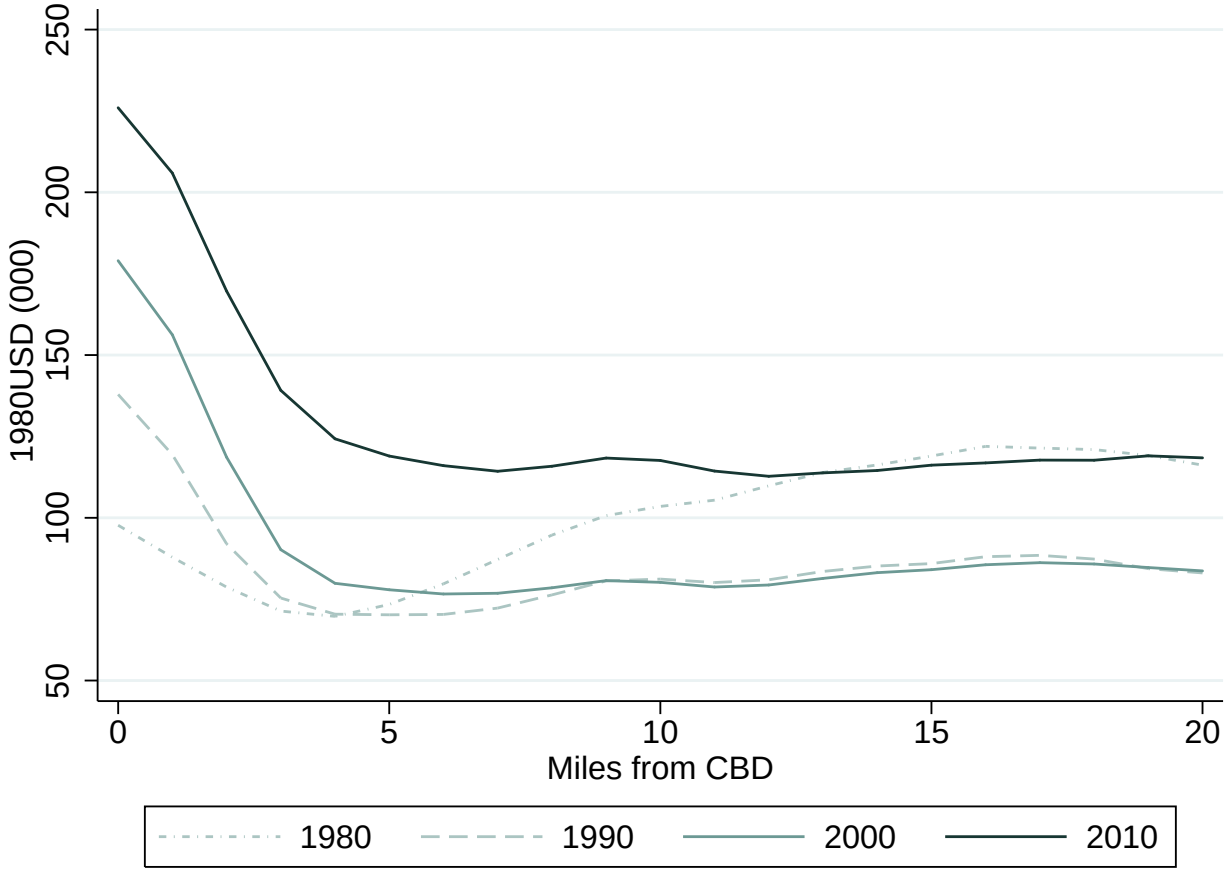
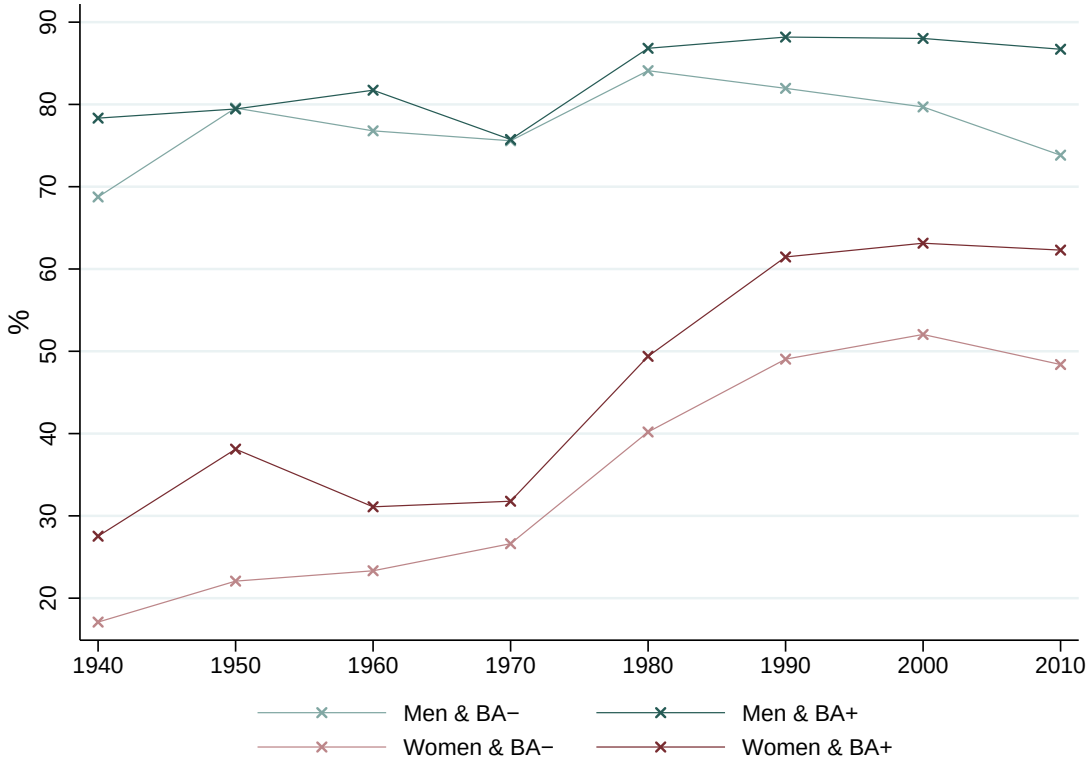
Graphs

Figure 1: Home Prices by location



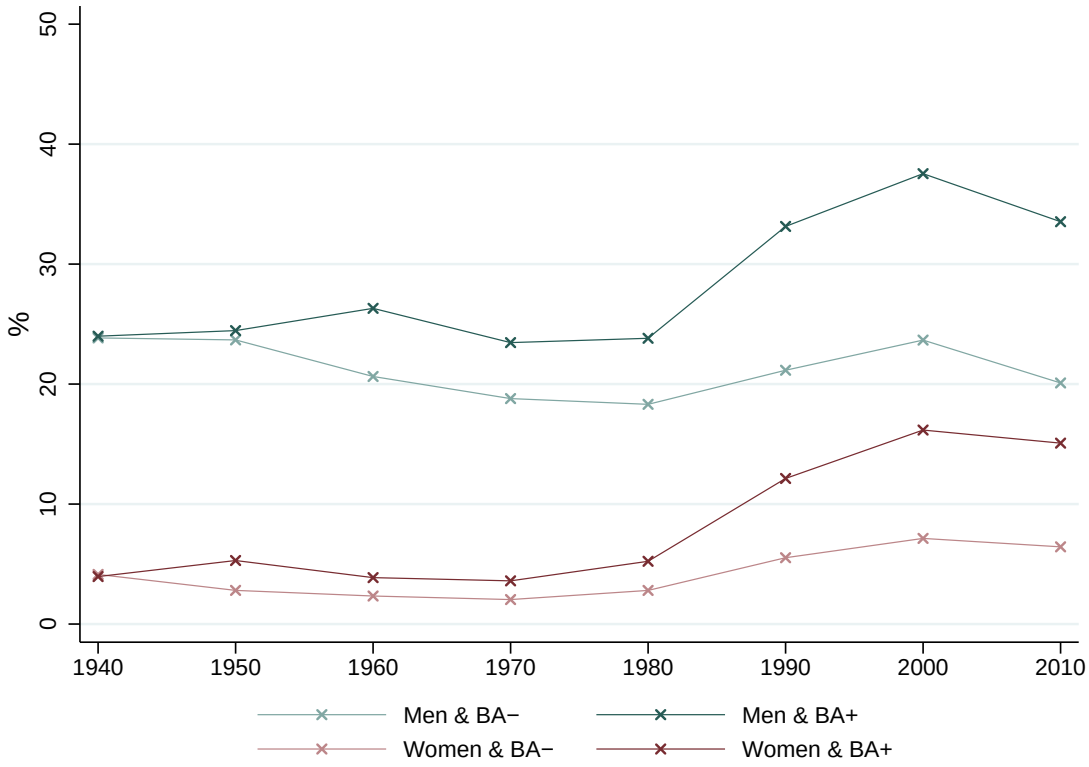
Notes: Owner-occupied, 2-3 bedroom, one-family homes. 20 miles includes 20-35 miles.
Source: Decennial censuses and the American Community Survey, restricted use data.

Figure 2: % Working full time, 40h/week, by sex and education



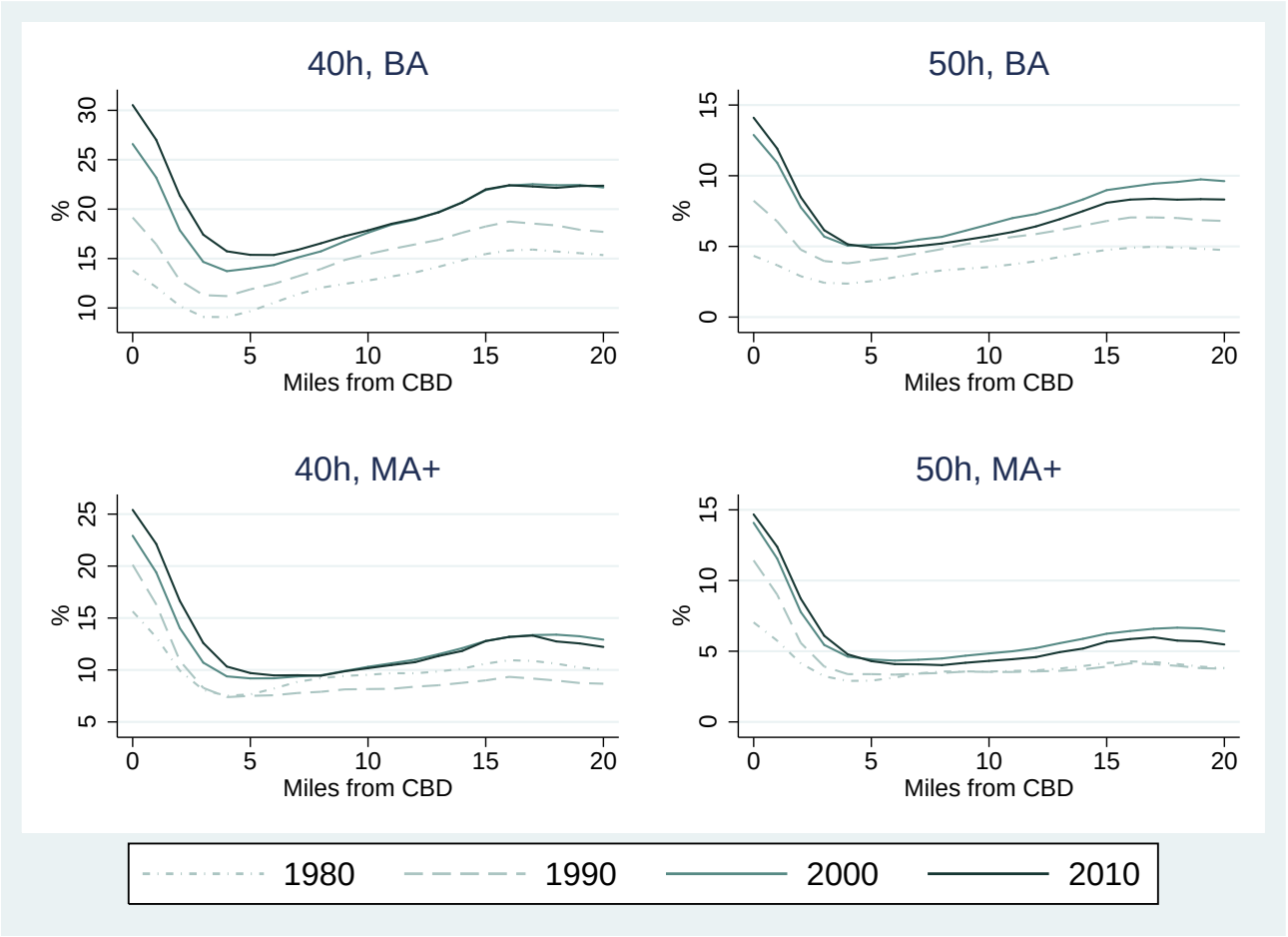
Note: Ages 25-55.
Source: Decennial censuses, integrated public use micro data series (IPUMS).

Figure 3: % Working full time, 50h/week, by sex and education



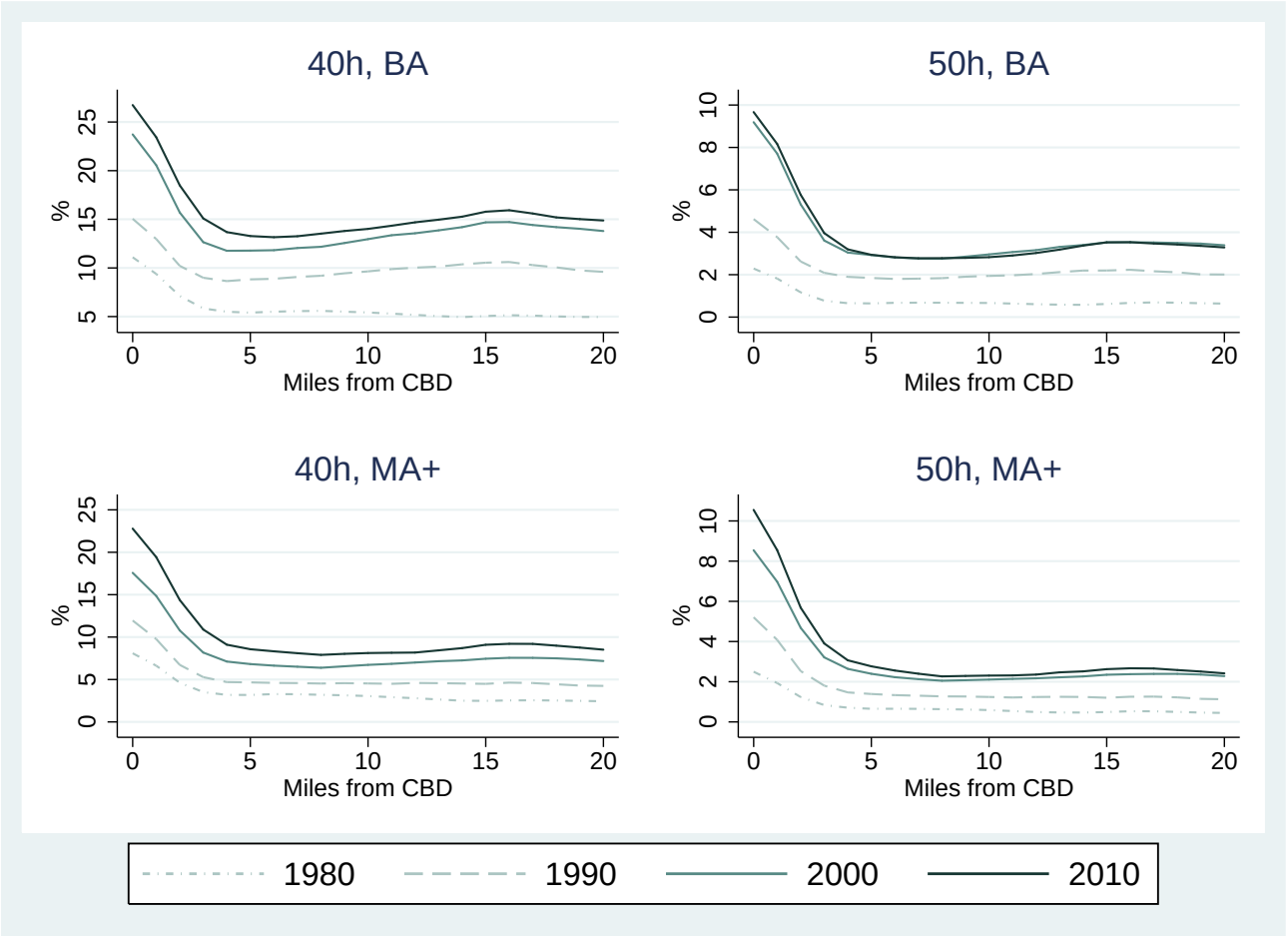
Note: Ages 25-55.
Source: Decennial censuses, integrated public use micro data series (IPUMS).

Figure 4: % full time and skilled among men 25-55



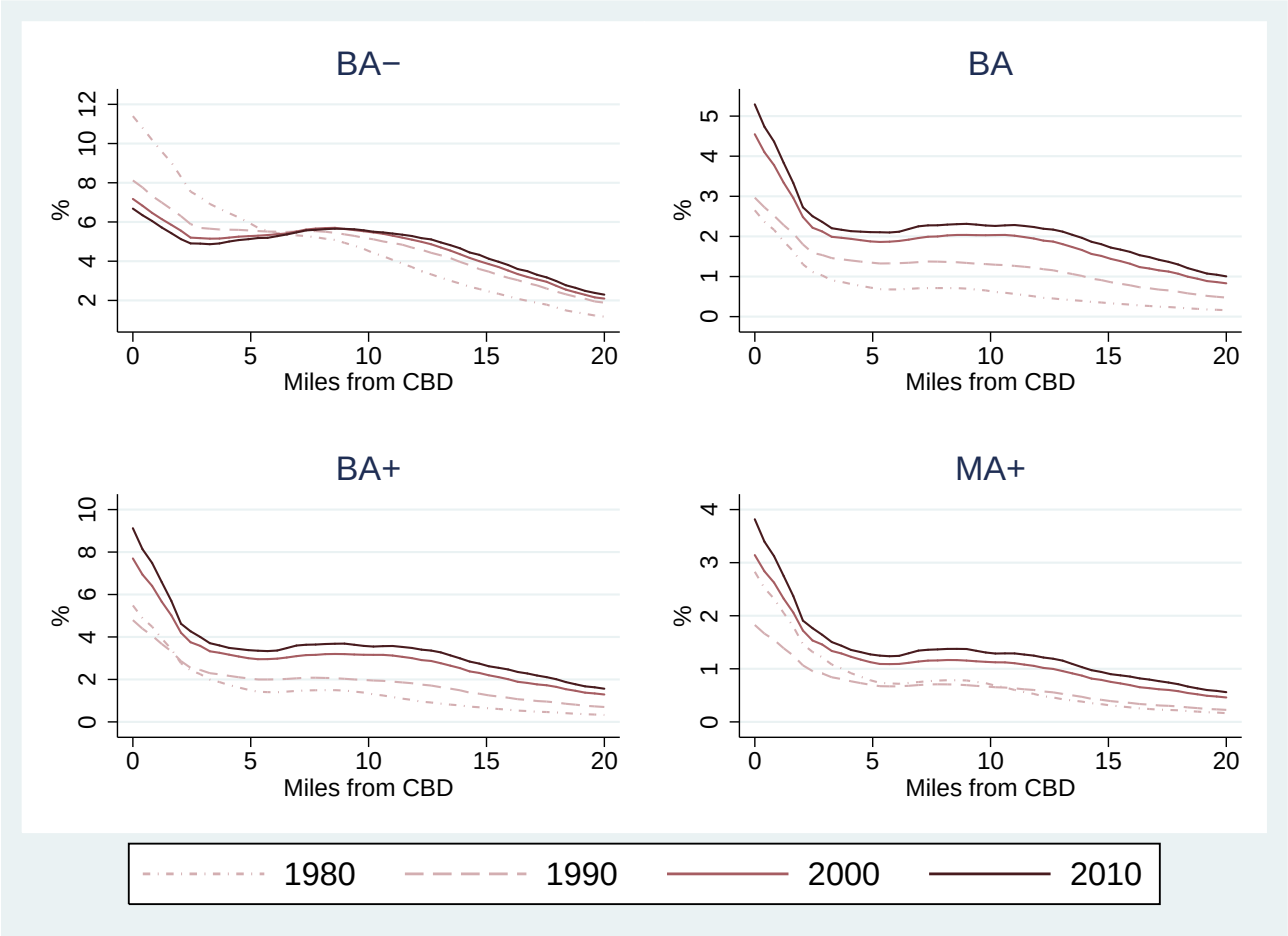
Universe: Men 25-55 residing $x = 0, 1, ...18, 19, 20 - 35$ miles from the CBD. Source: Decennial censuses and the American Community Survey, restricted use data.

Figure 5: % full time and skilled among women 25-55



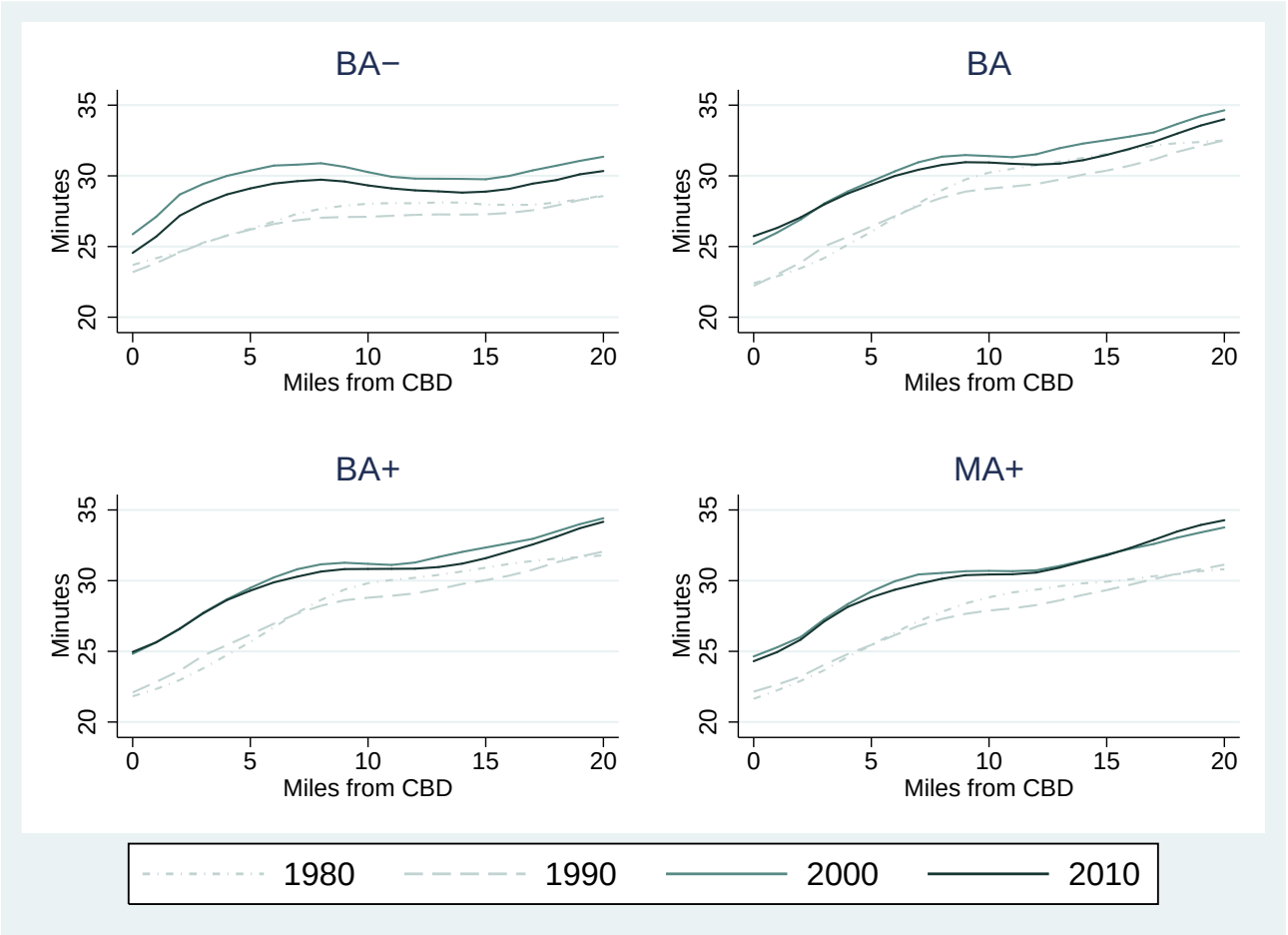
Universe: Women 25-55 residing $x = 0, 1, ...18, 19, 20 - 35$ miles from the CBD. Source: Decennial censuses and the American Community Survey, restricted use data.

Figure 6: Jobs by skill



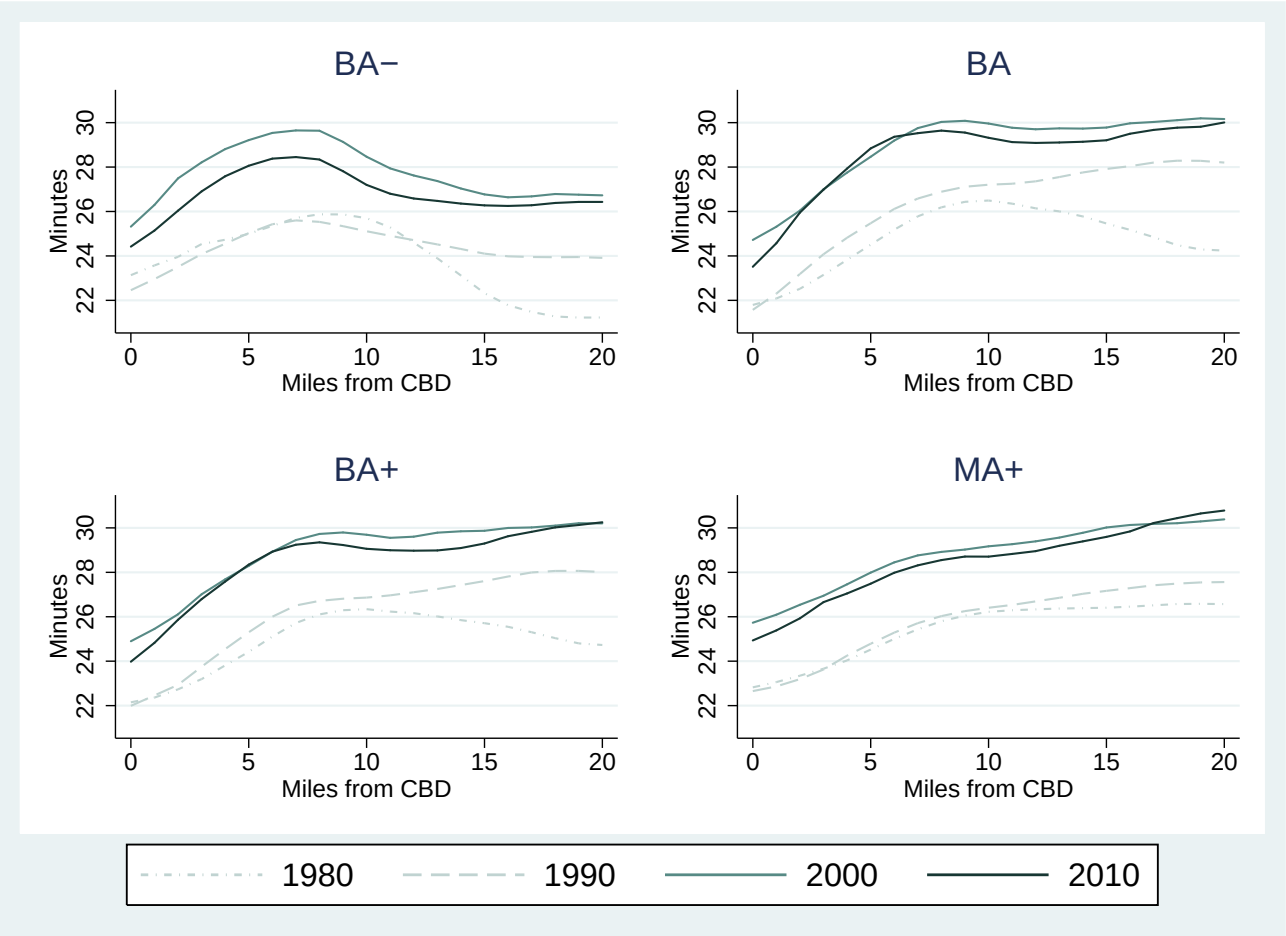
Universe: filled jobs within 35 miles of the CBD.
Source: Decennial censuses and the American Community Survey, restricted use data.

Figure 7: Commuting time by education and residence location, men



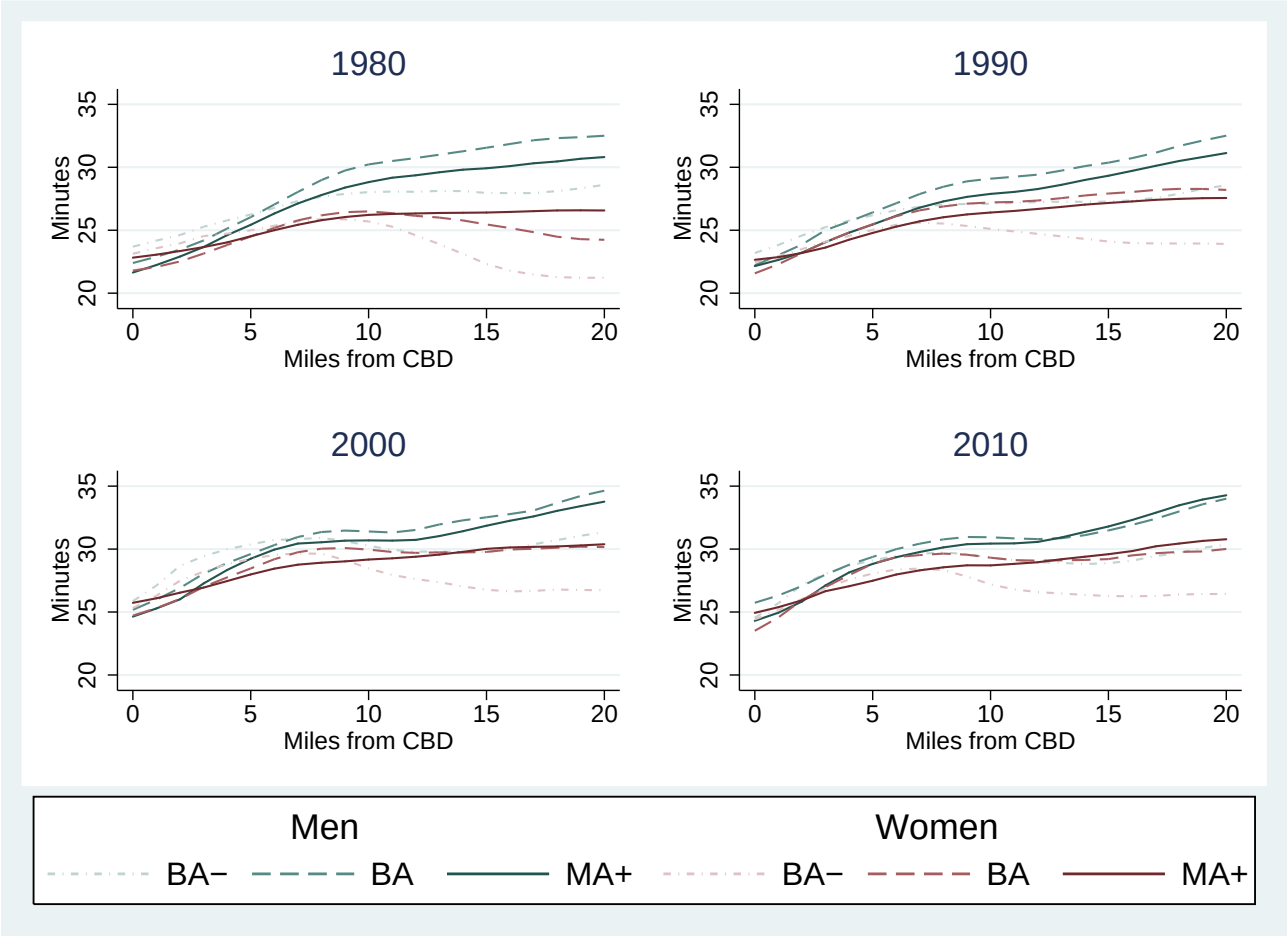
One way, door-to-door.
Universe: Men 25-55 who work away from home.
Source: Decennial censuses and the American Community Survey, restricted use data.

Figure 8: Commuting time by education and residence location, women



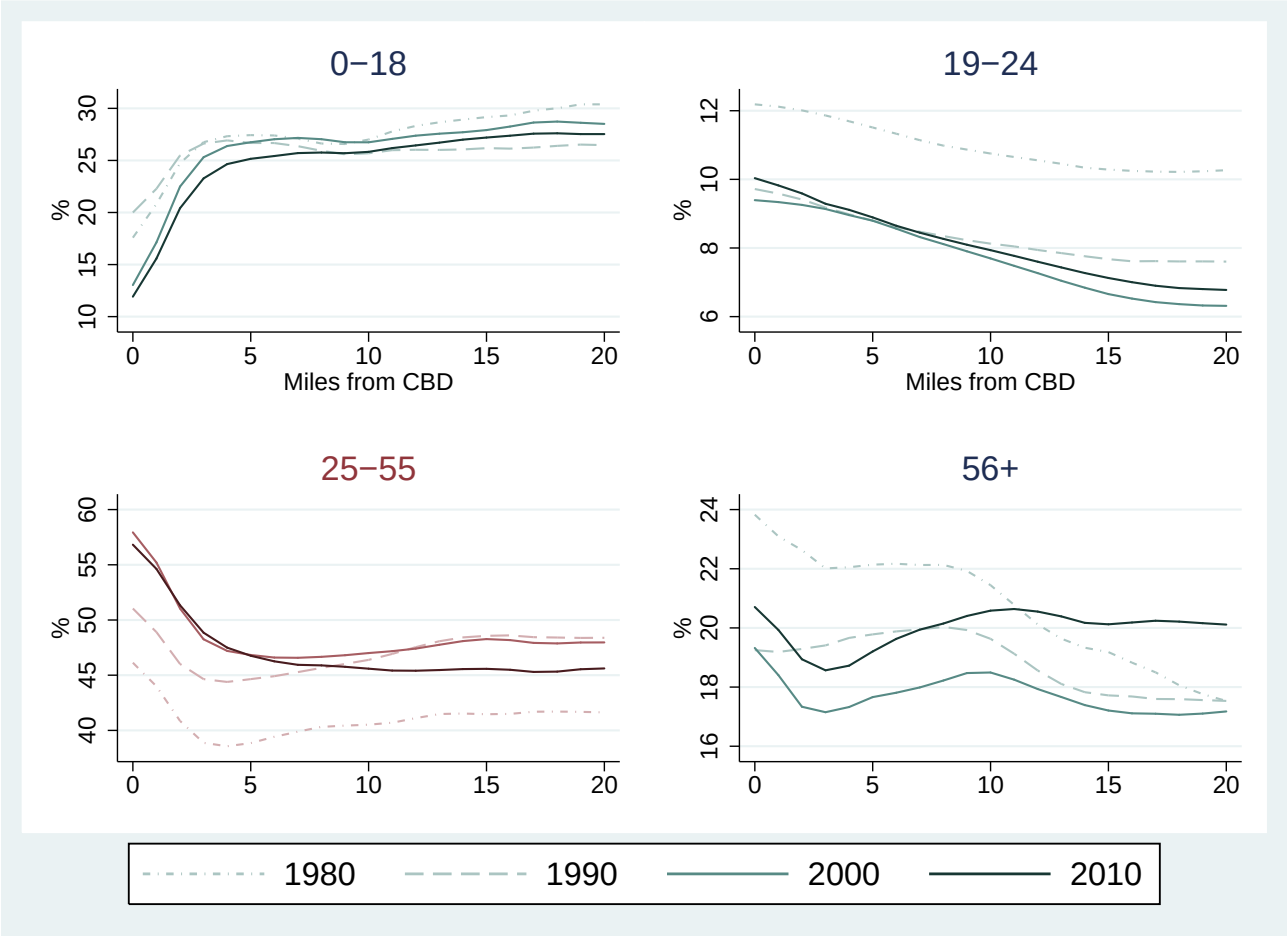
One way, door-to-door.
Universe: Women 25-55 who work away from home.
Source: Decennial censuses and the American Community Survey, restricted use data.

Figure 9: Commuting time, by sex, education, and residence location



Universe: Men and women 25-55 who work away from home. Source: Decennial censuses and the American Community Survey, restricted use data.

Figure 10: Age distribution by residence location



Universe: Residents residing $x = 0, 1, ...18, 19, 20 - 35$ miles from the CBD.
Source: Decennial censuses and the American Community Survey, restricted use data.

Figure 11: Predicted v. Actual Price increase, '000 1980$

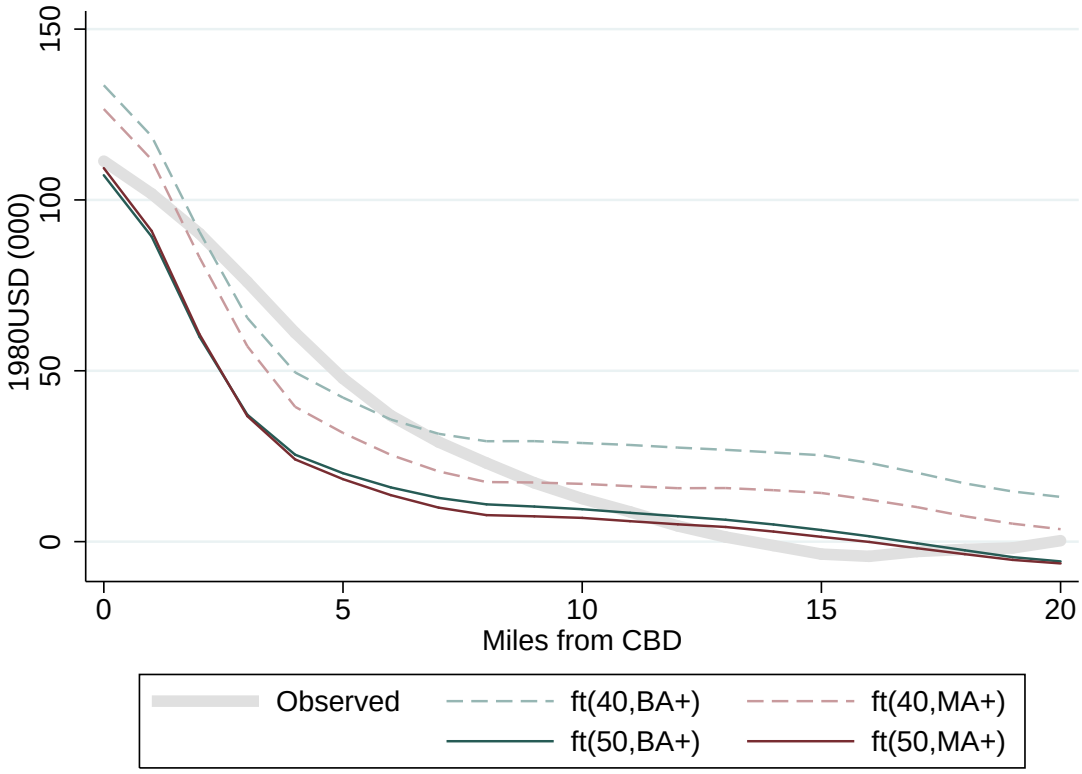
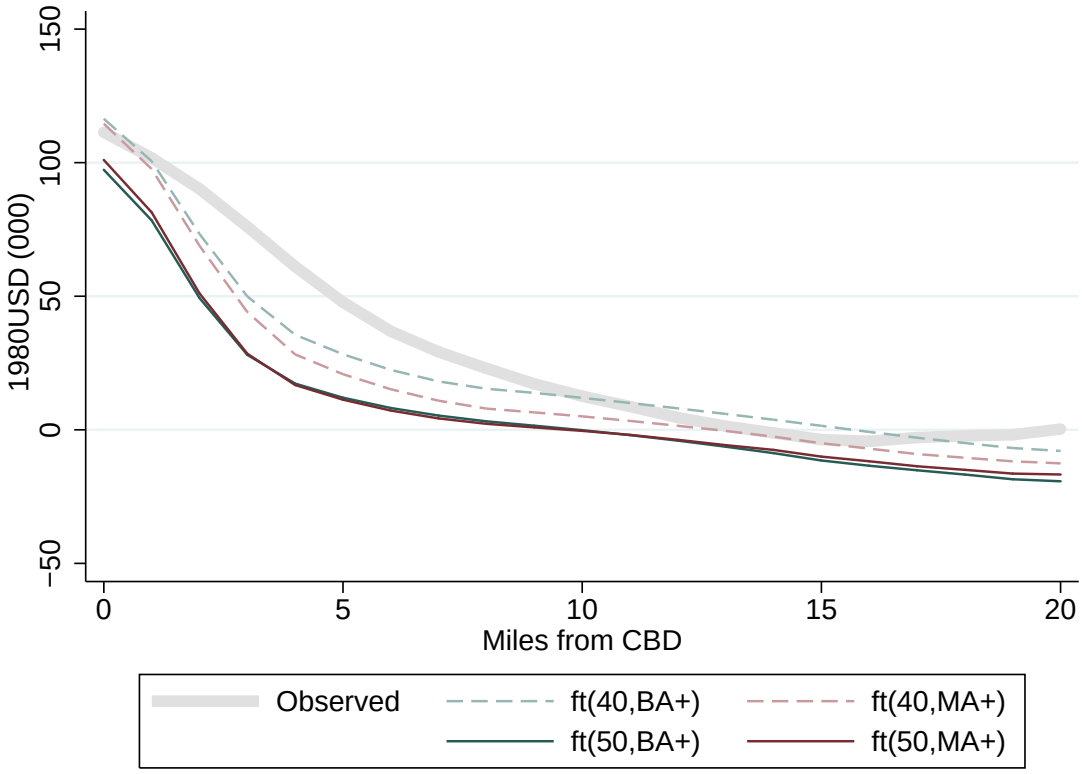


Figure 12: Predicted v. Actual Price increase, '000 1980$



Tables

Unless otherwise specified, the analysis is based on the decennial censuses and the American Community Survey, restricted use data. Throughout, sample sizes have been rounded to nearest 1000 for disclosure reasons. The repeated cross section has 65 thousand tract-years (53 thousand excluding New York); and the panel data set has 48 thousand tract-years.

Table 1: Summary Statistics

		(1)	(2)	(3)	(4)	(5)
		Distance to the CBD (miles)				
Variable	Year	$d1$=[0,3]	$d2$=(3,10]	$d3$=(10,20]	$d4$=(20,35)	[0,35)
House price	1980	66.64	79.16	108.23	114.06	92.5
('000 1980$)	2010	154.77	115.07	119.22	120.5	120.54
	Δ	88.13	35.91	10.99	6.44	28.04
FT(40,BA+)	1980	13.78	12.92	15.19	15.05	14.05
	2010	35.13	23.15	27.22	28.29	26.62
	Δ	21.35	10.23	12.03	13.24	12.57
FT(40,MA+)	1980	6.37	5.42	6.12	5.64	5.77
	2010	15.5	8.92	10.1	10.35	10.13
	Δ	9.13	3.5	3.98	4.71	4.36
FT(50,BA+)	1980	4.03	3.43	4.3	4.44	3.92
	2010	14.32	7.25	8.81	9.69	8.86
	Δ	10.29	3.82	4.51	5.25	4.94
FT(50,MA+)	1980	2.29	1.82	2.06	1.93	1.96
	2010	7.28	3.4	3.8	4.02	3.95
	Δ	4.99	1.58	1.74	2.09	1.99
Income	1980	10.53	12.06	14.25	14.3	12.94
('000 1980$)	2010	17.98	13.99	17.22	18.77	16.53
	Δ	7.45	1.93	2.97	4.47	3.59
White	1980	48.99	62.43	75.61	85.73	68.87
	2010	44.97	38.81	53.91	66.37	51.06
	Δ	-4.02	-23.62	-21.7	-19.36	-17.81
Black	1980	32.89	23.61	13.41	6.78	18.7
	2010	25	27.22	15.43	7.49	18.25
	Δ	-7.89	3.61	2.02	0.71	-0.45
Married	1980	46.29	62.67	72.22	77.35	66.32
	2010	36.13	48.25	60.72	66.59	56.14
	Δ	-10.16	-14.42	-11.5	-10.76	-10.18

Table 1: Summary Statistics, continued

		(1)	(2)	(3)	(4)	(5)
		Distance to the CBD (miles)				
Variable	Year	$d1$=[0,3]	$d2$=(3,10]	$d3$=(10,20]	$d4$=(20,35)	[0,35)
Ages:						
0-5	1980	8.03	7.85	7.51	8.23	7.82
	2010	6.99	8.32	8.04	8.12	8.08
	Δ	-1.04	0.47	0.53	-0.11	0.26
6-12	1980	9.04	9.56	10.09	11.02	9.9
	2010	6.58	9.02	9.63	10.12	9.33
	Δ	-2.46	-0.54	-0.46	-0.9	-0.57
13-18	1980	8.97	9.66	10.62	11.35	10.16
	2010	6.05	8.12	8.64	8.83	8.33
	Δ	-2.92	-1.54	-1.98	-2.52	-1.83
19-24	1980	12.45	11.21	10.41	10.46	10.97
	2010	10.31	8.58	7.36	6.77	7.84
	Δ	-2.14	-2.63	-3.05	-3.69	-3.13
25-55	1980	39	38.7	40.52	40.81	39.63
	2010	50.45	45.53	44.64	44.63	45.34
	Δ	11.45	6.83	4.12	3.82	5.71
56-65	1980	9.74	10.86	10.67	9.21	10.42
	2010	9.67	9.88	10.7	10.88	10.39
	Δ	-0.07	-0.98	0.03	1.67	-0.03
66-	1980	12.76	12.16	10.18	8.93	11.09
	2010	9.95	10.55	10.99	10.64	10.68
	Δ	-2.81	-1.61	0.81	1.71	-0.41
Private school:						
6-12	1980	21.71	25.55	19.89	12.99	21.41
	2010	20.38	15.75	14.25	12.04	14.65
	Δ	-1.33	-9.8	-5.64	-0.95	-6.76
13-18	1980	18.3	19.59	14.36	9.48	16.23
	2010	19.22	15.35	12.89	10.45	13.57
	Δ	0.92	-4.24	-1.47	0.97	-2.66
Commute	1980	23.54	26.59	27.76	26.31	26.6
(one-way)	2010	25.68	29.15	29.2	30.46	29.24
	Δ	2.14	2.56	1.44	4.15	2.64

Note: percent unless otherwise indicated. Income is total personal income. Source: Decennial censuses and the American Community Survey, restricted use data.

Table 2: The Effects of Demand Shock on Housing Values

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	House price ('000) 1980$							
Z	425.7				442.3			
	[264.1]				[298.6]			
$Z\times$								
$d1$	588.9**	580.7**			602.9***	633.1***		
	[168.6]	[169.1]			[121.2]	[123.1]		
$d2$	234.5***	249.7***			222.0**	285.2***		
	[52.21]	[49.95]			[61.10]	[54.47]		
$d3$	88.25***	98.22***			124.5**	153.8***		
	[18.25]	[18.49]			[36.41]	[41.01]		
$dist$			-50.30**	-95.95*			-47.81***	-87.37*
			[13.92]	[39.10]			[7.842]	[32.77]
$dist^2$			1.053**	4.479+			0.928***	3.735+
			[0.307]	[2.268]			[0.156]	[1.997]
$dist^3$				-0.0693+				-0.0537
				[0.0404]				[0.0364]
R^2	0.333	0.362	0.353	0.359	0.372	0.400	0.401	0.402
Fixed effects:								
City	✓							
Year	✓				✓			
City-year		✓	✓	✓		✓	✓	✓
City-distance					✓	✓	✓	✓
N ('000)	65	65	65	65	65	65	65	65

Z is the Bartik demand shifter, calculated per Equation 1, also see Table A2. Regressions 1,2,5, and 6 include the vector $(d1, d2, d3)$; regressions 3, and 7 include the vector $(dist, dist^2)$; regressions 4, and 8 include the vector $(dist, dist^2, dist^3)$. Significance levels: *** – 0.001; ** – 0.01; * – 0.05; + – 0.1.
Source: Decennial censuses and the American Community Survey, restricted use data.

Table 3: The Effects of Demand Shock on Tract Characteristics

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable:					
	Four-year college or more					
	40+ hours – $FT(40, BA+)$			50+ hours – $FT(50, BA+)$		
Z		56.73***			29.94**	
		[13.05]			[8.338]	
$Z\times$						
$d1$	97.27***	34.04*	33.13*	54.97***	35.34*	35.53*
	[12.58]	[13.08]	[13.42]	[11.44]	[14.41]	[14.72]
$d2$	16.94	-33.43***	-31.27***	8.181	-14.80***	-13.99**
	[14.58]	[8.600]	[8.374]	[7.638]	[3.882]	[3.868]
$d3$	6.977	-19.90*	-16.06+	2.720	-9.554*	-8.529*
	[16.93]	[7.414]	[8.572]	[7.520]	[3.755]	[4.130]
R^2	0.203	0.313	0.318	0.167	0.289	0.294
	Graduate degree					
	40+ hours – $FT(40, MA+)$			50+ hours – $FT(50, MA+)$		
Z		33.34***			16.92***	
		[5.585]			[2.390]	
$Z\times$						
$d1$	52.17***	14.86***	14.24**	29.22***	16.86**	16.79**
	[6.621]	[3.995]	[4.022]	[4.266]	[5.190]	[5.359]
$d2$	12.34	-15.59***	-15.65***	6.175	-6.302**	-6.289**
	[10.97]	[4.062]	[3.899]	[5.229]	[2.130]	[2.018]
$d3$	8.080	-8.819*	-7.335	3.229	-3.728+	-3.257
	[10.78]	[3.984]	[4.837]	[4.468]	[1.993]	[2.231]
R^2	0.185	0.278	0.283	0.147	0.249	0.253
Fixed effects:						
Year		✓			✓	
City-year	✓		✓	✓		✓
City-distance		✓	✓		✓	✓
N ('000)	65	65	65	65	65	65

Z is the Bartik demand shifter, calculated per Equation 1, also see Table A2. All regressions include the vector $(d1, d2, d3)$. Significance levels: *** – 0.001; ** – 0.01; * – 0.05; + – 0.1.

Table 4: The Effects of Demand Shock on Tract Characteristics

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable:					
	Black, %			non-Hispanic White, %		
Z		-14.23			-98.88***	
		[47.26]			[22.88]	
$Z\times$						
$d1$	-109.5*	-44.86***	-51.15***	166.2***	95.98***	94.61***
	[41.32]	[10.22]	[13.73]	[34.36]	[21.11]	[21.87]
$d2$	-39.96	14.62	10.62	29.94	-32.64	-30.46
	[34.53]	[17.21]	[16.59]	[22.17]	[23.65]	[27.08]
$d3$	12.43	28.19*	30.75**	-25.31	-41.20**	-36.33*
	[7.923]	[10.46]	[9.638]	[16.85]	[14.66]	[14.43]
R^2	0.167	0.273	0.279	0.348	0.438	0.443
	Married, %			Income, personal ('000) 1980$		
Z		85.94**			56.39***	
		[26.00]			[11.01]	
$Z\times$						
$d1$	16.47	16.35+	18.36*	34.72***	10.85	9.107
	[21.43]	[8.860]	[8.380]	[9.205]	[8.083]	[8.628]
$d2$	1.334	-27.29**	-26.71**	-0.534	-24.97***	-24.70***
	[9.552]	[8.193]	[8.146]	[10.95]	[6.044]	[5.899]
$d3$	-5.436	-17.31**	-19.29**	-1.104	-13.28*	-11.98*
	[7.039]	[5.367]	[5.899]	[8.898]	[4.792]	[5.183]
R^2	0.374	0.470	0.475	0.163	0.285	0.293
Fixed effects:						
Year		✓			✓	
City-year	✓		✓	✓		✓
City-distance		✓	✓		✓	✓
N ('000)	65	65	65	65	65	65

Z is the Bartik demand shifter, calculated per Equation 1, also see Table A2. All regressions include the vector $(d1, d2, d3)$. Significance levels: *** – 0.001; ** – 0.01; * – 0.05; + – 0.1.

Source: Decennial censuses and the American Community Survey, restricted use data.

Table 5: The Effects of FT on Housing Values: OLS

	(1)	(2)	(3)	(4)	(5)	(6)
	Four-year college or more					
	40+ hours – $FT(40, BA+)$			50+ hours – $FT(50, BA+)$		
FT	1.829***	2.037***	2.200***	4.003***	4.320***	4.408***
	[0.167]	[0.164]	[0.227]	[0.371]	[0.325]	[0.388]
$FT\times$						
$dist$		-0.0170*	-0.0486		-0.0260*	-0.0446
		[0.00686]	[0.0387]		[0.0124]	[0.0781]
$dist^2$			0.00103			0.000618
			[0.00106]			[0.00224]
R^2	0.475	0.475	0.476	0.488	0.488	0.489
	Graduate degree					
	40+ hours – $FT(40, MA+)$			50+ hours – $FT(50, MA+)$		
FT	3.502***	3.635***	3.861***	6.733***	6.740***	6.933***
	[0.340]	[0.335]	[0.435]	[0.651]	[0.625]	[0.813]
$FT\times$						
$dist$		-0.0115	-0.0564		-0.00123	-0.0426
		[0.0163]	[0.0764]		[0.0320]	[0.154]
$dist^2$			0.00148			0.00140
			[0.00203]			[0.00426]
R^2	0.475	0.475	0.476	0.480	0.480	0.480
Fixed effects:						
City-year	✓	✓	✓	✓	✓	✓
City-distance	✓	✓	✓	✓	✓	✓
N ('000)	65	65	65	65	65	65

Specifications including interactions also include all main effects in levels.
Significance levels: *** – 0.001; ** – 0.01; * – 0.05; + – 0.1.
Source: Decennial censuses and the American Community Survey, restricted use data.

Table 6: The Effects of FT on Housing Values: IV

	(1)	(2)	(3)	(4)	(5)	(6)
	Four-year college or more					
	40+ hours – $FT(40, BA+)$			50+ hours – $FT(50, BA+)$		
FT	2.007+	5.010***	4.526***	6.017***	7.039***	6.704***
	[1.201]	[1.049]	[1.137]	[0.889]	[0.810]	[0.996]
$FT\times$						
$dist$		-0.198***	-0.380**		-0.408***	-0.767*
		[0.0204]	[0.139]		[0.0467]	[0.352]
$dist^2$			0.00617			0.0119
			[0.00437]			[0.0110]
IV tests:						
K-P LM test (p)	0.00615	0.00247	0.000493	0.0163	0.00716	0.00203
C-D $Wald$ stat.	$77.35^{b_5,s_{10}}$	$79.06^{b_5,s_{10}}$	38.40^{b_5}	$169.4^{b_5,s_{10}}$	$148.3^{b_5,s_{10}}$	46.53^{b_5}
K-P $Wald$ stat.	$20.00^{b_5,s_{15}}$	$19.35^{b_5,s_{10}}$	11.66^{b_5}	$7.615^{b_{20}}$	$8.819^{b_{10},s_{15}}$	10.39^{b_5}
Overid. test (p)	0.0456	0.244	.	0.0299	0.345	.
	Graduate degree					
	40+ hours – $FT(40, MA+)$			50+ hours – $FT(50, MA+)$		
FT	3.212	11.12***	10.47***	13.15***	15.24***	14.77***
	[2.605]	[2.407]	[2.486]	[1.973]	[1.803]	[2.141]
$FT\times$						
$dist$		-0.509***	-1.014**		-0.928***	-1.709*
		[0.0590]	[0.387]		[0.115]	[0.823]
$dist^2$			0.0172			0.0260
			[0.0118]			[0.0254]
IV tests:						
K-P LM test (p)	0.00438	0.00182	0.000400	0.0164	0.00263	0.00127
C-D $Wald$ STAT.	63.02	63.65	33.45	111.2	97.07	34.76
K-P $Wald$ STAT.	30.01	20.77	14.32	10.05	11.43	14.27
Overid. test (p)	0.0589	0.204	.	0.0406	0.350	.
Fixed effects:						
City-year	✓	✓	✓	✓	✓	✓
City-distance	✓	✓	✓	✓	✓	✓
N ('000)	65	65	65	65	65	65

Notes on separate page.

Notes to Table 6.

Z is the Bartik demand shifter, calculated per Equation 1, also see Table A2. Throughout, the three instruments are $Z \times d1, Z \times d2, Z \times d3$. Specifications including interactions also include all main effects in levels.

K-P LM test (p) corresponds to the p-value of the Kleinbergen-Paap LM test. The null hypothesis is that the structural equation is underidentified (i.e., the rank condition fails).

C-D $Wald$ stat and K-P $Wald$ stat are the Cragg-Donald and Kleibergen-Paap Wald statistics for testing weak identification. In both cases, the critical values are the Stock and Yogo [2005] critical values initially tabulated for the C-D $Wald$ stat, see Table A4. We follow Baum [2007] and also apply the Stock and Yogo critical values to the K-P $Wald$ stat (critical values for the K-P $Wald$ stat do not exist). In each case, we specify whether the test statistics rejects the null hypothesis (at the 5% level) that the bias of of the IV estimates exceeds the OLS bias by 5, 10, 20 and 30 percent (b5, b10, b20, b30), and whether test statistics rejects the null hypothesis (at the 5% level) that the size of the test is greater than 10, 15, 20 and 25 percent (s20, s15, s20, s25). The critical values for the relative bias test cannot be computed for the case of 2 endogenous and 3 instruments and for 3 endogenous and 3 instruments, and we use the more conservative critical values for the case of 2 endogenous and 4 instruments and 3 endogenous and 5 instruments, see Stock and Yogo [2005] and Table A4. Critical values for the size test with 3 or more endogenous have not been computed.

Overid. test (p) corresponds to the p-value of the test of the overidentifying restrictions. The null hypothesis is that the instruments are valid instruments.

Significance levels: *** – 0.001; ** – 0.01; * – 0.05; + – 0.1.

Source: Decennial censuses and the American Community Survey, restricted use data.

Table 7: The Effects of FT on Housing Values: IV, continued

	(1)	(2)	(3)	(4)	(5)	(6)
	Sample:					
	Cross-section			Panel		
	Crime, high[a]	Crime, low[a]	not NYC[b]	All	Black, low[c]	Black, high[c]
	Dependent variable:					
	40+ hours, four-year college or more – $FT(40, BA+)$					
FT	5.957***	3.903***	3.570***	5.511***	5.848***	5.197***
	[1.262]	[1.149]	[0.969]	[1.131]	[1.021]	[1.314]
$FT \times dist$	-0.201***	-0.185***	-0.178***	-0.201***	-0.172***	-0.244***
	[0.0250]	[0.0294]	[0.0211]	[0.0256]	[0.0319]	[0.0429]
IV tests:[d]						
K-P LM test (p)	0.105	0.00938	0.00232	0.0166	0.168	0.0356
C-D $Wald$ stat.	53.96	25.45	44.53	391.6	153.3	205.8
K-P $Wald$ stat.	6.975	75.33	12.87	9.31	5.58	9.358
Overid. test (p)	0.18	0.717	0.332	0.345	0.102	0.529
	50+ hours, four-year college or more – $FT(50, BA+)$					
FT	7.041***	7.497**	6.407***	7.241***	6.626***	7.517***
	[0.813]	[2.330]	[1.605]	[0.811]	[1.146]	[1.070]
$FT \times dist$	-0.399***	-0.426***	-0.404***	-0.423***	-0.346***	-0.592***
	[0.0506]	[0.0749]	[0.0626]	[0.0499]	[0.0536]	[0.138]
IV tests:[d]						
K-P LM test (p)	0.0665	0.00764	0.00717	0.0386	0.242	0.0643
C-D $Wald$ stat.	116.4	25.58	59.01	602.8	325.5	218.3
K-P $Wald$ stat.	22.58	34.61	8.896	4.641	3.731	5.041
Overid. test (p)	0.0954	0.529	0.504	0.276	0.0945	0.433
	40+ hours, graduate degree – $FT(40, MA+)$					
FT	13.85***	8.345***	7.620***	12.01***	13.78***	11.03***
	[2.801]	[2.307]	[2.252]	[1.873]	[1.744]	[2.484]
$FT \times dist$	-0.556***	-0.442***	-0.454***	-0.527***	-0.467***	-0.674***
	[0.0732]	[0.0838]	[0.0616]	[0.0667]	[0.0739]	[0.138]
IV tests:[d]						
K-P LM test (p)	0.116	0.00693	0.00206	0.02	0.287	0.0296
C-D $Wald$ stat.	43.54	22.7	36.28	267.9	95.28	122.8
K-P $Wald$ stat.	6.382	41.89	13.8	5.944	2.574	8.915
Overid. test (p)	0.136	0.628	0.297	0.332	0.15	0.486

Table 8: The Effects of FT on Housing Values: IV, continued

	(1)	(2)	(3)	(4)	(5)	(6)
	Sample:					
	Cross-section			Panel		
	Crime, high[a]	Crime, low[a]	not NYC[b]	All	Black, low[c]	Black, high[c]
	Dependent variable:					
	50+ hours, graduate degree – $FT(50, MA+)$					
FT	15.95***	15.21***	13.05***	15.32***	14.83***	15.38***
	[1.776]	[4.498]	[3.286]	[1.554]	[2.150]	[2.468]
$FT \times dist$	-0.929***	-0.909***	-0.918***	-0.963***	-0.792***	-1.453***
	[0.131]	[0.204]	[0.167]	[0.118]	[0.117]	[0.380]
IV tests:[d]						
K-P LM test (p)	0.0682	0.00496	0.00271	0.0187	0.28	0.0624
C-D $Wald$ stat.	75.64	19.91	40.28	345.1	175.6	113.5
K-P $Wald$ stat.	17.37	21.87	11.32	4.783	2.686	4.894
Overid. test (p)	0.102	0.468	0.54	0.303	0.111	0.466
Fixed effects:						
City-year	✓	✓	✓	✓	✓	✓
City-distance	✓	✓	✓			
Tract				✓	✓	✓
N ('000)	65/2	65/2	53	48	48/2	48/2

Notes to Table 8.

Throughout, the three instruments are $Z \times d1, Z \times d2, Z \times d3$. Specifications including interactions also include all main effects in levels.

[a] High and low crime samples split cities in the cross sectional sample according to the decline in crime, see Table A1.

[b] Not NYC removes New York City from the cross sectional sample.

[c] High and low Black samples split tracts in the tract-panel sample according to their 1980 percent blacks in the tract.

[d] See notes to Table 6.

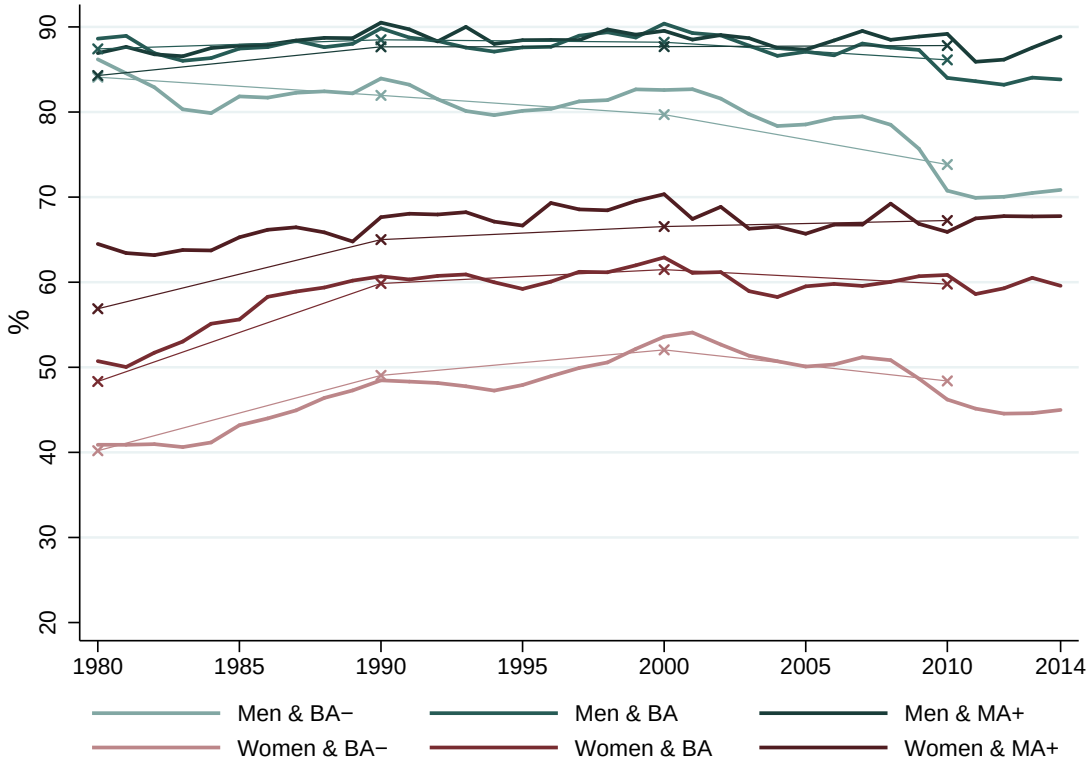
Significance levels: *** – 0.001; ** – 0.01; * – 0.05; + – 0.1.

Source: Decennial censuses and the American Community Survey, restricted use data.

APPENDIX

Figures

Figure A1: Full time (40h/week)

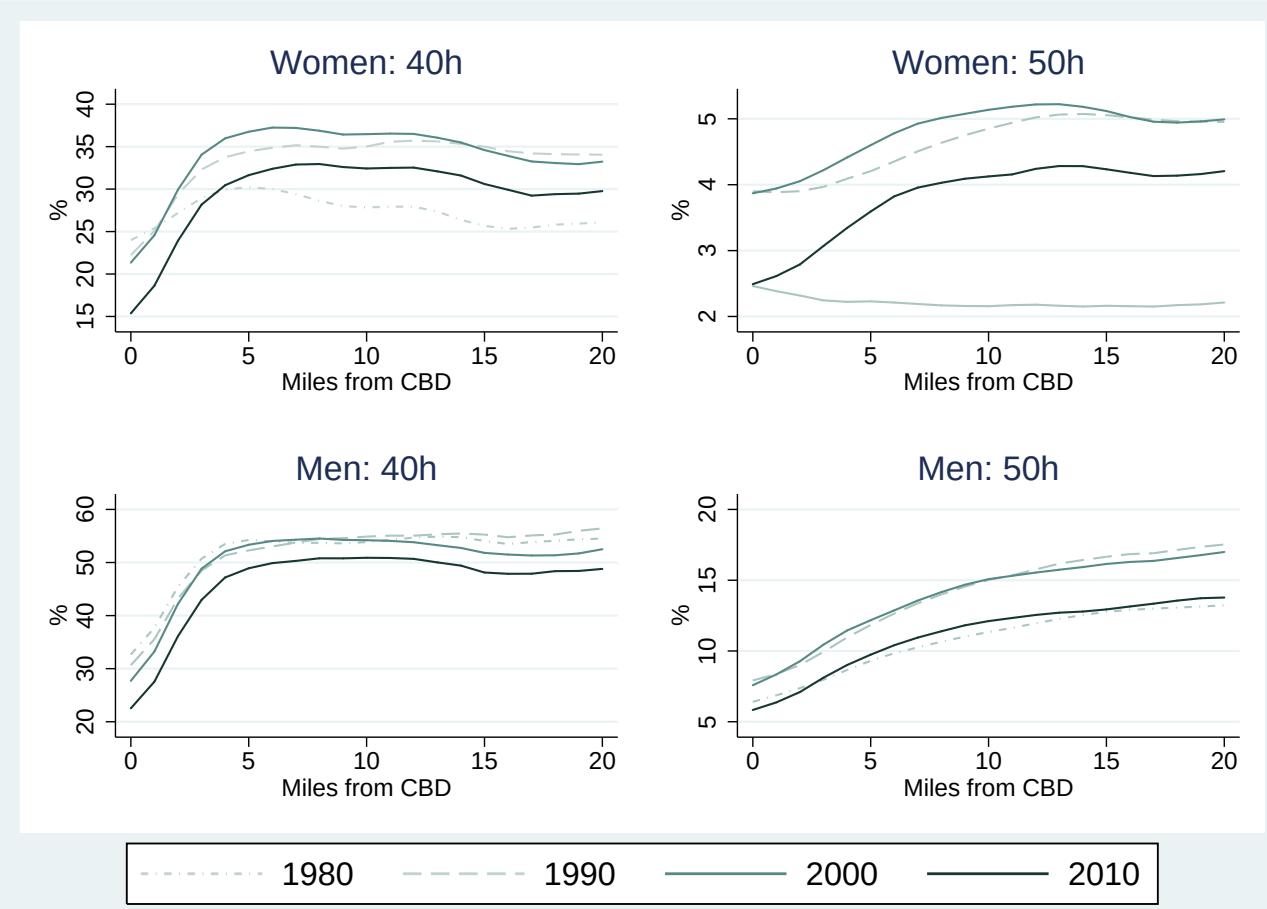


Note: Men and women ages 25-55.
Source: Decennial censuses, integrated public use micro data series (IPUMS).

Figure A2: Full time (50h/week)

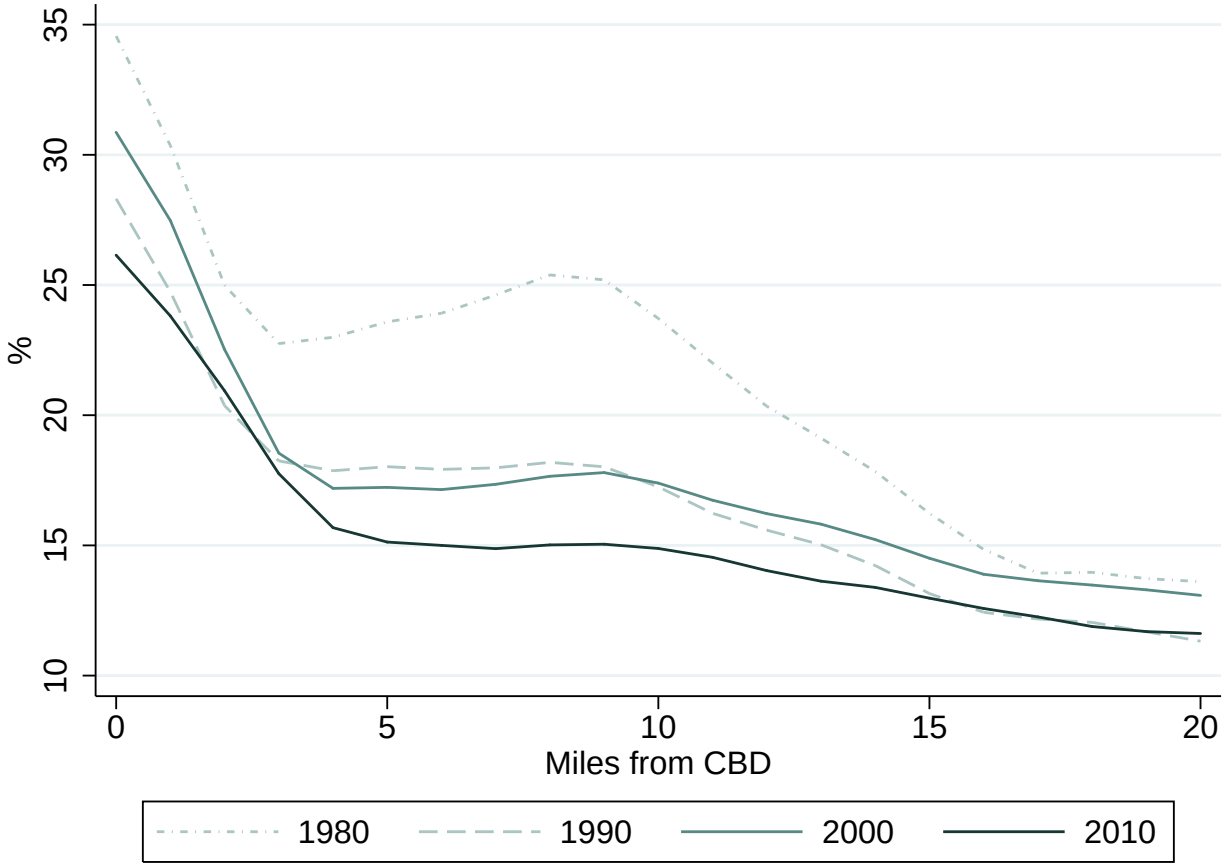
Note: Men and women ages 25-55.
Source: Decennial censuses, integrated public use micro data series (IPUMS).

Figure A3: % adults 25-55, unskilled and full time, by location



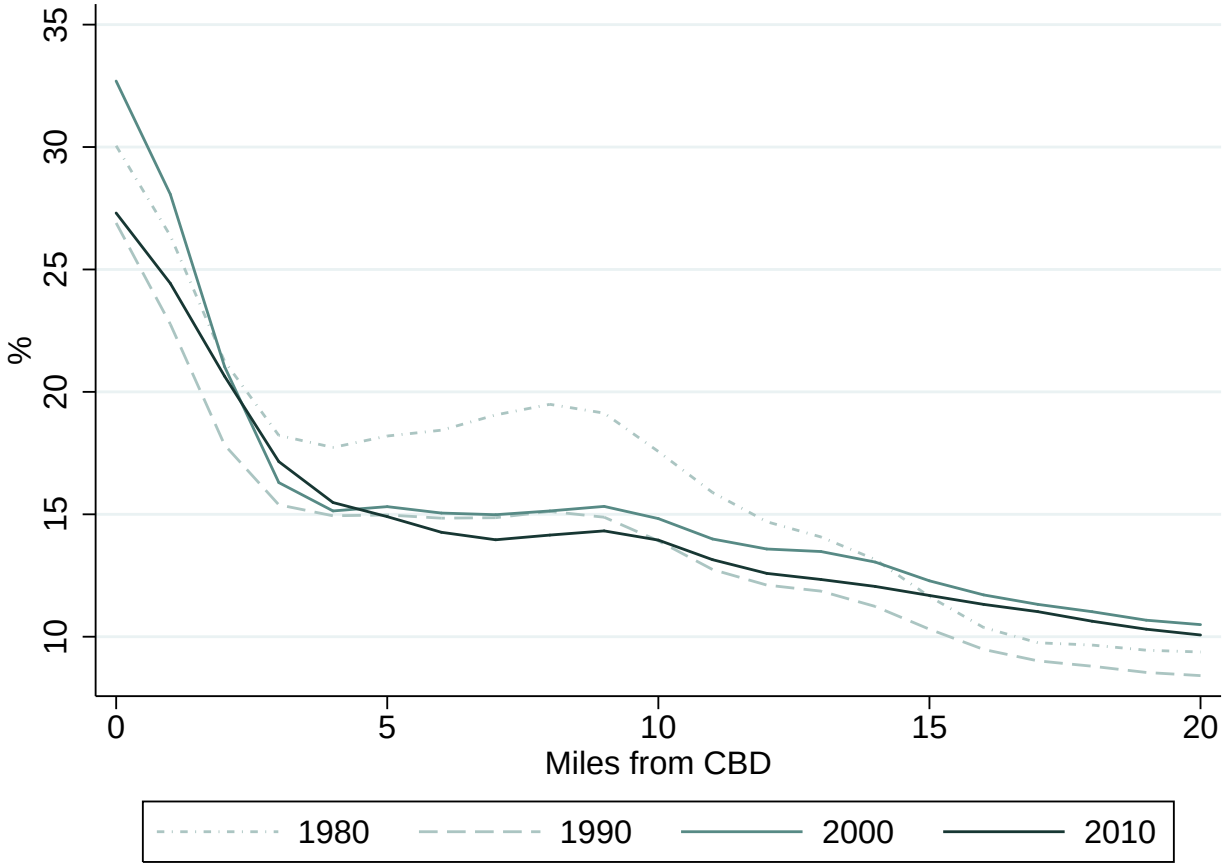
Source: Decennial censuses and the American Community Survey, restricted use data.

Figure A4: Private school by residence location, primary and middle school



Universe: Children 6-12 residing $x = 0, 1, ...18, 19, 20 - 35$ miles from the CBD.
Source: Decennial censuses and the American Community Survey, restricted use data.

Figure A5: Private school by residence location, high school



Universe: Children 13-18 residing $x = 0, 1, ...18, 19, 20 - 35$ miles from the CBD.
Source: Decennial censuses and the American Community Survey, restricted use data.

Table A1: Change in Violent Crime 1986-2012 – Crime

High Crime Reduction Cities	
New Orleans	-.64
New York City	-.60
Boston	-.55
Los Angeles County	-.54
Detroit	-.42
Baltimore City	-.41
Dallas	-.41
San Francisco	-.39
Low Crime Reduction Cities	
St. Louis	-.34
Jacksonville	-.28
City Of Fort Worth	-.28
Washington Metropolitan	-.26
San Diego County Sheriff	-.18
El Paso County Sheriff	-.18
Cleveland	-.17
San Jose	.02
Philadelphia	.10
Columbus*	.18
Memphis	.18
Phoenix	.25
San Antonio	.28
Houston	.31
Austin	.44
Milwaukee	.91
Indianapolis	1.15
Chicago	n.a.
Charlotte	n.a

* The entry for Columbus is for the period 1986-2011.

Violent crimes include murder, rape, robbery, aggravated assault. For a detailed description, see `http://www.ucrdatatool.gov/offenses.cfm`.

Source: Uniform Crime Report `http://www.ucrdatatool.gov/Search/Crime/Local/TrendsInOneVarLarge.cfm`

Bartik

We group industries into 41 categories using the 1990 industry classification available in IPUMS. Those groups are detailed in Table A3. In the preliminary analysis we also used a more aggregate grouping into seven industries, the results were very similar, but we favor the more disaggregate grouping because of the reduction in within-group industry heterogeneity.

Table A2: Bartik, Base Year 1970 – TBartik7A

Sorted alphabetically					
City	1980	1990	2000	2010	Center point Central Business District (CBD)
Austin	0.169	0.259	0.320	0.350	Texas Capitol
Baltimore	0.110	0.169	0.206	0.223	W. Lexington × Park Ave.
Boston	0.144	0.226	0.277	0.298	South Station
Charlotte	0.102	0.162	0.192	0.206	Charlotte Convention Center
Chicago	0.110	0.175	0.214	0.229	LaSalle × W. Congress Parkway
Cleveland	0.102	0.162	0.196	0.212	Soldiers' and Sailors' Monument
Columbus	0.126	0.197	0.242	0.262	E. Long Street × Route 3
Dallas	0.122	0.196	0.232	0.251	Dallas Convention center
Detroit	0.090	0.145	0.171	0.186	Grand Circus Park
El Paso	0.112	0.170	0.211	0.230	El Paso Art Institute
Fort Worth	0.122	0.196	0.232	0.251	Fort Worth Convention Center
Houston	0.137	0.209	0.243	0.266	Houston Center
Indianapolis	0.093	0.147	0.177	0.191	Monument Circle
Jacksonville	0.094	0.148	0.178	0.194	Bank of America Tower
Los Angeles	0.126	0.200	0.242	0.260	Pershing Square
Memphis	0.091	0.144	0.176	0.190	Beale St. × Riverside Drive
Milwaukee	0.102	0.159	0.192	0.207	Milwaukee County Court House
New Orleans	0.112	0.169	0.196	0.216	New Orleans Morial Convention Center
New York	0.136	0.217	0.266	0.286	Rockefeller Center
Philadelphia	0.105	0.165	0.202	0.218	City Hall
Phoenix	0.116	0.183	0.221	0.237	Phoenix Convention Center
Saint Louis	0.103	0.163	0.197	0.213	Federal Reserve
San Antonio	0.089	0.138	0.166	0.180	Tower of the Americas
San Diego	0.125	0.196	0.240	0.259	Horton Plaza
San Francisco	0.172	0.273	0.332	0.362	Transamerica Pyramid
San Jose	0.163	0.253	0.312	0.330	1 Infinity Loop (Apple headquarters)
Washington D.C.	0.229	0.344	0.426	0.461	White House

Table A2: Bartik, Base Year: 1970 – TBartik7D

Sorted by 2010-1980 difference					
City	1980	1990	2000	2010	2010-1980
San Antonio	0.089	0.138	0.166	0.180	0.091
Detroit	0.090	0.145	0.171	0.186	0.097
Indianapolis	0.093	0.147	0.177	0.191	0.098
Memphis	0.091	0.144	0.176	0.190	0.099
Jacksonville	0.094	0.148	0.178	0.194	0.100
Charlotte	0.102	0.162	0.192	0.206	0.104
New Orleans	0.112	0.169	0.196	0.216	0.104
Milwaukee	0.102	0.159	0.192	0.207	0.105
Cleveland	0.102	0.162	0.196	0.212	0.110
Saint Louis	0.103	0.163	0.197	0.213	0.110
Baltimore	0.110	0.169	0.206	0.223	0.113
Philadelphia	0.105	0.165	0.202	0.218	0.113
El Paso	0.112	0.170	0.211	0.230	0.118
Chicago	0.110	0.175	0.214	0.229	0.119
Phoenix	0.116	0.183	0.221	0.237	0.121
Dallas/Fort Worth	0.122	0.196	0.232	0.251	0.129
Houston	0.137	0.209	0.243	0.266	0.129
Los Angeles	0.126	0.200	0.242	0.260	0.134
San Diego	0.125	0.196	0.240	0.259	0.134
Columbus	0.126	0.197	0.242	0.262	0.136
New York	0.136	0.217	0.266	0.286	0.150
Boston	0.144	0.226	0.277	0.298	0.154
San Jose	0.163	0.253	0.312	0.330	0.167
Austin	0.169	0.259	0.320	0.350	0.181
San Francisco	0.172	0.273	0.332	0.362	0.190
Washington D.C.	0.229	0.344	0.426	0.461	0.232
Mean	0.122			0.250	0.128

Table A3: 41-Industry Bartik – Ti41

1	$ind \in [10, 32]$	agriculture
2	$ind \in [40, 50]$	mining
3	$ind = 60$	construction
4	$ind \in [100, 122]$	manufacturing nondurable food
5	$ind = 130$	manufacturing nondurable tobacco
6	$ind \in [132, 152]$	manufacturing nondurable textiles
7	$ind \in [160, 172]$	manufacturing nondurable paper, print and publish
8	$ind \in [180, 192]$	manufacturing nondurable chemical
9	$ind \in [200, 201]$	manufacturing nondurable petroleum
10	$ind \in [210, 212]$	manufacturing nondurable rubber
11	$ind \in [220, 222]$	manufacturing nondurable leather
12	$ind \in [230, 241]$	manufacturing durable lumber
13	$ind = 242$	manufacturing durable furniture
14	$ind \in [250, 262]$	manufacturing durable stone, glass
15	$ind \in [270, 301]$	manufacturing durable metal
16	$ind \in [310, 332]$	manufacturing durable machinery and computer
17	$ind \in [340, 350]$	manufacturing durable equipment and supplies
18	$ind \in [351, 370]$	manufacturing durable transportation equipment
19	$ind \in [371, 381]$	manufacturing durable professional equipment
20	$ind \in [391, 392]$	manufacturing durable other
21	$ind \in [400, 432]$	transportation
22	$ind \in [440, 442]$	communication
23	$ind \in [450, 472]$	utilities
24	$ind \in [500, 532]$	wholesale durable
25	$ind \in [540, 571]$	wholesale nondurable
26	$ind \in [580, 691]$	retail trade
27	$ind \in [700, 712]$	finance
28	$ind \in [721, 760]$	business and repair
29	$ind \in [761, 791]$	personal services
30	$ind \in [800, 810]$	entertainment
31	$ind \in [812, 830]$	prof office and clinics
32	$ind \in [831, 840]$	hospitals
33	$ind = 841$	legal
34	$ind \in [842, 861]$	education and training
35	$ind \in [862, 870]$	care
36	$ind \in [871, 881]$	services
37	$ind = 882$	engineering, architectural, and surveying services
38	$ind = 890$	accounting, auditing, and bookkeeping services
39	$ind = 891$	research, development, and testing services
40	$ind = 892$	management and public relations services
41	$ind \in [900, 932]$	public administration

Table A4: Threshold values for Cragg-Donald and Kleibergen-Paap $Wald$ statistics

	(1)	(2)	(3)
Endogenous	1	2	3
Exogenous	3	4[a]	5[b]
Stock-Yogo $TSLS$ Bias			
0.05	13.91	11.04	9.53
0.10	9.08	7.56	6.61
0.20	6.46	5.57	4.99
0.30	5.39	4.73	4.30
Stock-Yogo $TSLS$ Size			
0.10	22.30	13.43	
0.15	12.83	8.18	
0.20	9.54	6.40	
0.25	7.80	5.45	

[a] – used for our case of 2 endogenous and 3 exogenous, more conservative.
[b] – used for our case of 3 endogenous and 3 exogenous, more conservative.
Source: Stock and Yogo [2005, table 5.1 and 5.2].

V.1 Variable Construction

PRICE **2-3 Bedroom single-family Home** The decennial censuses and the ACS ask the owner of owner-occupied single-family homes the estimated value of the value of their home. While self-reported assessments of values, we will refer to them as housing prices.

In order to obtain numbers that are close to market prices, we restrict the sample to those who moved in within the last ten years, on the assumption that homes that owners of more recently bought and sold units would be more knowledgeable about price developments than those with longer tenure.

To obtain a price that refers to comparable units while preserving sample size, we focus on two or three bedroom single-family homes. Housing prices are given in intervals and the bracket values vary across the years. Therefore, we focus on the median bracket value. For tracts where the median bracket is the top code, we assign the dollar value that would be the mean if the top bracket had had the same range as the penultimate bracket. For instance, if the penultimate bracket ranged from 800 thousand to 1 million, and 1 million and above were the top bracket, we would give houses in the top bracket a 1.1 million dollar valuation. We chose this rule because it is conservative and if anything result in an underestimate of the price increases close to the CBD.

We focus on the median house price in the tract. Top coding is our reason for focusing on the median rather than a more selective percentile.

In our main specification, we impute a value that is the same distance to the top-code threshold as the immediately preceding midpoint value. For instance, if the top bracket is 800-1000, and values above 1000 are top coded, we assign the value 1100 to the top code. This method is conservative if the housing price distribution, like the wealth and income distributions, is right skewed.

We have also tried alternative top codings, including simply imputing the threshold value. Our qualitative results were not sensitive to the variation tried.

For the study period 1980-2010, our measure shows a 30 percent increase in constant dollars, a rise largely inline with the Case-Shiller national index's rise of 26 percent. The Case-Shiller national index went from 43.44 to 145.0, and the CPI from 100 to 264, yielding a constant dollar housing price increase of 26 percent ($=\frac{145}{43.44} \times \frac{100}{264} - 1$).

Another benchmark is offered by the Census Bureau's constant price index for new-family homes sold rose from \$72 to \$272 thousand, current dollars. In constant dollars, the increase was 30 percent ($=\frac{261}{76} \times \frac{100}{264} - 1$). `https://www.census.gov/const/www/constpriceindex_excel.html`

We use the Consumer Price Index (CPI) to deflate housing prices. A theoretical concern is that housing accounts for some 40 percent of the CPI and therefore a price index that excluded housing would be preferable, for instance the food

price index. Conveniently, the food price index moved very closely with the CPI and on those grounds we use the CPI despite its theoretical shortcomings.

Center point, Central Business District (CBD) For each city we identified the center with the help of Google maps. All cities had a clear central area identifiable from the convergence of roads, the presence of a main railway station, clusters of hotels with the national chain name prefixed by "down town" and a concentration of signature institutions and monuments. We used the thus identified area to designate a city center, with one exception. For San Jose, we placed downtown in Silicon Valley.

The only city with more than one clear center was New York City, where midtown and downtown both can credibly claim that title. We picked the midtown center but locating the center downtown resulted in similar results. Because of this ambiguity, in a robustness test we exclude the New York metropolitan area and results are robust to this exclusion (Table 8, column 3).

Within each center we picked a center point, a salient building or monument, and obtained its latitude and longitude from iTouchMap.com. For instance, for Washington DC, we picked the White House and for San Jose, Apple Inc. Headquarters. While there can be some discretion as to which coordinates represents the true center, most contenders would be within a mile or two of the points picked here. The list of center points are detailed in Table A2.

Distance to the CBD (*dist*) From tract shape files, we have generated latitude and longitude for the (population weighted) centroid of the tract, allowing us to calculate the distance between a tract and the CBD. We restrict our sample to tracts that are within 35 miles of the CBD.

In the preliminary analysis, we found our variables of interest to exhibit a pronounced j-shape with respect to distance to the CBD, the minimum located somewhere in the 3-7 mile range. Therefore we chose a non-linear specification with distance indicator variables for the following intervals:

d1 0-3 miles

d2 3-10 miles

d3 10-20 miles

d4 20-35 miles, reference category.

FT **Full Time** We let $FT(h, e)$ denote the fraction of adults 25-55 who worked more that $h, h = 40, 50$ hours per week and had education $e, e = BA+, MA+$.

Z **Metropolitan Area Demand Shifter for Skilled Workers** See description in Section 3.2

$INCOME$ **(Person)** Total personal income (which can be negative).

V.2 Panel data set construction

We use US2010 cross-walk files to create a tract-level panel data set, where for each tract in 2010 we construct its equivalent in previous years using cross-walk files from `http://www.s4.brown.edu/us2010/Researcher/Bridging.htm`. These files provide a mapping of tracts in a census year and 2010, as well as weights. For example, if there were a new tract B in 2010 that was the result of combining blocks from year 2000 tracts B1 and B2, then we would create a year 2000 tract B as a weighted average of B1 and B2. Thus, the ability to include tract fixed effects comes at the cost of data quality, and the problem worsens with the number of years to 2010 (more time allows for more changes to tracts). In order to explore the role of race, we are interested in parsing the sample by initial fraction blacks. Therefore, we restrict the sample to tracts for which we have an observation in 1980 and also remove tracts for which we only have one observation. We are left with a sample of about 48 thousand tracts (rounded to nearest '000 for disclosure reasons).