New Evidence on Trends in the Cost of Urban Agglomeration

Matthew E. Kahn

UCLA and NBER
November 2007

mkahn@ioe.ucla.edu

Prepared for the November 30th-December 1st NBER Economics of Agglomeration Conference. This research was supported by the Richard S. Ziman Center for Real Estate at UCLA.

I. Introduction

Big cities feature more congestion, pollution and crime than smaller cities (Glaeser 1998, Glaeser and Sacerdote 1999). These non-market local public bads can significantly reduce quality of life in big cities (Tolley 1974, Gyourko and Tracy 1991). In contrast, larger cities offer greater cultural and restaurant amenities than smaller cities. Big cities facilitate restaurant and store specialization because such niche businesses anticipate that aggregate demand for their services will be high enough to cover their fixed costs (Waldfogel 2007).

This suggests that big cities offer a quality of life tradeoff. Their market consumer goods and services span a larger set of varieties than smaller cities but big cities have worse levels of non-market local public goods than smaller cities. These marketable consumer amenities and non-market local public goods are likely to be complements.

Metropolitan areas that make progress with respect to congestion, pollution and crime have a better opportunity to compete as "consumer cities" (Glaeser, Kolko and Saiz 2001). This paper examines trends in three key indicators of urban quality of life; namely congestion, pollution and crime. I use several data sets to document two main facts. At a point in time, suburbanites face longer commutes, but are exposed to less pollution and crime than urban residents. Over time, suburban residents have enjoyed commute time reductions as employment has decentralized. Cities where employment has decentralization can absorb more growth without experiencing local quality of life degradation. As major metropolitan areas experience improvements in congestion, pollution and crime an incidence issue arises. At the end of the paper, I will examine the distributional effects of who gains from improvements in local quality of life in an open-economy featuring migration both within cities and across cities and more stringent housing supply regulation in some of the most desirable cities.

II. The Cost of City Bigness Revisited

The key parameters determining the cost of urban growth can be highlighted with a simple linear pollution example. Consider a city of size N identical people. When an extra person moves to the city, he creates E extra units of pollution. Each entrant has no incentive to internalize the social costs he imposes on everyone else in the city. Each person in the city suffers D extra units of health damage from each extra unit of pollution. Each person is willing to pay \$W to avoid a unit of health damage (D). In this case, aggregate damage caused by this entrant equals N*E*D*W. As the city's population and income grows, N and W will grow and the cost of urban growth could be large.

This economy abstracts from several real world features of cities that help to reduce the cost of city bigness. First, local public bad levels vary within cities. Within a city, there are pollution, crime and congestion hot spots. As I will document below, pollution levels are higher closer to the dense city center. As more people live and work in the suburbs, a smaller share of the population will be exposed to the highest pollution levels. Second, the population differs with respect to their disutility from disamenity exposure. Those who suffer relatively little from pollution, crime and congestion have a comparative advantage at living close to "ground zero" and renting the relatively cheap housing. Those who are risk averse, susceptible to pollution effects or have a high disutility from being stuck in traffic can minimize their exposure by paying a housing price premium to live in a nicer part of the city. The opportunity for heterogeneous households to Tiebout sort within major cities reduces the cost of city bigness.

The cost of city bigness literature implicitly assumes that people face high migration costs across cities. Such high migration costs mean that people cannot protect themselves by "voting with their feet" if a city's quality of life is degraded. If all residents are renters and face zero migration costs then they will not bear the incidence of unexpected negative shocks to quality of life.

III. New Facts on Three Costs of Urban Growth

Commuting

This section presents new facts about urban commuting patterns. I focus on three main questions. First, how do commute times and commute speeds vary as a function of city size? Second, over time as more workers suburbanize do commuters who live in the suburbs face a longer or a shorter commute in the year 2000 relative to in 1980? Third, in the major cities in the year 2000, what share of workers live a classic monocentric life featuring long commutes for those who live in single detached homes?

In this section, I use several data sets to investigate how commute times vary within cities and across cities. To begin to present some new commuting facts, I use micro data from the 2001 National Household Transportation Survey. This survey samples people from over 73 major metro areas. An attractive feature of this data is that it is possible to obtain residential zipcode identifiers. Table One reports three sets of regressions using this sample of metropolitan area residents. In the top panel, the dependent variable is the speed that workers commute at measured in miles per hour. I estimate equation (1).

$$\text{Speed} = \text{constant} + b_1 * \log(\text{MSA Population}) + b_2 * (\text{Distance to CBD}) + b_3 * 1(\text{Commute using Public Transit}) + U \quad (1)$$

The standard errors are clustered by metro area. A doubling of a metro area's population is associated with a reduction of speed of 1.6 miles per hour. For every extra mile that a household lives from the CBD, its commuting speed increases by .44 miles per hour. The third column shows how slow public transit is. People in big cities are more likely to commute using public transit and this increases their commute times. All else equal, a worker who commutes using public transit travels 11 miles per hour slower than a worker who commutes by car. Public transit use explains 25% of the big city speed penalty. Based on census tract level data, the average person who lived in a metropolitan area in 1970 lived 8.72 miles from the CBD while the average person who lived in a metropolitan area in the year 2000 lived 11.44 miles from the CBD. Based on the estimate reported in column (1), the rise in suburbanization between 1970 and 2000 has increased road speed by 1.2 MPH.

In the middle panel of Table One, I report estimates of equation (2).

$$\text{Commute Time} = \text{constant} + b_1 * \log(\text{MSA Population}) + b_2 * (\text{Distance to CBD}) + b_3 * 1(\text{Commute using Public Transit}) + U \quad (2)$$

A doubling of metro size increases the average one way commute time by 2 minutes. Public transit use in big cities explains half of this relationship. The average public transit user's commute is 23 minutes longer than the average car commuter's. Controlling for city size and distance to work, commute times are shorter for people who live further from the CBD.

To study trends over time in commuting, I use census tract data from 1980 and 2000 (for data details see Baum-Snow and Kahn 2005). Figure One presents results from 1980 and 2000. For all people who live within 30 miles of a CBD, I calculate the share of workers who have a commute over 45 minutes long by mileage distance to the CBD of the metro area they live in. The Figure's lines are roughly parallel. Very few commuters who live close to a CBD have a long commute in 1980 or 2000. The share with long commutes increases out to about 10 miles from the CBD and then in both years, the slope flattens. It is important to note that in the year 2000, a larger share of commuters do have long commutes relative to in the year 1980. This gap equals roughly 2 percentage points.

Figure Two examines time trends in short commutes (less than 25 minutes one way) in 1980 and 2000. The 1980 line falls steeply with respect to distance from the CBD. This is the expected pattern in a monocentric city where people work downtown. Within 25 miles of the CBD, at every distance from the CBD, a larger share of workers in the year 2000 had a short commute relative to in 1980. The gap between the 1980 and 2000 lines is maximized at 10 miles from the CBD. Consistent with the claim that quality of life for suburbanites has improved. Job suburbanization's consequences are clearly visible in the year 2000 as the share of workers with a short commute is roughly constant from 10 miles from the CBD to 25 miles from the CBD.

Figures Three and Four are identical to Figures One and Two except that Figures Three and Four include data solely on Chicago, Los Angeles and New York City. This cut of the data allows me to investigate changes in commuting patterns in the very biggest cities. Figure Three focuses on the share of workers with long commutes in these major cities. The first point to note is that the figure does not look like Figure One. From zero miles to ten miles from the CBD, the share with a long commute increases but in the eight to twenty mile range it declines sharply. Job suburbanization in these major cities has reduced mega-commuting. Figure Four looks more like Figure Two but the benefits of job suburbanization in causing short suburban commutes is even more clearly seen in the big three major cities than in the overall metro area diagram (Figure Two). As shown in Figure Four, in the year 2000 people who live 18 miles from the CBD had the same share of short commutes as people who live two miles from the CBD. These figures present suggestive evidence that job suburbanization increases the capacity of "mega-cities" to absorb growth without significant degradation of non-market quality of life factors.

Using year 2000 Census data on average commute times by census tract, in Figure Five I report average commute times for metropolitan area workers by mile of distance from their CBD. The Figure displays three different lines. One is for all urban workers, one is for workers who live in metropolitan areas with more than four million people and one is for workers who live in metropolitan areas with less than four million people. The average line highlights that average commute times rise with distance from the CBD. As expected, the big cities have higher commute times. At seven miles from the CBD, the average commute time in big cities is roughly 12 minutes longer one way than in small cities. But, note the convergence! Commute times in big city decline sharply from seven miles to the CBD out to 20 miles to the CBD. In contrast, average commute times rise in smaller cities over this same mileage interval.

One simple explanation for these facts is that employment decentralization in major cities has allowed suburbanites who work in the suburbs to enjoy shorter commutes. Firm fragmentation has reduced the number of workers at the corporate downtown headquarters and increased the number of “back office” jobs to the suburbs (Rossi-Hansberg, Sarte, and Owens 2006). As fewer workers are making classic suburban car based commutes to center city jobs this helps to mitigate road tragedy of the commons by easing bottlenecks.

In major cities, what share of workers live a classic “monocentric” life in the year 2000 featuring living in a single detached home and having a long commute to work? To investigate this question, I use the 2000 IPUMS micro 5% sample, for 10 major metropolitan areas. For household heads who work, I calculate the share who live in a single detached home, commute by private car and have a one way commute greater than or equal to 40 minutes. Call this group the “monocentric commuters”. I then report the share of total commuters who are monocentric commuters and live in a home that this less than or equal to twenty years old. I also report the share of workers who live in a single detached home, commute by private car and have a one way commute time of less than 25 minutes.

Table Two reports the means for these four dummy variables for the ten largest metropolitan areas in the United States. Contrast the New York City and Atlanta metropolitan areas. In New York City, only 3% of its workers commute by car, have a one way commute over 40 minutes and live in a single detached house in the year 2000. It Atlanta almost 19% of commuters fall into this category. The ratio of commuters who have a short commute, commute by car and live in a new single detached home in Atlanta relative to the same group in New York City is 26 to 1 (.1307/.0045). Across all four columns, New York City stands out as an outlier. Consider it with Dallas. In Dallas, a larger share of commuters (12.5%) live in new housing and have a short car commute than live in new housing and have a long car commute (8.5%). Detroit also stands out for its absence of "monocentric" commuting. In Detroit, 33% of its workers have short car commutes and live in single detached housing while only 12.5% of its workers have long car commutes and live in single detached housing. The table highlights that the classic tradeoffs predicted in the monocentric model are not observed even in the largest major metropolitan areas in the year 2000 (see Lee 2007).

To further study, the demand for living in one of the four categories reported in Table Two, I estimate Engel curves. For each of these four dummies, I estimate the following linear probability model where the unit of analysis is person j in metropolitan area m.

$$Dummy_{jm} = \Phi_m + b_1*age_j + b_2*age*age_j + f(\text{household income}) + U \qquad (3)$$

I specify f() to be a quartic. For each of the four dependent variables, I estimate (3) and holding age at its sample mean predict how the share of household heads for who the dependent variable equals one varies with household income. Note that these categories are not mutually exclusive and thus do not need to add up to one.

In Figure Six, I report the predicted share/income relationships for all metropolitan areas. For the ten largest metro areas, I have also re-estimated equation (3) and made new predictions. These are presented in Figure Seven. For the entire metro sample, the Figure shows that the probability of commuting by car and living in a detached home and having a short commute rises sharply with respect to income until income reaches $100,000. The figure shows that nation wide, very few commuters live in new detached housing and have a long commute. Among the wealthy, only roughly 10% of households live this “classic monocentric” lifestyle.

Turning to the Figure for the largest metro areas, different patterns emerge. One similarity across Figures Six and Seven is that the share of commuters with a short commute rises with income. One major difference across the figures pertains to the share of workers with a long commute. Across all metro areas, there are equal shares of household heads having a long commute and living in detached housing relative to short commute and living in new detached housing. In contrast, in larger cities there are many more households with a long commute who live in detached housing relative to those with a short commute who live in detached housing.

In Figure Eight, I report one last set of facts for the ten largest metropolitan areas. I report the share of households who live in single detached homes who have long commutes (45 minutes or longer) by distance from the Central Business District. I also report the share of households whose household head has a short commute and I also report the shares of household heads who live in new housing (built between 1980 and 2000) and have a short commute. Ten miles from the CBD, roughly 17% of the sample live in a detached home and have a short commute to work while roughly 8% of the sample live in a detached home and have a long commute to work. It is interesting to note that over the range of 10 miles to 20 miles to the CBD that the four lines are roughly parallel. In contrast to the monocentric model, increases in distance to the CBD lead to a rising share of households with a long commute and a short commute.

Urban Pollution Progress

Water and air pollution has been a second set of major external cost of living in big cities. The scale effects of concentrating millions of people into a small geographical area created major public health problems. At the turn of the 20th century, the average white urbanite paid a ten year "mortality penalty" for not living in the countryside (Haines 2001). By 1940, this mortality premium had vanished. Both cross-city research (Cutler and Miller 2004, Cain and Rotella 2001) and city specific case studies such as Ferrie and Troesken's (2004) investigation of Chicago highlight the importance of large scale water treatment infrastructure in reducing death from water borne disease.[1] These investments helped to reduce the public health costs of urban density. Using data for 31 Philadelphia Wards, Condran and Cheney (1982) find that tuberculosis and pneumonia death rates were higher in 1880 in wards with higher population density. These

[1] One benefit of city bigness is that this reduces the average cost of providing expensive high fixed cost infrastructure. Haines (2001) documents that while middle sized cities had higher death rates than small cities that these middle sized cities also had higher death rates than large cities who had the scale to pay for infrastructure.

coefficient estimates are borderline statistically significant. Based on their ward estimates from 1930, Condran and Cheney (1982) find that the population density effect on death rates from these diseases shrinks sharply.

In recent years, major cities have experienced large water quality gains (see http://www.epa.gov/owm/wquality/benefits.htm). In New York City, people are fishing in its rivers again and wild creatures such as beavers are spotting swimming in its waters. The media is celebrating the pollution progress in major rivers such as Boston's Charles River and the Cleveland 1969 on the Cuyahoga River is receding from memory. Today, more and more cities such as Chicago and Pittsburgh are reclaiming their waterfronts as leading amenity areas whose aesthetic value is capitalized into local home prices.

Ambient air pollution in major cities such as London, New York City and Pittsburgh first increased and then decreased over the 20th century. The causes of this Environmental Kuznets Curve pattern can be traced in part to the use of dirty fuel sources such as coal for home heating and cooking and the rising scale of industrial manufacturing activity in major cities. Environmental historians have documented these patterns. London in response to the fog of December 1952 enacted the Clean Air Act of 1956 which sharply regulated domestic coal smoke. This helped London switch to gas and electric heat. Same story in Pittsburgh; converted to cleaner anthracite coal, oil and natural gas piped in from Texas rather than bituminous coal (McNeil 2000). From a public health perspective, the rising and declining levels of ambient particulates is especially important given their impact on morbidity and mortality risk (Chay and Greenstone 2004).

Urban industrial transition is another cause of declining pollution in big cities. In Figures Nine and Ten, I graph the share of workers by county who work in manufacturing as a function of the log of the county's population. In 1969, there were many big cities where a large share of workers worked in manufacturing. Note that by the year 2000, there is a clear negative correlation between manufacturing's employment share and county population size. There are large public health gains from removing older polluting manufacturing plants from heavily populated areas. New York City offers one example. Between 1969 and 2000, the number of manufacturing jobs in New York County (Manhattan) declined from 451,330 to 146,291. Manufacturing accounted for 16.2 percent of the county's employment in 1969 compared to only 5.3 percent in 2000.

The rise of private vehicle use contributed to rising levels of ambient smog and lead in cities (Reyes 2007). Under the Clean Air Act, new vehicles only faced stringent emissions standards starting in the early 1970s (Kahn 2006). As pre-1975 built vehicles have been scrapped, the average vehicle on the roads has become so much cleaner that many major cities such as Los Angeles have experienced significant smog progress despite ongoing growth in population and miles driven (Kahn and Schwartz 2007).

Consider Los Angeles time trends over the last 25 years. For ambient ozone, a leading indicator of smog, the average of the top 30 daily peak one-hour readings across the county's 9 continuously operated monitoring stations declined 55% from 0.21 to 0.095 parts per million between 1980 and 2002. The number of days per year exceeding the federal one-hour ozone standard declined by an even larger amount—from about 150 days per year at the worst locations during the early 1980s, down to 20 to 30 days per year today. Recent pollution gains are especially notable because Los Angeles County's population grew by 29 percent between 1980 and 2000, while total automobile mileage grew by 70 percent (California Department of Transportation 2003). For air quality to improve as total vehicle mileage increases indicates that emissions per mile of driving must be declining sharply over time.

To provide new facts about air pollution trends in ambient pollution, I use the U.S. Environmental Protection Agency's Annual Summary Table Query database to examine the relationship between county population size and ambient pollution levels between 1973 and 2000.[2] The EPA widely monitors air pollution, and most of these monitoring stations are located in relatively heavily populated counties. County level year data on population and the share of employment in manufacturing is available from the REIS data base.

For each seven different measures of ambient pollution, I calculate the county mean concentration by calendar year and regress this on a state fixed effect, the log of the county's population, the county's manufacturing share of total employment and a time trend.[3] Table Three presents the results from six OLS regressions based on estimates of equation (4) using county level panel data from 1973 to 2000.

$$\text{Log(Ambient Pollutant)} = \text{state fixed effect} + b_1\text{*log(Population)} + b_2\text{*Trend} + b_3\text{*(\% Manufacturing)} + U \qquad (4)$$

[2] See U.S. Environmental Protection Agency, "Monitor Data Queries: Annual Summary Table Query" (www.epa.gov/aqspubl1/annual_summary.html).

[3] This specification implicitly imposes that emissions activity in one county does not drift over into adjacent counties.

As shown in Table Three, for five of the six pollutants (the one exception is ozone), county population has a positive and statistically significant effect on county ambient pollution levels. Nitrogen Oxide emissions has the highest population elasticity of .29.   Particulates and PM10 are especially bad for health because of the risk of mortality (Chay and Greenstone 2004). The population elasticites for these pollutants are small at .09 and .06 respectively. Holding county population size constant, the time trends indicate significant annual progress in reducing ambient pollution.   Ozone is the only ambient pollutant with a non-negative time trend.   Consider PM10. This ambient pollutant is declining by 3.4% per year. Given that big cities have higher pollution levels, this percentage reduction translates into greater overall pollution progress. I have tested for whether counties with larger populations have experienced a greater percentage progress. I cannot reject the hypothesis of no differential.

Big city deindustrialization has helped to improve urban air quality.[4] For counties that had at least 250,000 people in 1969 the average share of manufacturing declined from 21.9% to 10.6% in the year 2000. The results in Table Three provide some indication of how this deindustrialization translates into pollution progress.   Consider the results for sulfur dioxide and nitrogen oxides. A 10 percentage point decline in manufacturing's share (an industrial composition shift) is associated with a 10%

[4] Declining transportation costs have allowed manufacturing to locate in low labor cost regions. Big cities are more likely to face more stringent Clean Air Act regulation and this has displaced footloose dirty industries to less regulated attainment counties (Henderson 1996, Becker and Henderson 2000, Greenstone 2001).

reduction in sulfur dioxide and a 6% decline in nitrogen oxide and a 3% decline in particulates.[5]

Surburbanization Reduces Exposure to Urban Pollution

Pollution is not uniformly distributed within cities. This section tests the intuitive claim that pollution levels are higher in center cities relative to the suburbs of the same metro area. If environmental quality is higher in the suburbs, then population suburbanization reduces average pollution exposure. Such suburbanization creates a “moat” effect. If pollution is concentrated in the dense, older industrial core of a city then the aggregate social cost caused by such externalities is reduced as people increase their distance from this polluted area.

Does ambient air pollution get better with distance from the CBD? To answer this question, I focus on ambient monitoring stations in the 89 metropolitan areas with at least 500,000 people. My sample includes all monitoring stations within thirty miles of a CBD. For this set of major cities, I calculate each ambient monitoring station’s distance to the Central Business District. For six different measures of ambient pollution I then run OLS regressions of the form:

$$\text{Log(Pollution)} = \text{MSA fixed effect} + \text{controls} + b*(\text{Monitor Distance to CBD}) + U \quad (5)$$

[5] Chay and Greenstone (2003) report that a 1% decline in TSP is associated with a .5% reduction in the infant death rate.

I test whether b<0. Table Four reports general evidence supporting this claim. Within the same metropolitan area, the marginal reduction in ambient particulates and sulfur dioxide is 1% per mile of increased distance from the CBD. Ambient carbon monoxide and nitrogen dioxide decline by 2% per mile of distance. Ozone is the only pollutant that does not decline as a function of distance to the CBD.

A second indicator of local environmental quality is the presence of noxious facilities such as Toxic Release Inventory sites or Superfund sites. The Environmental Protection Agency provides each site's and each facility's zip code. I use this information to code up for 15,000 zip codes whether there is at least one noxious site in the zip code. I estimate linear probability models where the dependent variable equals one if the zip code has at least one noxious site within its borders.

$$1(\text{Noxious site}) = \text{MSA Fixed Effect} + \text{controls} + b*(\text{Zip Code distance to CBD}) + U \quad (6)$$

I test whether b<0. In Table Four, I report regressions where the unit of analysis is a zip code. The sample includes all zip codes within 25 miles of 297 different metropolitan area CBDs. Controlling for a metro area fixed effect and a zip code's land area (a dart board measure), I test whether the probability that a noxious site is present is lower further from the CBD. In column (7) of Table Two, I document that the probably that a TRI site is located in a zip code declines by 1.5 percentage points for each mile of distance from the CBD. In column (8), I show that the probability that there is at least one superfund site in a zip code declines by 1 percentage point for each mile of distance from the CBD.

While suburbanization reduces the average urbanite's exposure to local public bads, it increases the likelihood that this person consumes more energy resources. Low density, car centered living increases gasoline consumption by around 30% relative to living and working in more compact cities and living in multifamily housing units (Bento et. al , Kahn 2000). Suburbanites are likely to consume more electricity as they live in larger homes. Given the current absence of a carbon tax, the typical household ignores its greenhouse gas contribution in its own pursuit of high quality of life.

Crime

Crime is a key urban disamenity. Big city crime rates are higher than smaller cities (Glaeser and Sacerdote 1999). Crime and poverty go hand in hand. Given that the poor are over-represented in center cities and often do not have access to cars, crime is concentrated in urban neighborhoods and other neighborhoods that can accessed using public transit (Bowes and Ihlandfelt 2001, Glaeser, Kahn and Rappaport 2007, Brueckner and Rosenthal 2007). Crime has declined in big cities starting in the early 1990s. The relative importance of abortion, lead, crack cocaine, police hires, and incapacitation in explaining this trend continue to be debated (Levitt 2004, Reyes 2007).

To present some new results on crime and urban density, I focus on counties that are located in metropolitan areas and use county FBI victimization data over the years 1994 to 2002. The data source is: **http://fisher.lib.virginia.edu/collections/stats/crime/).** The dependent variable is the log of the county's murder count or violent crime count.

$$\text{Log(Crime Count)} = c + \text{Fixed Effects for MSA} + b_1\text{*log(population)} + b_2\text{*Trend} + b_3\text{*(Center County)} + b_4\text{*Trend*Center County} + U \quad (7)$$

In estimating equation (7), I am especially interested in the coefficient estimates of b_2 and b_4. The results in column (1) highlights that the murder count has fallen by 8.6% per year in the center county while it has fallen by 5.1% per year in the suburban counties. Violent crime trends reveal a similar pattern. Controlling for population size, the center counties have higher crime levels but have enjoyed greater crime progress between 1994 and 2002. These trends are consistent with Reyes' (2007) claim that lead exposure is a key determinant of crime trends. If ambient lead levels are highest downtown and if the poor are disproportionately concentrated in downtowns then I would predict that the greatest increases and subsequent reductions in crime (18 years after the enaction of unleaded gasoline) would take place in the center cities.

IV. Urban Housing Price and Quantity Dynamics Caused By Improved Quality of Life

If a city experiences reductions in crime, pollution and congestion, then demand to live there will rise. The elasticity of housing supply is thus a key determinant of whether prices or quantities adjust in response. Consider a city where it is easy to build new housing because the regulatory tax is low (Glaeser, Gyourko and Saks 2005). In such an elastic housing supply city (think of Riverside and San Bernardino, Los Angeles), new housing will be built, population growth will take place. As the population grows, average commute times could rise and pollution levels could rise. In the new compensating differentials equilibrium, the city will feature more people but relatively little home price appreciation (see Kahn 2000). In contrast, in an inelastic housing supply city such as San Francisco or New York City, improved quality of life will translate into rising home prices.

Could improvements in local quality of life fuel the rise of "Superstar cities"? Gyourko, Mayer and Sinai's (2006) emphasize the combination of inelastic supply and the rising skewness of the income distribution. As the count of the wealthy increases, they bid up the price of the scarce set of housing units in certain desirable cities. A complementary hypothesis is that the rich's willingness to pay for living a specific city increases as its amenities increase. As prices rise in San Francisco and New York City, the average entrant has more education than the average person who is "priced out" of this city. This gentrification process raises the city's overall average education level. Rising city human capital levels offer the potential for social spillover benefits in terms of productivity effects (Moretti 2004). In a gentrifying city, the commercial and cuisine opportunities upgrade as restaurants and stores that cater to these groups appear (Waldfogel 2007). The net effect of this "virtuous cycle" is even higher home prices. Home owners in such cities will benefit from this process while renters could actually be made worse off by amenity improvements that trigger gentrification (Sieg et. al. 2004). Future work could investigate the general equilibrium effects introduced by amenity improvements in an open city model where demographic groups face different cross-city migration costs (Bayer, Keohane, Timmins 2006, Chay and Greenstone 2005).

V. Conclusion

Congestion, pollution and crime represent three major quality of life challenges that big city residents face. This paper has used several data sets to optimistically argue that significant quality of life progress has taken place in large metropolitan areas in recent years. Big city pollution and crime problems have fallen sharply in the United States in the recent past.

While high profile studies such as the Texas Transportation Institute's Urban Morbility report paint a gloomy picture of how much time urbanites spend "stuck in traffic", such macro studies mask significant within city heterogeneity with respect to commute time progress. As employment has suburbanized, many people who live ten to twenty miles from the city center now have short commutes.

Suburbanization causes households to be able to drive at higher speeds, and be exposed to less local pollution and crime risk. The net effect of declining commute times, pollution and crime in big cities is a reduction in the cost of urban agglomeration. Optimal city size grows as the marginal cost of city bigness declines.

This paper's evidence has all been based on U.S data but the findings may speak to mega city growth around the world. As mega cities grow in developing countries how much does urban quality of life decline? Similar to the U.S experience at the turn of the 20^{th} century, the negative quality of life consequences of living in a growing city hinges on whether government has the resources (Cutler and Miller 2004) and the incentives to provide necessary pubic infrastructure and regulation.

References

Banzhaf, S., H. Sieg, V.K. Smith and R. Walsh. 2004. Estimating the General Equilibrium Benefits of Large Changes in Spatially Delineated Public Goods, *International Economic Review* 45: 1047-1077.

Baum-Snow, Nathaniel and Matthew E. Kahn (2005) The Effects of Urban Rail Transit Expansion: Evidence from Sixteen Cities from 1970 to 2000, Brookings-Wharton Conference on Urban Affairs . Volume, edited by Gary Burtless and Janet Rothenberg Pack.

Bayer, Patrick, Nathaniel Keohane, and Christopher Timmins Migration and Hedonic Valuation: The Case of Air Quality , NBER # 12106 (2006).

Becker, Randy, and Vernon Henderson. 2000. "Effects of Air Quality Regulations on Polluting Industries." Journal of Political Economy 108, no. 2: 379–421.

Bento, Antonio M., Maureen Cropper, Ahmed Mushfiq Mobarak and Katja Vinha: "The Impact of Urban Spatial Structure on Travel Demand in the United States" Review of Economics and Statistics, 87(3) 466-478

Bowes, David and Keith Ihlanfeldt 2001. Identifying the Impacts of Rail Transit Stations on Residential Property Values. Journal of Urban Economics 50, 1-25.

Brueckner, Jan and Stuart Rosenthal. Gentrification and Neighborhood Housing Cycles: Will America's Future Downtowns be Rich? U.C Irvine Working Ppaer

Cain, Louis P., and Elyce J. Rotella. 2001. "Death and Spending: Urban Mortality and Municipal Expenditure on Sanitation." Annales de Démographie Historique 1: 139–54.
.
Chay, Kenneth Y., and Michael Greenstone. 2003. "The Impact of Air Pollution on Infant Mortality: Evidence from Geographic Variation in Pollution Shocks Induced by a Recession." Quarterly Journal of Economics 118, no. 3: 1121–67.

Condran, Gretchen and Rose Cheney. Mortality Trends in Philadelphia: Age and Cause Specific Death Rates 1870-1930. Demography 19(1) 1982 97-123.

Cutler, David M., and Grant Miller. 2004. "The Role of Public Health Improvements in Health Advances: The 20th Century United States." NBER working paper #10511.

Cutler, David, and Grant Miller. 2005. "Water, Water, Everywhere: Municipal Finance and Water Supply in American Cities." Working Paper 11096. Cambridge, Mass.: NBER (January).

Ferrie, J.P. and Troesken Death and the city: Chicago's mortality transition, 1850-1925, W. | NBER Working Paper No. 11427 (June).

Glaeser, Edward. L. Are cities dying? Journal of Economic Perspectives 12(2) (1998) 139-160.

Glaeser, Edward L, Joseph Gyourko, and Raven Saks. 2005. Why is Manhattan So Expensive? Regulation and the Rise in House Prices." Journal of Law and Economics. 48(2): 331-370.

Glaeser, Edward and Matthew E. Kahn: (2004) "Sprawl and Urban Growth" (Chapter in the Handbook of Urban Economics Volume IV) , edited by Vernon Henderson and J. Thisse. Volume 4, North Holland Press.

Glaeser, Edward., Matthew E. Kahn, and Jordan Rappaport: (2007) "Why Do the Poor Live in Cities?" Journal of Urban Economics, forthcoming

Glaeser, Edward, Jed Kolko, and Albert Saiz. 2001. "Consumer City." Journal of Economic Geography 1, no. 1: 27–50.

Glaeser, Edward and Bruce Sacerdote, 1999. "Why Is There More Crime in Cities?," Journal of Political Economy, University of Chicago Press, vol. 107(S6), pages S225-29, December.

Gordon, Peter, Ajay Kumar and Harry Richardson: (1991) "The Influence of Metropolitan Spatial Structure on Commuting Time." Journal of Urban Economics 26(2): 138-151.

Gordon, Peter, Bumsoo Lee and Harry Richardson: (2004) Travel Trends in U.S Cities: Explaining the 2000 Census Commuting Results. USC Working Paper April 2004.

Greenstone, Michael. 2002. "The Impacts of Environmental Regulation on Industrial Activity." Journal of Political Economy 110, no. 6.: 1175–1219.

Greenstone, Michael. Did the Clean Air Act cause the remarkable decline in sulfur dioxide concentrations? Journal of Environmental Economics and Management, 47 (2004) 585–611

Gyourko, Joesph. and Joesph Tracy. 1991, The structure of local public finance and the quality of life, Journal of Political Economy. 91(4), 774-806.

Gyourko, Joseph ,Christopher Mayer, Todd Sinai Superstar Cities, 2—6 NBER 12355

Haines, Michael. 2001. “The Urban Mortality Transition in the United States, 1800–1940.” Historical Paper 134. Cambridge, Mass.: NBER (July).

Henderson, Vernon. 1996. “The Effect of Air Quality Regulation.” American Economic Review 86, no. 4: 789–813.

Henderson, Vernon. Urban primacy, external costs, and quality of life, Resource and Energy Economics, Volume 24, Issues 1-2, 15 February 2002, Pages 95-106.

Kahn, Matthew E: “The Environmental Impact of Suburbanization” Journal of Policy Analysis and Management, Vol. 19, No. 4, Fall 2000, pp. 569-86

Kahn, Matthew E. 1999. “The Silver Lining of Rust Belt Manufacturing Decline.” Journal of Urban Economics 46, no. 3: 360–76.

Kahn, Matthew E. Smog Reduction's Impact on California County Growth
Journal of Regional Science, Vol. 40, Issue 3, August 2000

Kahn, Matthew E. and Joel Schwartz Urban Air Pollution Progress Despite Sprawl: The “Greening” of the Vehicle Fleet. Journal of Urban Economics, forthcoming.

Lee, Bumsoo. 2007. “Edge” or “Edgeless” Cities? Urban Spatial Structure in U.S Metropolitan Areas, 1980 to 2000. Journal of Regional Science. 47(3) 479-515.

Levitt, Steven D: “Understanding Why Crime Fell in the 1990s: Four Factors that Explain the Decline and Six that do Not” Journal of Economic Perspectives, 2004 18(1) pages 1673-190.

Margo, Robert. 1992. “Explaining the Postwar Suburbanization of the Population in the United States: The Role of Income.” Journal of Urban Economics 31, no. 3: 301–10.

McNeil, J.R., Something New Under the Sun: An Environmental History of the 20th Century World. Norton Press. 2000

Melosi, Martin V. 2000. The Sanitary City: Urban Infrastructure in America from Colonial Times to the Present. Baltimore: The Johns Hopkins University Press.

Moretti, Enrico. Human Capital Externalities in Cities" Handbook of Regional and Urban Economics, North Holland-Elsevier, 2004

Noll, Roger, Mary M. Shirley, and Simon Cowan. 2000. “Reforming Urban Water Systems in Developing Countries.” In Economic Policy Reform: The Second Stage, NBER Volume edited by Anne O. Krueger. University of Chicago Press.

Reyes, Jessica Wolpaw (2007) "Environmental Policy as Social Policy? The Impact of Childhood Lead Exposure on Crime," The B.E. Journal of Economic Analysis & Policy*:* Vol. 7 : Iss. 1 (Contributions), Article 51.
Available at: http://www.bepress.com/bejeap/vol7/iss1/art51

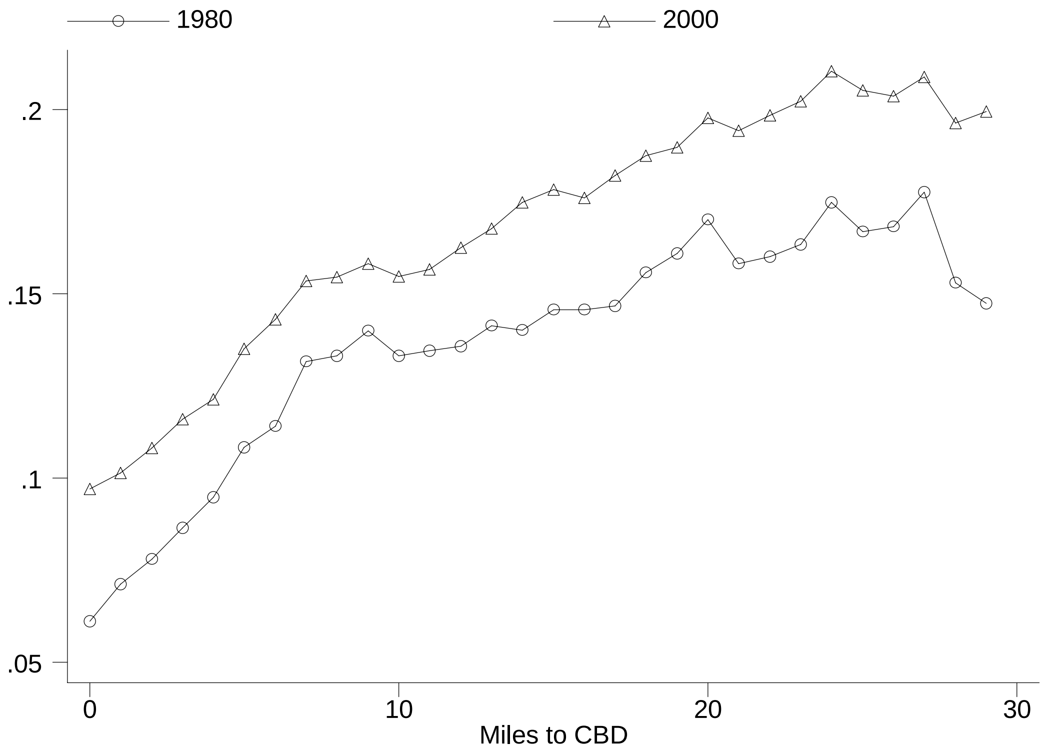
Rossi-Hansberg,Esteban, Pierre-Daniel Sarte, Raymond Owens III Firm Fragmentation and Urban Pattterns NBER Working Paper No. 11839 Issued in December 2005

Stavins, Robert. 1992. 1998. “What Can We Learn from the Grand Policy Experiment? Lessons from SO2 Allowance Trading.” Journal of Economic Perspectives 12, no. 3: 69–88.

Tolley, G.S. The welfare economics of city bigness, Journal of Urban Economics 1(3) (1974) 324-345.

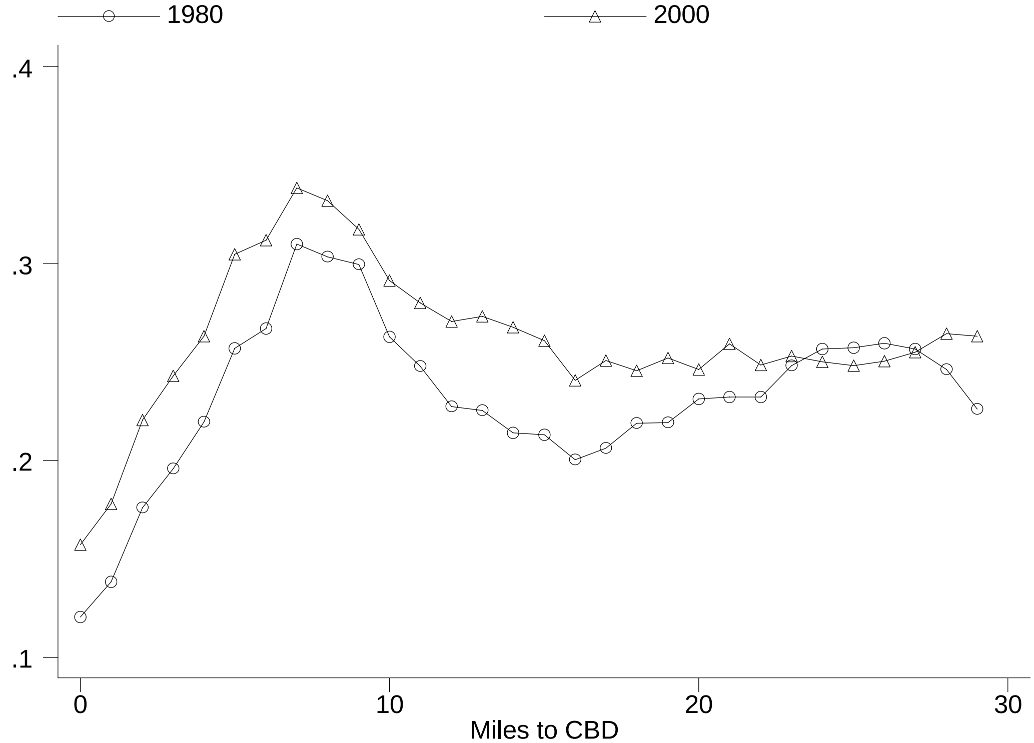
Waldfogel, Joel. The Median Voter and the Median Consumer. Local Private Goods and Residential Sorting. Journal of Urban Economics 2007.

Figure One



Share of Workers Whose One-Way Commute Time is Over 45 Minutes, All Metro Areas

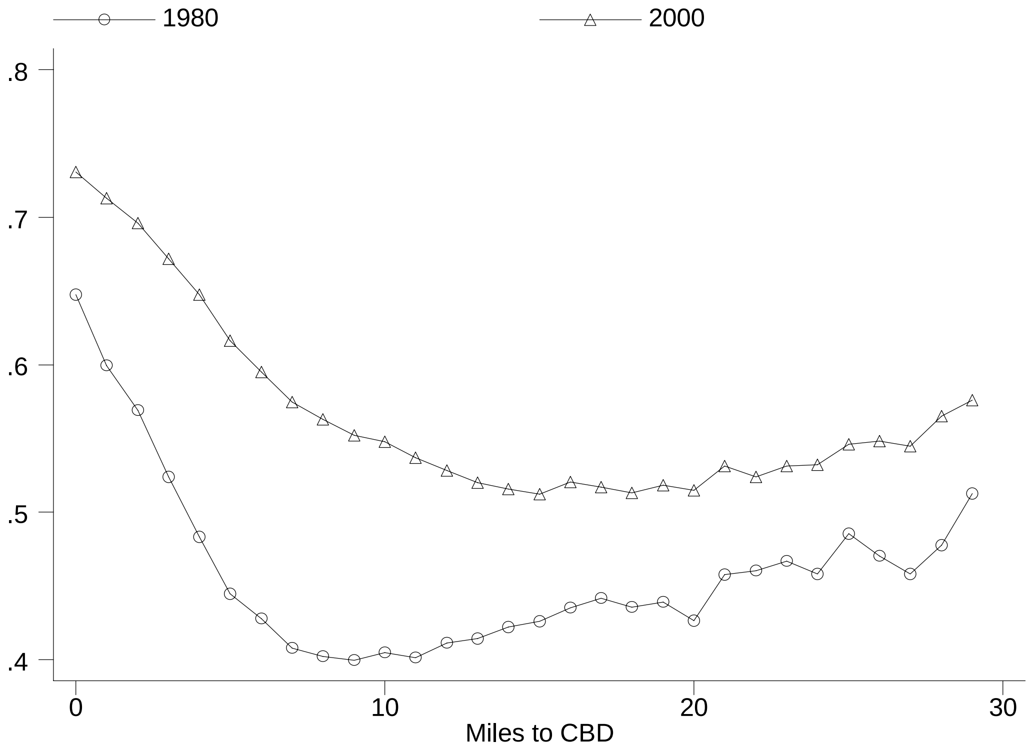
Figure Two



Share of Workers Whose One-Way Commute Time is Over 45 Minutes

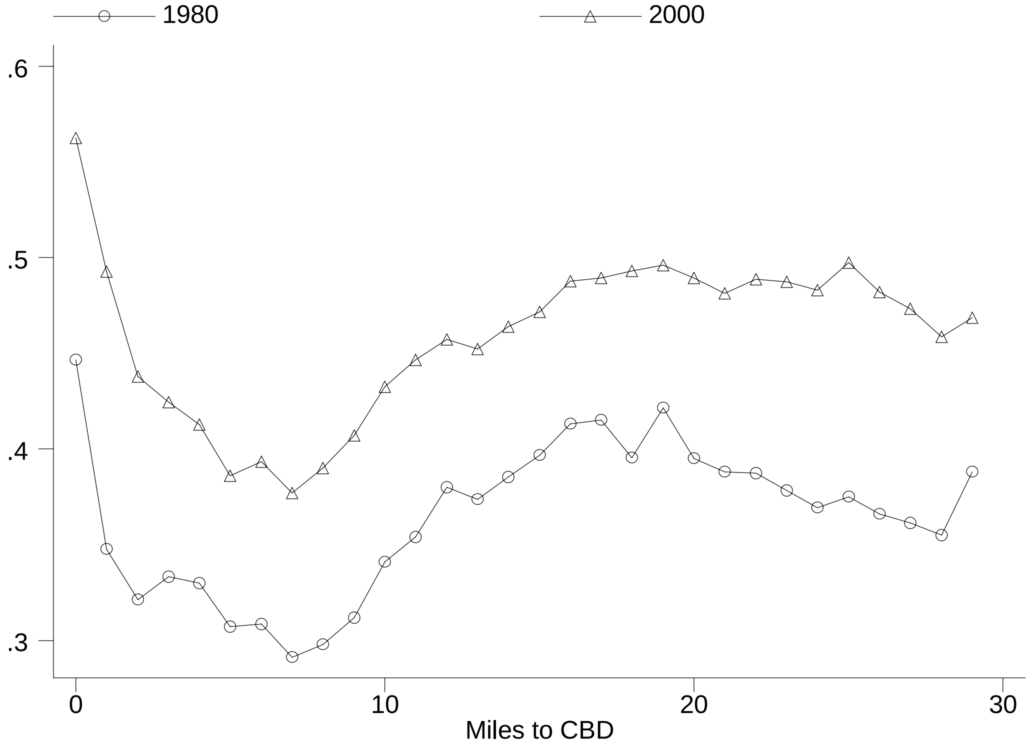
Sample Includes Chicago, Los Angeles and New York City

Figure Three



Share of Commuters Whose One Way Commute is Less than 25 Minutes, All Metro Areas

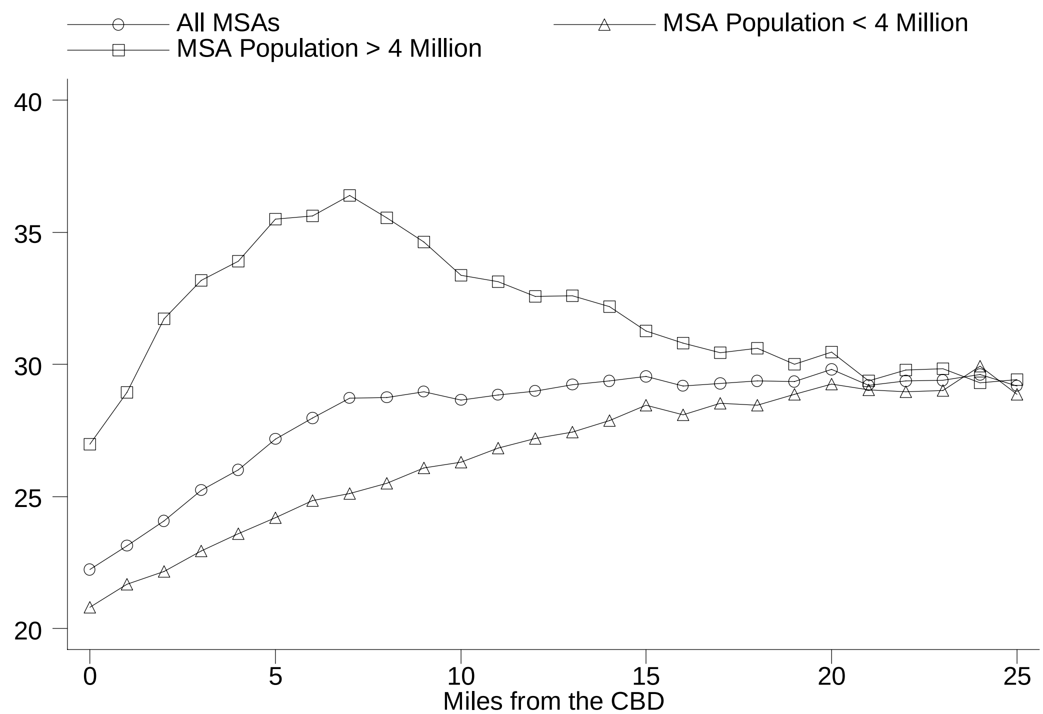
Figure Four



Share of Commuters Whose One Way Commute is Less than 25 Minutes

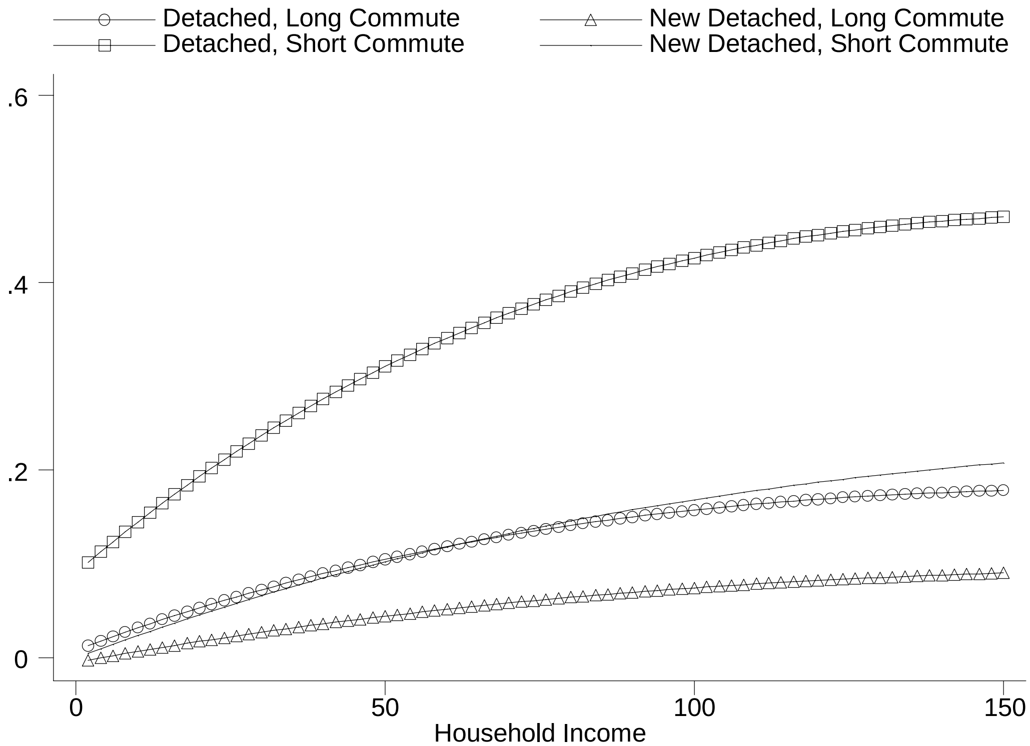
Sample Includes Chicago, Los Angeles and New York City

Figure Five



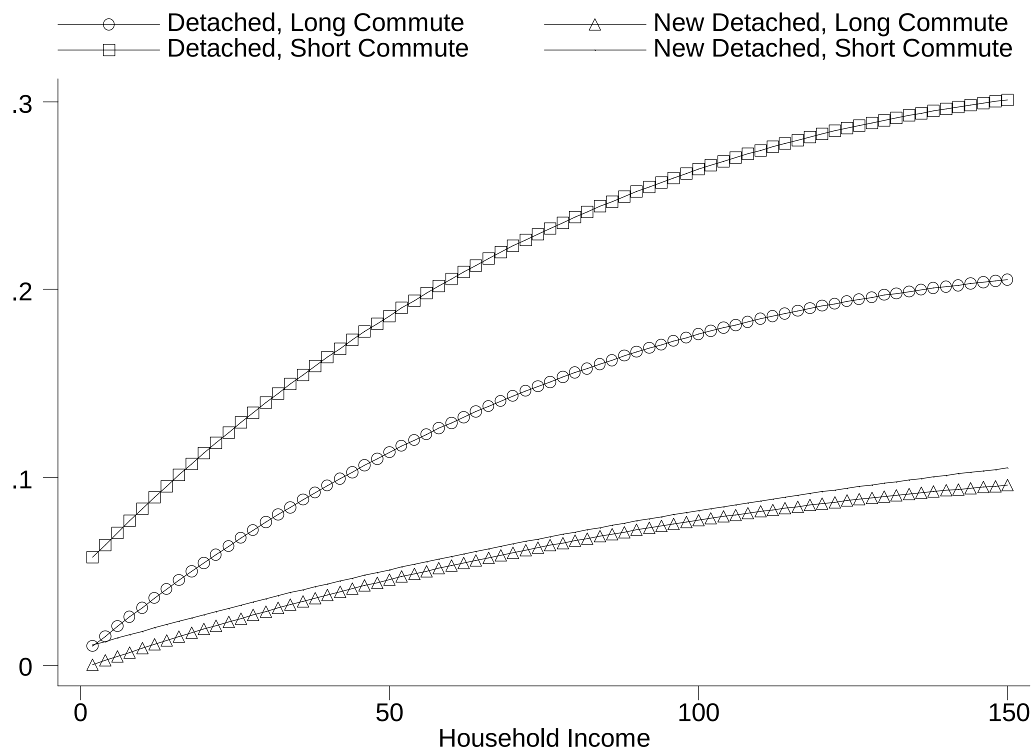
Average Commute Time in the Year 2000 By City Size

Figure Six



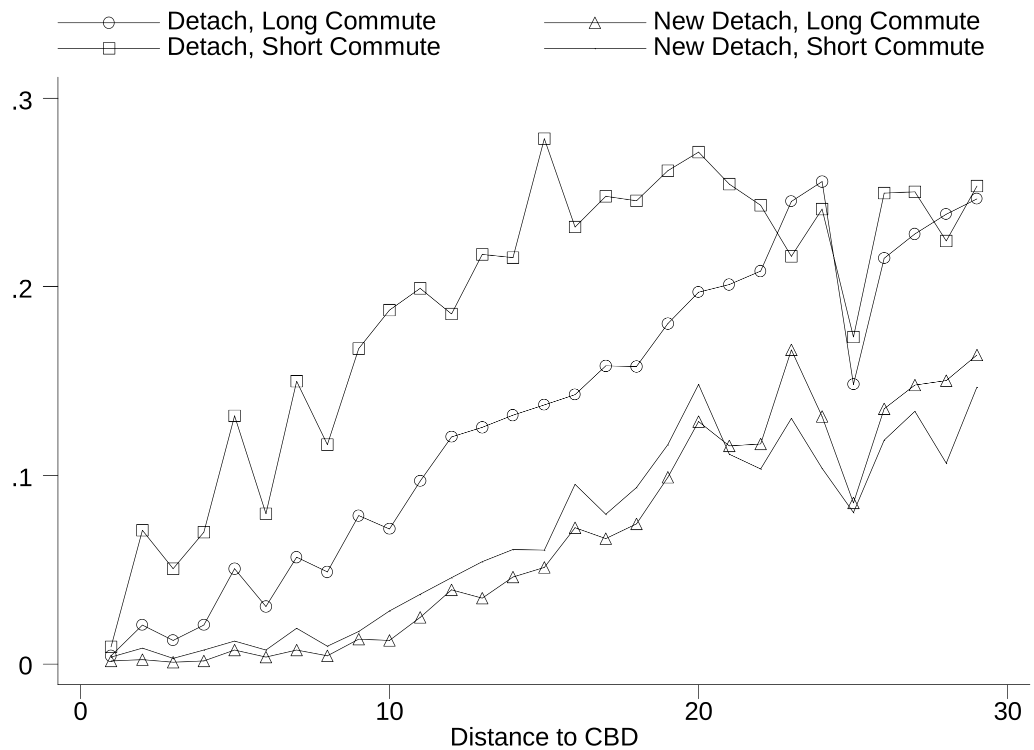
This table is based on year 2000 IPUMS micro data. This figure is based on four separate linear probability models based on equation (3) in the text.. For example, the category “Detach, Long Commute” represents the probability that a household commutes by private car, lives in a single detached house and has a one way commute time of 45 minutes or longer. This figure is based on results using all metropolitan areas and holding the household head’s age at the sample mean.

Figure Seven



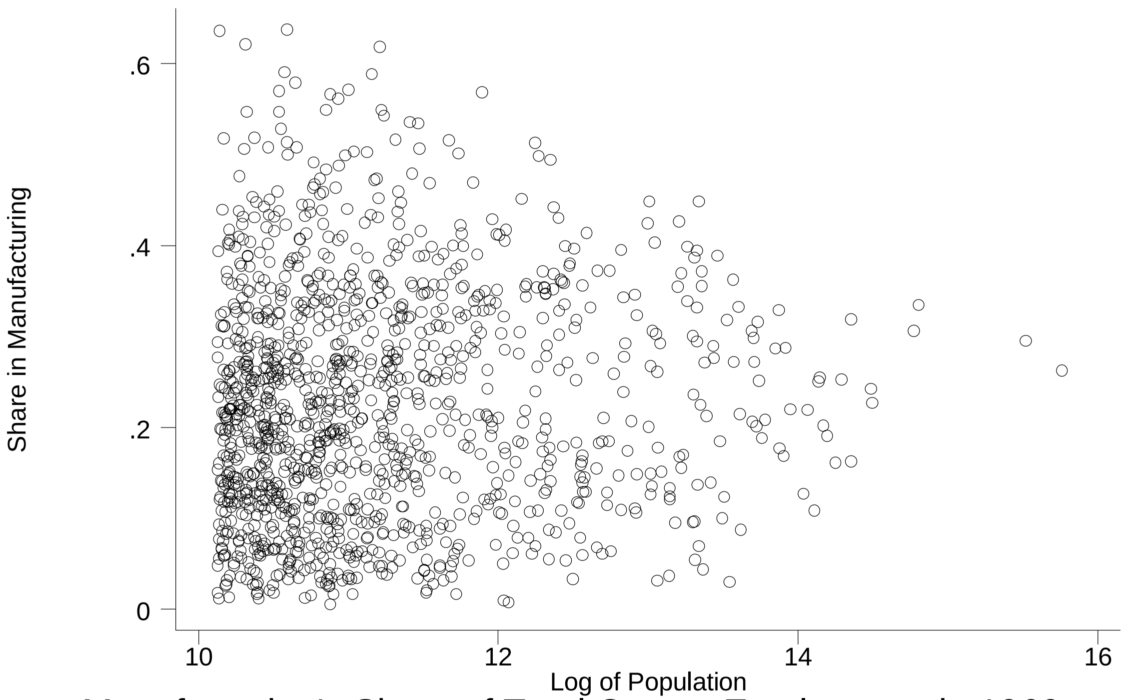
This table is based on year 2000 IPUMS micro data.   This figure is based on four separate linear probability models. For example, the category “Detach, Long Commute” represents the probability that a household commutes by private car, lives in a single detached house and has a one way commute time of 45 minutes or longer. This figure is based on results using only households who live in the ten largest metropolitan areas. In this figure, the household head’s age is held constant at the sample mean.

Figure Eight



This table is based on year 2000 IPUMS micro data. The category "Detach, Long Commute" represents the probability that a household commutes by private car, lives in a single detached house and has a one way commute time of 45 minutes or longer. The category "Detach, Short Commute" represents the probability that a household commutes by private car, lives in a single detached house and has a one way commute time of 25 minutes or shorter. The category "new" represents household heads who live in a home that was built between 1980 and 2000. This figure is based on results using only households who live in the ten largest metropolitan areas.

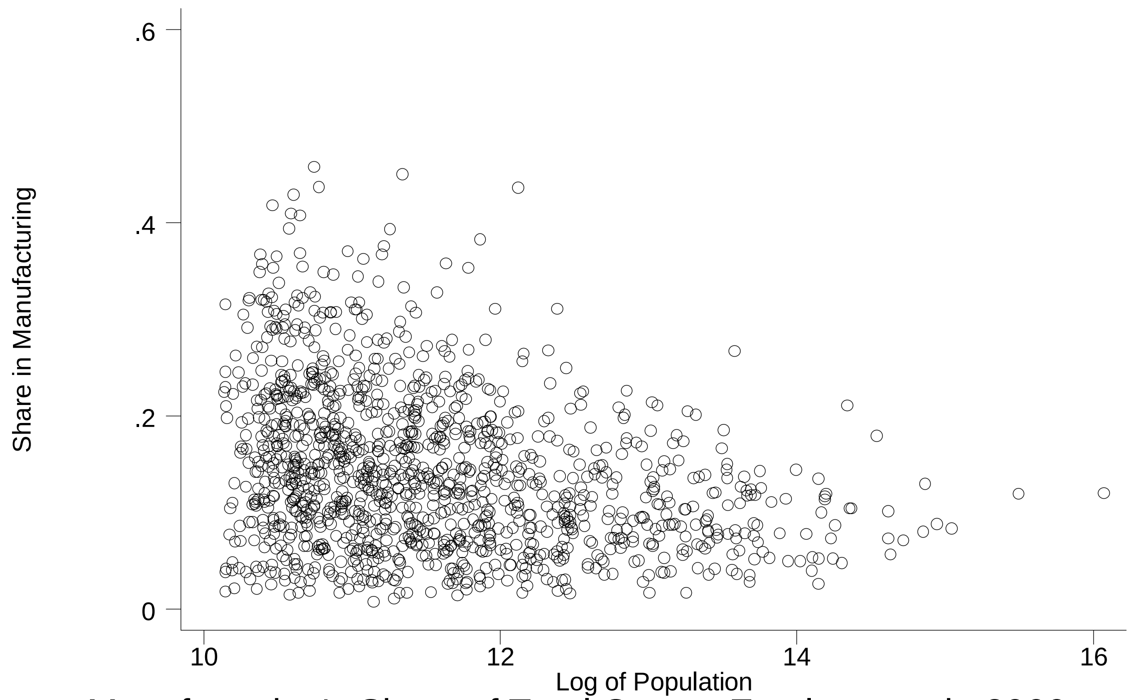
Figure Nine



Manufacturing's Share of Total County Employment in 1969

N=1242; at least 25,000 people in 1969

Figure Ten



Manufacturing's Share of Total County Employment in 2000

N=1242; at least 25,000 people in 1969

Table One: 2001 Urban Commute Speeds and Commute Times

Speed Measured in Miles Per Hour

Column	(1)		(2)		(3)	
	beta	s.e	beta	s.e	beta	s.e
Log(City Size)	-2.2870	0.4227	-2.4625	0.2774	-1.8149	0.2067
Distance to CBD			0.4472	0.0363	0.3847	0.0306
Commute Using Public Transit					-10.5490	0.7344
constant	62.5491	6.1644	59.9064	3.8177	51.6993	2.9003
observations	25778		25778		25778	
R2	0.023		0.0680		0.1010	

Commute Time in Minutes

Column	(4)		(5)		(6)		(7)	
	beta	s.e	beta	s.e	beta	s.e	beta	s.e
Log(City Size)	2.8024	0.1982	2.7324	0.1968	1.3495	0.3275	2.5958	0.2796
Distance to CBD			0.1784	0.0317	0.3117	0.0395	-0.1998	0.0325
Distance to Work							1.2649	0.0311
Commute Using Public Transit					22.5271	1.7225		
constant	-18.8196	2.8554	-19.8738	2.9573	-2.3477	4.4455	-27.4718	4.0011
observations	25778		25778		25778		25778	
R2	0.029		0.0360		0.1650		0.529	

This table reports seven OLS regressions. The unit of observation is a commuter. Standard errors are clustered by metropolitan area. The data source is the 2001 National Household Transportation Survey.

Table Two: Monocentric Commuters Versus Suburban Commuters by Metropolitan Area

Metropolitan Area	Commute by Car Live in Single Detached Home One Way Commute Time >= 40 Minutes	Commute by Car Live in Single Detached Home That was built in the last twenty years One Way Commute Time >= 40 Minutes	Commute by Car Live in Single Detached Home One Way Commute Time <= 25 Minutes	Commute by Car Live in Single Detached Home That was built in the last twenty years One Way Commute Time <=25 Minutes
Atlanta, GA	0.1886	0.1370	0.2394	0.1307
Boston, MA	0.1121	0.0320	0.1954	0.0417
Chicago-Gary-Lake, IL	0.1214	0.0355	0.1797	0.0407
Dallas-Fort Worth, TX	0.1403	0.0853	0.2596	0.1245
Detroit, MI	0.1245	0.0379	0.3311	0.0588
Houston-Brazoria, TX	0.1350	0.0771	0.2422	0.0993
Los Angeles-Long Beach, CA	0.0948	0.0158	0.1856	0.0212
New York-Northeastern NJ	0.0334	0.0052	0.0401	0.0045
Philadelphia, PA/NJ	0.1068	0.0415	0.1962	0.0537
Washington, DC/MD/VA	0.1384	0.0708	0.1528	0.0563

This table reports the share of all households who fall into each category based on the 5% IPUMS Year 2000 data sample.

Table Three: Time Trends in Ambient Air Pollution Levels

	Pollutant											
	Carbon Monoxide		Sulfur Dioxide		Ozone		Nitrogen Dioxide		Particulates		PM10	
	coeff	s.e	coeff	s.e	coeff	s.e	coeff	s.e	coeff	s.e	coeff	s.e
time trend	-0.0438	0.0007	-0.0121	0.0007	0.0029	0.0002	-0.0205	0.0006	-0.0201	0.0004	-0.0337	0.0070
log(county population)	0.1926	0.0054	0.1480	0.0049	-0.0061	0.0015	0.2892	0.0039	0.0939	0.0019	0.0608	0.0025
% of County Employment in Manufacturing	-0.3126	0.0820	0.9928	0.0672	0.0959	0.0240	0.6294	0.0550	0.3030	0.0247	0.1625	0.0439
constant	-1.6960	0.0707	-0.0870	0.0592	3.8881	0.0201	-0.6492	0.0480	3.0432	0.0219	3.1827	0.0340
State Fixed Effects	Yes		Yes		Yes		Yes		Yes		Yes	
Observations	6735		13318		12200		8397		21089		8897	
R2	0.564		0.446		0.282		0.602		0.37		0.3980	

The unit of analysis is a county/year. The dependent variable is the log of a specific ambient pollutant. The data are from the years 1973 to 2000.

Table Four: Exposure to Ambient Pollution and Noxious Facilities as a Function of Distance to the Central Business District

	The dependent variable is the Log of the Ambient Pollutant												Dummy Variable			
	Particulates		Carbon Monoxide		Sulfur Dioxide		Nitrogen Dioxide		Ozone		PM10		Toxic Release Inventory Site present		Superfund Site present	
Column	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)	
	beta	s.e	beta	s.e	beta	s.e	beta	s.e	beta	s.e	beta	s.e	beta	s.e	beta	s.e
Miles to CBD	-0.0107	0.0002	-0.0245	0.0007	-0.0137	0.0006	-0.0274	0.0005	0.0051	0.0002	-0.0102	0.0003	-0.0148	0.0005	-0.0098	0.0004
Constant	4.3896	0.0044	0.8880	0.0127	-4.7545	0.0114	-3.3816	0.0087	-3.1386	0.0048	4.5327	0.0365	0.3725	0.0087	0.2590	0.0081
Observations	27413		10650		15251		11349		28680		13585		15463		15463	
R2	0.436		0.613		0.585		0.593		0.332		0.511		0.163		0.126	
Unit of Analysis	Monitor		Monitor		Monitor		Monitor		Monitor		Monitor		zip code		zip code	
MSA Fixed Effect	Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes	

This table reports eight regression models based on equations (5) and (6) in the text. In columns (7) and (8), I report linear probability models where the unit of analysis is a zip code. These regressions include the zip code's total land area as a control. The sample includes all residential zip codes that are within 30 miles of a CBD.
In columns (1) through (6), the sample includes all monitoring stations within 30 miles of a CBD in metropolitan area that has at least 500,000 people.
The sample covers the years 1973 to 2005.

Table Five: Metropolitan Area Crime Trends from 1994 to 2002

	Log(1+Murder Count)				Log(1+Violent Crime Count)			
Column	(1)		(2)		(3)		(4)	
	coeff	s.e	coeff	s.e	coeff	s.e	coeff	s.e
log(county population)	0.9144	0.0140	-0.0018	0.1436	1.1610	0.0200	-0.0649	0.2153
time trend	-0.0512	0.0048	-0.0359	0.0044	-0.0615	0.0068	-0.0410	0.0065
Center County in Metro Area	0.6010	0.0444			0.5322	0.0635		
(Center County)*Time Trend	-0.0364	0.0078	-0.0433	0.0061	-0.0426	0.0111	-0.0519	0.0091
constant	-9.1321	0.1604	1.9119	1.6956	-8.6748	0.2292	6.0011	2.5430
Fixed Effects	MSA		fips		MSA		fips	
Observations	6338		6338		6338		6338	
R2	0.711		0.842		0.725		0.834	

The unit of analysis is a county/year. The sample includes all counties between 1994 and 2002 for the subset of counties that are part of a metro area. The omitted category is a suburban county in a metropolitan area.