



TECHNICAL MEMORANDUM 1: **EXISTING TRENDS ANALYSIS**

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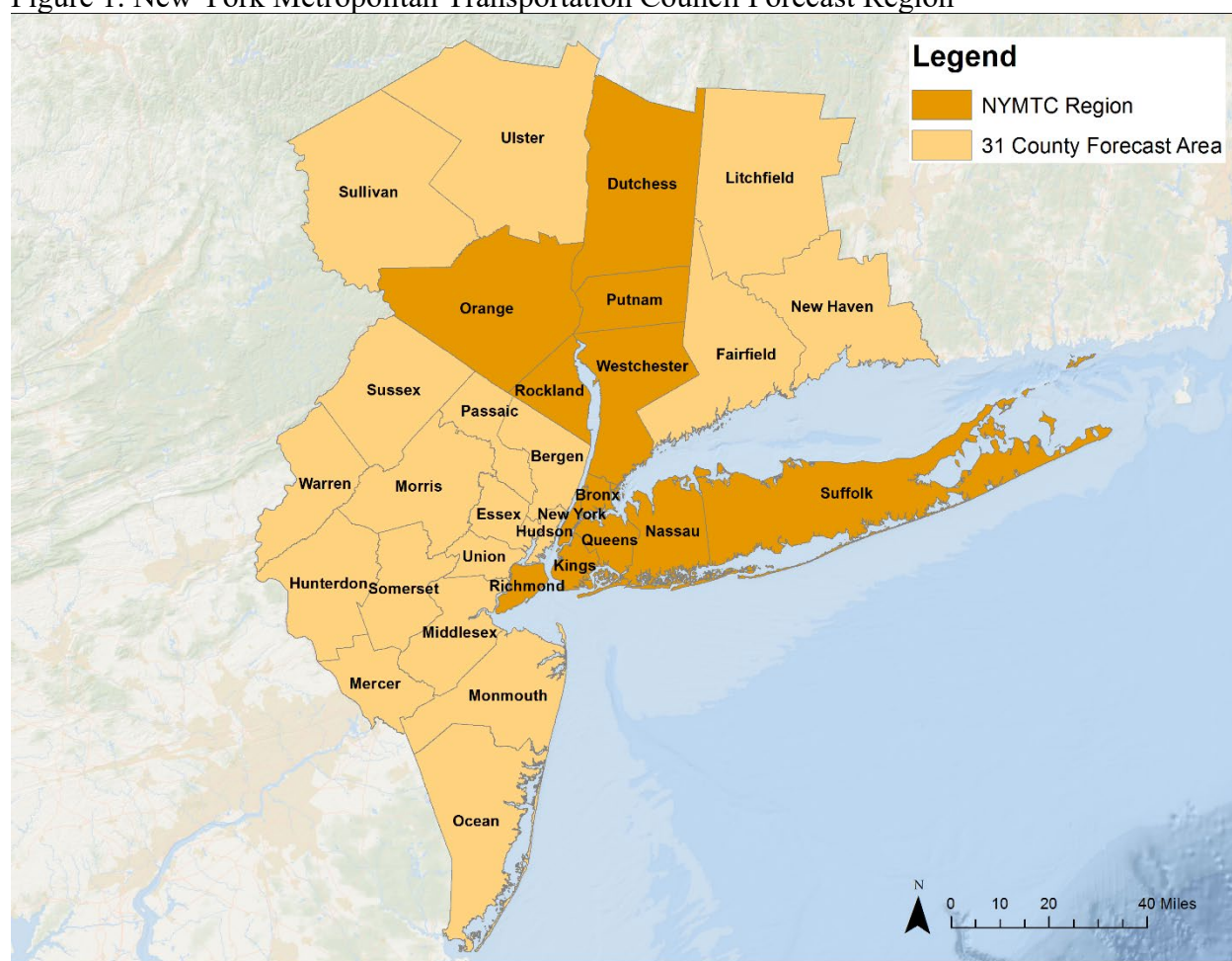
Table of Abbreviations

ACS - American Community Survey
ASDR – Age-Specific Death Rates
ASFR – Age-Specific Fertility Rates
CTPP - Census Transportation Planning Products
DCP - New York City Department of City Planning
EV - Electric Vehicle
FWG - Forecast Working Group
GDP - Gross Domestic Product
IoT - Internet of Things
NYMTC - New York Transportation Metropolitan Transportation Council
PHEV - Plug-In Hybrid Electric Vehicle
SED - Socioeconomic Demographic
TAZ - Transportation Analysis Zone
TNC - Transportation Network Company

Introduction

The New York Metropolitan Transportation Council has charged WSP and Urbanomics to update the existing 2050 employment, population, household, and labor force forecast models, as well as the Transportation Analysis Zone (TAZ) distribution model, to a 2017 base year, and then extend the forecast period from 2050 to 2055. The purpose of this technical memorandum is to provide an overview of the demographic and economic trends, emerging issues, infrastructure changes, and transformational technologies that will influence the Socioeconomic and Demographic (SED) forecast update to 2055 and to get Forecast Working Group (FWG) feedback regarding the potential impact of these trends and technologies on the constituent counties of the New York Metropolitan Transit Council Forecast Region.¹

Figure 1. New York Metropolitan Transportation Council Forecast Region



¹ The NYMTC Forecasting Region includes the following counties: Bronx, NY; Kings, NY; New York, NY; Queens, NY; Richmond, NY; Nassau, NY; Suffolk, NY; Dutchess, NY; Orange, NY; Putnam, NY; Rockland, NY; Sullivan, NY; Ulster, NY; Westchester, NY; Fairfield, CT; Litchfield, CT; New Haven, CT; Bergen, NJ; Essex, NJ; Hudson, NJ; Hunterdon, NJ; Mercer, NJ; Middlesex, NJ; Monmouth, NJ; Morris, NJ; Ocean, NJ; Passaic, NJ; Somerset, NJ; Sussex, NJ; Union, NJ; and Warren, NJ.

To this end, the draft technical memorandum concluded with a survey listing each trend/technology and asking the FWG members to rate each by the level of impact expected on the member's area of representation as well as WHEN that impact is likely to be felt. These ratings are intended to provide local insight that will inform FWG discussions on how adjustments and enhancements to the weights could be applied to various characteristics in the existing Population, Employment and TAZ distribution models. This, the final version of the technical memorandum, presents trends and issues as well as impressions shared through the survey and describes how the adjusted weights are to be applied.

Executive Summary

Significant Trends

On both a national and regional basis, the following trends will have significant impacts on the updated model results.

- Declining fertility rates
- Declining mortality rates
- Aging population
- Less international immigration
- Increasing housing costs
- Decreasing personal income
- Declining unemployment
- Shifts in industry mix

All of these yield an overall decrease in the employment projections shown in the latest versions of the national drivers used in the employment model.

In addition there are emerging issues that may have impacts on future land use, traffic and transit. These include:

- Transit & transportation trends such as ridesharing
- Sea Level Rise and climate change
- Land use trends (headquarters relocations, the growth of coworking spaces, conversions of office parks, malls, and golf courses)
- Infrastructure considerations such as utility access and congestion pricing
- Transformational technologies including e-commerce, alternative energy and autonomous/unmanned vehicles, and smart cities.

The extent to which each impacts the 31-County Region as a whole and on an individual county basis was influenced by the input of FWG members and others with local knowledge (e.g., County planners). They serve to provide a higher level framework for the detailed information gathered from the development inventories and county planning meetings.

Local Impacts of Trends: Survey Results

The FWG was asked to consider the presented national and regional trends in demographics, housing, employment as well as emerging issues. Figure 2 presents the survey results ranked by relative anticipated level of influence and anticipated year of the height of impact.

Figure 2. Local Impacts Survey Results Ranked by Anticipated Level of Influence

Topic	High/Med/Low Influence	Anticipated Average Year for Height of Impact (2020-2050)
High housing costs/ lack of affordability	High	2025
Sea level rise and climate change will have on your area.	High	2030
Senior housing choices	High	2030
Building boom	High	2030
Aging populations	Medium	2030
NYC congestion pricing	Medium	2025
E-commerce	Medium	2030
Shifting industry mix	Medium	2030
Millennial housing choices will have on your area	Medium	2025
Ridesharing	Medium	2025
Changing regional malls	Medium	2030
Increasing sewer access	Medium	2030
Expansion of the freight industry	Medium	2030
Smart cities	Medium	2035
Reinventing office parks	Medium	2025
Electric vehicles	Medium	2030
Headquarters relocation's	Medium	2030
Coworking spaces	Medium	2030
Declining housing value	Low	2030
Golf course conversions	Low	2030
Autonomous vehicles	Low	2040
Slow growth of GDP	Low	2030
Autonomous terrestrial delivery vehicles	Low	2040
Short distance aerial delivery vehicles	Low	2035
Moratorium on Con-Ed Gas hookups/infrastructure constraints	Low	2030

Source: Survey of NYMTC Forecast Working Group Members April/May 2019

Model Recommendations

Significant trends and input from FWG members have influenced the following recommendations for enhancements to the Population and Zonal Allocation Models.

- The Population model includes headship rate controls using varying rates based on decennial census data. Based on continuing changes, it is recommended that additional controls should be added to reflect more recent rates.
- The Population model's sub-regional cohort component sections account for trend in aging quite well, however incorporating more detailed weighting on foreign and domestic migration would be valuable.
- Consider incorporating a family/non-family component into the sub-regional household models.
- Currently, the Zonal Allocation Model incorporates a housing price variable; however, the variable used is median housing value as determined from the Census' American Community Survey. The model may be better served by either current asking price data drawn from multiple listing services and/or housing costs instead.
- Suggest incorporating assumptions for loss of available land area due to sea level rise by Traffic Analysis Zone (TAZ) in each cohort year using the best available resources, including maps and models.
- In the existing Zonal Allocation Model, new sewer access is an input to the "pro-growth" environmental weight. It is recommended that significant capacity improvements also be included in the weighting.
- Consider an additional infrastructure "low-growth" weight that would correspond to the "pro-growth" weights that include infrastructure improvements such as sewer expansions.
- Abrupt and significant changes in land use and employment may cause inconsistencies in Zonal Allocation Model outputs that will raise questions. It is suggested that a change of use flag be incorporated into the database whenever a TAZ demonstrates significant differences in land use from the land use inputs of the previous model.

Demographic Trends

In this analysis we will discuss major trends in the US economy over the period from 1990 to 2017 and compare the future trend expectations for the period from 2017 to 2048 using the 30 year forecast released by IHS Markit² in November 2018. *It should be noted that while other national driver forecasts are used in the Employment Model, only the IHS dataset, as acquired for the purposes of this project, includes demographic and other components beyond employment by industry.*

² Formerly known as IHS Global Insight.

For the forecast period, remember that this is a **trend** forecast whose primary purpose is for planning. It purposefully does not indicate cyclical changes in the economy or try to pinpoint when they might occur. Thus, the forecasts for interest rates, productivity, and population growth rates, upon which long term forecasts depend heavily, are stable over the long term.

Population Trends

The civilian population of the US grew from 250.6 million in 1990 to 310.1 million in 2010, an annual rate of growth of 1.1 percent per year. From 2010 to 2048 growth is expected to trend down, from 0.7 percent per year between 2010 and 2020, to 0.6 percent between 2020 and 2040, to 0.5 percent a year from 2040 to 2048. Thus, from 2010 to 2048 the country will add 2 million residents per year, compared to a rate of 3 million per year from 1990 to 2010.

Falling Birthrates

In this period the crude birth rate (births per 1,000 residents) trended down from 16.7 in 1990 to 12.4 in 2016.³ With the crude birth rate likely to continue to decline and the age distribution of the population trending older, population growth will continue to fall.

Aging Population

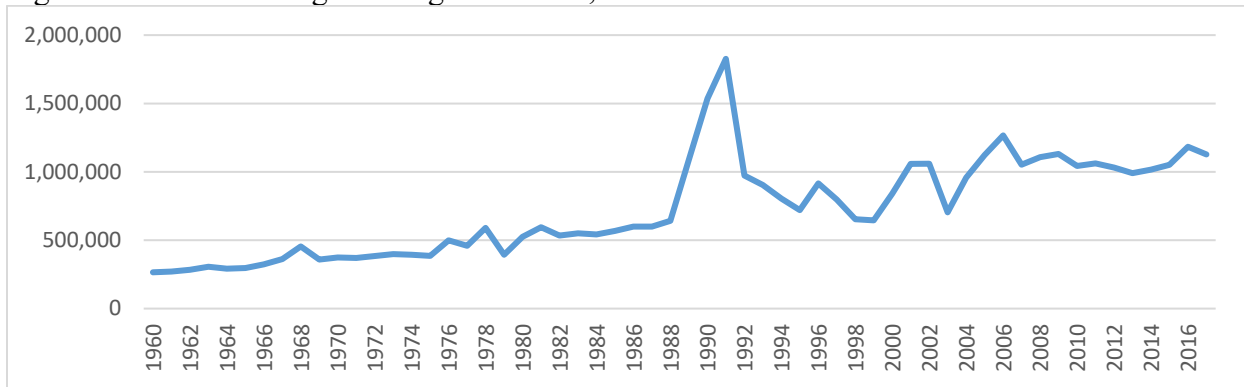
The nation's declining population growth is at least partially explained by the aging of the population. In 1990, 23.0 percent of the population was school-age or less, while 64.5 percent of the population was of prime working age (defined for purposes of this document), and 12.5 percent was 65 years old or more. That is, about two thirds of the population was supporting one third. By 2010, those proportions had shifted slightly, with the percentage of children falling to 21 percent. By the end of the forecast period the proportions will have changed more significantly: the percentage of children in the population will fall to 18 percent and that of the elderly will rise to 22 percent. The very elderly proportion of the population (85 years of age and more) will have grown from 1 percent to 5 percent of the total. Thus 60 percent of the population (of prime working age) will be supporting the other 40 percent. These population shifts will have consequences in the housing, transportation, education, and health and social services sectors, among others.

Immigration Declines

Another possible reason for the expected decline in population growth in the US is the likelihood that immigration rates, both legal and undocumented, will fall under current regulations. Figure 3 shows legal immigration to the US from 1960 to 2017.⁴ Since the spike in the early 1990s after the collapse of the Soviet Union, the number of legal immigrants has averaged about 1.1 million a year. IHS makes no explicit assumptions about immigration.

³ FRED: Crude Birth Rate for the United States.

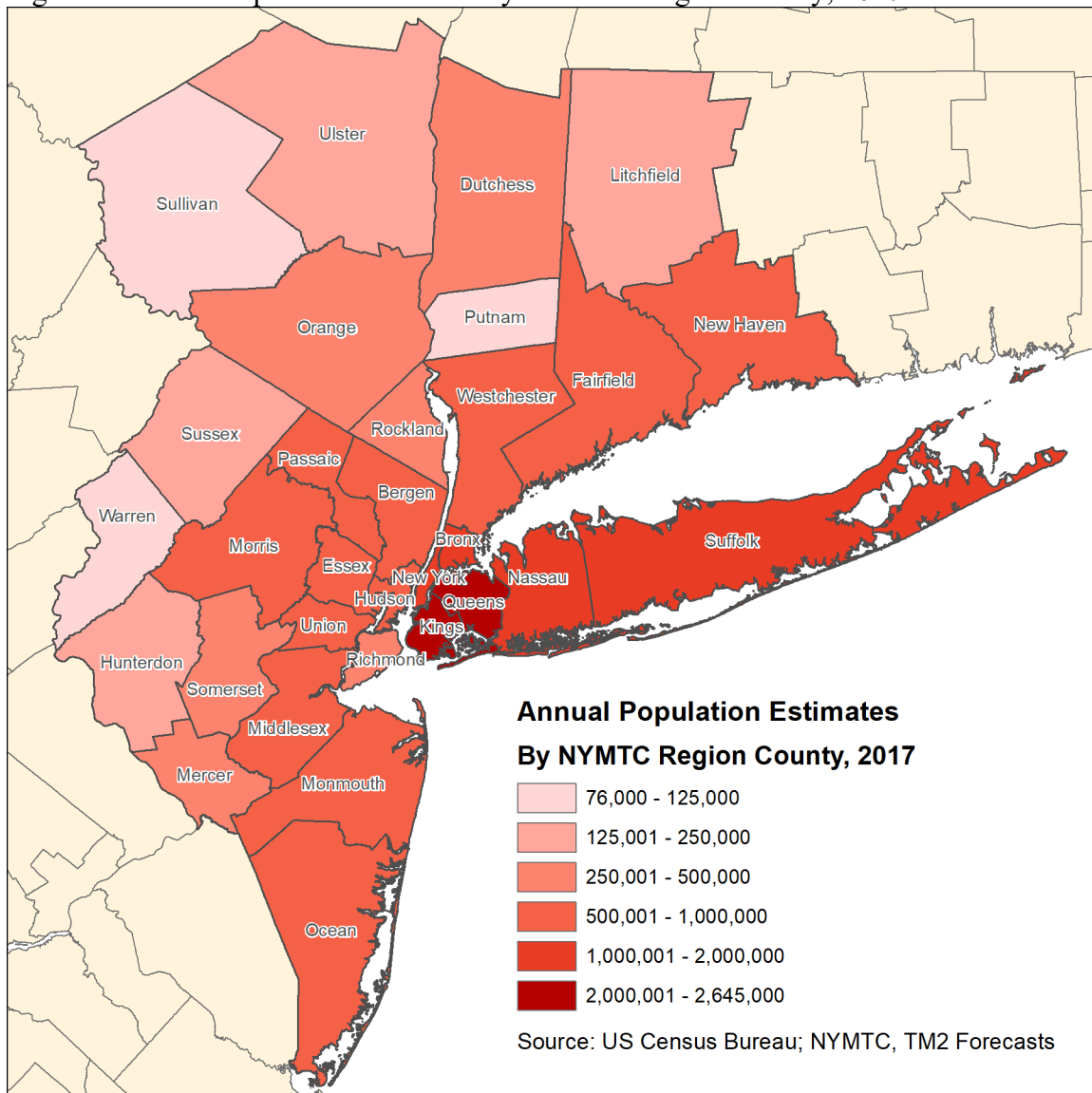
Figure 3. Number of Legal Immigrants to US, 1960 to 2017



Source: U.S. Department of Homeland Security, 2017 Yearbook of Immigration Statistics, Table 1

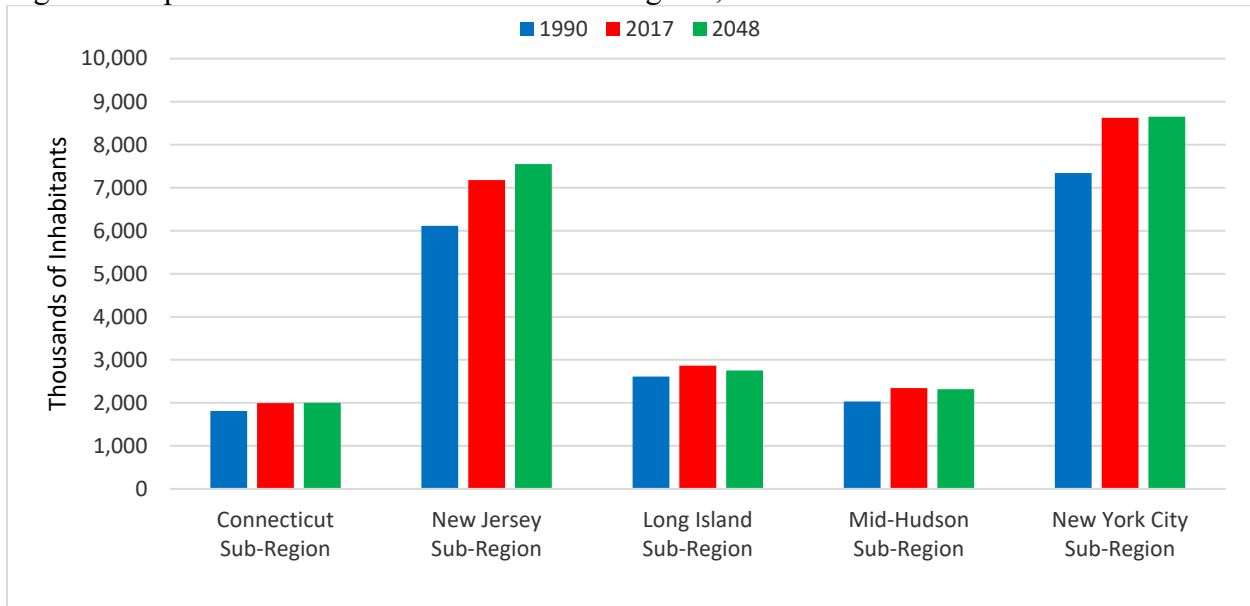
Regional Population Trends

Figure 4. Annual Population Estimates by NYMTC Region County, 2017



The population of the 31-County Region as a whole grew from 19.9 million in 1990 to 23 million in 2017 (Figure 4), a growth of 3.1 million during the period and an average annual growth rate of 0.5 percent a year. The IHS forecast projects for very little growth in the forecast period; almost all of that is expected to occur in the New Jersey sub-region.

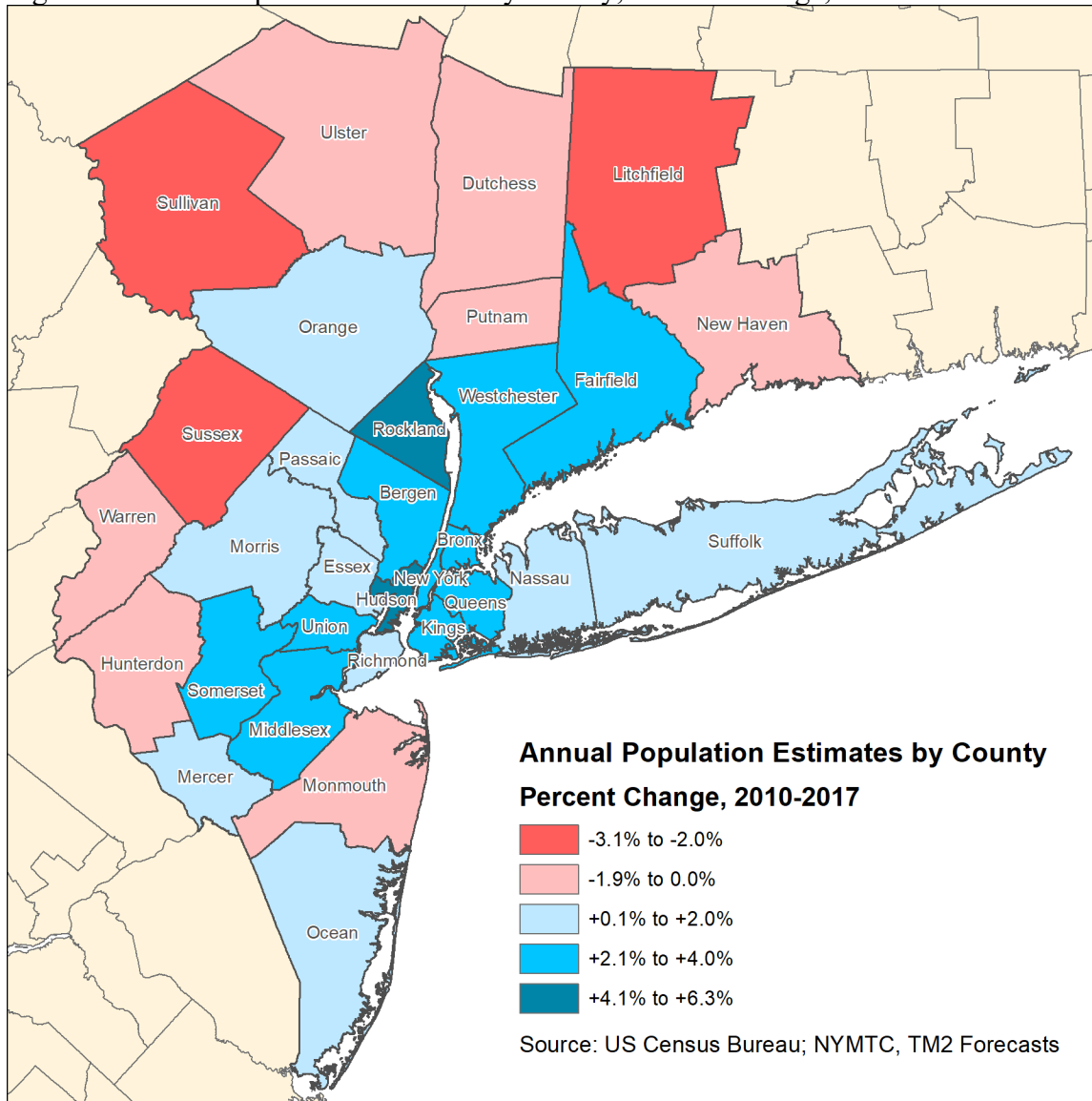
Figure 5. Population in NYMTC Forecast Sub-Regions, 1990 to 2048



Source: IHS Markit and Urbanomics

New York City grew by 1.3 million inhabitants between 1990 and 2017 for a growth rate of 0.6 percent a year. The fastest growing counties were Richmond at 0.9 percent a year and, Queens and the Bronx both at 0.7 percent a year. Kings and New York counties grew only 0.5 and 0.4 percent a year, respectively. Queens added nearly 400,000 people, Kings added 343,000, followed by the Bronx, New York, and Richmond. The population over 65 years of age grew near 1 percent a year in all counties except Richmond where it expanded by more than 2 percent a year. The working age population, here defined as people between 25 and 64 years of age, rose close to 1 percent a year in all counties except New York County where it rose 0.4 percent a year. The population of children and young adults rose 0.3 percent a year or less in all the counties, actually falling slightly in Kings. IHS forecasts a small decline in population in New York and Queens counties over the 30 year forecast period and very small increases in the other New York City counties.

Figure 6. Annual Population Estimates by County, Percent Change, 2010 to 2017



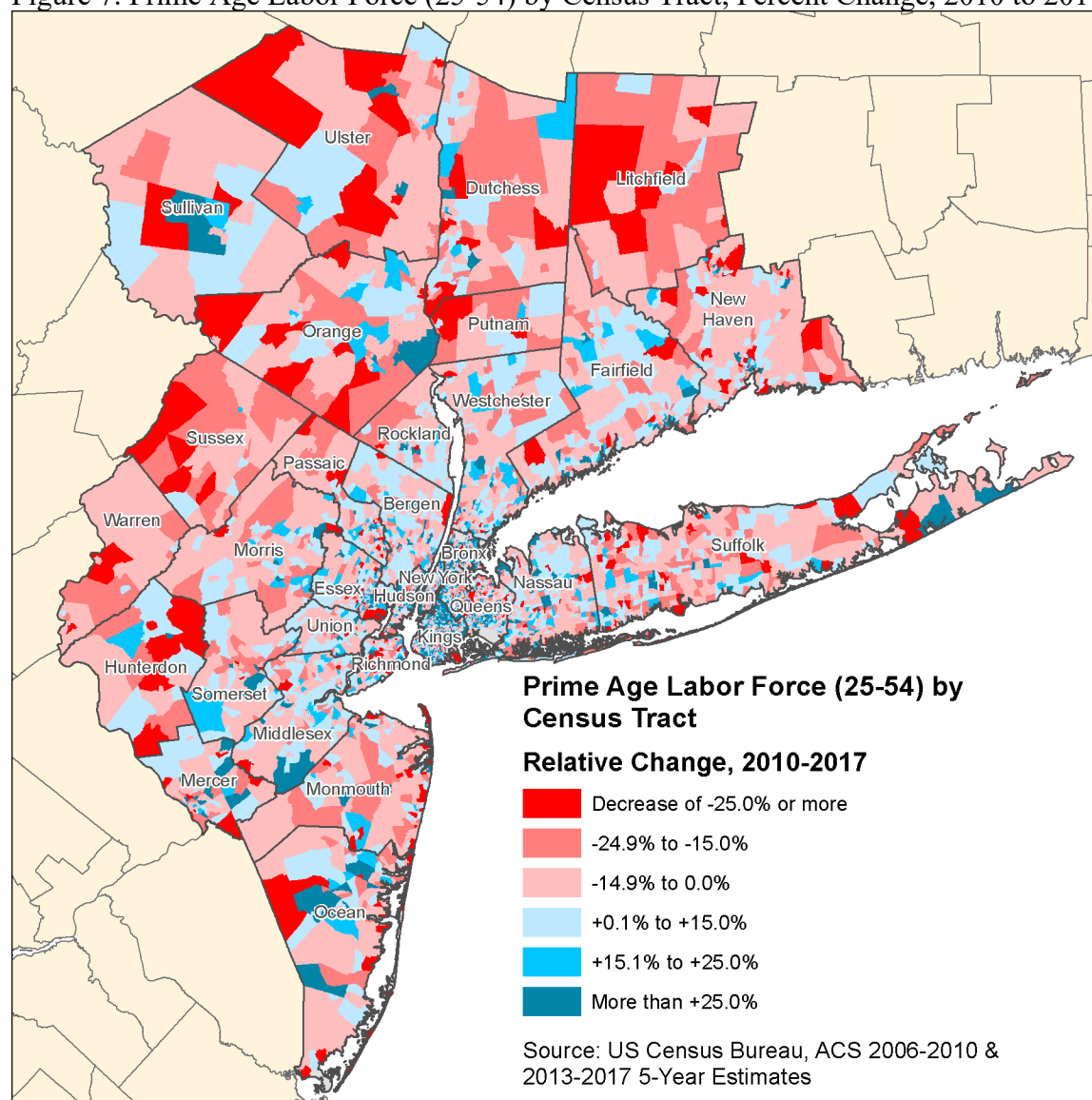
Source: Population change is based on annual estimates from the US Census Bureau's Population Estimates Program's (PEP) Annual Estimates of the Resident Population. Due to differences in methodology, PEP estimates are not comparable to the historic population estimates from the SED Forecast which are sourced from the Census Bureau's Decennial Census (2000 and 2010) and American Community Survey 5-Year Estimates (2015 and 2017).

Long Island grew by 250,000 inhabitants between 1990 and 2017 for a growth rate of 0.3 percent a year. Suffolk County added nearly 170,000 inhabitants compared to 82,000 in Nassau. In both counties more than 60 percent of the growth was attributed to people over 65 years of age and both the school age and young adult populations declined slightly. The working age population rose 0.2 percent in Nassau and 0.5 percent in Suffolk. IHS forecasts small population declines in both counties, 74,000 in Nassau and 39,000 in Suffolk.

The Mid-Hudson sub-region grew by 310,000 inhabitants between 1990 and 2017 for a growth rate of 0.5 percent a year. The fastest growth was in Orange and Rockland counties at 0.8 percent

a year for a total of 73,000 and 63,000 people respectively. Dutchess and Putnam counties each grew 0.5 percent a year, and Westchester County grew by 0.4 percent. In 2017 Westchester County was home to a quarter of the Mid-Hudson's population and had added a third of its new residents. In rural Sullivan and Ulster counties, population growth was only 0.3 percent a year. The fastest growth in all counties in the sub-region was for people over 65; Dutchess, Putnam, Sullivan and Ulster counties all lost population under age 25. The working age population rose in all the Mid-Hudson counties, with the fastest growth in Orange and Putnam counties. The IHS forecast is for essentially no change in population in the Mid-Hudson sub-region. By county it projects declines of 0.2 percent a year in Sullivan and Ulster counties, 0.1 percent a year in Dutchess, Putnam, and Westchester counties, and growth of 0.1 percent a year in Orange County and 0.2 percent in Rockland County

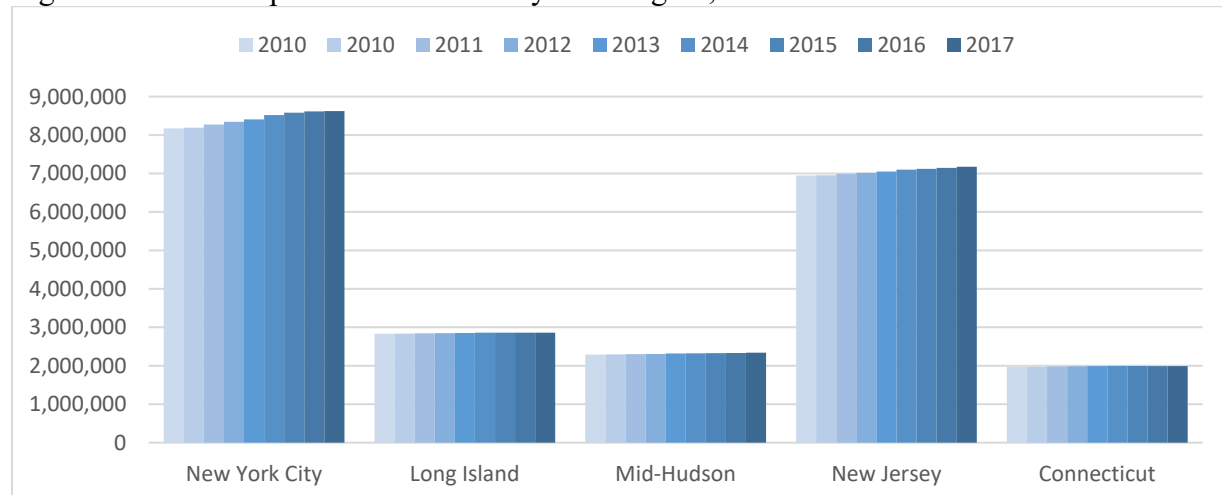
Figure 7. Prime Age Labor Force (25-54) by Census Tract, Percent Change, 2010 to 2017



The Connecticut sub-region added population at a rate of 0.4 percent a year between 1990 and 2017 adding 183,000 inhabitants. Two-thirds of the growth was in Fairfield County, which had 48 percent of the region's population in 2017. Litchfield and New Haven counties both lost some school age and young adult population over the period, while in Fairfield that population group grew at the same rate as the working age population, at 0.4 percent a year. In all of the counties the older population grew considerably faster than the whole with the greatest disparity in Litchfield County. The IHS forecast is for essentially no change (an addition of 10,000 people) in population in the Connecticut sub-region, with population falling very slightly in Litchfield and New Haven counties and rising slightly in Fairfield County.

The New Jersey sub-region added population at a rate of 1 percent a year between 1990 and 2017 adding 1.1 million inhabitants. The fastest growth, at an average rate of 1.8 percent, was for people aged 65 years or older. The working age population grew 1 percent a year, and children and young adults at 0.5 percent a year. The fastest rate of growth at nearly 2 percent a year was in Ocean and Somerset counties, while the slowest was in Essex County at only 0.2 percent a year. Of some interest is the pattern of growth in the counties within the sub-region. Several appear to be appealing to older people as destinations to retire. For instance, the population of people 65 and over grew by 4.5 percent a year in Hunterdon County and over 3 percent a year in Morris, Somerset, and Sussex counties. Other counties with high rates of increase of the older population were Mercer, Middlesex, Monmouth, and Warren counties. All New Jersey sub-region counties had at least some increase in working age population, with the strongest growth in Ocean, Hudson, and Somerset counties. The IHS forecast is for a much slower rate of population growth in the forecast period at 0.2 percent a year in the sub-region which would add less than 400,000 people over the next 30 years. The forecast is for small declines in Essex, Monmouth, and Sussex counties. The fastest growth is predicted for Ocean and Somerset counties at 0.4 percent a year followed by Hudson and Middlesex counties at 0.3 percent a year.

Figure 8. Census Population Estimates by Sub-Region, 2010 to 2017



Source: US Census Bureau, Annual Estimates of the Components of Resident Population Change, 2018

Near-Term Change in Population

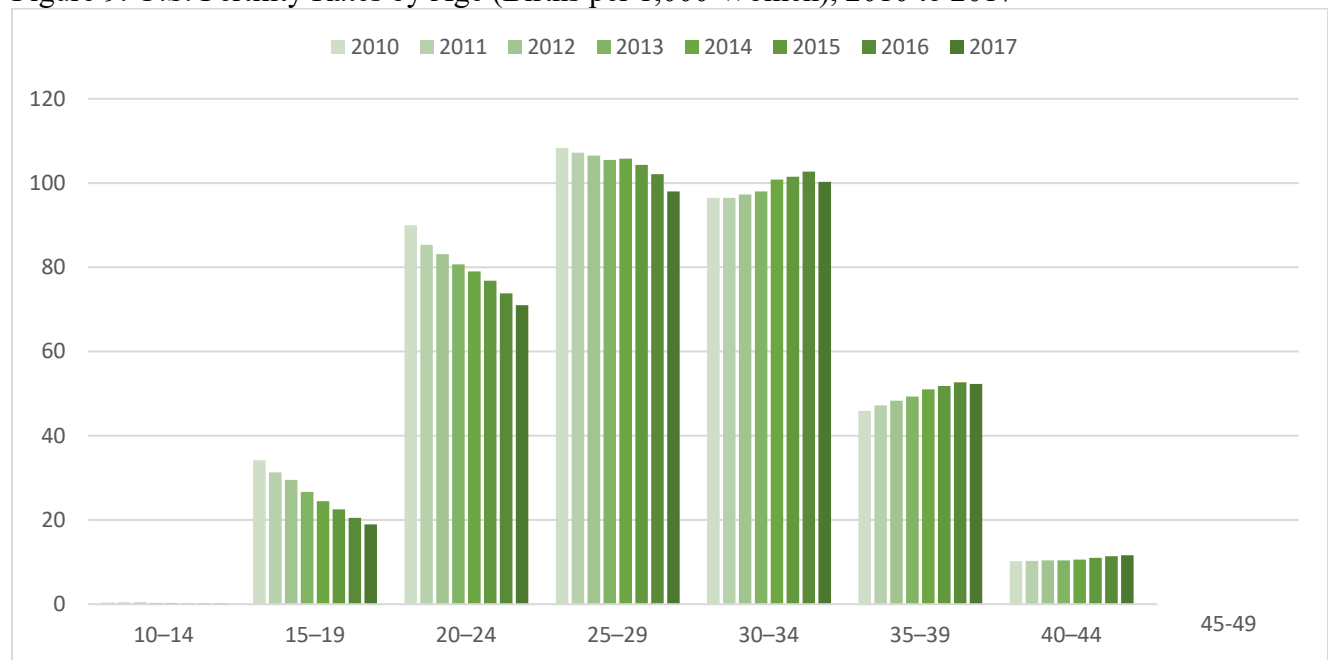
Regional population has not changed significantly since 2010 as shown in Figure 8. In that time, New York City saw an increase of 5.5 percent, followed by the New Jersey sub-region with 3.3 percent. The Mid-Hudson sub-region saw more modest growth with an increase of 2.2 percent (roughly 50,000); followed by the Connecticut sub-region at 1.2 percent, and the Long Island sub-region at 1.0 percent.

Fertility

Age-specific fertility rates (ASFR) are used in the model to estimate the number of births in each time interval. These are calculated by dividing the number of live births reported by females within a given age cohort by the total population of females within that cohort and is expressed as the number of live births per 1,000 females.

As shown in the figure that follows, US fertility rates have continued to sharply decline in the three age cohorts between the ages of 15 and 29 years of age.

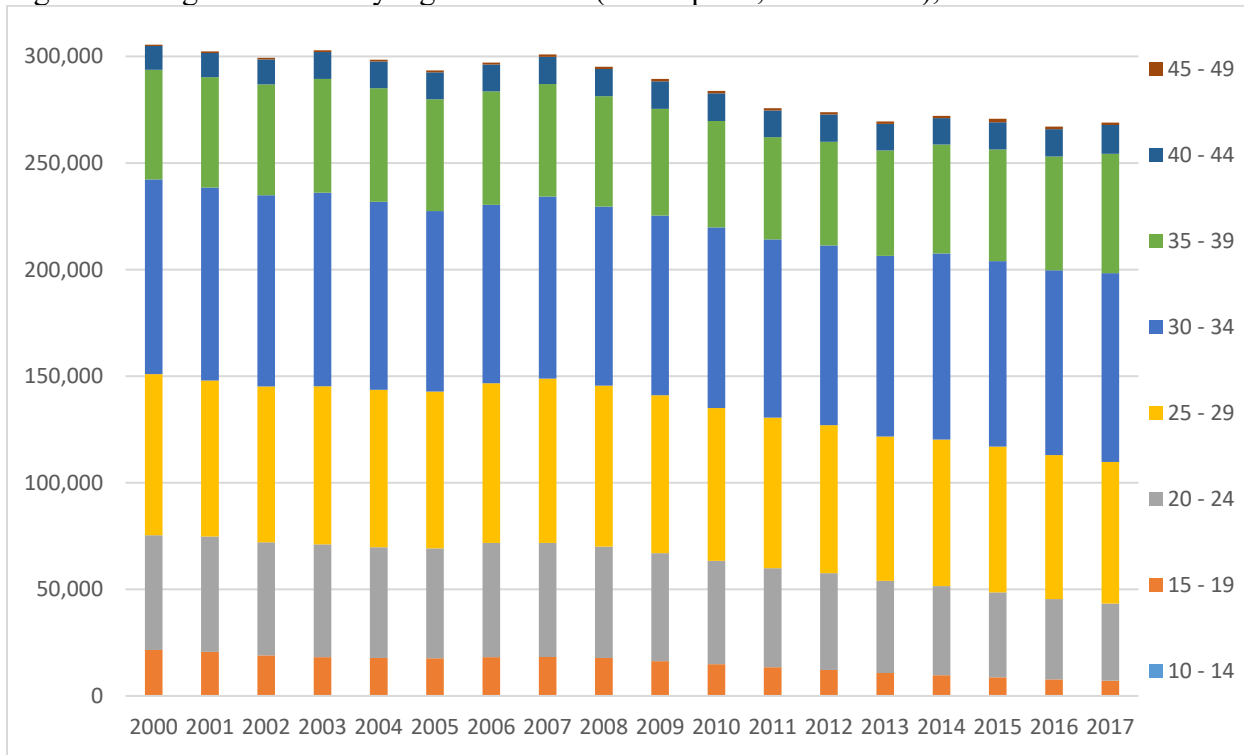
Figure 9. U.S. Fertility Rates by Age (Births per 1,000 Women), 2010 to 2017



Source: US CDC National Vital Statistics Reports

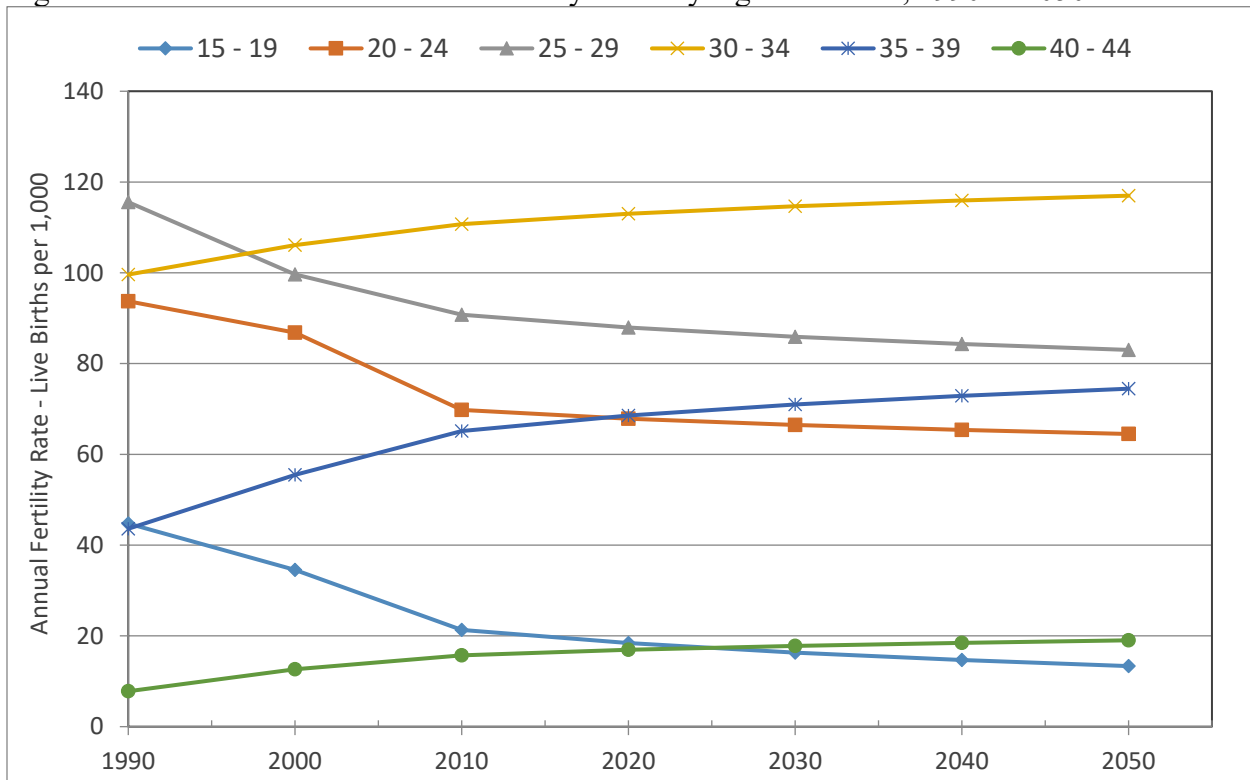
Regional fertility rates were derived from birth data collected from the New York City and NY, NJ and CT State Departments of Health. As shown in the figures that follow, regional and sub-regional birth rates are following national trends with steep declines in the age cohorts under the age of 30.

Figure 10. Regional Births by Age of Mother (Births per 1,000 Women), 2000 to 2017



Source: NYC, CT, & NJ Departments of Health, US CDC National Vital Statistics Reports

Figure 11. Historical and Forecasted Fertility Rates by Age of Mother, 1990 to 2050

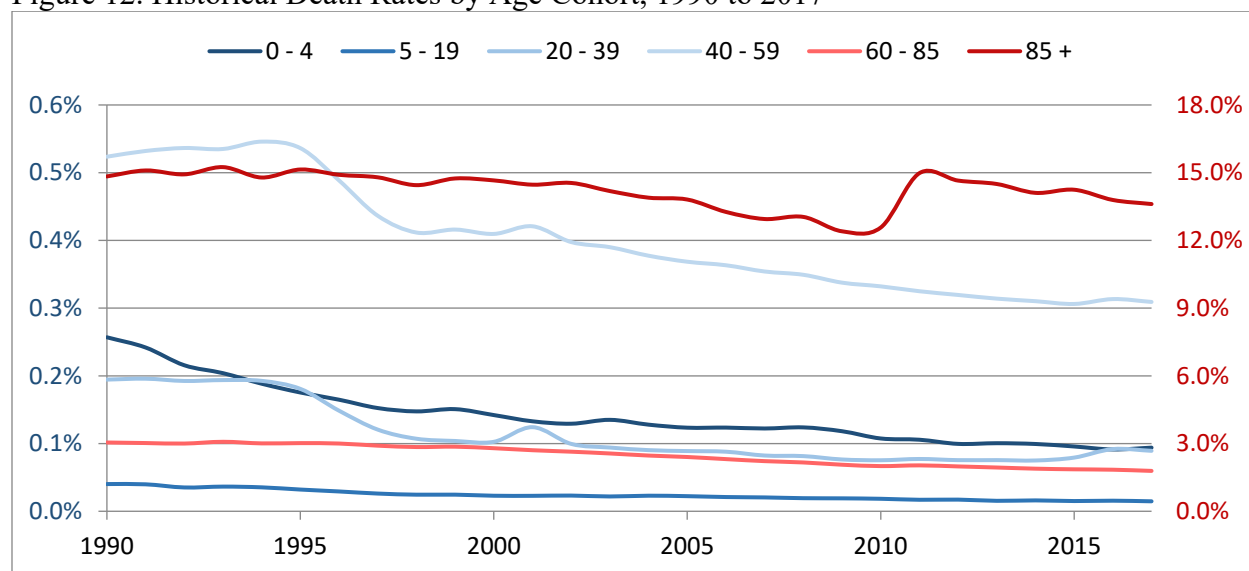


Source: NYC, CT, & NJ Departments of Health, US CDC National Vital Statistics Reports

Mortality Trends

Age-Specific Survival Rates representing the probability of surviving from one age cohort to the next were calculated using Age Specific Death Rates (ASDR) calculated for each county. ASDRs represent the proportion of persons in each age cohort by gender that die in a given year divided by the total population in that age/sex cohort. As shown in the following figures, while mortality rates have been on an overall decline in all age cohorts since 1990, in the last few years (since 2012) there has been a slight increase in deaths for the 20-39 cohort, with a significant gain in the death rate for those over the age of 85.

Figure 12. Historical Death Rates by Age Cohort, 1990 to 2017

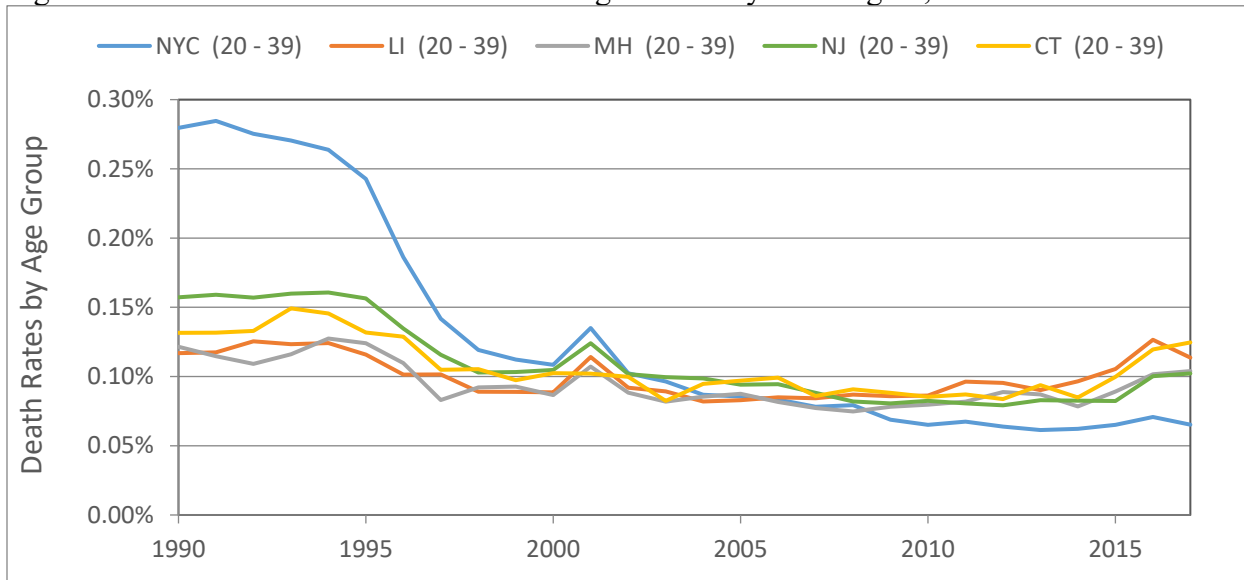


Note: The left axis in blue applies to the 0-4, 5-19, 20-39 and 40-59 age cohorts while the right axis in red applies to the 60-85 and 85+ age cohorts.

Source: NYC, CT, & NJ Departments of Health, US CDC National Vital Statistics Reports

As shown in Figure 13, death rates in the 20-39 cohort have increased since 2012 in each of the sub-regions with the exception of New York City.

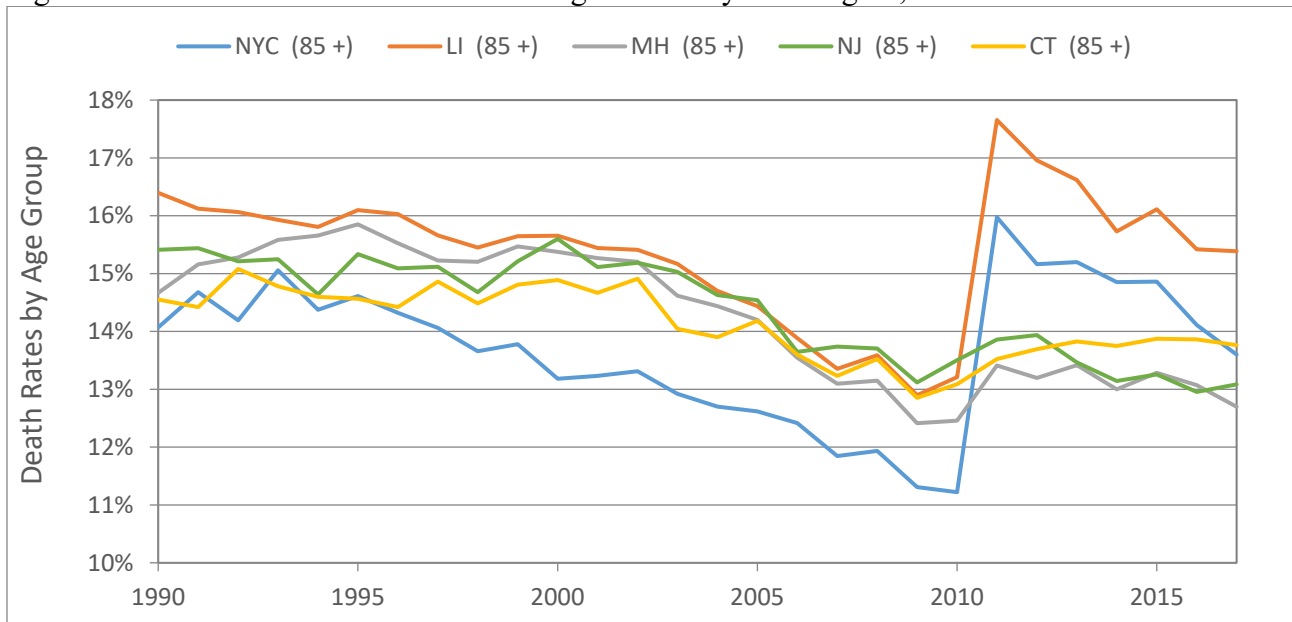
Figure 13. Historical Death Rates for 20-39 Age Cohort by Sub-Region, 1990 to 2017



Source: NYC, CT, & NJ Departments of Health, US CDC National Vital Statistics Reports

New York City and Long Island are the source of the regional increase in the mortality rate in those 85 and older.

Figure 14. Historical Death Rates for 85+ Age Cohort by Sub-Region, 1990 to 2017



Source: NYC, CT, & NJ Departments of Health, US CDC National Vital Statistics Reports

Migration Rates

The third driver of population change, net migration accounts for the residual change in population not caused by natural increase. The net migration level is determined for each age cohort within the model based on the difference between historic natural increase and census counts. For the original 2050 forecast prepared in 2015, the Project Team conducted several five-year survival analyses over two decades (1990-2010) to create a range from which a more reliable average rate of migration could be calculated and applied in the forecasting process. These rates varied based on sub-region.

Households and Household Size

As the Baby Boom and the Baby Bust generations aged over time, the number of households formed each decade in the US shrank from a high of nearly 16 million from 1970 to 1980 to 12.5 million between 1980 and 1990, and to less than 10 million per decade between 1990 and 2010. The number of household formations will average about 10 million per decade from 2010 to 2048.

Household size shrank from an average of more than 3 persons per household in 1960 to about 2.5 in 1990 and averaged about 2.6 persons per household between 1990 and 2010. It is expected to resume a minimally downward direction in the forecast period, ending the forecast period at 2.4 persons per household. The expected decrease in household size combined with little movement in mortgage rates will keep single family homes at about 70 percent of housing starts in the forecast period and multi-family units at about 30 percent.

Regional Households and Household Size

In the NYMTC 31-County Region the number of households grew similarly to population between 1990 and 2017 in most counties. Within both the NYMTC 31-County Region and the New York NYMTC12-county sub-region, which encompasses the New York City, Long Island and Mid-Hudson sub-regions, household size grew from 2.7 to 2.8 persons per housing unit. The changes were small in the New York sub-regions and counties, however there were differences in direction of change among the counties in each sub-region. In Long Island average household size rose in Nassau County but fell in Suffolk County; in the Mid-Hudson sub-region it rose only in Rockland and Westchester counties, and in New York City it fell only in Richmond County. Household size differed considerably among counties with the smallest average size in New York County at 2.1 in 2017 and the largest in Rockland County at 3.2 in 2017.

The IHS forecast shows household size falling in all counties within the New York 12-county sub-region. By 2048 it will have fallen to just under 2.0 in New York County and to nearly 3.0 in Rockland County. In the Connecticut sub-region household size declined slightly between 1990 and 2017, with an uptick in Fairfield County from 2.7 to 2.8 and small declines in Litchfield and New Haven counties. The IHS forecast projects household size falling slightly in all the Connecticut sub-region counties between 2017 and 2048. In the New Jersey sub-region household size increased very slightly, from 2.77 to 2.78, between 1990 and 2017 and is expected to decline between 2017 and 2048 to 2.57. Household size rose in Bergen, Mercer, Middlesex, Ocean,

Passaic, Somerset, and Union counties, and fell in the other counties. The largest household size in 2017 was in Passaic County (3.044), and the smallest was 2.554 in Warren County. In 2048, IHS expects the smallest household size to be 2.337 in Warren County and the highest to be 2.838 in Passaic County.

It is likely that the smaller household size in the forecast period is a result of the aging population. Older people who live in their own homes are likely to live in households of one or two people. Figures 15-17 illustrate the shares of the aging population as well as single-person households throughout the region.

Figure 15. Non-Family Householders Age 65+ by County, Share of Total Households, 2017

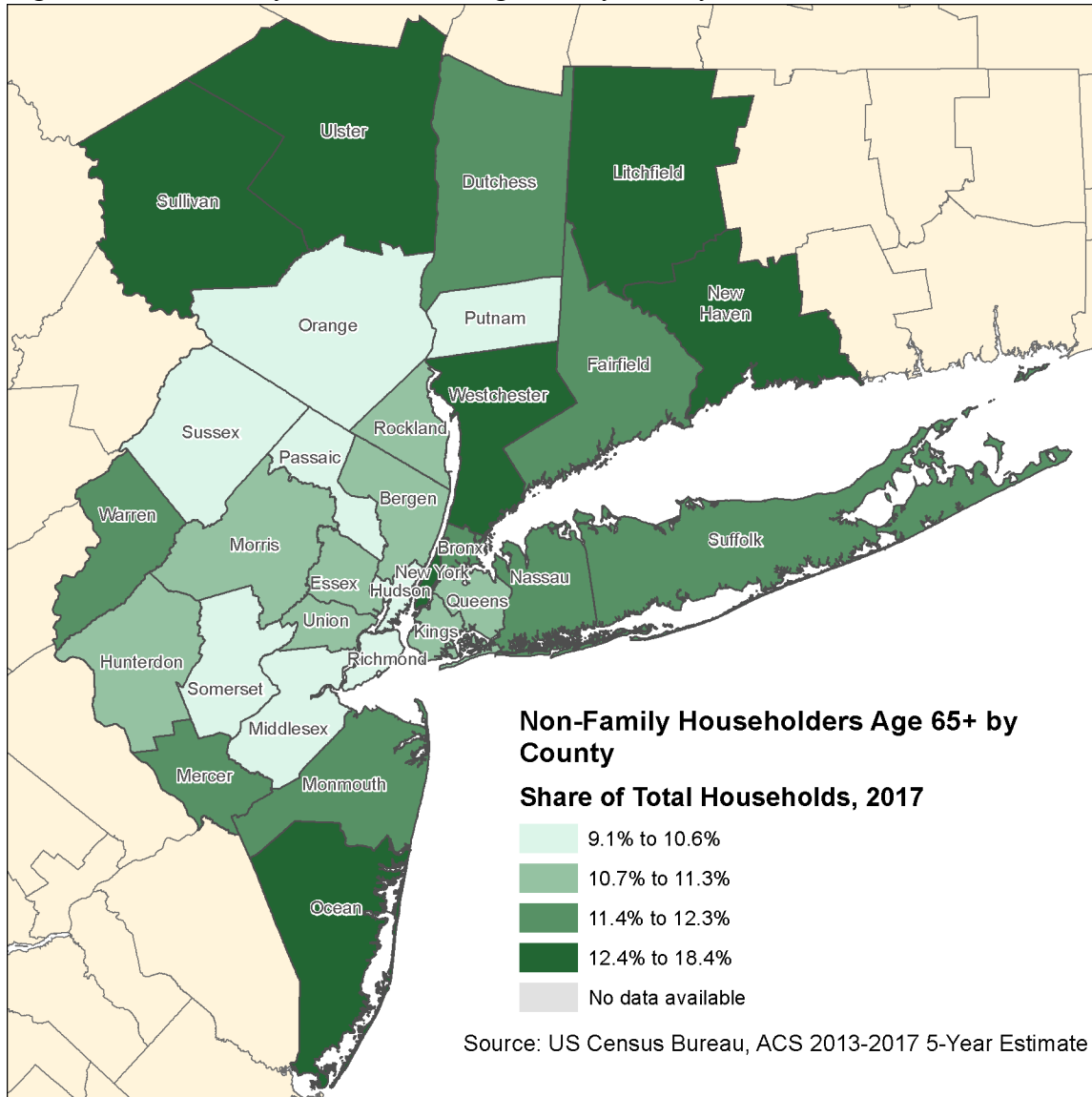


Figure 16. Single-Person Households by County, Share of Total Households, 2017

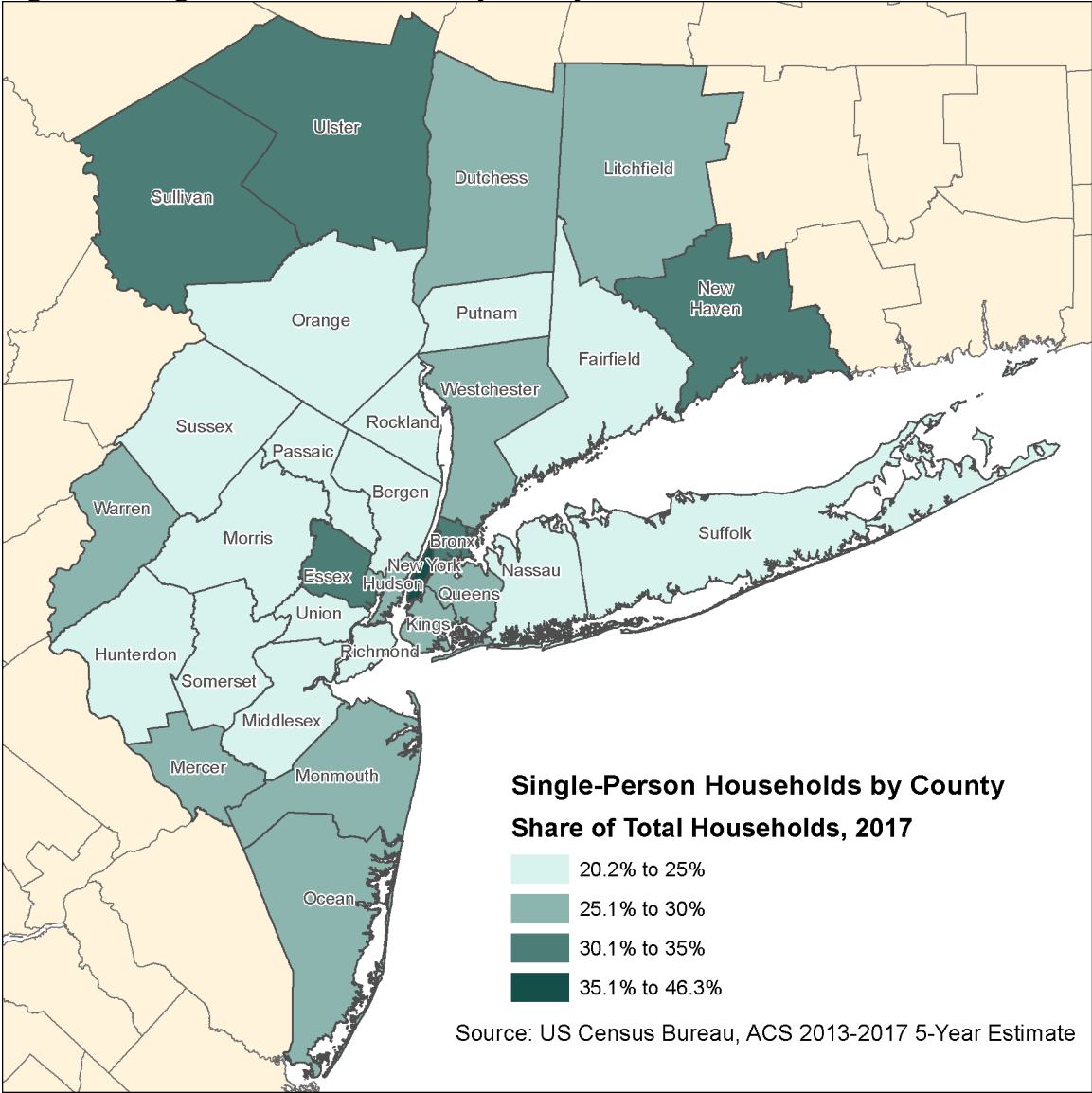
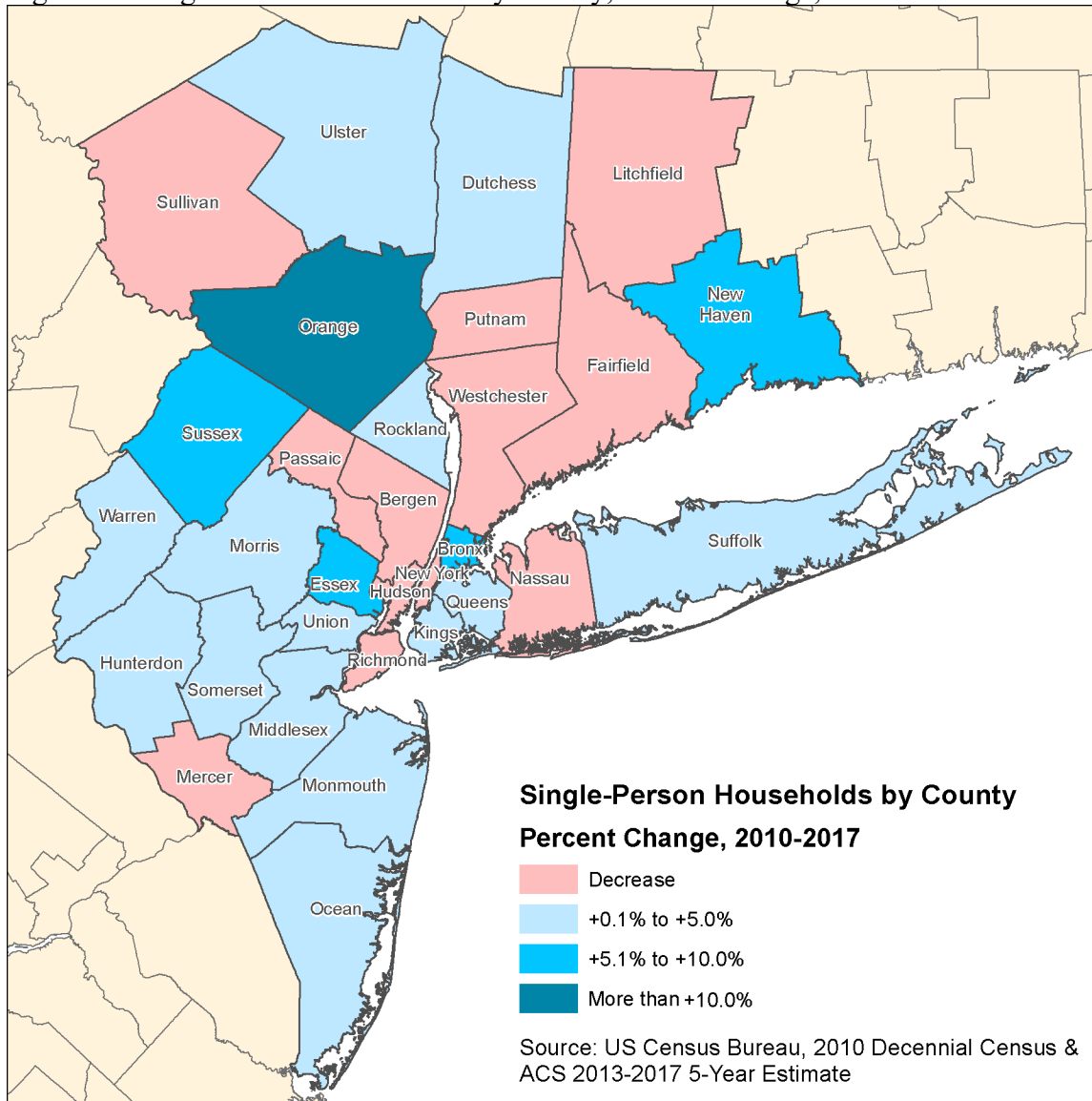


Figure 17. Single- Person Households by County, Percent Change, 2010 to 2017



Labor Force

The US labor force increased at a rate of 0.9 percent per year between 1990 and 2017, less than half the rate in the previous three decades when women entered the labor force in large numbers. Their participation rate rose from 37 percent in January 1960 to 57.7 percent in January 1990. The women's participation rate peaked at 60.2 percent in November 1999 and had declined to 56.9 percent at the end of 2017.⁵ The labor force declined slightly during the "Great Recession" of 2007-2009 with the decline confined to workers between 16 and 64 years old.

⁵ FRED, Civilian Labor Force Participation Rate: Women (LNS11300002), from USBLS, February 2019

The number of people in the labor force who are 65 years old or more has been increasing since 1960. By 2017 older adults were 6 percent of the labor force, up from 2.7 percent in 1990. This increase in participation by older people is likely the result of a combination of factors including better health care making for longer, healthier lives and changes to the national economy's industrial structure and workforce environment, resulting in less workers involved in physical labor.

The increase in participation by older people is expected to continue in the forecast period, so that by 2048 more than 11 percent of the labor force will be age 65 or older. However, the growth of the labor force will fall to only 0.6 percent a year between 2017 and 2048, primarily because of the concomitant decline in population growth in the US as well as the likely stability of the women's participation rate.

Housing

Housing demand outpaces supply in much of the NYMTC Region. The NYU Furman Center *Changes in New York City's Housing Stock* report indicates that while the City's housing stock grew by 8 percent between 2000 and 2016, the population increased by 11 percent. According to the US Census Bureau's American Community Survey (ACS), homeowner vacancies were very low in all NYMTC counties in 2017 with vacancy rates ranging from 0.8 percent in Putnam County to 4.8 percent in Sullivan County while renter vacancy rates were somewhat higher ranging from 2.2 percent in the Bronx to 11.2 percent in Sullivan County. Among NYMTC sub-regions, Long Island had the lowest homeowner vacancy rate in 2017 at 1.3 percent while the Mid-Hudson had the highest rate at 2.1 percent. At 4.5 percent, New York City had a considerably lower renter vacancy rate than all four suburban regions.

Figure 18. Vacancy Rates by Tenure, 2010 to 2017

	Homeowner			Renter		
	2010	2017	Change, 2010-2017	2010	2017	Change, 2010-2017
NYC	2.9%	1.8%	-1.0%	3.5%	4.5%	+1.1%
Bronx	2.3%	2.9%	+0.6%	4.3%	2.2%	-2.1%
Kings	3.2%	2.7%	-0.5%	4.2%	3.4%	-0.8%
New York	4.4%	2.9%	-1.5%	5.0%	4.6%	-0.4%
Queens	2.4%	1.9%	-0.5%	4.4%	2.7%	-1.7%
Richmond	1.4%	2.4%	+1.0%	5.6%	6.5%	+0.9%
Long Island	1.4%	1.3%	-0.1%	5.0%	5.5%	+0.4%
Nassau	1.2%	1.3%	+0.1%	4.8%	4.5%	-0.3%
Suffolk	1.5%	1.7%	+0.2%	6.0%	5.3%	-0.7%
Mid-Hudson	2.0%	2.1%	+0.1%	5.5%	6.7%	+1.2%
Dutchess	2.1%	1.7%	-0.4%	8.2%	5.3%	-2.9%
Orange	2.2%	1.7%	-0.5%	7.4%	4.7%	-2.7%
Putnam	1.6%	0.8%	-0.8%	7.6%	4.8%	-2.8%
Rockland	1.2%	1.4%	+0.2%	5.9%	4.2%	-1.7%
Sullivan	4.8%	4.2%	-0.6%	12.5%	11.2%	-1.3%
Ulster	2.4%	1.8%	-0.6%	7.9%	5.6%	-2.3%
Westchester	1.7%	1.8%	+0.1%	5.5%	5.5%	+0.0%
Connecticut	1.8%	1.9%	+0.1%	+6.9%	8.1%	+1.2%
Fairfield	1.7%	1.7%	+0.0%	7.8%	6.0%	-1.8%
Litchfield	2.0%	1.3%	-0.7%	8.2%	4.7%	-3.5%
New Haven	1.8%	1.6%	-0.2%	8.3%	7.8%	-0.5%
New Jersey	1.8%	1.7%	-0.1%	+5.1%	7.1%	+2.0%
Bergen	1.2%	1.1%	-0.1%	5.6%	3.6%	-2.0%
Essex	2.5%	2.4%	-0.1%	9.6%	7.7%	-1.9%
Hudson	4.5%	4.1%	-0.4%	6.6%	5.1%	-1.5%
Hunterdon	1.2%	1.0%	-0.2%	5.9%	5.2%	-0.7%
Mercer	1.6%	1.4%	-0.2%	8.5%	6.1%	-2.4%
Middlesex	1.4%	1.6%	+0.2%	5.3%	3.8%	-1.5%
Monmouth	1.6%	1.8%	+0.2%	8.2%	4.2%	-4.0%
Morris	1.3%	1.0%	-0.3%	6.7%	6.0%	-0.7%
Ocean	2.5%	2.4%	-0.1%	10.3%	3.1%	-7.2%
Passaic	1.4%	1.6%	+0.2%	4.8%	4.1%	-0.7%
Somerset	1.1%	1.0%	-0.1%	6.1%	7.9%	+1.8%
Sussex	1.9%	2.7%	+0.8%	8.6%	6.7%	-1.9%
Union	1.8%	1.8%	+0.0%	6.2%	4.0%	-2.2%
Warren	1.9%	2.1%	+0.2%	10.3%	4.6%	-5.7%

Source: US Census Bureau, 2010 Decennial Census and ACS 2013-2017 5-Year Estimate

Building Boom

In recent years, housing development activity has been strong throughout the 31-county region, especially in urban centers of New York City, Hudson and Essex counties in the New Jersey sub-region and, to a lesser extent the inner ring suburban counties as illustrated in the housing permits mapped in Figures 19 and 20. According to county planners in the New York suburban counties, Westchester County currently has the largest number of units in the pipeline at roughly 34,000

units, followed by Suffolk County at 18,100 units and Dutchess County at 11,200 units. In total more than 73,000 units are in the pipeline in the Long Island and Mid-Hudson Valley sub-regions. (Figure 21).

Figure 19. Total Housing Permits Issues by NYMTC Region County, 2012 to 2018

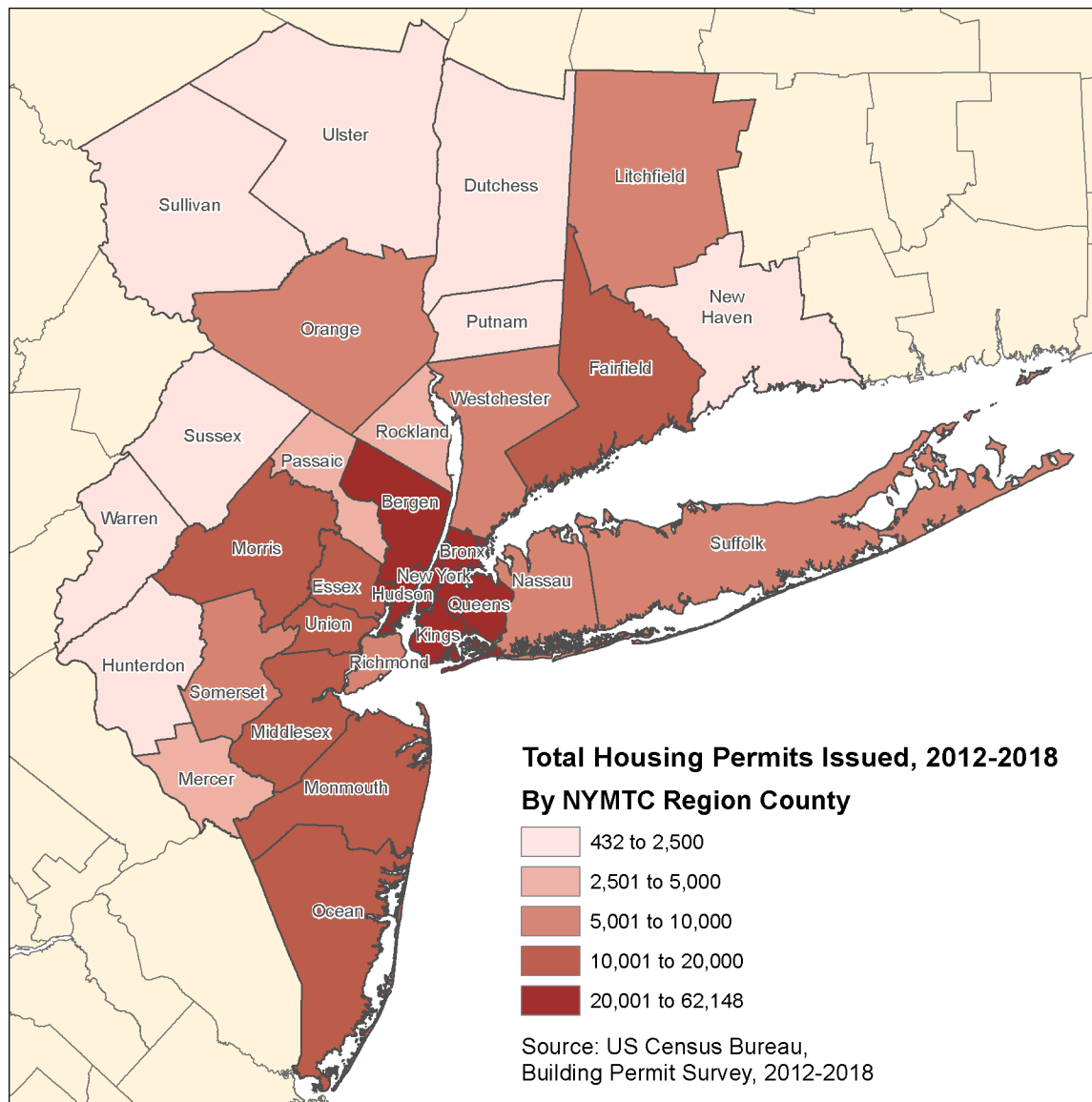


Figure 20. Annual Housing Permits Issued by NYMTC Region County, 2018

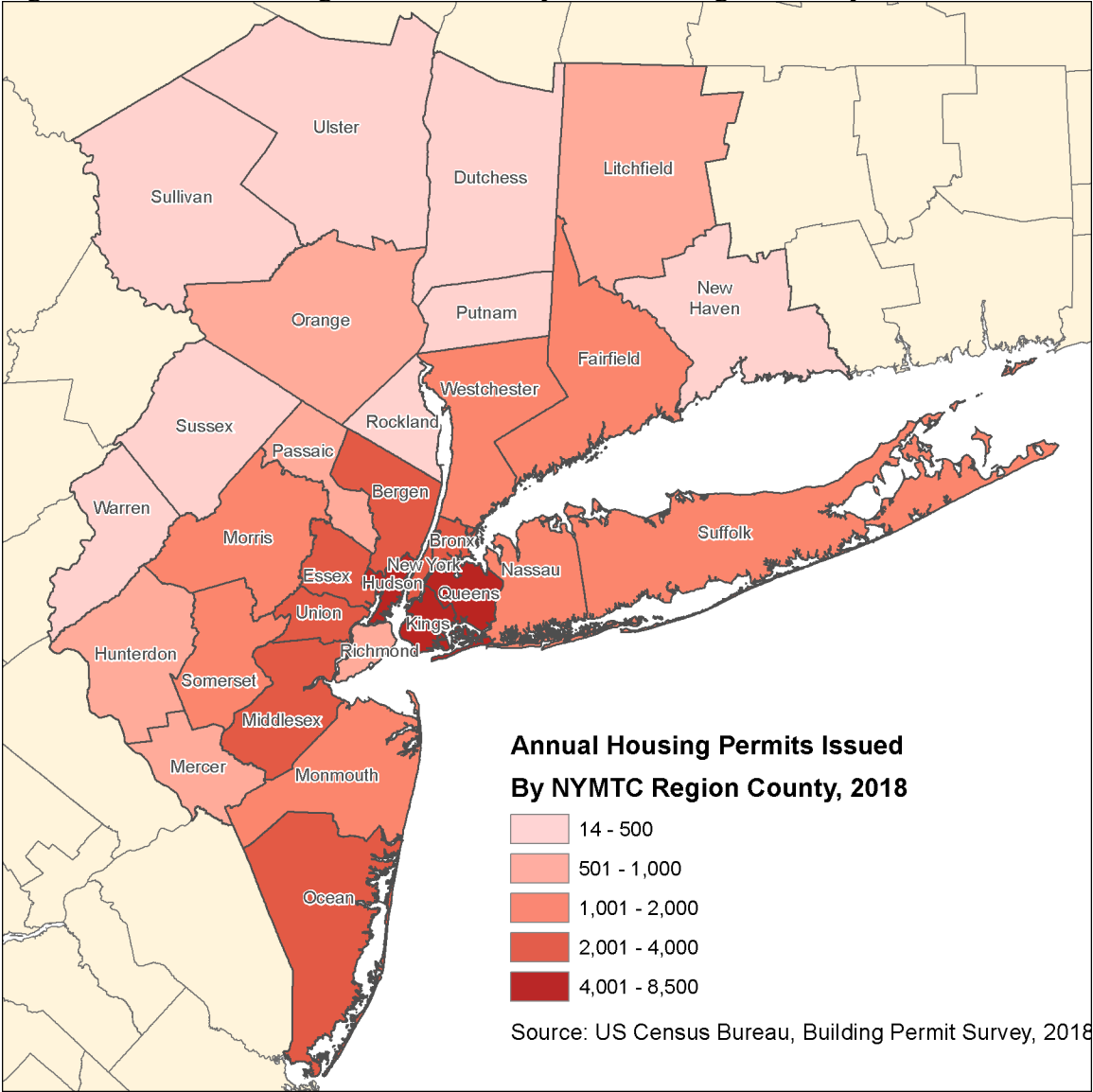
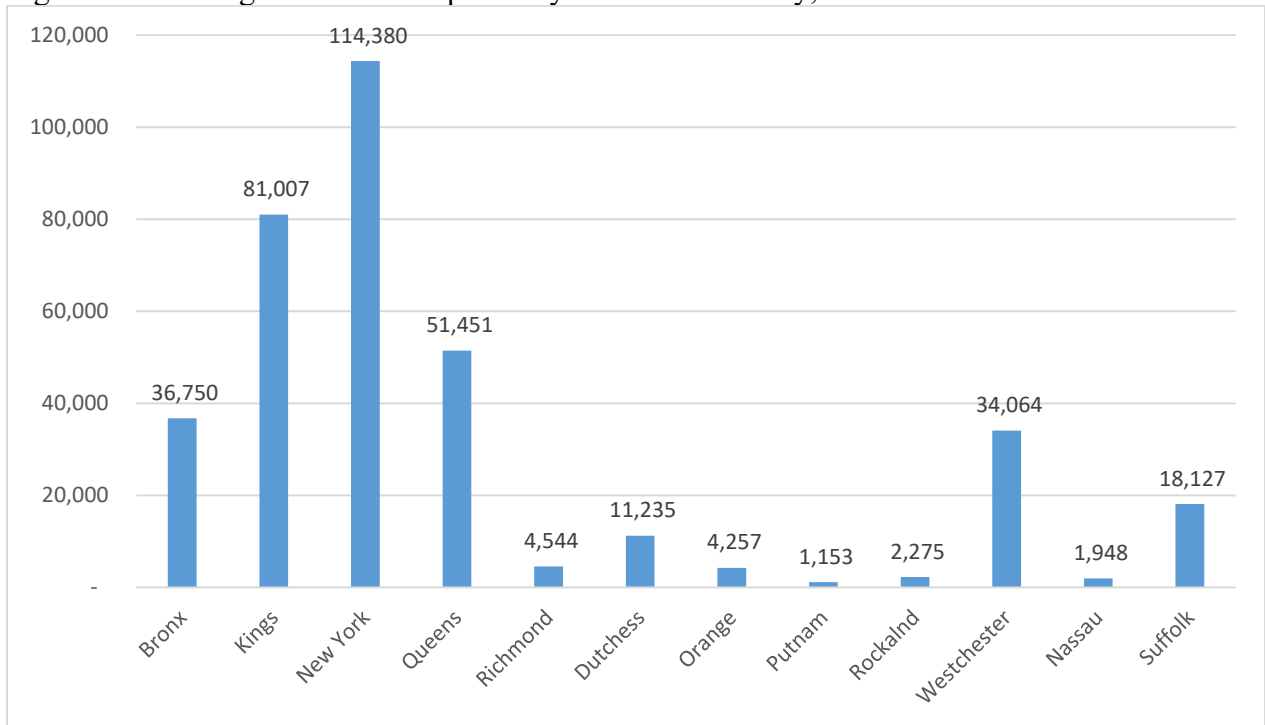


Figure 21. Housing Units in the Pipeline by New York County, 2019



Source: NYMTC, County Planning Departments, NYC DOB HousingDB_19v1 2019

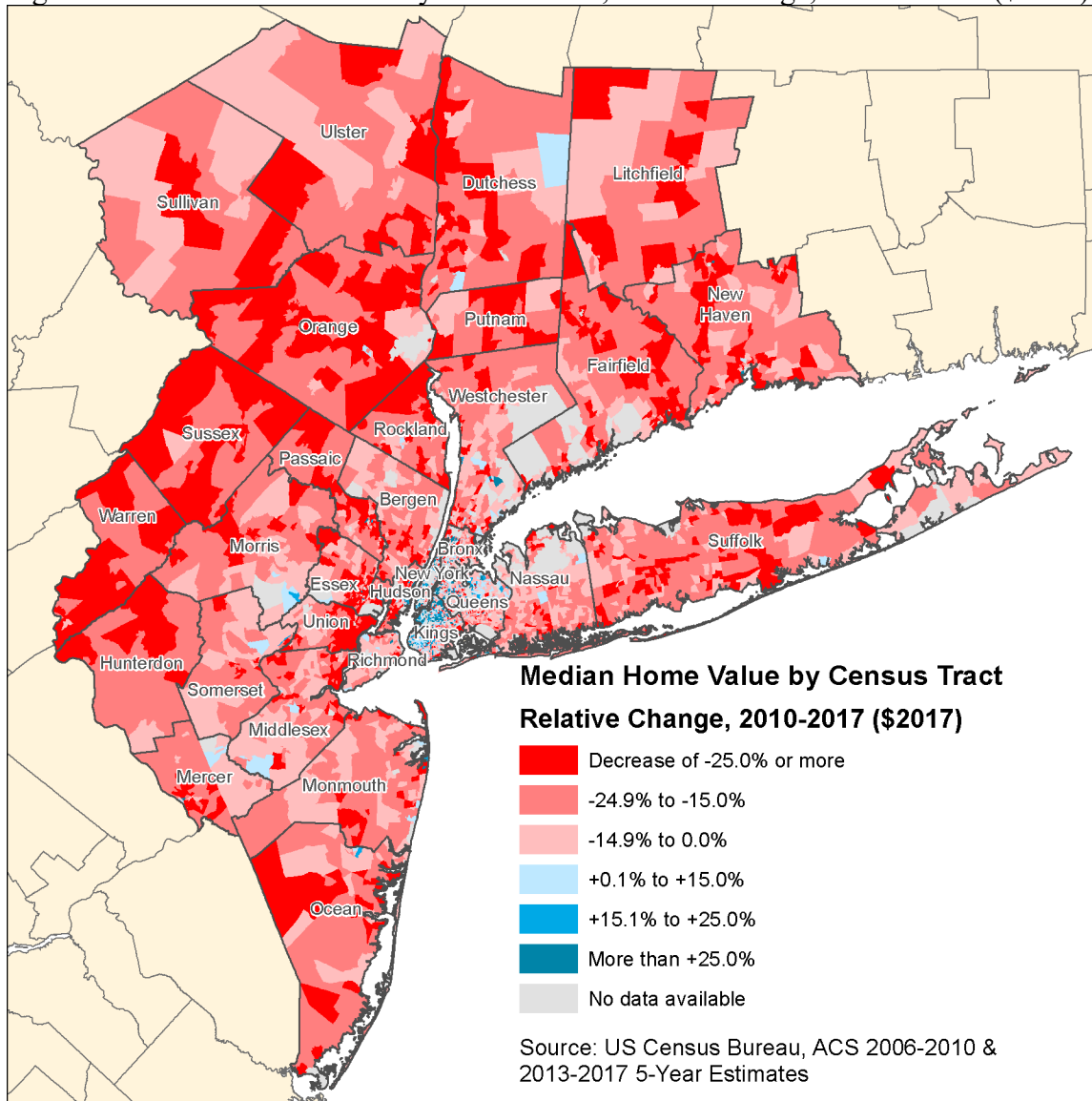
Out of 288,132 anticipated units (net 135,000) in New York City according to New York City Department of Buildings data provided by New York City Department of City Planning (DCP), roughly half have been issued building permits.

Value, Price, and Affordability

Value

With the exception of New York City, inflation-adjusted home values have declined throughout the 31-County Region as shown in the following figure. This reduction in value has implications on municipal and school district property taxes, which could have serious impacts on services.

Figure 22. Median Home Value by Census Tract, Percent Change, 2010 to 2017 (\$2017)



Costs and Affordability

Despite decreases in housing value throughout the majority of the region, housing costs, in particular rents, continue to increase as shown in the following figure. A common measure of housing unaffordability or housing cost-burdenship is the share of households spending more than 30 percent of income on housing related expenses including mortgage, rent or utilities. Figures 23-25 illustrate the share of households by tenure spending more than 30 percent of income on housing. The largest share of such homeowner households is concentrated in New York City, the inner suburban counties including Bergen, Hudson, Essex, Union, Nassau and Suffolk counties as well as counties further away from New York City such as Ocean and Putnam counties. High levels of renter housing cost-burdened households are present generally further outside of New York City where the availability of rental housing is scarce, and low cost rental housing even more

so, while high levels of homeowner housing cost-burdenship is present such as in Ocean, Rockland, Suffolk and Passaic counties.

Figure 23. Median Gross Rent by Census Tract, Percent Change, 2010 to 2017 (\$2017)

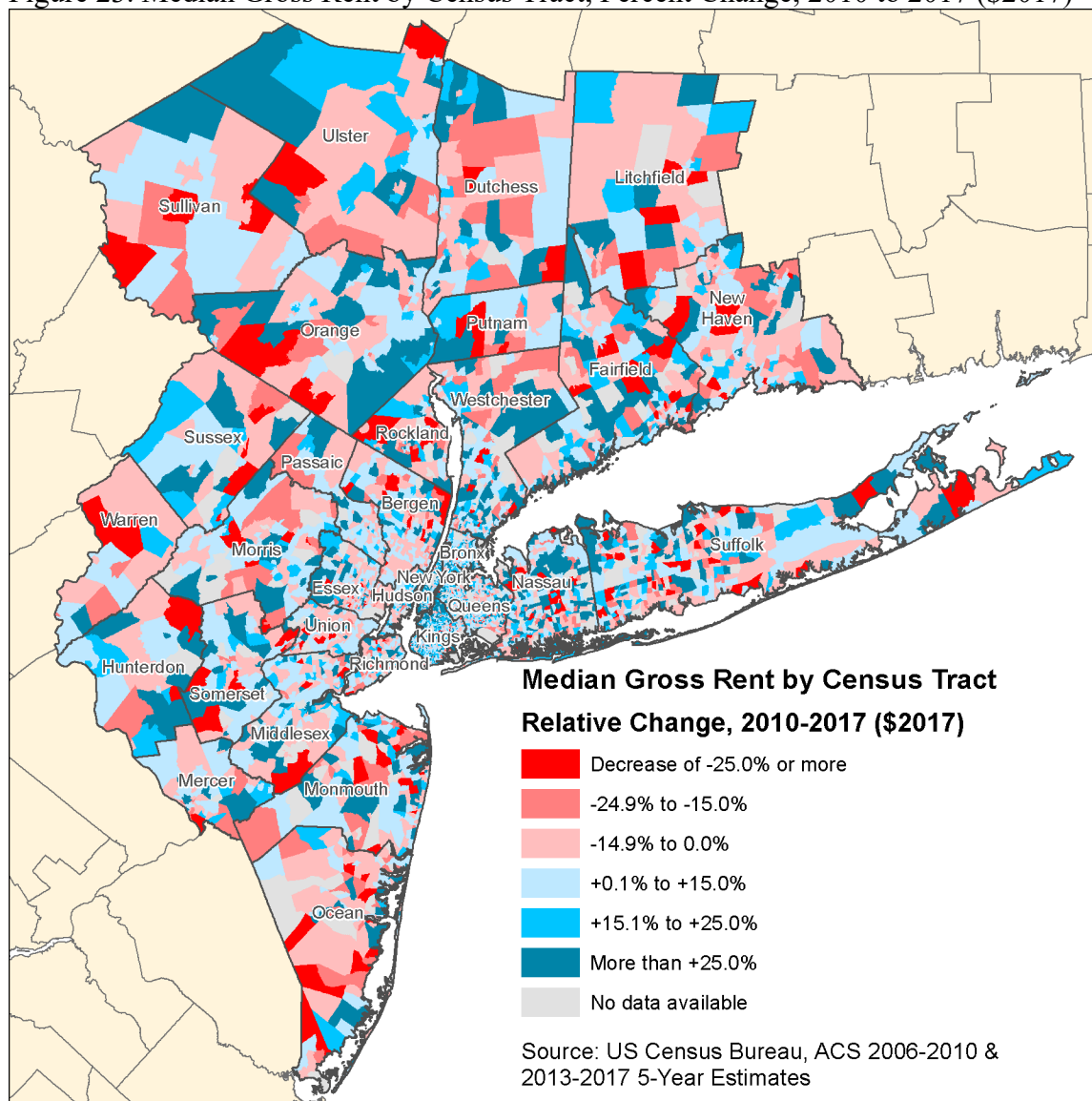


Figure 24. Share of Homeowners Spending 30% or More of Income on Housing, 2017

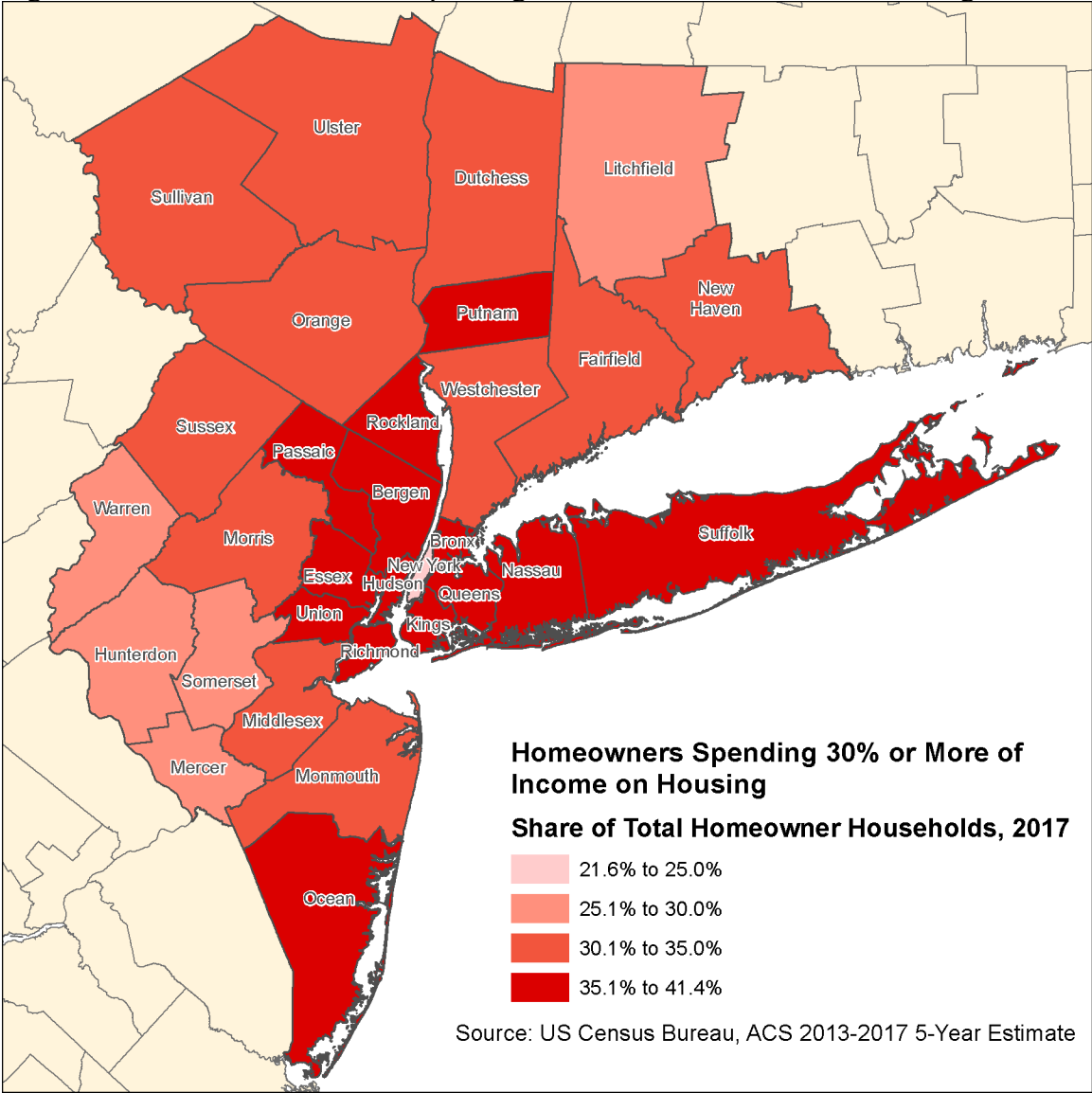
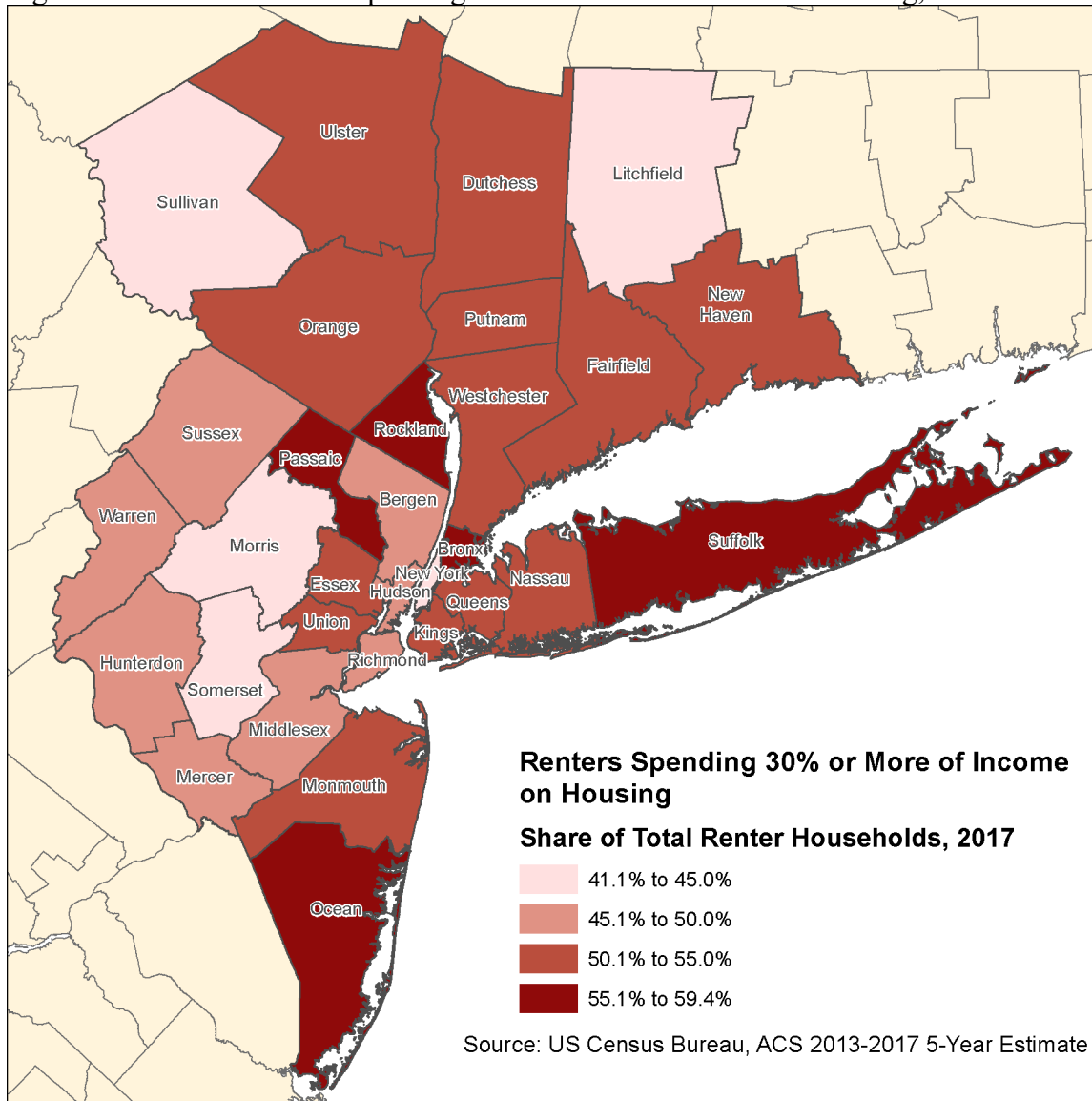


Figure 25. Share of Renters Spending 30% or More of Income on Housing, 2017



Changing Preferences

Along with market factors, behavioral trends influence settlement patterns. In particular, the preferences of millennials and seniors are affecting the housing market.

Millennial Housing Choices

Millennials are less likely to be homeowners than baby boomers aged 55 to 74 and Gen Xers age 35 to 54. The homeownership rate among millennials ages 25 to 34 is 8 percentage points lower than baby boomers and 8.4 percentage points lower than Gen Xers in the same age group. However, in 2015, millennials purchased 35 percent of homes, and their prime home buying years

are coming soon; the generation's median age is 25, while the average age of a first-time homebuyer is 31. A recent Washington Post report indicated growth in the far-out exurbs of major urban areas is, in part, attributed to millennials looking for affordable houses where they can find them.⁶

According to an Urban Institute study, millennials have different characteristics and preferences from earlier generations, which partially explain why their homeownership rate is lower. Millennial housing choices are bound to high standards. When they buy, they are looking for bigger homes with technology upgrades. When they rent, they demand well-maintained spaces, including fast response from management/maintenance—in the same day, if not the same hour; affordability—they don't want to be overcharged for parts or labor; and high quality of work.

In terms of locations, millennials want places they can call home such as cities with mixed-use development. Eighteen hour cities attract millennials because they are lively both day and night, with below average unemployment rates. If they choose suburban areas, the area has a mix of suburban and urban features that are in good condition and affordably-priced. Areas that attract millennials are not necessarily major urban centers, but areas that appeal to a desired well-rounded lifestyle—universities, green spaces, historic architecture, affordable housing stock, arts communities, and nightlife.

External barriers have also deterred millennials from owning a home

- Growing education debt has reduced millennials' likelihood of owning a home, as debt increases their debt-to-income ratios and lowers their remaining income to save for a down payment.
- High rental costs make it difficult for millennials to save for a down payment.
- Since the housing market crisis obtaining a mortgage has become more challenging because of an unstable labor market and tightening credit standards.
- The supply of affordable housing has declined over the past decade, especially in areas where millennials prefer living.

Senior Housing Choices

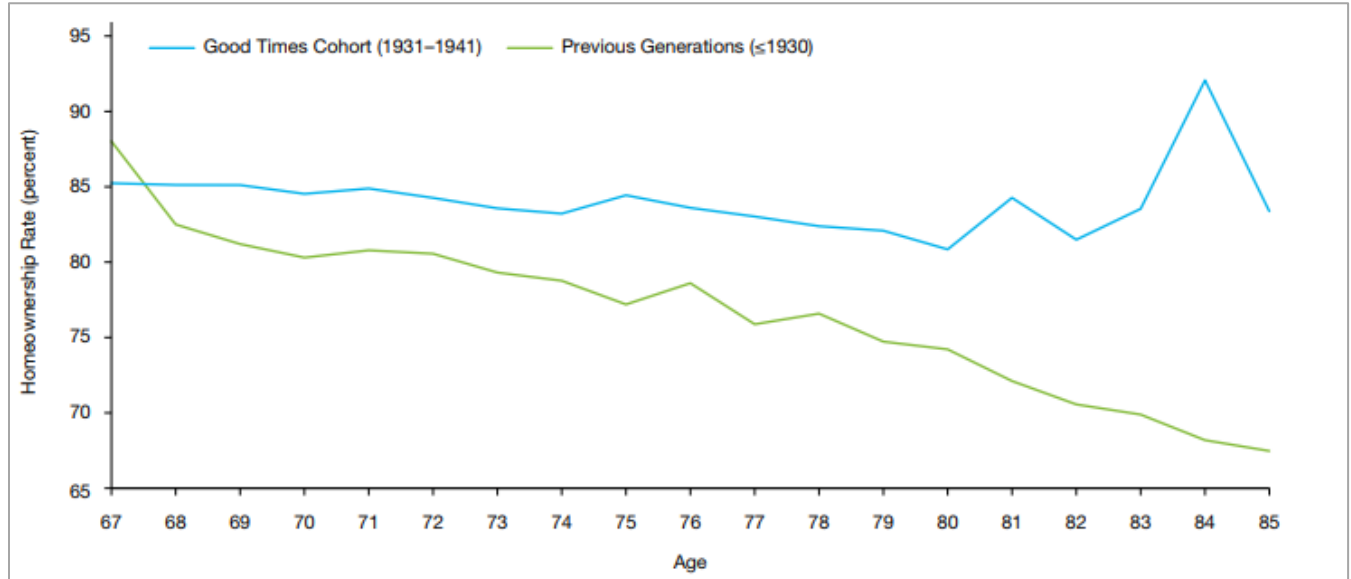
More than half of the nation's households are now headed by someone at least 50 years of age. Among all households age 65 and over, 44 percent are married or partnered and 43 percent are single. After age 65, though, the share of married or partnered adults falls and the share of single-person households rises. However, at the same time multigenerational living arrangements are becoming more common. In 2016, nearly 11 million older adults in the US lived in households where at least two related generations were present.

Approximately 1.6 million more senior households are staying in place than would have been the case if they behaved like older generations of homeowners, largely due to better health/longer life.

⁶ The Millennial Home Buying Effect (<https://www.washingtonpost.com/sf/brand-connect/nar/the-millennial-home-buying-effect/>)

These households are increasingly concentrated in lower-density communities where more than half of the population is at least age 50. Between 2000 and 2016, the number and share of census tracts with a majority of older adults jumped from 1,499 (2%) to 4,764 (7%).

Figure 26. Historical Homeownership Rate by Household Heads Aged 67-85



Source: Freddie Mac: Health and Retirement Survey

Of those who are relocating, a growing share are choosing age-restricted housing, which includes senior apartments and independent living units (which may provide some services such as meals or laundry), as well as assisted living facilities (which provide assistance with activities of daily living such as bathing, dressing, and eating).

There is an acknowledged shortage of accessible housing, a problem given that in 2016, 26 percent of households age 50 and over included a member with at least one vision, hearing, cognitive, self-care, mobility, or independent living difficulty.

Economic Trends

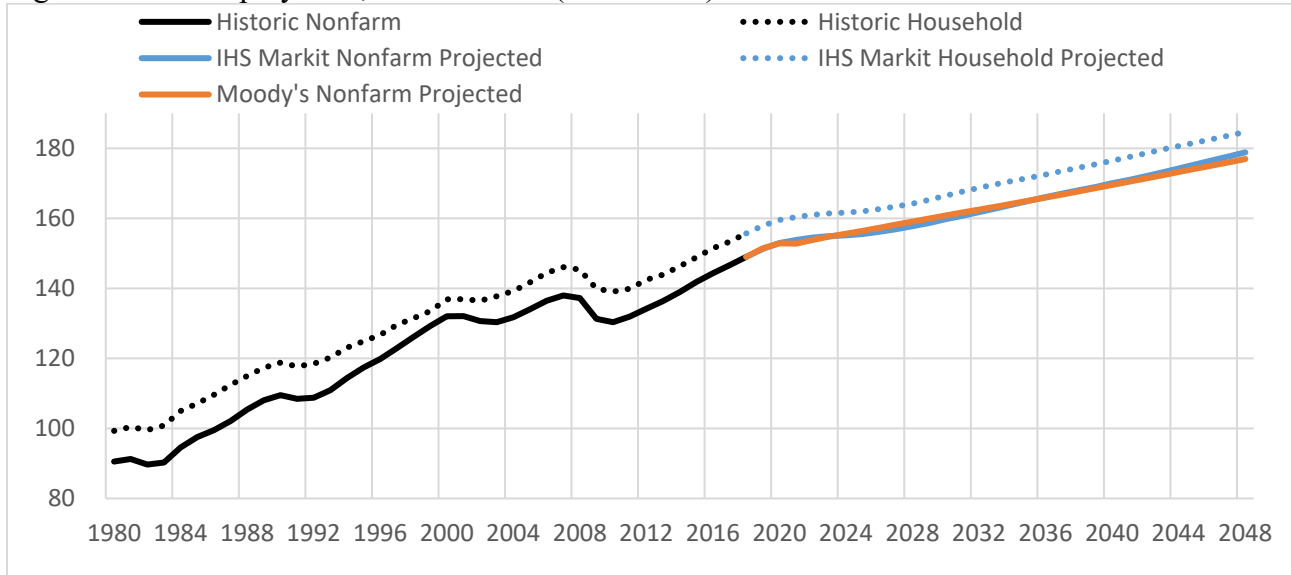
Employment Trends

Total non-agricultural employment, or work-place employment, in the US rose from 90.5 million in 1980 to 146.6 million in 2017 (Figure 27). The impact of the recessions of the early 1980s and early 1990s can be seen in the dips in employment in those periods. The recovery from the much larger dip following the 2001 recession ended in 2004, while that after the “Great Recession” of 2007 to 2009 lasted until 2014.

Total household employment includes proprietors as well as agricultural jobs, neither of which is included in the non-agricultural data. Total household employment has always been higher than non-agricultural employment, but its reaction to the business cycle tends to be more muted, falling more slowly in downturns and rising more slowly in upswings. That pattern will continue in the

forecast period according to forecasts by IHS Markit. Between 2017 and 2048 non-agricultural employment will rise at a rate of 0.64 percent a year compared to 0.60 percent a year for household employment. Over that period workplace jobs are expected to rise by 32.2 million and household employment by 31.3 million. Moody's non-agricultural employment forecasts projected slightly weaker average annual employment growth at 0.61 percent over that period.

Figure 27. US Employment, 1980 to 2048 (in Millions)



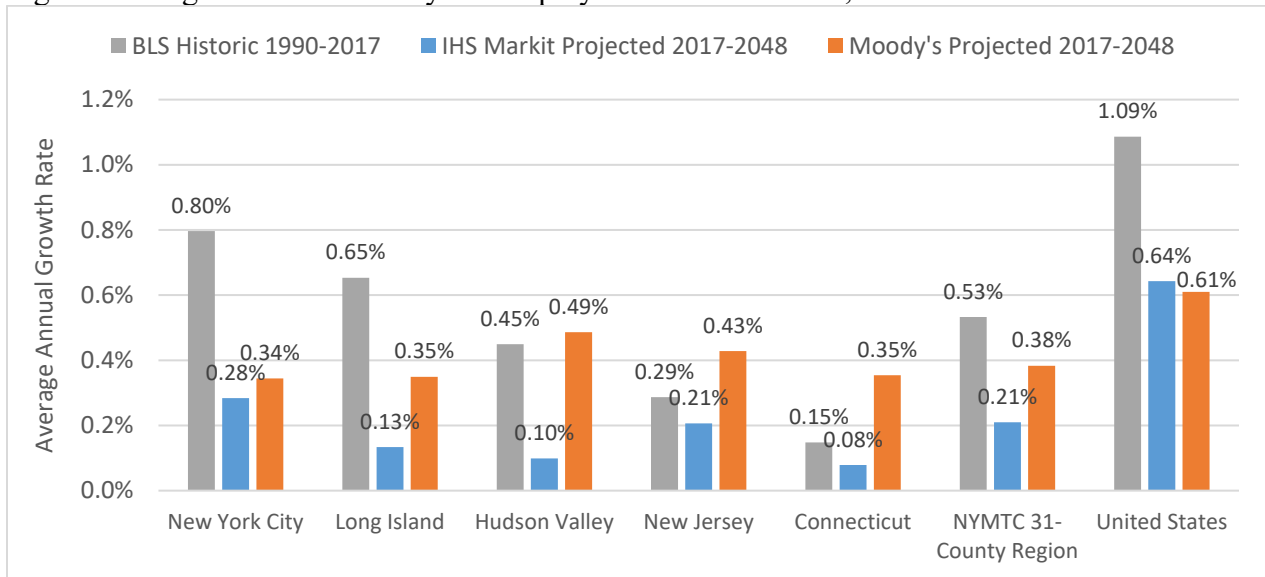
Source: USBLS, Current Employment Statistics Survey, IHS Markit & Moody's Employment Forecasts

Employment trends for the 31-County Region and its components are similar in some ways but quite different in others. Figure 28 shows the percentage growth in employment by sub-region compared to the 31-County Region as a whole and to the US.

Over the historical period New York City was the growth leader for the 31-county region, with employment increasing at an average rate of 0.8 percent. Long Island added jobs at a rate of 0.65 percent a year, while the Mid-Hudson and New Jersey sub-regions lagged at only 0.45 percent and 0.29 percent respectively; the Connecticut sub-region had the least growth at only 0.15 percent. All were considerably slower than the US which added jobs at a rate of 1.1 percent a year.

Future growth forecasts developed by IHS Markit and Moody's were similar at the national level but diverged at the 31-County Region and sub-region level. Moody's forecasts projected double the rate of growth forecasted by IHS Markit in the 31-County Region (+0.38% and +0.21% respectively). In New York City both forecasts projected annual average growth of roughly 0.3 percent while Moody's forecasts far exceeded growth projections in all other sub-regions.

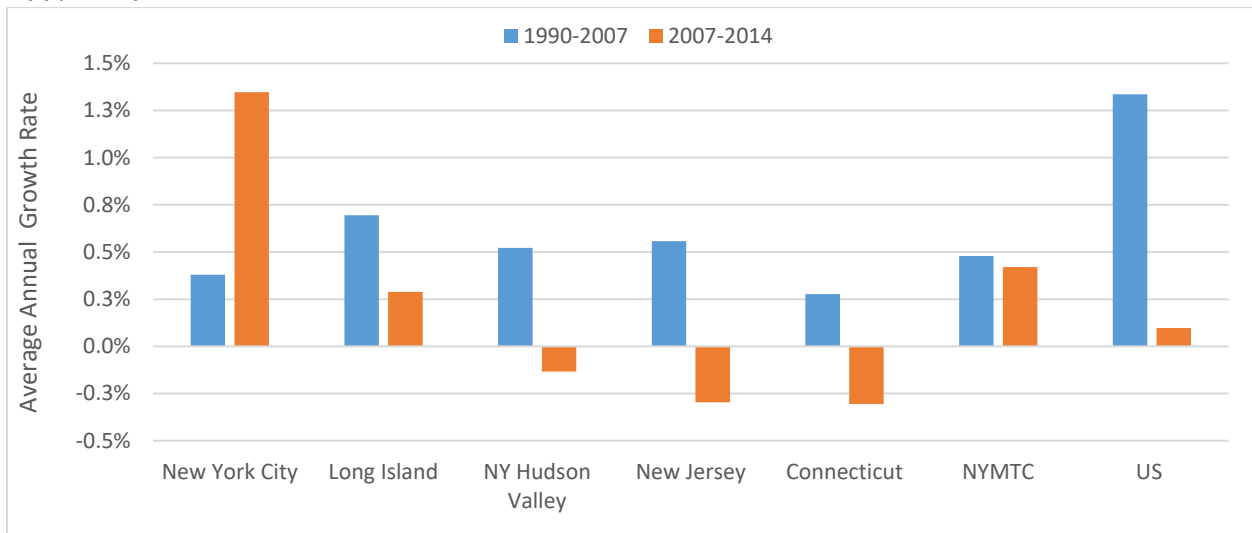
Figure 28. Regional Nonfarm Payroll Employment Growth Rates, 1990-2017 and 2017-2048



Source: USBLS, Current Employment Statistics Survey, IHS Markit & Moody's Employment Forecasts

The differences in the regional growth rates are to a great extent attributable to the regions' reactions to the Great Recession (Figure 29). Between 1990 and 2007 all five sub-regions grew less than 1 percent a year, Connecticut and New York City at the low end of the range and the more suburban areas in New York and New Jersey at the high end. Employment in the City peaked in 2008, a year after the national peak and the lost jobs (by number not industry) were recovered by 2011. The number of jobs lost in the recession were recovered in Long Island in 2013 and not until 2014 in the US. The job recovery was completed in 2015 and 2016 in the Mid-Hudson and New Jersey sub-regions respectively. But in the Connecticut sub-region, as of 2018, the job recovery was still not yet complete.

Figure 29. Regional Employment Growth Before & During the Great Recession 1990 to 2007 & 2007 to 2014



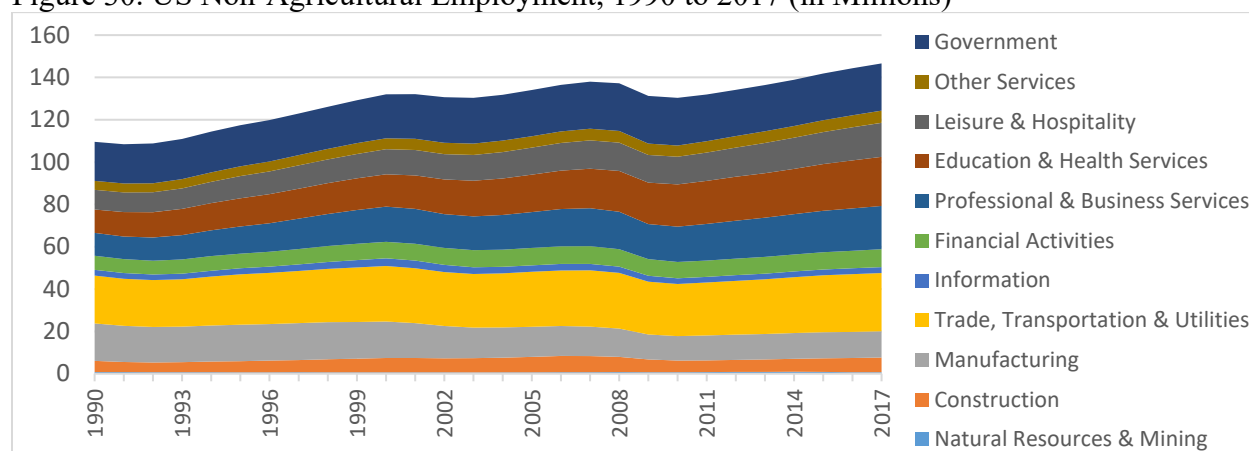
Source: USBLS, Current Employment Statistics Survey

Industry Mix for Employment:

Between 1990 and 2017 the industry mix for non-agricultural employment in the US changed substantially with a major shift in the number of jobs concentrated in the services sectors. Jobs in services of different sorts rose from 35 million in 1990 to 67 million in 2017 (Figure 23). During this period services industries⁷ accounted for 81 percent of the increase in jobs in the US, with the rest mostly in state and local government and retail trade. The best that can be said for manufacturing is that its decades long decline was arrested in 2009 and stabilized at about 12 million.

The 2007-2009 recession had a major impact on the long-term transformation of employment. To some extent the differences in the recovery time were due to industry structure—for both jobs and wages, but other reasons for the differences result from changes in demographics and locational decisions of corporations. In New York City, by 2017 jobs had increased by close to 400,000 over the 2007 level. The increases were in all private sectors except finance and manufacturing; growth was strong in technology and other high wage sectors like information and professional and business services, as well as in education and health care. By 2017 the very high wage financial sector had more than recovered from the recession as well. In Long Island, the only growth sectors coming out of the recession were the services industries, led by education and health care. Wage rates in that sector tend to be lower than in professional and business services although higher than in either leisure and hospitality services or “other” services.⁸ The same was true of the Hudson Valley and the New Jersey and Connecticut counties in the 31-county region. While businesses flocked to New York City, great swathes of New Jersey and Connecticut were covered with suburban office parks that had to be closed or repurposed. The younger generation of workers chose to be located in a city environment and corporations followed their lead.

Figure 30. US Non-Agricultural Employment, 1990 to 2017 (in Millions)



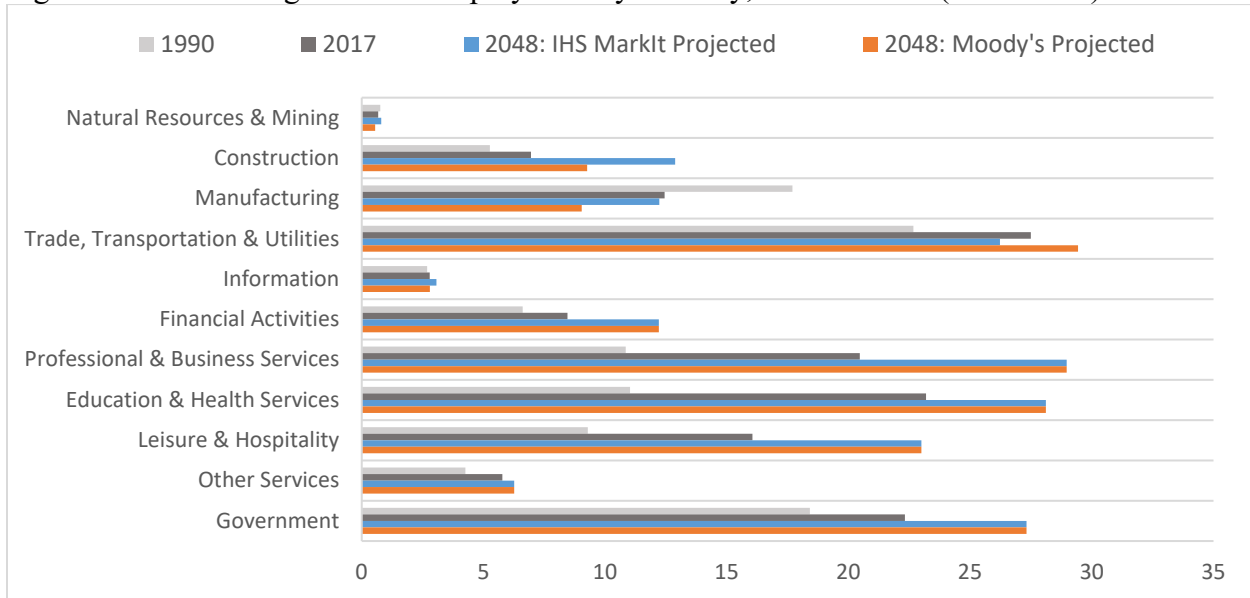
Source: USBLS, Current Employment Statistics Survey

⁷ Includes information, financial activities, professional services, education and health services, leisure and hospitality and other services industry groups.

⁸ US Bureau of Labor Statistics, Table B-3. Average hourly and weekly earnings of all employees on private nonfarm payrolls by industry sector, March 2019.

Employment forecasts from Moody's and IHS Markit offer similar projections of future industry-level employment in the United States. Both project continued growth in the combined services sector with expectations of an increase in share from 52.3% of nonfarm workers in 2017 to 57.3 percent of workers in 2048. Laborers employed in government, trade, transportation, warehousing and utilities are expected to decrease as a share of total employment from just over one-third of workers (34.0%) in 2017 to 29.5 percent according to IHS Markit while Moody's projects a minimal shift in distribution to 32.1 percent of total laborers.

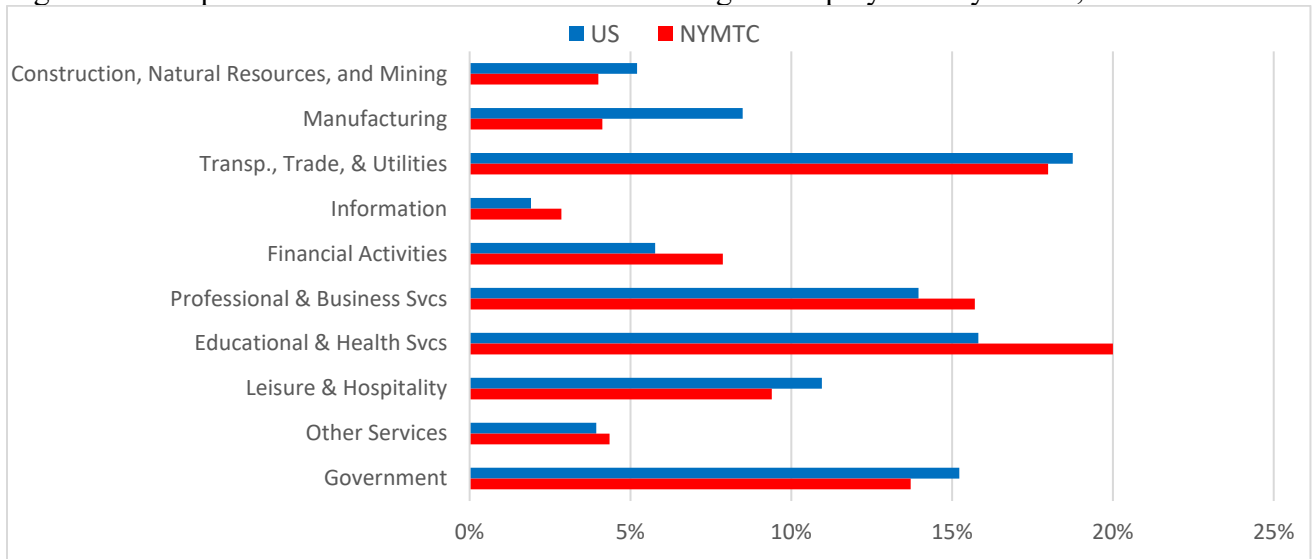
Figure 31. US Non-Agricultural Employment by Industry, 1990 to 2048 (in Millions)



Source: USBLS, Current Employment Statistics Survey, IHS Markit & Moody's Employment Forecasts

A closer view of the industry mix shows that most of the growth during the forecast period will be in professional and business services, followed by health care and social services. Other growing industries will be state and local government and leisure and hospitality industries. IHS Markit projects strong growth in the construction sector with a gain of 6 million jobs while the Moody's forecast for that sector is considerably less optimistic with a gain of 2 million workers. There is little or no growth expected elsewhere. Of the industries in which the 31-County Region is particularly concentrated compared to the US (Figure 32), that is information, financial activities, professional and business services and educational and health services, only the two service sectors are expected to show much growth in the forecast period.

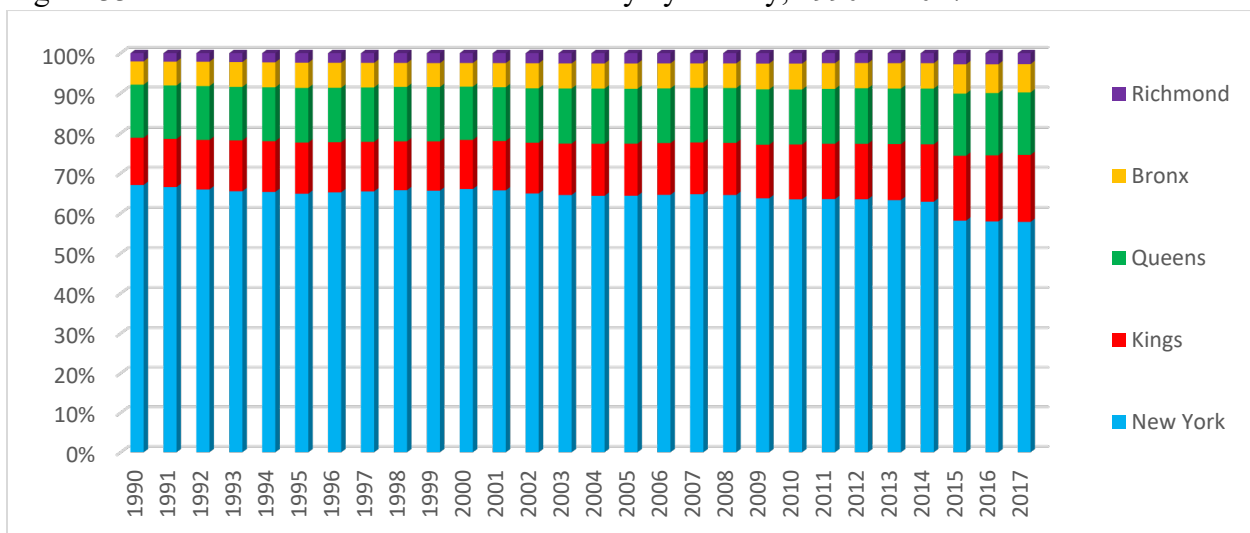
Figure 32. Comparison of US and NYMTC Forecast Region Employment by Sector, 2017



Source: USBLS, Current Employment Statistics Survey

Within New York City, in 1990 two thirds of total jobs and 63.9 percent of jobs in the private sector, were located in New York County (Figure 33). However, over nearly the next three decades, New York County's rate of growth was dwarfed by that in all the other boroughs. By 2017 New York County accounted for 57.9 percent of jobs and 59.1 percent of private sector jobs. Kings County increased its share of New York City's employment from 11.8 percent to 16.7 percent, Queens County from 13.2 percent to 15.6 percent, the Bronx County from 5.8 percent to 7.1 percent and Richmond County increased from 2.0 percent to 2.7 percent. In all boroughs except New York County the major growth industries were education and health services and state and local government. In New York County the major growth industry was professional and business services, followed by educational and health services and leisure and hospitality services.

Figure 33. Distribution of Jobs in New York City by County, 1990 to 2017

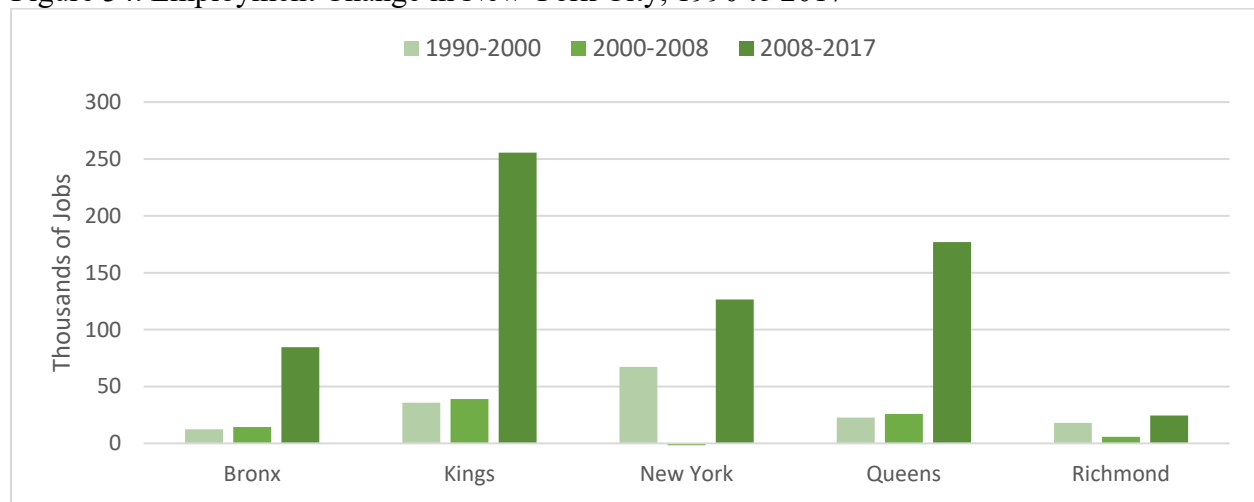


Source: USBLS, Current Employment Statistics Survey

Employment growth in New York City was dominated by that in New York County in the 1990s, when that borough added 67,000 new jobs, nearly 45 percent of the City’s jobs increase. That pattern changed substantially between 2000 and 2008 when New York County suffered a substantial job loss in the recession of 2001 to 2003, while the other counties were barely affected by it.

In the lead up to the Great Recession, the City’s employment peaked in 2008, a year after the peak in the US. Employment in Bronx and Kings counties grew straight through the recession, Queens County recovered in 2011, New York County in 2012, and Richmond County in 2013. Between the 2008 peak and 2017, Kings and Queens counties were the growth leaders for the City, followed by New York County and Bronx County (Figure 34).

Figure 34. Employment Change in New York City, 1990 to 2017



Source: USBLS, Current Employment Statistics Survey

In the 1990s, in the New Jersey sub-region counties a similar kind of change was underway. The sub-region as a whole added jobs at a rate of 0.5 percent per year between 1990 and 2017, with growth considerably faster in the first decade than in the rest of the period. Employment in the sub-region was lost and then regained in and after both the recessions of the early 1990s and early 2000s. It reached a new peak in 2007, but recovered from the loss during the Great Recession only in 2016.

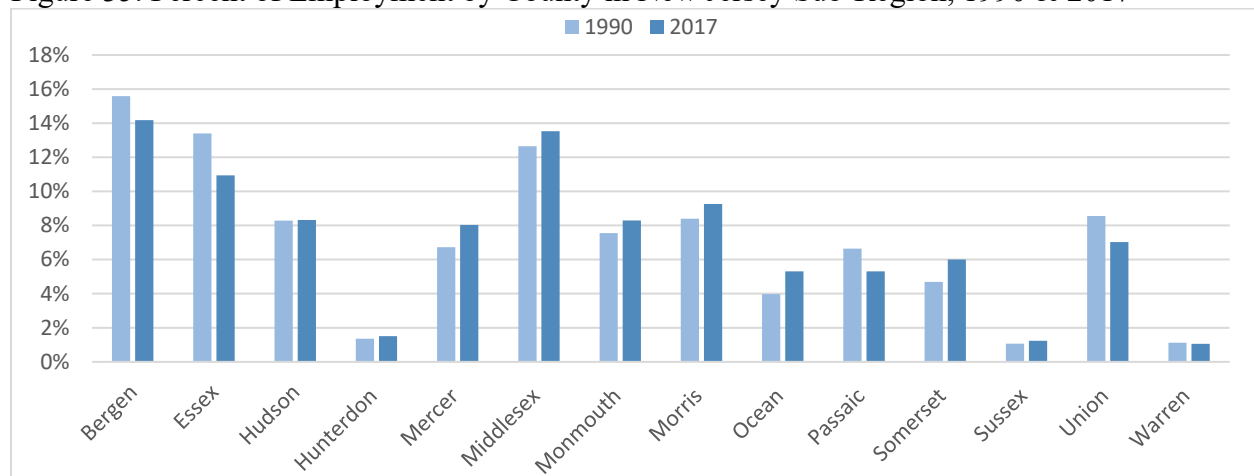
Half of the counties in the sub-region still had not fully recovered in 2017 including the counties in the old industrial core of the sub-region, Bergen, Essex, Passaic, and Union. Between 1990 and 2017 each lost at least half of its 1990 manufacturing jobs without gaining significantly in another high paying industry sector. All those counties were hurt also by losses in information and financial services. Of the inner core counties, only Hudson has achieved some growth over the 1990 to 2017 period as financial and professional services moved into the revitalized area in Jersey City from New York City and later in nearby towns like Hoboken and Weehawken.

The major growth areas in the New Jersey sub-region have been the central and shore counties. Over the 27-year period Ocean County added jobs at a rate of 1.5 percent a year; Somerset County at 1.4 percent; Mercer County at 1.1 percent; Monmouth County and Sussex County at 1.0 percent;

Morris and Hunterdon counties at 0.8 percent; and Middlesex County at 0.7 percent. All of these counties grew faster than the 31-County Region as a whole.

Figure 35 illustrates the change in employment distribution by county in the New Jersey sub-region. Education and health services was the growth leader in Hunterdon, Middlesex, Monmouth, Morris, Ocean, and Sussex counties. Professional and business services was the leader in Mercer and Somerset counties. Mercer was the only one of these counties with strong growth in state and local government—not a surprise with the state capital located in Trenton. Except for Middlesex and Mercer counties, all the other counties lost state and local government jobs during and after the Great Recession. Another growth industry in several of the counties on the shore and in the mountains was leisure and hospitality services.

Figure 35. Percent of Employment by County in New Jersey Sub-Region, 1990 & 2017



Source: USBLS, Current Employment Statistics Survey

In the 1990s employment growth in both Nassau and Suffolk counties was led by the services industries, particularly professional and business services in Suffolk County and educational and health services in Nassau County. However, in the 2000s, the strongest growth in both counties was in educational and health services. Since the Great Recession employment in both counties has grown, although more in Suffolk County than in Nassau County.

In the Mid-Hudson sub-region the job dynamic was somewhat different. That is, the share of employment shifted away from the most highly industrial county (Westchester) and towards the more suburban Orange and Rockland counties. In 1990, Westchester County accounted for 48.4 percent of the jobs in the Mid-Hudson (Figure 37). However, the county grew at an annual average rate of only 0.3 percent between 1990 and 2017, with a large decline in jobs and very slow recovery during and after the Great Recession. By 2017 Westchester County accounted for only 46.2 percent of Mid-Hudson jobs. Between 1990 and 2017 the county's economy lost a significant number of jobs in manufacturing, transportation and trade, and information, while gaining in services, particularly in education and health care and leisure services, as well as less strongly in professional and business services.

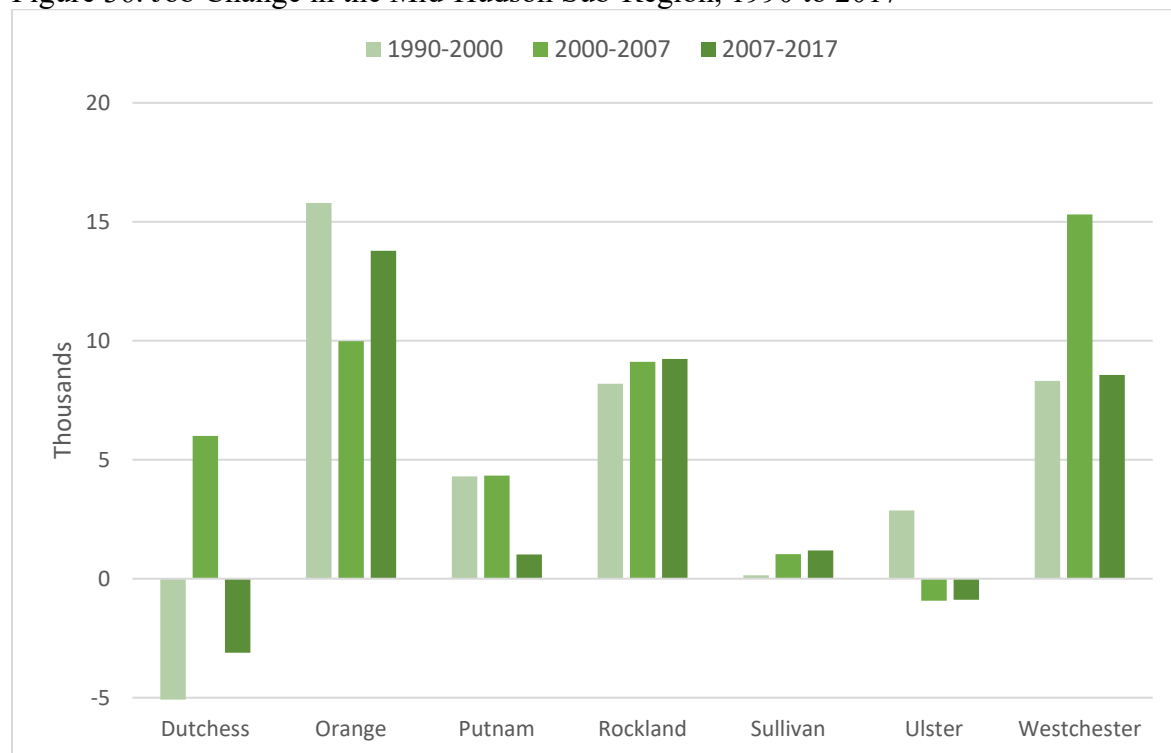
Dutchess County lost about 2,000 jobs over the 27-year period and its Mid-Hudson job share declined from 14.4 percent to 12.5 percent of the regional total. As in Westchester County there

were heavy losses in manufacturing and most gains were in education and health care and leisure services. Sullivan and Ulster counties both gained jobs very slowly and lost job share. In 1990 Sullivan County's largest industry was leisure and hospitality services, however, it lost jobs in that industry through most of the period ending in 2017. In 1990 Ulster County's largest industrial sectors were transportation, trade and state and local government. That was still the case in 2017, although the education and health care sector, its fastest growth industry, was almost as large as the other two.

Putnam County gained jobs quickly from a base of only 18,700 in 1990 to a high of 26,500 in 2017. Its Mid-Hudson job share rose from 2.2 percent to 3.0 percent. The sectors that maintained relatively steady growth over that period were transportation and trade, educational and health services, leisure and hospitality services, and state and local government.

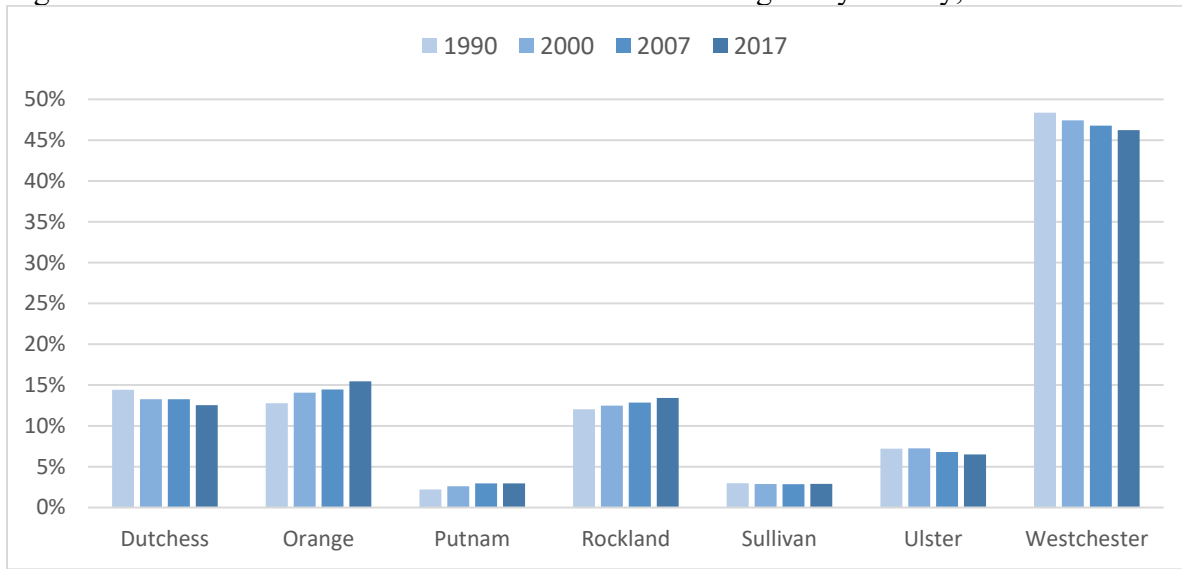
Orange and Rockland counties, on the western side of the Hudson River, each gained jobs at an average annual rate of about 1 percent a year. Orange County suffered a minimal job loss and rapid recovery from the Great Recession. The sectors maintaining relatively steady growth over the period in Orange County were transportation and trade, professional and business services, and educational and health services. The loss and recovery in Rockland County was slightly larger and longer (Figures 36 and 37). It suffered large losses in manufacturing, which were more than compensated by the gains in professional and business services, educational and health services, and leisure and hospitality services.

Figure 36. Job Change in the Mid-Hudson Sub-Region, 1990 to 2017



Source: USBLS, Current Employment Statistics Survey

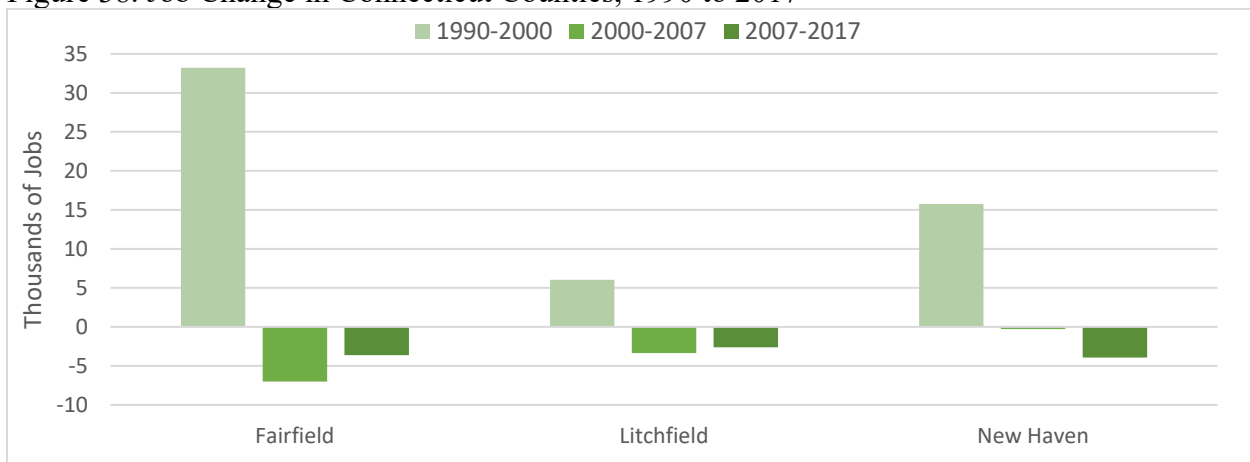
Figure 37. Distribution of Jobs in the Mid-Hudson Sub-Region by County, 1990 to 2017



Source: USBLS, Current Employment Statistics Survey

Employment in the Connecticut sub-region grew at a rate of only 0.1 percent a year between 1990 and 2017. Employment in the sub-region and the three counties peaked in 2000 and was on its way to recovering when the Great Recession hit. By 2017 the counties had not regained their 2007 mini-peaks much less the one in 2000 (Figure 38). There were major losses in manufacturing and military jobs in all three counties, as well as in information and finance in Litchfield and New Haven. All three counties gained jobs in the services sectors—particularly in education and health services, but also in leisure and hospitality, and to a lesser extent in professional and business services.

Figure 38. Job Change in Connecticut Counties, 1990 to 2017

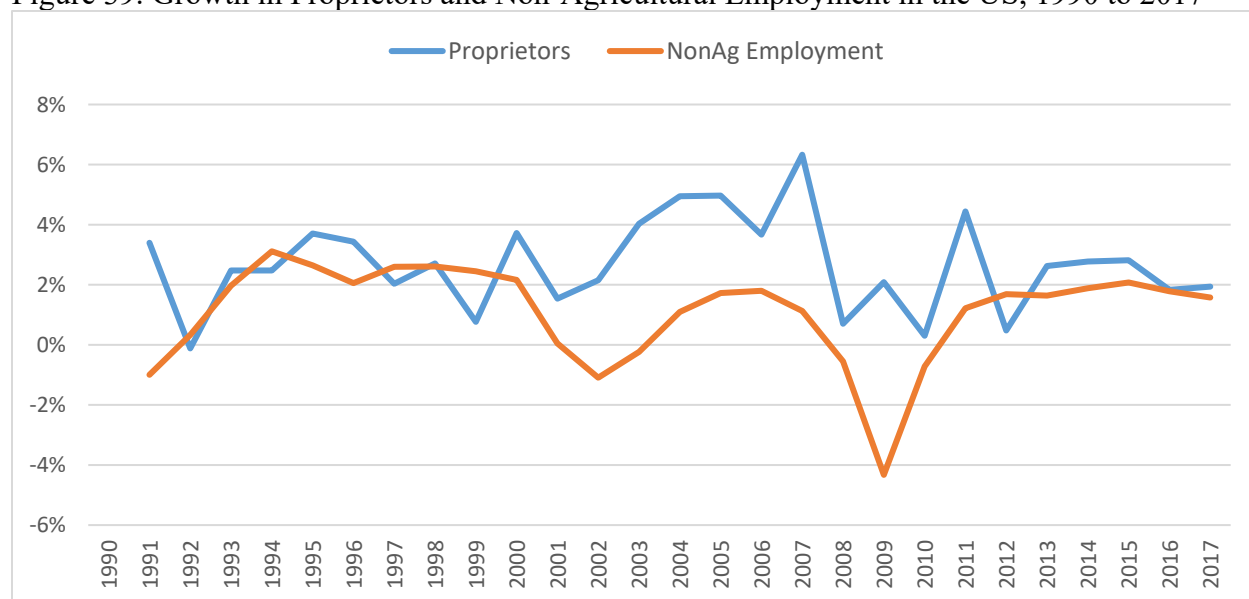


Source: USBLS, Current Employment Statistics Survey

The number and industrial distribution of jobs is only part of the story of employment patterns in the US and the NYMTC region. Another piece is the increase in the number of proprietorships in the economy. These businesses can be in any industry although they are more prevalent in the services and construction sectors than in manufacturing or any other industry. Over the period

from 1990 to 2017 the proportion of proprietors in total employment⁹ in the US has risen from 16.6 percent to 23.2 percent. The number of proprietors in the US has grown at an average rate of 2.7 percent a year, with lower growth recession than during growth periods, but no declines during recessions (Figure 39).

Figure 39. Growth in Proprietors and Non-Agricultural Employment in the US, 1990 to 2017

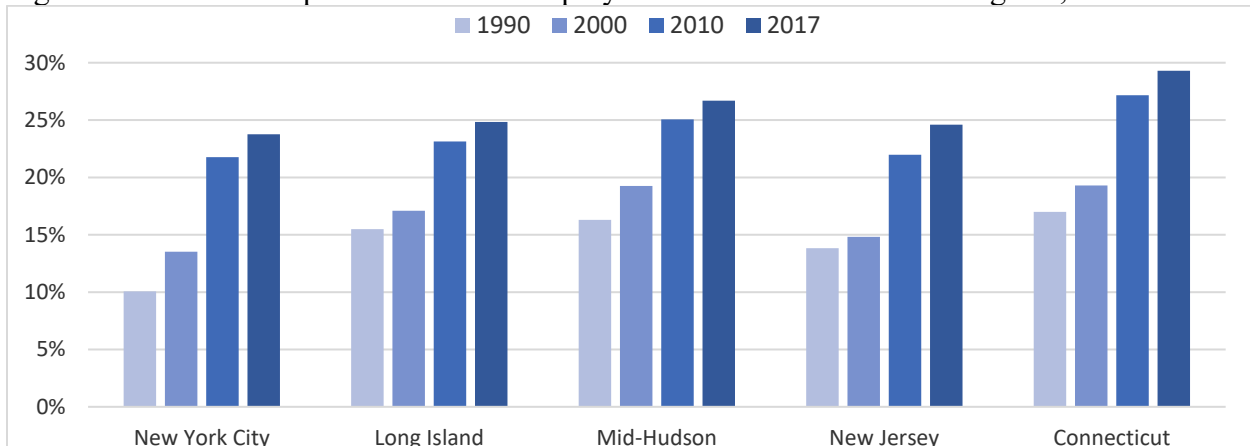


Source: IHS Markit

The number of proprietorships grew faster in all the NYMTC sub-regions than in the US between 1990 and 2017. New York City gained proprietors at a rate of 4.7 percent a year, Long Island at 2.9 percent and the Mid-Hudson sub-region at 2.8 percent. However, in the Mid-Hudson only Rockland and Westchester counties added proprietors as rapidly as the US. In the sub-region of Connecticut, only Fairfield County added proprietors as quickly as the US. In the New Jersey sub-region the more rural areas and government-dependent Mercer County added proprietors more slowly than the US, but the sub-region as a whole added them swiftly. The number of proprietorships has also grown more rapidly in all the sub-regions than has workplace employment. Thus the proportion of proprietors in the total number of jobs has risen tremendously all over the 31-County Region (Figure 40).

⁹ Total employment is defined here as nonagricultural employment plus proprietors.

Figure 40. Ratio of Proprietors to Total Employment in the NYMTC Sub-Regions, 1990 to 2017

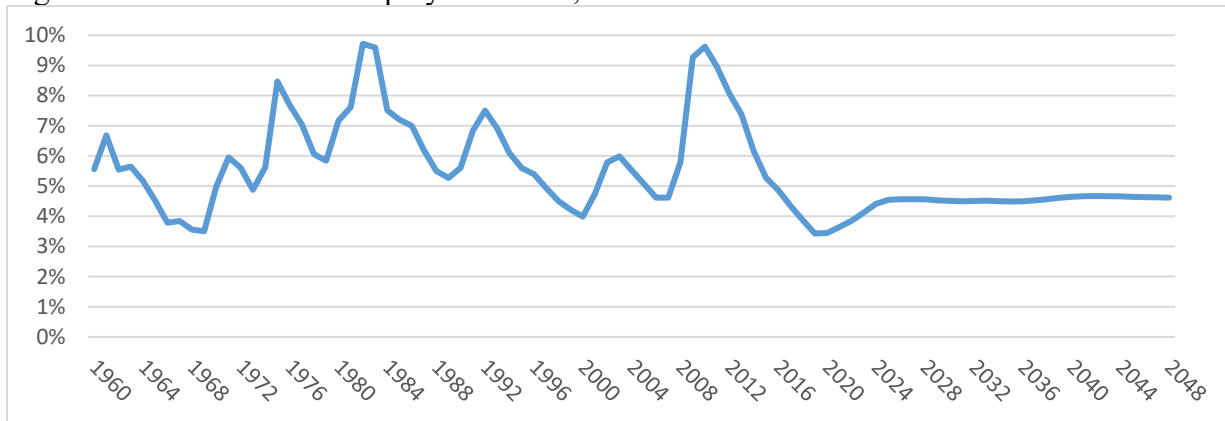


Source: IHS Markit

Unemployment

Beginning in 1960, the unemployment rate ranged from a low of 3.5 percent in 1969 to a high of 9.7 percent in 1982 (Figure 41). It trended downward for most of the next two decades, before trending up again and peaking at 9.6 percent in 2010 during the worst year of the Great Recession. The rate fell in the intervening years to 3.9 percent in 2018. The forecast is for relatively strong economic growth in 2019 and 2020, pulling the unemployment rate down to 3.4 percent in 2020. It will settle at an average rate of 4.6 percent from 2024 on, as employment rises at 0.6 percent a year.

Figure 41. US Civilian Unemployment Rate, 1960 to 2048

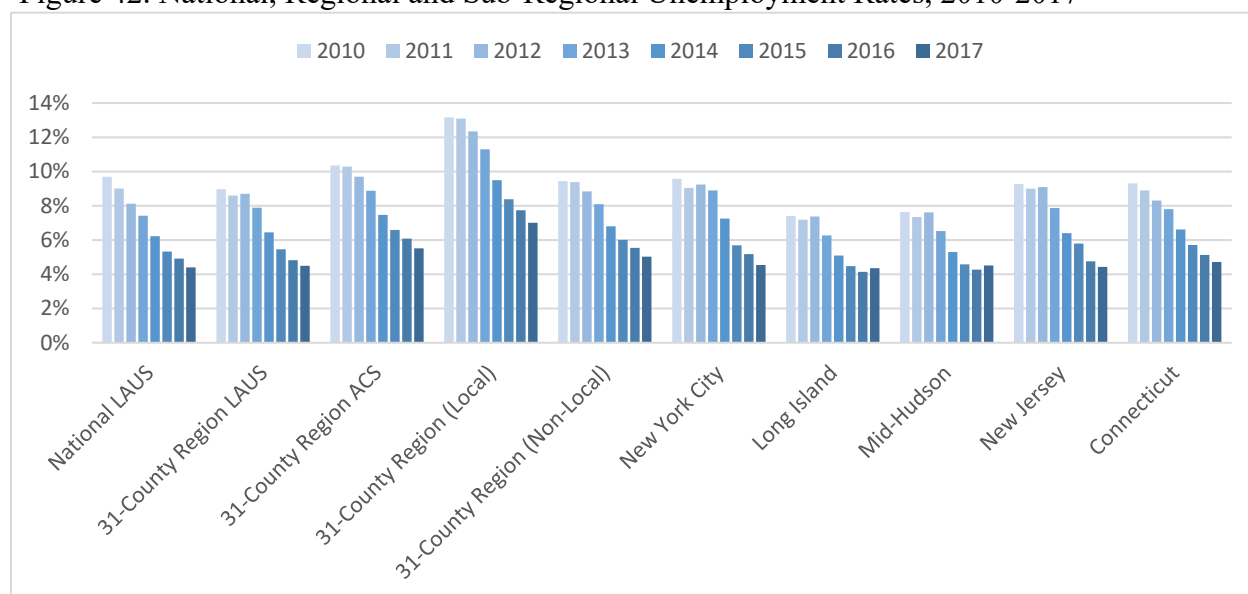


Source: IHS Markit

Regional Unemployment

The figure that follows presents the unemployment rates for the nation and NYMTC's 31-County Region and sub-regions from both Bureau of Labor Statistics and Census sources. There has been a significant decrease in unemployment in every sub-region of study since the 31-County Region exited the recession in 2011. It is notable that unemployment is higher for the local or non-basic industries.

Figure 42. National, Regional and Sub-Regional Unemployment Rates, 2010-2017



Source: Bureau of Labor Statistics Local Area Unemployment Statistics, US Census Bureau ACS

Commutation Trends

The Census Transportation Planning Products (CTPP) County Worker Flows (Figures 43 and 44) show that commuting patterns within the NYMTC 31-County Region and its sub-regions have not changed substantially over the last several years according to 2006-2010 and 2012-2016 5-year sample CTPP data. New York City has drawn an increasing number of workers residing in the surrounding suburban counties as fewer New York City residents commute to those counties for work. The exception is in Long Island where the number of New York City residents working there increased from 1,043,100 to 1,072,500 workers from 2010 to 2016.

In the Mid-Hudson sub-region, the number of workers also living in that area climbed upwards from 791,400 to 802,200 workers (+10,900). The number of workers commuting there from New Jersey increased from 21,800 to 24,900 workers (+3,100). Workers commuting from Connecticut also expanded from 27,900 to 29,400 (+1,600).

Commutation trends in the Connecticut sub-region are characterized by workers generally commuting within their counties of residence with a smaller share commuting to neighboring counties. A small share of Fairfield County workers commute to Manhattan and Westchester. The Connecticut sub-region experienced small gains in workers commuting from the Mid-Hudson (+3,000) and New Jersey (+100) sub-regions but fewer number of workers from New York City (-800) and Long Island (-50).

New Jersey sub-region residents commuting into New York City has increased in recent years as New Jersey residents also working there grew from 2,822,900 to 2,885,300 workers (+62,300), as the number of workers commuting there from other sub-regions declined (-7,000 in NYC, -900 in Mid-Hudson, -100 in Connecticut and -500 in Long Island).

Figure 43. NYMTC Region Commuter Flow Totals, 2006-10 & 2012-16

		Year	Work Region								
			NYMTC Region	NYC Region Sub-Region	Non-NYC Sub-Regions	Long Island Sub-Region	Mid-Hudson Sub-Region	New Jersey Sub-Region	Connecticut Sub-Region	Outside NYMTC Region	Total Primary Jobs by POW
Residence Region	NYMTC Region	2010	10,073,356	4,185,712	5,887,644	1,167,604	912,881	2,955,531	851,628	172,682	10,246,038
		2016	10,528,475	4,517,749	6,010,726	1,202,419	928,019	3,009,396	870,892	179,655	10,708,130
	NYC Sub-Region	2010	3,614,259	3,337,908	276,351	114,162	66,482	84,087	11,620	27,146	3,641,405
		2016	3,872,544	3,601,755	270,789	117,325	65,514	77,140	10,810	26,301	3,898,845
	Non-NYC Sub-Regions	2010	6,459,097	847,804	5,611,293	1,053,442	846,399	2,871,444	840,008	145,536	6,604,633
		2016	6,655,931	915,994	5,739,937	1,085,094	862,505	2,932,256	860,082	153,354	6,809,285
	Long Island Sub-Region	2010	1,335,728	277,931	1,057,797	1,043,110	5,312	7,636	1,739	7,068	1,342,796
		2016	1,377,508	290,150	1,087,358	1,072,530	5,954	7,185	1,689	6,422	1,383,930
	Mid-Hudson Sub-Region	2010	1,042,013	181,953	860,060	4,673	791,358	38,142	25,887	12,106	1,054,119
		2016	1,069,472	196,339	873,133	4,860	802,210	37,214	28,849	11,888	1,081,360
	New Jersey Sub-Region	2010	3,203,429	351,468	2,851,961	4,427	21,838	2,822,930	2,766	63,080	3,266,509
		2016	3,307,804	388,540	2,919,264	6,209	24,901	2,885,260	2,894	67,821	3,375,625
	Connecticut Sub-Region	2010	877,927	36,452	841,475	1,232	27,891	2,736	809,616	63,282	941,209
		2016	901,147	40,965	860,182	1,495	29,440	2,597	826,650	67,223	968,370
	Outside NYMTC Region	2010	311,475	64,647	246,828	10,174	21,259	159,308	56,087	N/A	311,475
		2016	304,665	63,616	241,049	8,526	18,096	155,444	58,983	N/A	304,665
	Total Primary Jobs by POW	2010	10,384,831	4,250,359	6,134,472	1,177,778	934,140	3,114,839	907,715	172,682	10,557,513
		2016	10,833,140	4,581,365	6,251,775	1,210,945	946,115	3,164,840	929,875	179,655	11,012,795

Source: US Census Bureau, CTPP, 2006-2010 & 2012-2016 5-Year Estimates

Figure 44. NYMTC Region Commuter Flow Shares, 2006-10 & 2012-16

		Year	Work Region								Total Primary Jobs by POW
			NYMTC Region	NYC Region	Non-NYC Region	Long Island	Mid-Hudson	New Jersey	Connecticut	Outside NYMTC Region	
Residence Region	NYMTC Region	2010	98.3%	40.9%	57.5%	11.4%	8.9%	28.8%	8.3%	1.7%	100.0%
		2016	98.3%	42.2%	56.1%	11.2%	8.7%	28.1%	8.1%	1.7%	100.0%
	NYC Region	2010	99.3%	91.7%	7.6%	3.1%	1.8%	2.3%	0.3%	0.7%	100.0%
		2016	99.3%	92.4%	6.9%	3.0%	1.7%	2.0%	0.3%	0.7%	100.0%
	Non-NYC Region	2010	97.8%	12.8%	85.0%	16.0%	12.8%	43.5%	12.7%	2.2%	100.0%
		2016	97.7%	13.5%	84.3%	15.9%	12.7%	43.1%	12.6%	2.3%	100.0%
	Long Island	2010	99.5%	20.7%	78.8%	77.7%	0.4%	0.6%	0.1%	0.5%	100.0%
		2016	99.5%	21.0%	78.6%	77.5%	0.4%	0.5%	0.1%	0.5%	100.0%
	Mid-Hudson	2010	98.9%	17.3%	81.6%	0.4%	75.1%	3.6%	2.5%	1.1%	100.0%
		2016	98.9%	18.2%	80.7%	0.4%	74.2%	3.4%	2.7%	1.1%	100.0%
	New Jersey	2010	98.1%	10.8%	87.3%	0.1%	0.7%	86.4%	0.1%	1.9%	100.0%
		2016	98.0%	11.5%	86.5%	0.2%	0.7%	85.5%	0.1%	2.0%	100.0%
	Connecticut	2010	93.3%	3.9%	89.4%	0.1%	3.0%	0.3%	86.0%	6.7%	100.0%
		2016	93.1%	4.2%	88.8%	0.2%	3.0%	0.3%	85.4%	6.9%	100.0%
	Outside NYMTC Region	2010	100.0%	20.8%	79.2%	3.3%	6.8%	51.1%	18.0%	N/A	100.0%
		2016	100.0%	20.9%	79.1%	2.8%	5.9%	51.0%	19.4%	N/A	100.0%
	Total Primary Jobs by POR	2010	98.4%	40.3%	58.1%	11.2%	8.8%	29.5%	8.6%	1.6%	100.0%
		2016	98.4%	41.6%	56.8%	11.0%	8.6%	28.7%	8.4%	1.6%	100.0%

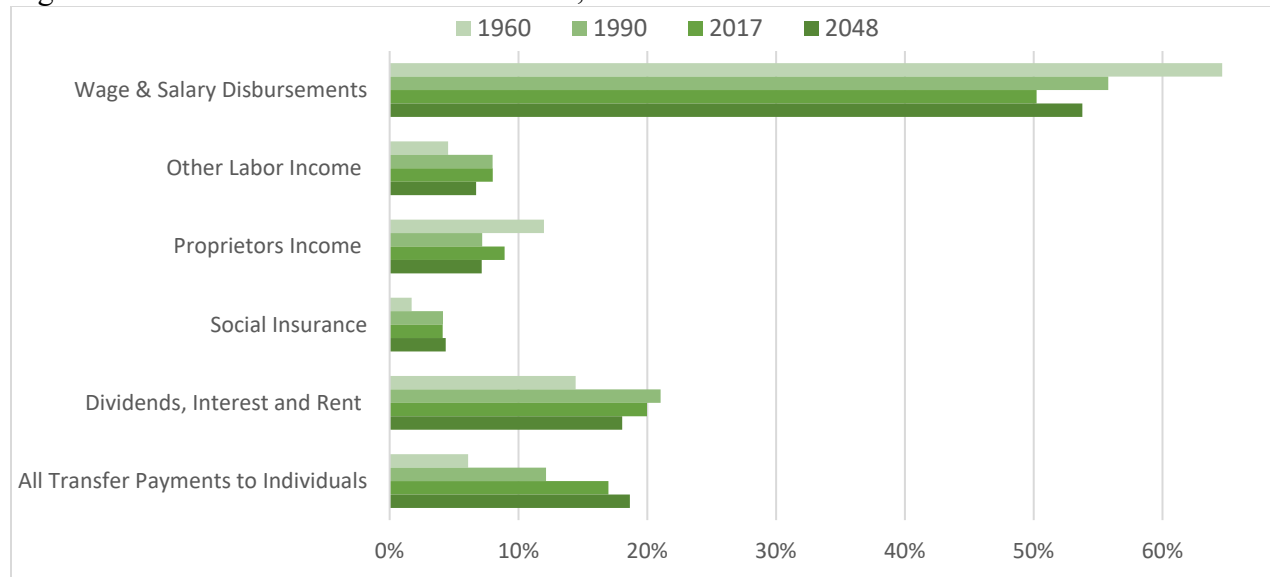
Source: US Census Bureau, CTPP, 2006-2010 & 2012-2016 5-Year Estimate

Income

Personal income in the US has risen every year between 1960 and 2017 with the exception of 2009 during the Great Recession. In this section income growth will be considered in real terms rather than in current dollars. During the 1960s real income and disposable (after tax) income grew at an average annual rate near 5 percent. Since then real disposable income growth have fluctuated in a range between 1.7 percent and 3.6 percent. With lower growth expected for employment and output during the forecast period, average income growth will be between 2 and 3 percent a year from 2017 and 2048.

The changing structure of the economy and population is reflected in the sources of personal income (Figure 45). In 1960, 64.6 percent of personal income came from wages and salaries, 4.5 percent from other labor income or benefits, and 12.0 percent from proprietors' income—that is more than 80 percent of personal income came from work-related income sources and only 6.1 percent came from transfer payments to individuals (primarily social security). By 1990 the proportion of income from work-related sources had fallen to 71.0 percent and transfer payments had risen to 12.1 percent. The trend towards less reliance on work-related sources for income and more from transfers continued into 2017, and is expected to continue until the end of the forecast period. Much of the change has to do with the aging of the population. To some extent it is also the result of the change in industry structure, with its increasing reliance on jobs in services—particularly educational and health services and leisure and hospitality services which tend to have lower wage rates than other sectors.¹⁰

Figure 45. US Personal Income Distribution, 1960 to 2048



Source: IHS Markit

¹⁰ As an example, at the end of 2017, average weekly earnings on private, nonfarm payrolls was \$919. The wage rate for educational and health services was \$877, and that for leisure and hospitality services was \$410. Source: USBLS, Establishment Data, Table B-3a, Average Hourly & Weekly Earnings of all Employees on Private Nonfarm Payrolls by Industry Sector.

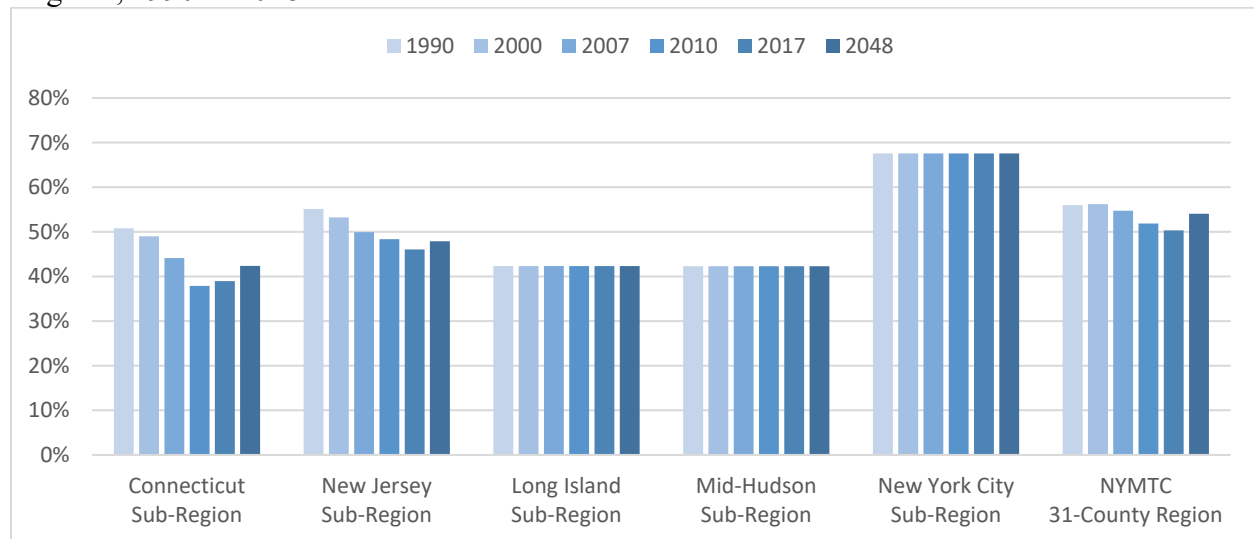
Personal income in the 31-County Region increased at an average annual rate of 4.3 percent between 1990 and 2017. Wages increased 3.9 percent a year and nonwage income a hefty 4.7 percent a year. In 1990 wages accounted for 55.8 percent of personal income; that proportion fell to only 50.2 percent in 2017 as income from proprietor's income, unearned income, and transfer payments grew rapidly. Income growth was similar in the New York counties, although wage growth was slightly faster and nonwage growth slightly slower. The wage portion of income fell in the New York counties from 57.2 percent of the total in 1990 to 54.3 percent in 2017.

Within the 12 New York counties, New York County had the fastest growth in income between 1990 and 2017 at an average rate of 5.0 percent a year—not much of a surprise since it is home to so many in the financial and professional services industries. Queens County had the lowest rate of growth in personal income in the region. In the Connecticut sub-region, personal income growth equaled that of New York County in Fairfield County, but was less than 4 percent a year in New Haven and Litchfield County. In the New Jersey sub-region personal income growth was fastest in Somerset County at 5.3 percent and 5.0 percent in Hudson County.

In the New Jersey sub-region personal income growth averaged 4.2 percent a year, but growth in nonwage income was much faster than income from wages as employment growth was slower than in New York. In New Jersey the wage proportion of income fell from 55.1 percent in 1990 to only 46.1 percent in 2017. Growth in personal income was fastest in Connecticut, but wage income increased only 3.4 percent a year as employment barely rose. Nonwage income grew at an average annual rate of 5.2 percent a year—by far the fastest growth in the Region. Wage income fell from 51 percent of total income in 1990 to only 39 percent in 2017 (Figure 46). The question posed by this decline in wages as a proportion of personal income is “is this a healthy economy if an increasing part of income derives from non-work sources?”

The IHS forecast is for healthier growth in wages in the period from 2017 to 2048 than in the historical period.

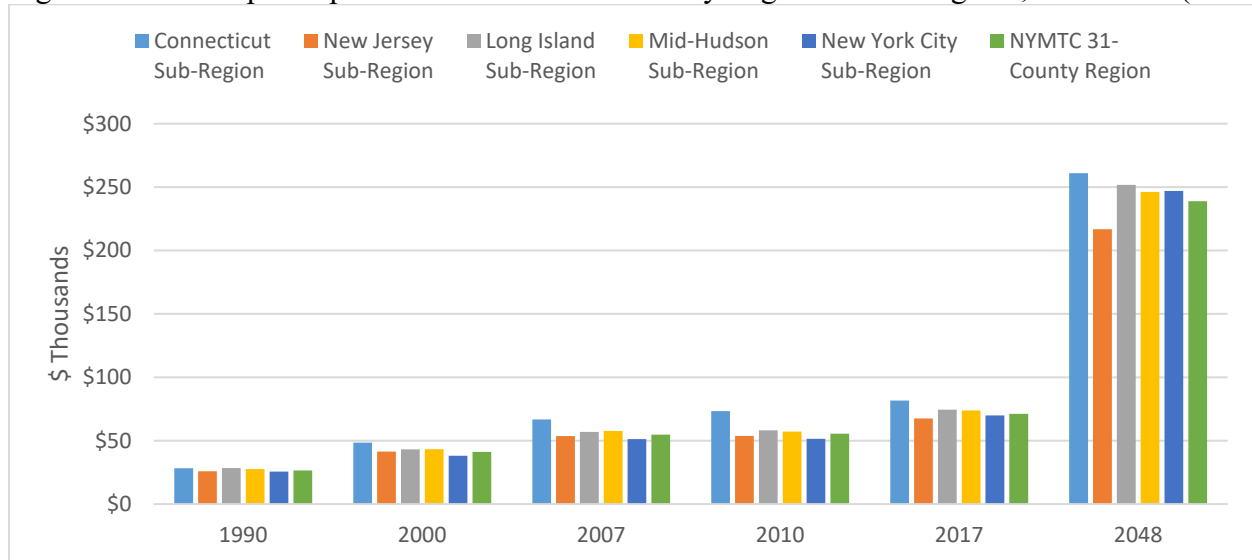
Figure 46. Proportion of Wages in Personal Income in the NYMTC 31-County Region & Sub-Regions, 1990 to 2048



Source: IHS Markit

Income per capita, as shown in Figure 47, was essentially identical throughout the 31-County Region in 1990, just slightly higher in the Connecticut sub-region than in the rest of the 31-County Region. However, between 1990 and 2017 income per capita grew faster in Connecticut than in the rest of the Region, partially because of faster growth in personal income with its dependence on unearned income instead of wages, and partially because of very slow population growth. By 2017, income per capita was 14.8 percent higher than in the 31 counties as a whole. Per capita income grew 3.6 percent a year in both the Long Island and New Jersey counties, 3.8 percent a year in the Mid-Hudson counties and 3.7 percent a year in the New York City counties and 31-County Region as a whole. The IHS forecast implies that in 2048 income per capita will still be higher in Connecticut than in the whole Region—but by only 9.2 percent. New Jersey’s population growth, expected to average 0.2 percent a year for the sub-region, will hold back its per capita income. There is expected to be almost no change in population in the Connecticut and New York counties.

Figure 47. Income per Capita in the NYMTC 31-County Region & Sub-Regions, 1990-2048 (2018\$)

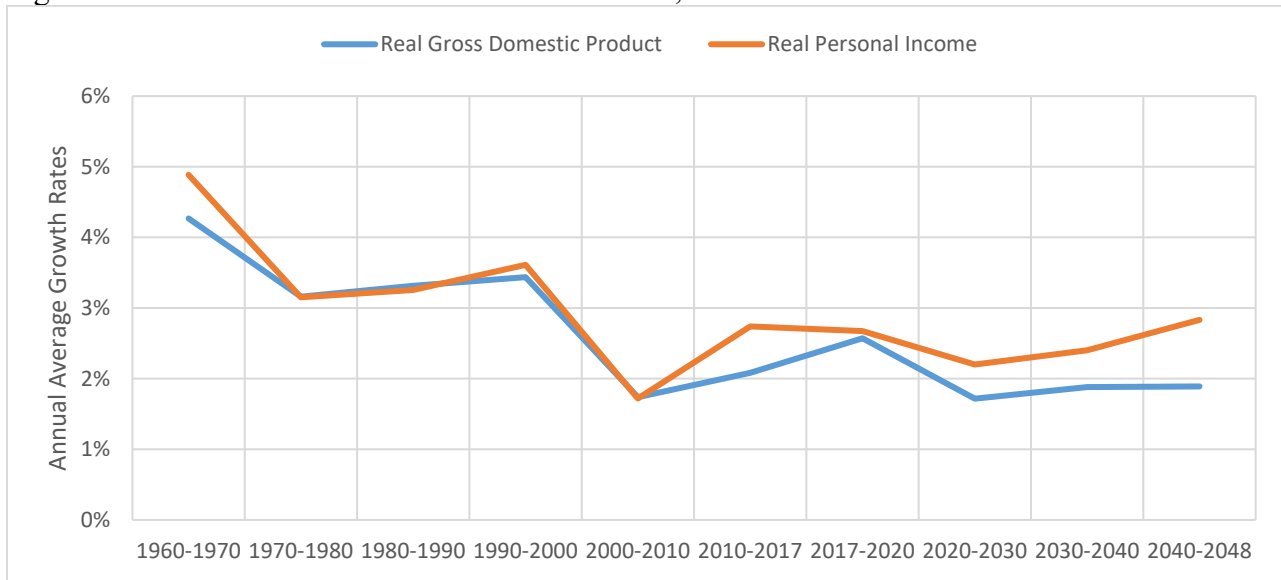


Source: IHS Markit

Gross Domestic Product and Productivity

Real gross domestic product in the US rose rapidly in the 1960s, 1970s, 1980s and 1990s with annual increases well above 3 percent in most years and strong recoveries after the recessions of the mid-1970s and early 1980s. The Great Recession of 2008 and 2009 was a different story. Recovery was slow and weak and Gross Domestic Product (GDP) did not regain its 2007 peak until 2011. During the last few years annual GDP growth has not reached as high as 3 percent, nor is it expected to in the next several years. In the period from 2017 to 2048 growth in real GDP is expected to average 1.9 percent a year, keeping it below the expected growth in real personal income (Figure 48). During this period the proportion of the economy devoted to personal consumption spending and investment will increase while both net exports and the government sectors will lose some of their importance to the economy.

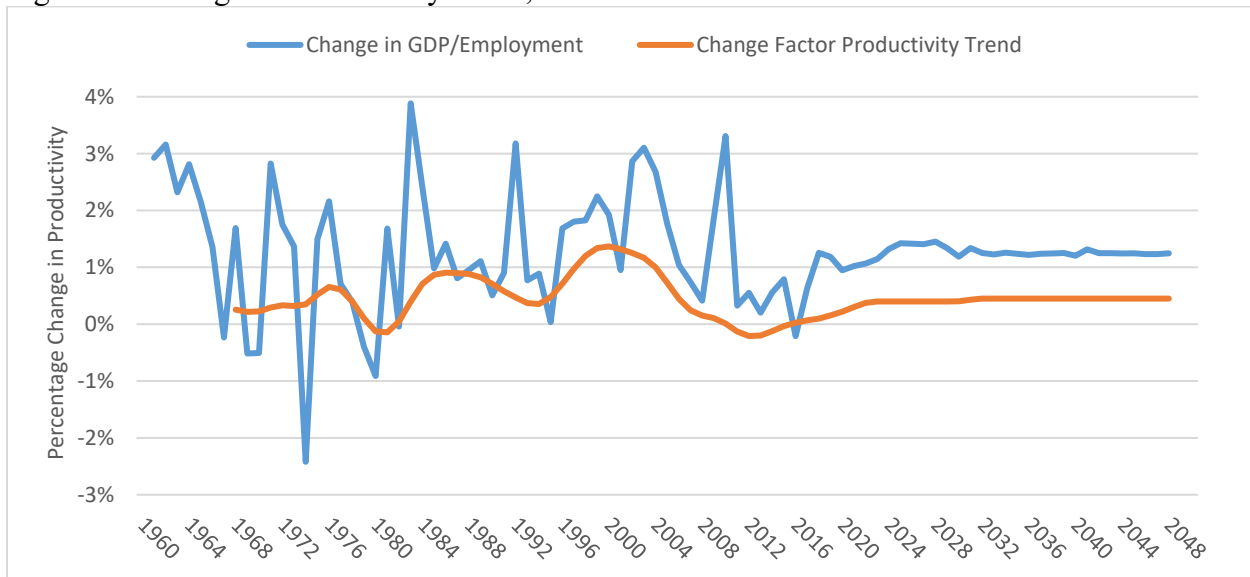
Figure 48. Growth in US GDP and Personal Income, 1960 to 2048



Source: IHS Markit

Among reasons for the slow growth in GDP in the 2000s and 2010s may be a drop in overall productivity in the economy. IHS provides a measure of productivity: an index called total factor productivity trend. Another possible, though simple, measure of productivity is the ratio of real GDP to employment. The year to year changes in both of the measures (Figure 49) show that productivity tends to trend down during recessions and trend up during recoveries and expansions. The factor productivity measure shows a clear decrease in growth in productivity between 2000 and 2015. Beginning in the early to mid-2020s productivity change flattens out at a relatively low rate using the GDP to employment measure and at an average rate for the factor productivity measure.

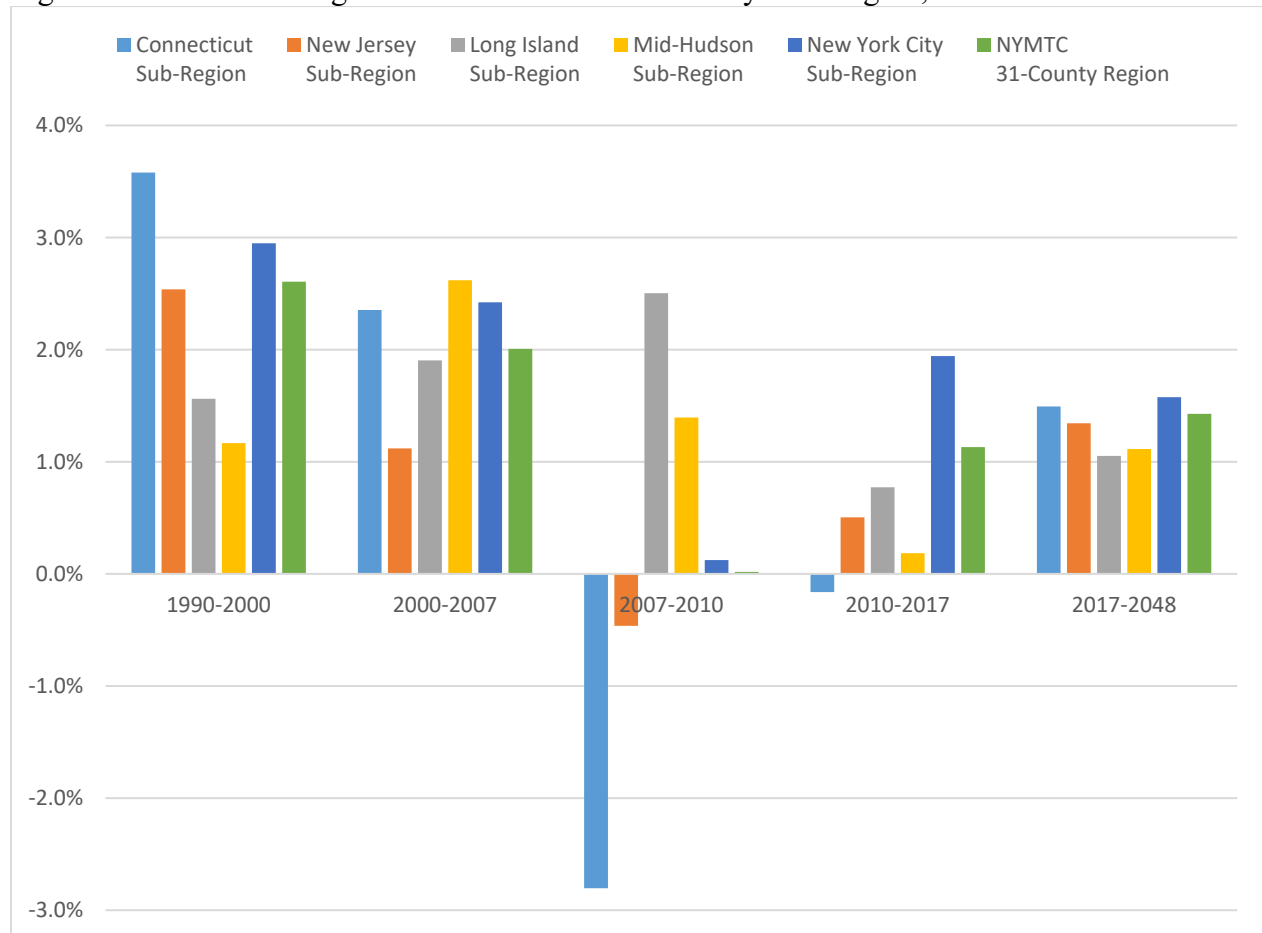
Figure 49. Change in Productivity in US, 1960 to 2048



Source: IHS Markit

Growth in real gross regional product averaged 2.6 percent per year in the decade of the 1990s, led by very strong growth in the Connecticut sub-region (Figure 50). It fell to 2 percent a year in the lead up to the Great Recession, held back by weakness in the New Jersey sub-region. As the country and the region fell into the recession and then began to recover there were on-going losses in the Connecticut sub-region through 2017 and in the New Jersey sub-region through 2011. The New York counties recovered quickly and came out of the recession in 2010. The IHS forecast is for GDP growth in all the regions in the neighborhood of 1.4 percent a year from 2017 to 2048.

Figure 50. Annual Average Growth Rates of Real GDP by Sub-Region, 1990 to 2048



Source: IHS Markit

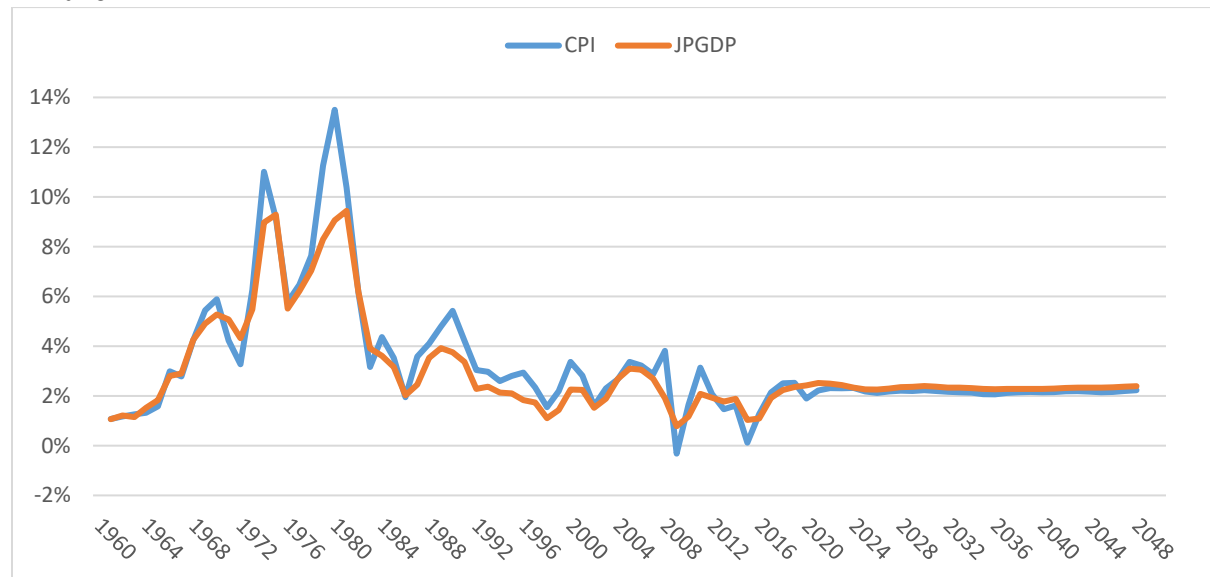
In the 1990 to 2017 period, Fairfield County led the Connecticut sub-region in output growth; Somerset, Ocean and Sussex counties were growth leaders in the New Jersey sub-region with growth of at least 2 percent a year; in New York real output in all the counties in New York City grew at least 2 percent a year, as did Orange County in the Mid-Hudson and Suffolk County in Long Island. In New Jersey only Passaic, Union, and Warren counties had output growth of less than 1 percent a year, as did Litchfield County in Connecticut, and Dutchess, Sullivan, and Ulster counties in New York. Thus in the New Jersey sub-region the slow growth was primarily in old heavily industrial counties, whereas in the Connecticut sub-region and New York sub-regions the slower growth was in the more rural counties. In New Jersey, in the forecast period, Somerset,

Hudson, Middlesex, Mercer, Morris, and Ocean counties are all expected to grow faster than average, while only Passaic and Sussex counties may grow less than 1 percent a year. In Connecticut only Fairfield County is expected to grow faster than the regional average and in New York, only New York County is expected to outperform the 12-county New York NYMTC region in terms of output growth.

Inflation Rates (CPI and GDP chained price index)

The extreme changes in the rate of inflation in the US that were experienced in the 1970s and early 1980s were to a large extent the result of the dependence on oil and fossil fuels for both industrial and residential purposes, a reduction in US production, and the OPEC oil embargo for several months beginning in late 1973. By the 1980s the US was beginning to use alternative fuels and finding new oil fields outside of OPEC. For both of those reasons the economy reacted less strongly to changes in oil prices, and inflation rates reacted more to cyclical changes in the economy. This can be seen particularly in the period of the Great Recession when demand was so weak that the CPI actually declined. Between 1990 and 2007 the change in the CPI averaged 2.8 percent a year. Since then the inflation rate has averaged only 1.7 percent a year. As Figure 51 shows, consumer prices and the GDP index of inflation tend to move in tandem, with mostly smaller variations in the GDP index which covers a much larger range of transactions. In the forecast period, from 2017 to 2048, both indices are expected to increase in a range near 2.2 to 2.3 percent a year.

Figure 51. US Inflation for the Consumer Price Index and the Chained Price Index for GDP, 1960 to 2048



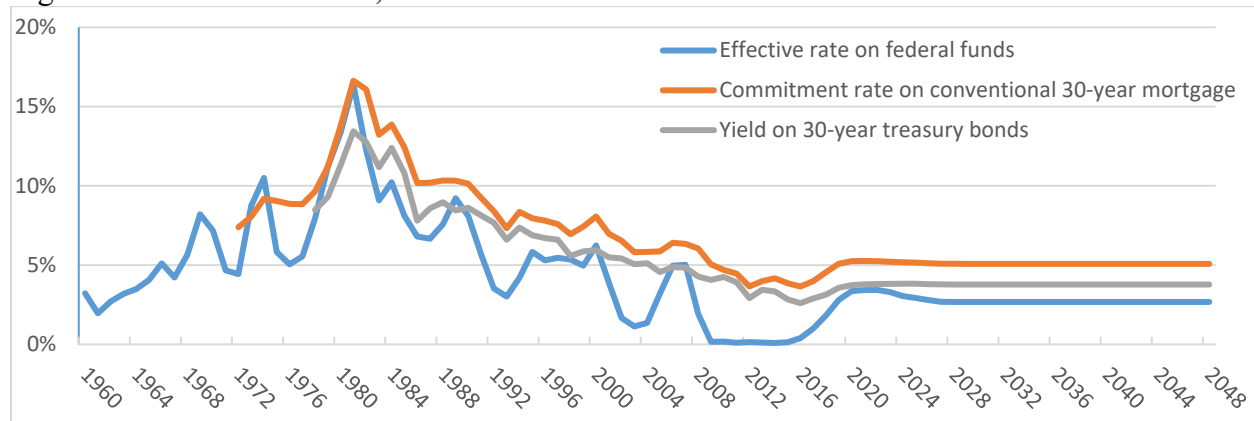
Source: IHS Markit

Interest Rates, Monetary and Fiscal Policy

Interest rates in the US were pushed to very high levels in the 1970s and 1980s by the Federal Reserve in order to try to constrain inflation (Figure 52). After 1990 the Federal Funds rate, an indicator of the policy of the Federal Reserve's Open Market Committee, moved down from 8.1 percent to an average of 5 percent during the remainder of the decade. The rate was kept at close to 0 percent in the period after the financial crisis of 2007-2009 as a way to encourage lending to resume. It rose from 0.1 percent in 2001 to 1.8 percent in 2018. The indication from the Fed in early 2019 is that further immediate increases are less likely now than they were when the IHS forecast was completed. Thus the rather steep rise in rates in 2019 to 2022 shown in the forecast may be slower and lower. In any case the Federal Funds rates in this long term trend forecast will be fixed at 2.7 percent between 2027 and 2048.

In general, long term rates are higher than short term rates. During the highly inflationary period of the late 1970s and early 1980s the yield curve was inverted when short term rates were considerably higher. In the rest of the historical period the longer term rates (exemplified here by the 30-year Treasury bond rate and the 30-year mortgage rate) followed short term rates down. In the forecast period they will rise through 2021 and then stabilize.

Figure 52. US Interest Rates, 1960 to 2048



Source: IHS Markit

Fiscal policy in the forecast period includes the Tax Cuts and Jobs Act of 2017. Thus the forecast lowers the corporate tax rate from 35 percent to 21 percent and cuts the effective tax rate on personal income by close to 6 percent for FY2018.¹¹ However, after a couple of small further declines and increases the effective personal income tax rate will hover near 19 percent from 2027 on. On a unified budget basis, the federal deficit—which declined from 2010-2016—began to increase again in FY 2017. The increase in the deficit in FY 2018 is attributable to the decline in corporate tax collections resulting from the 2017 Tax Act. Corporate tax revenues will not return to the 2016 level till the mid-2030s and the deficit will rise through the full forecast period.

¹¹ The IHS model uses effective rates rather than marginal rates for modeling and forecasting tax revenues.

Emerging Issues

Transit and Transportation

Transit-ridership continued to drop, car ownership climbed and transportation network companies poached more rides.

Transit

Transit difficulties in New York City, but also in Los Angeles and Boston have affected ridership levels as well. According to the New York City Department of Transportation's Mobility Report 2018, although higher than 2010 levels by 9.5 percent, subway ridership was down in 2016; whereas bus ridership has declined every year since 2010. In contrast, the number of daily cycling trips continues to grow, with 10,000 additional daily trips between 2015 and 2016, leading to an 84 percent increase from 2010 totals and after dipping in 2013 and 2014, ferry ridership increased by 14,000 trips a day from 2015, and has increased by 12 percent since 2010.

Ridesharing

Use of ridesharing services has increased over time and has expanded into more markets and has taken a greater share of commuter trips in spite of regulatory concerns. According to a Pew Research study conducted in 2018, 36 percent of U.S. adults say they have used a ride-hailing service such as Uber or Lyft, up from 15 percent in 2015. Usage is more common among young adults 18-29 (51%), those with household incomes of \$75,000 or more (53%) and those with college degrees (55%) (Jiang, 2019). Today, Uber operates in 83 countries and 674 cities worldwide while Lyft operates within 45 states in over 400 cities within the United States.

Figure 53. Pew Research Center Ride-Hailing Survey Results, 2018

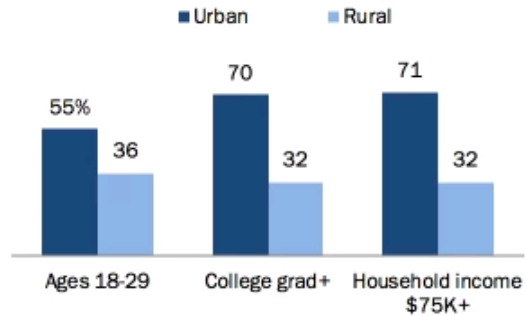
Ride-hailing has become more common across most demographic groups

% of U.S. adults who say they have ever used ride-hailing services like Uber or Lyft

	2015	2018	Difference
U.S. adults	15	36	+21
18-29	28	51	+23
30-49	19	43	+24
50+	7	24	+17
HS or less	6	20	+14
Some college	15	36	+21
College grad+	29	55	+26
Less than \$30K	10	24	+14
\$30K-\$74,999	13	35	+22
\$75K or more	26	53	+27

Wide urban-rural gaps in ride-hailing among younger, more affluent adults

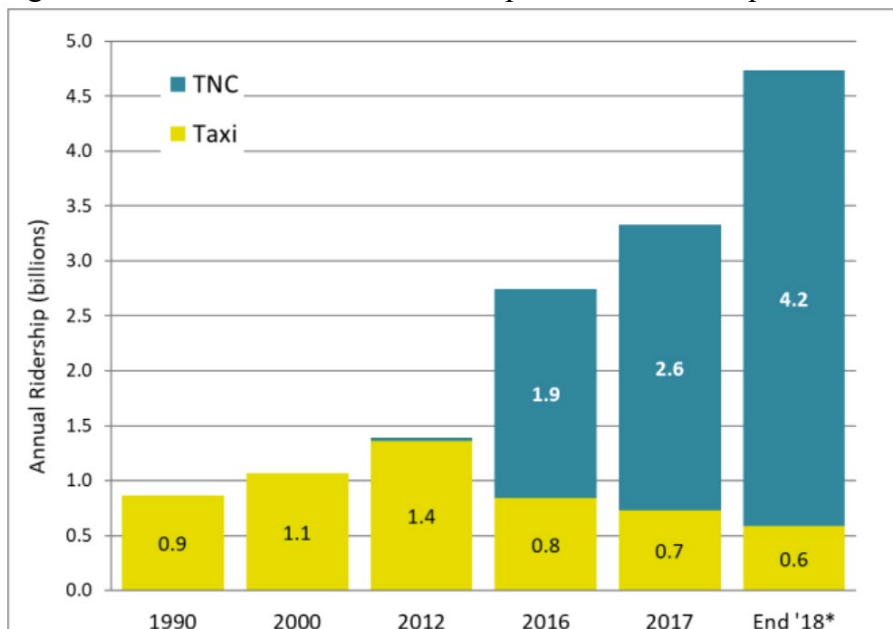
% of U.S. adults in each category who say they have ever used ride-hailing services like Uber or Lyft



Source: Pew Research Center. More Americans are using ride-hailing apps

Urban users (19%) are more likely to use these services weekly than suburban (6%) or rural users (5%) and users ages 18 to 49 are somewhat more likely than those 50 and older to report weekly usage (12% vs. 7%).

Figure 54. Rideshare and Taxi Ridership, Annual Ridership in Billions



Source: Schaller, Bruce. The New Automobility: Lyft, Uber and the Future of American Cities

The implications of rideshare on traffic and transit was thoroughly discussed in Bruce Schaller's report: *The New Automobility: Lyft, Uber and the Future of American Cities*. Much of this section is drawn from his work. Rideshare trips account for 90 percent of rideshare/taxi trips in eight of

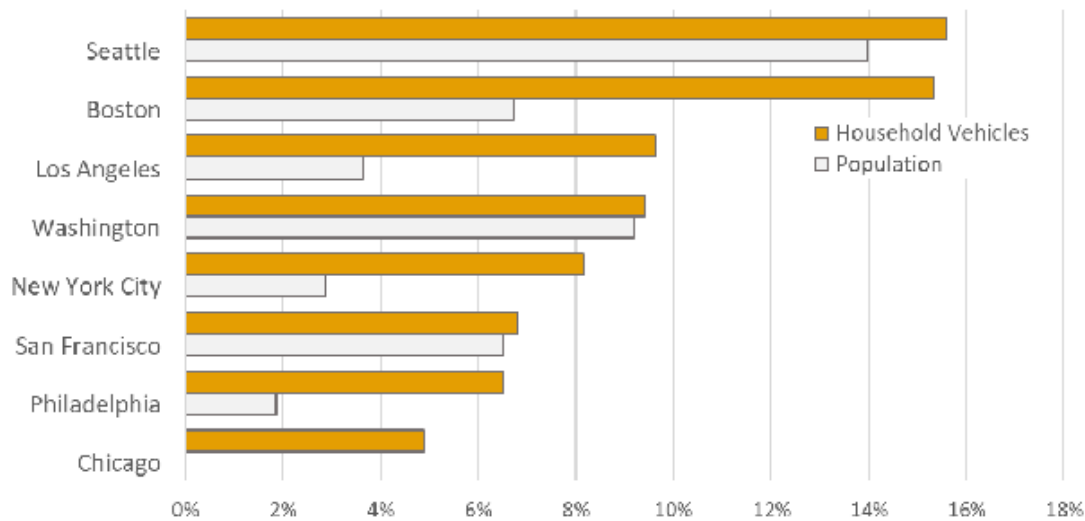
the nine large, densely-populated metro areas (New York is the exception) and in other census tracts with urban population densities. However, rideshare trips account for only 13 percent of trips taken by those without a smartphone.

Rideshare is actually increasing vehicle miles traveled on urban streets:

- About 60 percent of Transportation Network Company (TNC) users in large, dense cities would have taken public transportation, walked, biked or not made the trip if TNCs had not been available for the trip.
- Private ride services (UberX, Lyft) put 2.8 new vehicle miles on the road for each mile of personal driving removed, for an overall 180 percent increase in driving on city streets.
 - Inclusion of shared services (UberPOOL, Lyft Line) results in marginally lower mileage increases – 2.6 new TNC miles for each mile in personal autos taken off the road. (This is based on the current rate of about 20 percent of these trips being shared.)

In New York City alone, ridesharing services added 976 million miles of driving to city streets from 2013 to 2017. Rideshare is not expected to have a negative impact on the auto industry for either new or used cars (Hughes, 2017). Household vehicle ownership has actually increased in cities where Uber and Lyft are most heavily used since 2012 (the year the companies started offering affordable everyday ride services like UberX). Further, the vehicle growth rate has exceeded population growth in five of the eight cities (Boston, Los Angeles, New York, Philadelphia and Chicago). This reverses the trend from mid-2000 to 2012 in which transit ridership increased while car ownership grew slowly, if at all (Schaller, 2019).

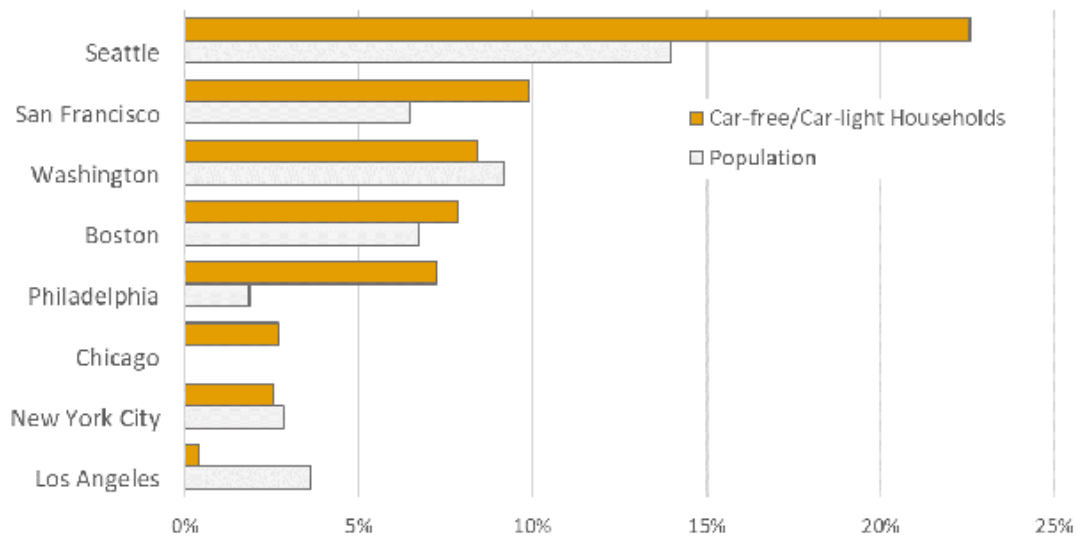
Figure 55. Change in Household Vehicle Ownership and Population, 2012-2017



Source: Schaller, Bruce. The New Automobility: Lyft, Uber and the Future of American Cities

Paradoxically, at the same time, more urban households also have zero or relatively few cars. These households are often referred to as “car-free” (no cars available to the household) or “car-light,” e.g., a working couple that owns one vehicle.

Figure 56. Change in Car-Free and Car-Light Households and Population, 2012-2017



Source: Schaller, Bruce. The New Automobility: Lyft, Uber and the Future of American Cities

One of the forces behind increased ride-hailing is transit difficulties in cities like New York and Washington, D.C. Ride-hailing also becomes a habit as one comes to expect on-demand transportation. To reverse the rise of for-hire and personal auto use in major American cities, it is believed that cities need to continue to expand space-efficient and active transportation options.

Expansion of Freight Industry

The US Bureau of Labor Statistics (BLS) Current Population Statistics program reports that there are more than 1.7 million tractor-trailer driving jobs in the United States. A recent study by National Public Radio found that truck drivers were the most dominant job in 29 U.S. states, including California and Texas. The industry is expected to continue to grow as shown in the following table.

Figure 57. Trucking Freight Volume Growth

For 2017	2.8%
Per Annum 2018-2023	3.4%
Per Annum 2024-2028	2.3%
Total growth, today-2028	36.6%

Source: RTS Financial, Why Trucking is Still America's Number One Job, 2019

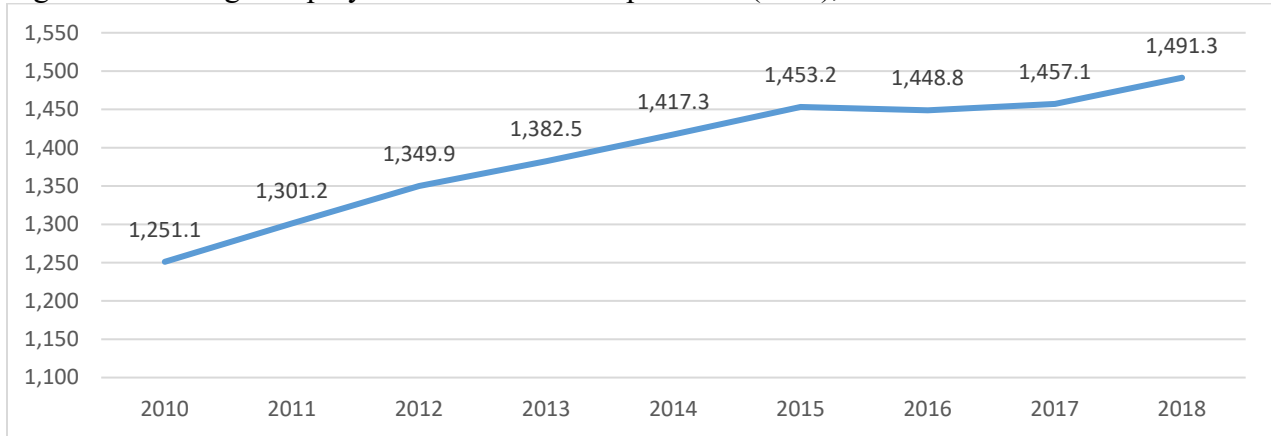
At a time when many American blue-collar jobs have been in decline, the number of truck driving jobs has grown. That is because trucking has been immune to two of the biggest forces affecting the U.S. workforce today—automation and offshoring (RTS Financial).

Trucking remains a solid, middle-class living, but there is concern about the industry's wage growth and ability to recruit younger workers. According to the National Transportation Institute, driver compensation has risen only 6.3 percent over the past five years. By comparison, the

minimum wage has increased 45.2 percent over the same period of time. Possibly reflecting limited wage increases, a number of industry sources report a shortage of drivers.

National employment in the trucking industry has grown steadily since 2010 (Figure 58). According to the US Department of Transportation’s *Beyond Traffic 2045* report, by 2045, freight volume (truck and rail freight movements) will increase by more than 40 percent in the next 30 years. Subsequently, by 2040, 30,000 miles of our business highways will be clogged on a daily basis.

Figure 58. Average Employment in Truck Transportation (000s), 2010 to 2018



Source: Bureau of Labor Statistics, Current Employment Statistics, 2010-2018

Sea Level Rise and Climate Change

Climate change and a lack of safe and affordable housing are two of the most pressing emergencies in contemporary times. In 2019, climate change action and questions about the effectiveness of future climate change action, must be measured in urban growth boundaries, flood insurance maps and reduced Vehicle Miles Traveled (VMT).

Land Use Trends

Building for People - Cars no longer drive urban planning – people do and they want human-oriented design. “Place-making,” once the watchword of every urban designer, is no longer enough. Now it is all about experience—how buildings and the spaces between them are treated in relation to human-scale design. Developers are rediscovering the importance of leveraging authenticity and contextualism—“franchise architecture” and cookie-cutter designs are out. Experience has real dollar value—from adjacency to open space to unique developments as destinations. Experience brings customers back again and again—not just for the retail offerings, but also for the sense of belonging and ownership.

Corporate Headquarters Relocations

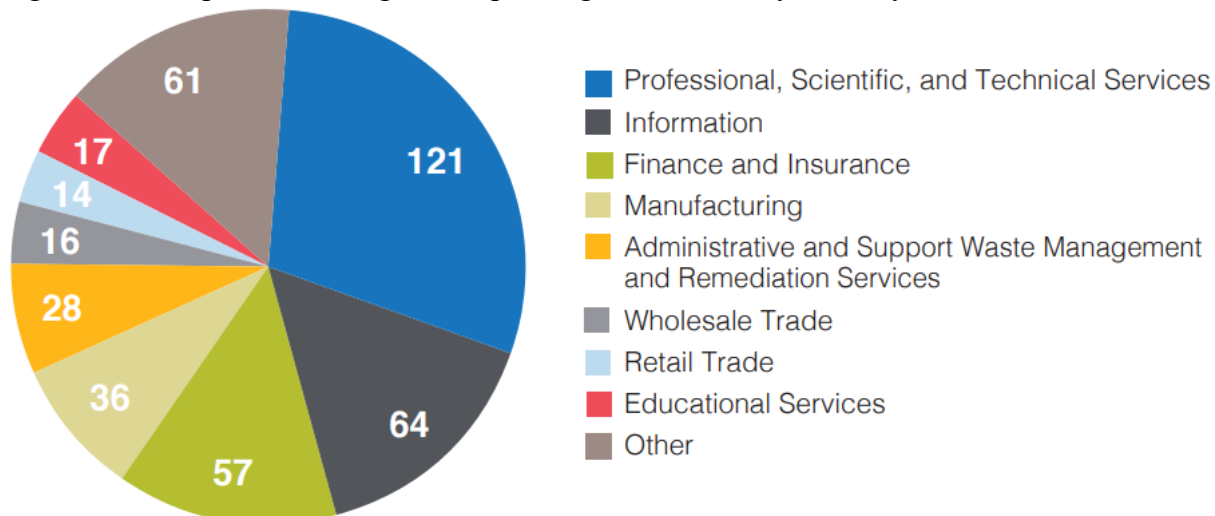
Downtowns

Headquarters are moving to downtowns of central cities, as witnessed by the secondary headquarters search of Amazon, as well as many significant office relocations from suburbs to centers in pursuit of millennial workers who generally choose lifestyle over workplace (Williams, 2017). “We’re seeing a profound change in workforce values,” says Scott Homa, Senior Vice President and Director of U.S. Office Research at JLL. “Millennials don’t share the old mentality that self-worth can be defined by the kind of car you drive or the size of your office. Today’s workers want to feel connected to work, without sacrificing personal time, so they’re gravitating to dense, vibrant and walkable communities where they can ditch the time-sucking commute and live more sustainable, sociable and efficient lives.”

Examples of these moves include General Electric relocating its headquarters from the suburbs of Connecticut to Boston; Marriot International to Downtown Bethesda, MD; McDonalds to downtown Chicago; HomeAdvisors from Golden, Colorado to Denver’s River North Arts District; Expedia to Seattle; Coca Cola from its suburban office to Atlanta; and Pinterest from Palo Alto to San Francisco.

Core Values: Why American Companies are Moving Downtown, a collaboration between Smart Growth American and Cushman & Wakefield, examines the characteristics, motives and preferences of companies that have either relocated, opened new offices, or expanded in walkable downtowns between 2010 and 2015. The study, which included 500 relocating companies, revealed an enormous diversity of businesses choosing to locate downtown as shown in the graphic that follows.

Figure 59. Companies Moving and Expanding Downtown, by Industry

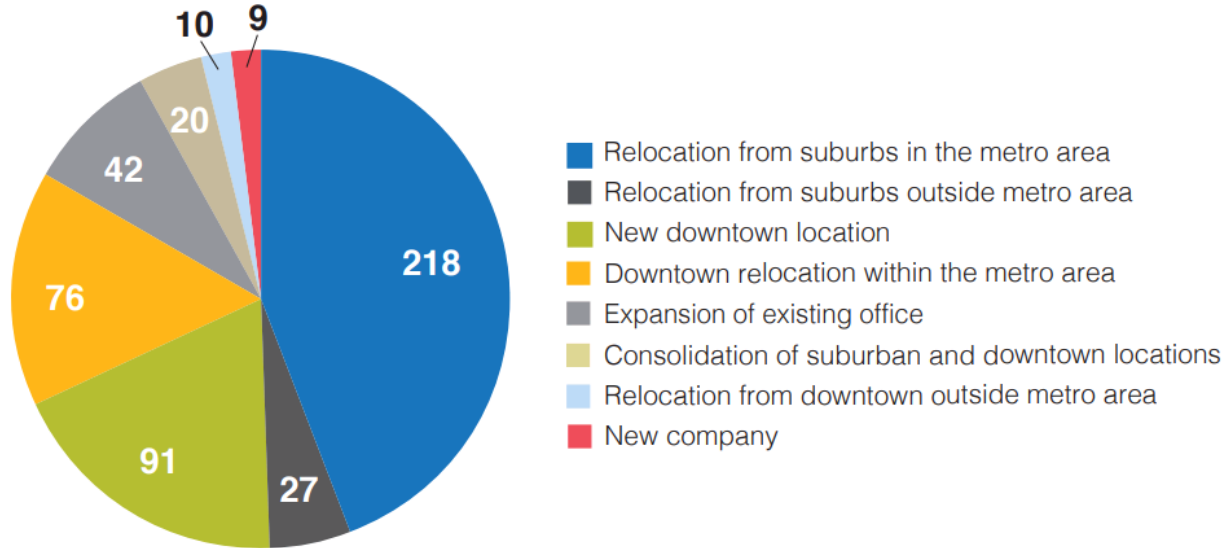


Note: Industries with less than 10 instances within the sample have been categorized as “other.”

Source: Core Values: Why American Companies are Moving Downtown

Almost half of the firms relocated from a suburban location (either within the metro area or from a different region) while one third either opened a new downtown location or branch or relocated within downtown. The others either expanded existing downtown office space, consolidated a suburban and downtown location, moved from a different downtown, or were brand new companies.

Figure 60. Relocations, Expansions and New Office Creation



Source: Core Values: Why American Companies are Moving Downtown

Motivations for these companies' moves were:

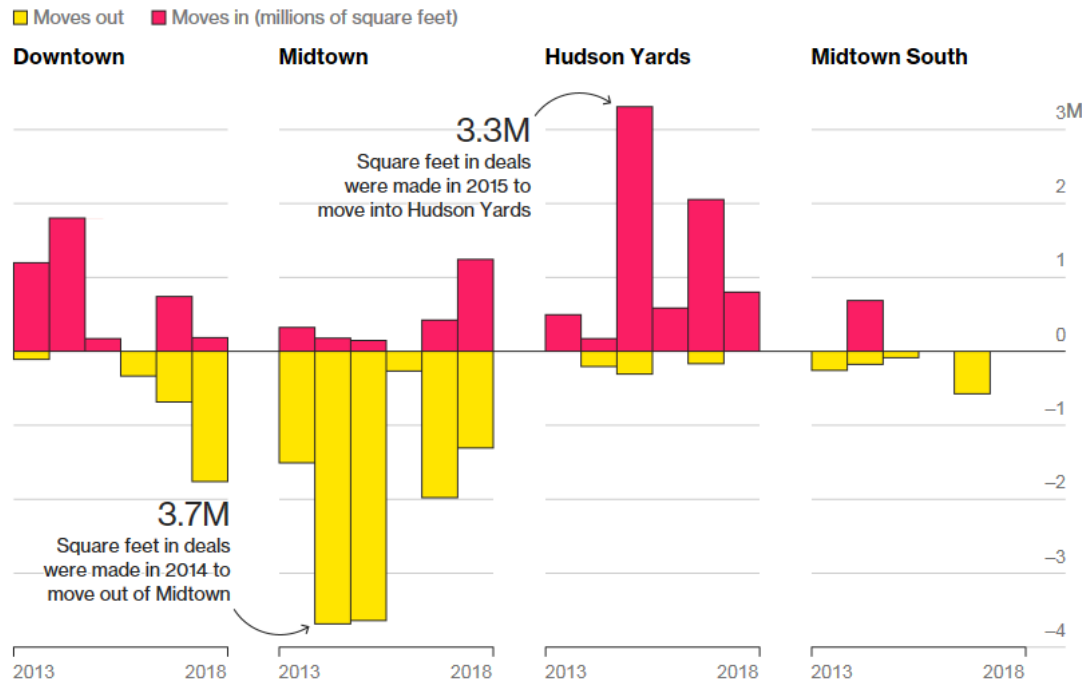
- To attract and retain talented workers by meeting well-documented millennial desires for walkable, urban live/work/play neighborhoods,
- To build brand identity and company culture,
- To support creative collaboration through use of open office space to allow and encourage interaction among employees,
- To be closer to customers and business partners, as well as allow easier travel from the central office to off-site meetings locally and in other cities,
- To centralize operations,
- To support triple-bottom line business outcomes, and
- To more deeply utilize resources from municipalities to support expansion including financial incentives, permitting assistance, business incubation services.

The impacts of these relocations are an increasing challenge for suburban areas--jobs leaving and poverty rates expanding, suburbs are increasingly facing the issue of job flight that in the past challenged cities. In order to compete with cities, suburban areas will have to redevelop in order to reflect the demand for more flexible workspaces as well as the desire for density and walkability.

New York City

There have also been shifts within New York City as exemplified with new development centered not only in areas of Manhattan but in Downtown Brooklyn, Long Island City, among others as well. Figure 61 illustrates one such shift as Hudson Yards opens and offices move north from Wall Street.

Figure 61. Companies Planning to Leave Midtown for Hudson Yards



Source: Savills Studley Inc.

There has been 7.4 million total square feet of relocations into Hudson Yards, the largest industry by percentage of which is financial services. In the same period, there have been 4.1 million square feet of relocations into Downtown—a net loss of 3.3 million square feet. In the same period, a net 10 million square feet of occupancies have either moved or are planning to move from Midtown Manhattan, which is the nation's costliest business district, according to real estate brokerage Savills Studley.

Reinventing Office Parks

In light of the relocations described in the previous section as well as work densification and the decline in the workforce required for clerical services and data processing, given new technologies, some municipalities are seeing opportunities in vacant suburban office spaces.

Some major office parks originally built as business headquarters are being remodeled to accommodate multiple tenants. This may include coworking spaces to draw area workers into office buildings who seek to avoid long commutes but desire an active business community.

For some this means reimagining the buildings with amenities. According to real estate brokerage Jones Lang Lasalle, some property owners have sought to reconstruct the character of single-use

office parks to support a mixed-use live-work-play environment by rezoning properties to support a mix of uses including convenience retail, restaurants and recreational activities. Efforts to attract younger workers also include changes to mobility in the form of improvements to sidewalks, bike lanes and revamped street grids to better support pedestrian uses as well as programming of film and/or musical events.

In other locations, properties are being considered as a low-cost option to expand housing, in particular, affordable housing, though that has proven to be somewhat controversial. Some New Jersey municipalities have attempted to convert vacant office parks into residences in response to a longstanding court order to expand affordable housing. But while the costs might be lower than building from scratch, the efforts in some cases have provoked a backlash (Corasaniti, 2018).

There can be multiple difficulties to conversion according to Ralph Zucker, the CEO of Somerset Development, redeveloper of the Bell Labs as Bell Works in Holmdel, New Jersey. “Not every office park has the right bones, but it can work.” Having the proper infrastructure and zoning is key to the success of these sites, according to Zucker. And many suburban office parks suffer from “bad politics, bad zoning, bad location and bad design,” a confluence of factors that is hard to recover from (Murdocco, 2016).

While conversion is not easy, there are numerous examples of proposed and completed conversion in the region:

- IBM offices (Fishkill, NY): In one of the two 700-acre former IBM campuses, Dan Fraioli, president and owner of Air Structures American Technologies, completed in 2018 one of the largest indoor sports domes in North America. The 30 acre site has climate-controlled indoor turf fields for baseball, field hockey, lacrosse and soccer. Status: Completed in 2018.
- 104 Corporate Park Drive (Harrison, NY): Conversion by Simone Development of 118K SF office building once used by Malcolm Pirnie to a four-level modern health care center that will be leased by Montefiore. Plans include: urgent care space; lab facilities; an imaging suite with MRI, CT, radiology and other technology; behavioral health offices; maternal fetal medicine; sports medicine; and a children’s evaluation and rehabilitation center. Negotiations are underway for a cancer care center on the first floor. Status: Expected to be approved in 2019.
- Hitachi building (Tarrytown, NY): Conversion of 51K SF former US headquarters of Hitachi, a Japanese tool manufacturer at 50 Prospect Ave to medical uses by Simone Development. Status: Expected to be approved in 2019.
- 900 King Street (Rye Brook, NY): 215K SF office campus formerly used by IBM to be demolished and replaced with 445K SF senior living facility including 160 independent living units, 85 assisted living units and 24 townhomes. Status: *Not yet approved*.
- Chappaqua Crossing (Chappaqua, NY): The Chappaqua Crossing development will transform the former Reader's Digest property into a mixed-use development featuring a Whole Foods Market, a LifeTime fitness center and more than 500,000 square feet of rental office space, along with 91 luxury townhomes and 28 units of affordable housing.
- New York Center for Innovation (Pearl River, NY): IRG aims to redevelop the 200 acre former Pfizer complex into a mixed-use, multi-tenant campus that offers collaborative meeting spaces along with dining, shopping and entertainment options, complementing

existing lab and office buildings. Status: The mixed-use components of the project have not moved forward while major pharmaceutical and biotechnology firms have signed large leases.

- Carraway (Harrison, NY): Normandy Real Estate Partners, in partnership with home builder Toll Brothers, is currently building a 421-unit rental apartment complex and indoor parking garages on its property at 103-105 Corporate Park Drive, razing two dated and underused office buildings on the 10.35 acre site. Status: Under construction.
- Former headquarters and printing plant of the Journal News (Harrison, NY): Offices razed for the development of a 109K SF Life Time Fitness club on 24 acres. Status: Under construction.
- 500 Westchester Ave (Harrison, NY): In 2014, Memorial Sloan Kettering Cancer Center converted a former Verizon research building into an outpatient center. Status: Completed.
- The Flats (White Plains, NY): "The Flats" is a plan to build 303 apartments on a vacant 20-acre portion of the 74-acre office park at 1133 Westchester Ave. The proposal calls for one-, two- and three-bedroom rental units to be divided among three five-story buildings, overlooking the nearby Maple Moor Golf Course. In 2017, the Hospital for Special Surgery opened a \$20 million, 50,000-square-foot regional center at the same former office park.
- Wegmans Westchester County (Harrison, NY): Three office buildings containing 250K SF were demolished were replaced with a 125K SF Wegmans grocery store. Status: Completed.
- 3 Westchester Park Drive (Harrison, NY): Plans to build a 450-unit, two-building apartment complex have been proposed for the 10 acre 160K SF office campus site.
- iPark City (East Fishkill, NY): \$300 million mixed-use redevelopment project of the former IBM Fishkill Campus by the real estate development group National Resources. The project will convert 300 acres of land with 2 million square feet of buildings and add residential, retail and hotel options. Globalfoundries, with its 2,500 local employees, will retain 160 acres and lease several buildings from National Resources.
- Bell Works, former campus of Bell Laboratories (Holmdel, NJ): Vacated in 2006 and being redeveloped by Somerset Development into a 2M SF mixed-use development on the 150-acre property will include 1.2M SF office space, 60K SF retail and restaurants, 60K SF of conference facilities, storage and amenities including arts and culture space and 380 multi-family units and 170 townhomes on the surrounding property. The developer recently announced 40,000 square feet of leases, including tenants Acacia Communications, Nvidia Corp. and McCann Systems (Marsh, 2016). Status: Complex opened in 2013.
- Pearson Education Building (Upper Saddle River, NJ): 475K SF office building and 48-acre site formerly used by Pearson Education was demolished by Mack-Cali and being redeveloped for mostly residential uses by Toll Brothers with plans for 186 townhomes and 22 affordable units. The proposal includes a 3,450 square-foot clubhouse, outdoor pool and 24 parking spaces for residents. The Borough of Upper Saddle River paid Mack-Cali \$2 million for 9 acres of the property for the development of a potential municipal town hall and office building, library or park.
- Continental Plaza (Hackensack, NJ): Three existing office towers and a restaurant totaling 650K SF are proposed to be converted into a mixed-use development including residential units, retail space, a hotel and public open space.
- Sony Electronics corporate campus (Park Ridge and Montvale, NJ): The Town of Park Ridge supported an attempt to redevelop the 37-acre property into affordable housing but

the proposal ultimately failed to materialize. Currently a developer has proposed 972 multi-family units at the Montvale section which is in litigation to determine the number of affordable units allowed while 185 units have been approved for the Park Ridge section.

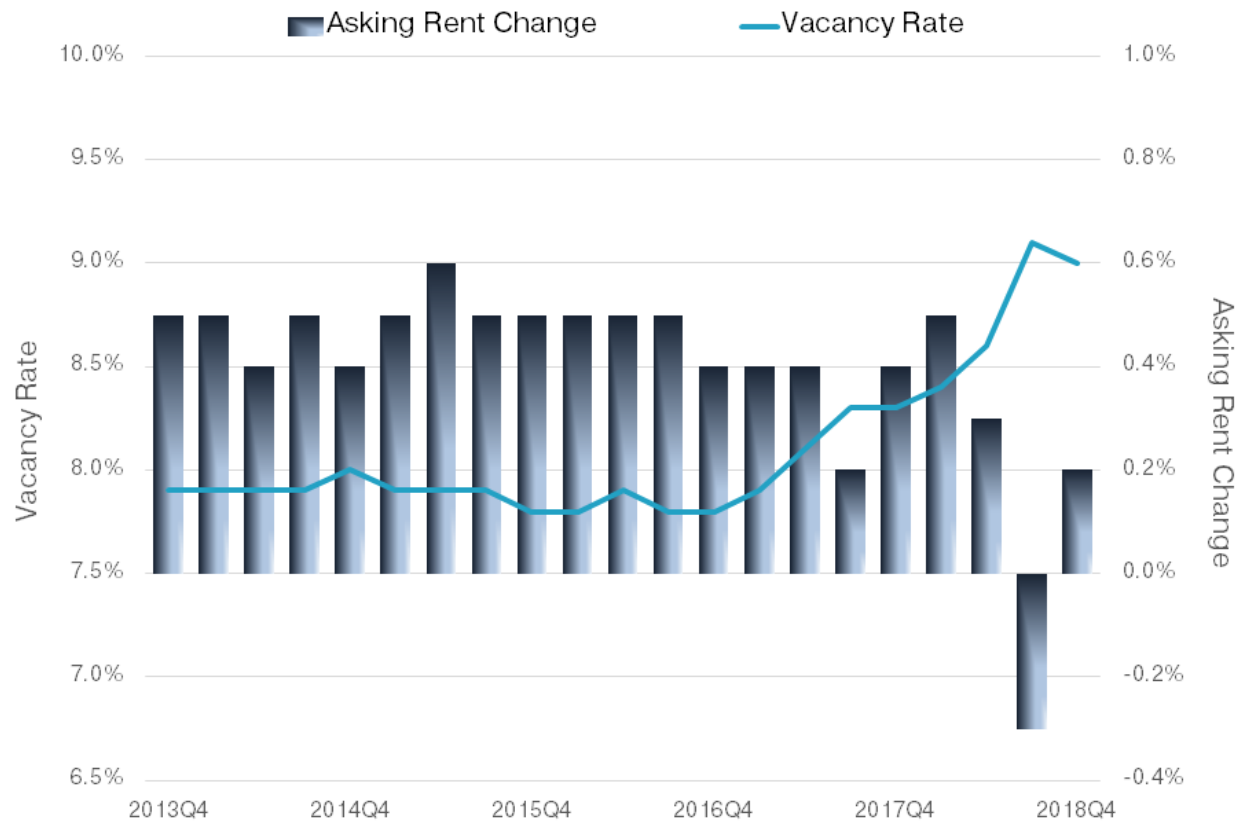
- District at 1515 (Parsippany-Troy Hills, NJ): Two office buildings formerly occupied by Dialogic and Intel were demolished and are proposed to be replaced with a mixed-use development including 441 apartment units and 100K SF of retail space. 34 units will be affordable housing. The site may contain a “woonerf” — a groundbreaking “living street” public space concept imported from the Netherlands.
- 56 at Roseland (Roseland, NJ): Remodeled in 2017 from the 400K SF US headquarters of Organon, a subsidiary of Merck, into a multi-tenant space with two large tenants and several smaller ones, with large conference and meeting areas that can be shared by the tenants. The building’s two major anchor tenants are Lowenstein Sandler LLP and Connell Foley LLP, both law firms (Verdon, 2018).
- Former Continental Insurance Building (Cranbury, NJ): Former 500K SF office of Continental Insurance was converted into a building for Aetna Insurance and then briefly used as a data center. Status: building is currently planned for demolition and the site will be redeveloped for two industrial warehouse buildings.
- Memorial Sloan Kettering Cancer Center (Middletown, NJ): Former 280K SF office building of Lucent Technologies on a 40-acre site was converted in 2016 into a 120K SF medical facility and 50K SF data center. Status: Completed.
- Triboro Square (Montvale, NJ): Former Mercedes-Benz headquarters proposed to be redeveloped into a mixed-use center with more than 300 housing units, two office buildings with ground floor retail including a pharmacy and shops, a plaza and a four-story hotel with 150 rooms. Status: Currently not approved.
- Prism Capital ON3 (Nutley and Clifton, NJ): The former 1.2M SF US headquarters of F. Hoffmann-La Roche AG, a multi-national health care firm is planned to be converted into a speculative laboratory and flagship facility for Quest Diagnostics. Together, the facilities will add 400,000 additional square feet of space to the 116-acre campus. Other tenants include Seton Hall University’s Hackensack-Meridian School of Medicine, Graduate College of Nursing and School of Health and Medical Sciences, Hackensack Meridian’s Clinical Research Center, biofabrication company Modern Meadow and the Ralph Lauren Corporation.
- Former Colgate-Palmolive industrial and office campus (Morris Township, NJ): In 2018, JMF Properties was designated the official redeveloper of the 64 acre Colgate Palmolive site and has proposed a 150,000 square-foot shopping center, 143 townhomes and 60 rental.
- Center of Excellence (Bridgewater, NJ): Successful redevelopment of former Sanofi U.S. Research and Development Campus by Advance Realty. The 110-acre site with 1.2M SF contains offices, retail, businesses, 400 apartments, wellness center, hotel with at least 100 rooms and an 80K SF supermarket. The 1960s era buildings were demolished while the 1980s era buildings were renovated. Major office tenants include Nestle Health Science.

Changing Regional Malls

By 2022, analysts estimate that one out of every four malls in the U.S. could be out of business, becoming victims of changing tastes, a widening wealth gap and the embrace of online shopping, according to a 2017 Time Magazine article. The decline began in the mid-2000s as online shopping

began to take market share and the Great Recession led to a drop in sales and foot traffic at anchor retailers. Between 2010 and 2013, mall visits during the holiday season dropped by 50%. There are still about 1,100 malls in the U.S. today, but a quarter of them are at risk of closing over the next five years, according to estimates from Credit Suisse (Sanburn, 2017).

Figure 62. Regional & Super Regional Malls Vacancy & Rent Trends, 2013 to 2018



Source: Reis, Real Estate Solutions by Moody's Analytics

Over time, successful malls have become less about shopping and more about consumers looking for experiences beyond shopping. Super-regional malls, which are leisure destinations as well as retail destinations, registered solid occupancy rates across 2017 despite the impact of retail bankruptcies. A number of major shopping center owners are following the trend by moving away from specialist apparel stores and focusing instead on bringing in grocery and other everyday-goods retailers, while others are moving toward mixed-use spaces that incorporate leisure and entertainment venues.

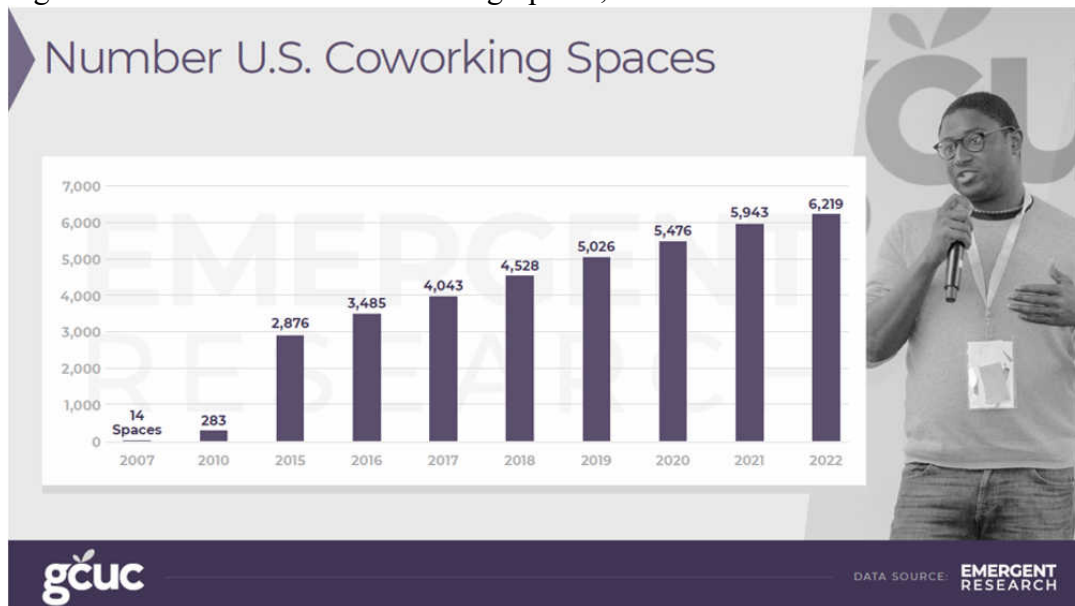
Coworking Spaces

It has long been possible for entrepreneurs and others telecommuting out of their homes with internet connections to rent an office or conference space for meetings for the very short term. The development of WiFi has allowed these individuals to work from any location with a hotspot. A business idea germinated from the prevalence of individuals working on their laptops in public

spaces, including the ubiquitous coffee house, coworking spaces were developed to not only provide the communal experience desired, but to also provide basic office infrastructure/ facilities to be used by as needed by members.

In 2010 there were only 283 coworking spaces in the United States, having grown from 14 in 2007. By 2015, there were 10 times that number—2,876. The industry is expected to add roughly 500 spaces each year through 2022 according to estimates prepared by Emergent Research (Coworking Resources, 2019). Every state in the country has coworking space, but states with the most consistent coworking activity are Texas, California, and New York.

Figure 63. Number of U.S. Coworking Spaces, 2007 to 2022



Office

Real estate sources concur that the demand for flexible offices will maintain momentum. Cushman and Wakefield reports that flexible spaces currently account for 1 percent of total office inventory, but they expect the sector to triple in size in the foreseeable future and represent between 5 percent and 10 percent of inventory in many markets. In each of the past three years, more than 5 million square feet (msf) of new space has come on line. It should be noted that only 30-40 percent of this space is new stock—the rest is taken from traditional office space by relocation and increasing of density.

Figure 64. New Coworking Leasing Activity in the U.S. Among Top 10 Providers, 2014 to 2018



New York City boasts significantly more coworking space than any other market, with approximately 12M SF as of midyear 2018, of which 10.7M SF is in Manhattan. WeWork recently became the second-largest renter of office space in Manhattan (4.6M SF), behind only JPMorgan (5.2M SF). New York City coworking inventory is nearly equal to the five other gateway markets combined. While coworking space has worked well in cities, according to one Long Island provider, suburban coworking spaces work best on a small scale of 5,000 square feet or less, at or near train stations as part of transit-oriented developments.

A significant attraction of office coworking spaces is the “vibe”. The spaces become communities of like-minded individuals attracted to the comforts of the facility. These range from the sleekly hyper-modern in new construction, to “cool” conversions of old warehouse space or other architecturally interesting structures that have been upgraded to allow for state of the art technology.

Returning to the Coffee House

A new firm called KettleSpace is partnering with restaurants, bars, and hotels throughout New York City to provide coworking space with guaranteed seats, outlets for charging, and inclusive of caffeine and snacks. This business formalizes the previously existing relationship with those who prefer the less formal coffee house feel and guarantees a steady income stream to the businesses providing space. Other firms have established coworking spaces in restaurants and bars during the 9-5 workday when such spaces are typically closed or have few customers.

Specialty Incubators

Some coworking spaces are specialized incubators dedicated to a specific industry such as shared laboratory space, art production, or industrial kitchens for start-ups. These spaces provide not only a work place, but serve as stepping stones to business expansion and economic development; as such they are often subsidized by a municipality and/or a university.

Golf Course Conversions:

The popularity of golf is on the decline. According to one study by the golf industry group Pellucid Corp., the number of regular golfers fell from 30 million to 20.9 million between 2002 and 2016. Ratings are down, equipment sales are lagging, and the number of rounds played annually has fallen (Gray, 2018).

More commercial real estate developers are considering troubled golf courses for new housing developments as a glut of these properties are in distress or bankruptcy. “A golf course has the unique potential to redevelop in a way that makes sense, which is to reduce the number of holes and build homes. It’s harder to generate meaningful revenue with membership [fees] or selling rounds, but people love houses next to golf courses because of the green, and they will pay a premium for that,” said Steven Werth, an associate of law firm Sulmeyer Kupetz, who specializes in Chapter 7 and 11 cases (Hsieh, 2016).

There can be opposition to residential uses on old courses. This can be due to present zoning: Many golf courses were broadly zoned for commercial uses to allow for things like clubhouse restaurants and bars, meaning that they can be redeveloped into shopping centers and office buildings without difficulty. The main variable blocking new housing on old golf courses might be due to concerns regarding traffic and school child generation from new residential uses. There is often political and emotional resistance to removing a course. Converting courses into open space, wetlands, and nature preserves is often more amenable and has occurred in places nationwide where local land trusts have been able to purchase the tracts.

In New York and New Jersey however, where a significant housing shortage exists, and office parks are no longer in demand, residential redevelopment is a much more likely option for adding value to country clubs and golf courses. Common redevelopment concepts in New York and New Jersey include downsizing the course and adding luxury homes or assisted living units; total conversion to a mixed-use center and conversion to public parks.

There have been numerous regional examples of golf course conversions:

- Roselle Golf Club Redevelopment (Roselle, NJ): Conversion to parks, playgrounds and other passive recreational uses, recreational facilities, community gardens and landscaped perimeter buffers to neighboring residents.
- Woodmere Golf Club Redevelopment (Hempstead, NY): Currently in litigation, a local developer has proposed 121 (down from 385) housing units to be constructed at the 120 acre golf club. The Town of Hempstead currently has a moratorium on development at Woodmere and other local golf courses to protect environmentally sensitive lands from development.
- Metropolis Country Club (Greenburgh, NY): A six acre tract of the country club was sold to Brightview for Independent Living, an assisted living facility for use in developing 90 independent living units, 45 assisted living and 25 units for Alzheimer’s patients. The development will not reduce the size of the existing golf course but rather stabilize the country club’s finances.
- Hampshire Country Club (Mamaroneck, NY): Addition of 105 residential units on 29 acres of the 116-acre property, including 64 carriage homes that will target empty

- nesters looking for low-maintenance property ownership. The 18-hole golf course will be redesigned into a 9-hole course. Country club amenities, such as the clubhouse, tennis courts and swimming facilities are proposed to remain.
- Elmwood Country Club (Greenburgh, NY): The entire country club is proposed to be redeveloped into a 175-unit townhouse-style community for people age 55 and older or 119-unit single family subdivision plan.
 - Pine Hills Golf and Country Club (Brookhaven, NY): The existing 18-hole golf course would be redeveloped to add 125 additional town homes and 74 acres will be donated to the town for preservation as open space.
 - Edgewood Country Club (River Vale, NJ): 225 market-rate town houses and condominiums and 24 affordable-housing rental units in a three-story building are currently proposed in a 50-acre section of the 187-acre site. The country club facilities and 18-hole golf course are proposed to remain.
 - Apple Ridge Country Club (Mahwah, NJ): Entire country club was redeveloped and remediated into an 80-home Toll Brothers development on the 108-acre site.
 - Golf Land (Voorhees, NJ): 8-hole pitch-and-putt course proposed to be converted into 85K SF of commercial retail space.
 - Eagle Ridge Golf Club (Lakewood, NJ): Public 27-hole golf course proposed to be redeveloped into a mixed-use complex with 556 residential units — 278 duplex buildings — a shopping center, four community centers, multiple parks and pedestrian paths on the golf course while preserving nine holes of the original course.
 - Engineers Country Club (Roslyn Harbor, NY): RXR Realty purchased property in 2017 with plans to add luxury homes on a section of the property and maintain the existing golf course

Infrastructure Considerations

Along with emerging trends and behaviors, local infrastructure considerations can impact development potential, work and settlement patterns. This section presents a few of the issues that will impact the region.

Con Ed Moratorium on Gas Hookups

As of March 15, 2019, ConEdison declared a moratorium for applications for new natural gas connections for any new residential, commercial and industrial developments in Westchester County, NY due to demand outpacing supply on the coldest days of the year. The moratorium also includes connections for any new heating, hot water, laundry and cooking uses in existing buildings that had not previously had gas appliances. Although credits and bonuses are provided for alternative energy sources such as geothermal and solar, it is unlikely that these will see widespread adoption in time to ease the existing demand enough to lift the constraint, which will severely limit new development beyond those projects with applications that pre-dated the moratorium.

A few northern Westchester towns are not currently included in this moratorium, nor is the rest of the region. Similar constraints have been seen elsewhere in the United States. Given fracking and

pipeline development limitations in New York State, the current situation may spread. However, the moratorium may give a boost to development of the local alternative energy industry.

Sewer Access

While regulations vary from municipality to municipality, access to sewer infrastructure allows for significantly more robust property development. Areas without such infrastructure are limited to large lot single family homes and stand-alone commercial entities that can exist with septic tanks and/or leach fields. In the New York metropolitan area, the majority of downtowns have sewer connections allowing for and controlling for density of housing and commercial development. As additional areas throughout the region connect to municipal sewer systems, the potential for development increases.

NYC Congestion Pricing

New York State has passed a non-specific Congestion Pricing Policy for drivers entering Manhattan below 60th Street with the goals of reducing traffic congestion as well as providing a funding source for much-needed improvements to the transit system including the NYC Subway, Long Island Railroad, and MetroNorth Railroad. The toll would be directed to the MTA for capital projects, but would not go into effect until December 2020. The details of the plan have yet to be decided upon, and many groups are lobbying to be exempted from the tolls.

Transformational Technologies

Technology is changing at exponential rates—many of today’s jobs did not exist 30 years ago. These changes in technology will have land use implications, some of which are already being experienced.

E- Commerce

The well-established practice of buying and selling of goods and services using the internet, the first major shopping sites, Amazon and eBay launched within a year of the release of early web browsers. Since then, the percentage of retail transactions enacted online has grown steadily. According to the US Census Bureau, the e-commerce share of US retail sales has increased from nearly 4 percent in 2009 to 10.2 percent in the first quarter of 2019 and is projected to grow by roughly 1 percentage point per year in the near term according to research prepared by eMarketer.

The growing share of e-commerce will decrease business at brick & mortar retail stores, but in terms of transportation the impact will shift the last mile delivery service from the purchaser to delivery services. This will also drive demand for new warehousing and logistics centers near major population centers.

Alternative Energy (Electric) Vehicles

The focus on urban sustainability and reductions in emissions over the past decade within our cities, coupled with the fast-improving battery technology and growth in electric vehicle (EV) demand are generating discussions around the next evolution of mobility infrastructure.

In 2017, 1.15 percent (200,000) of all cars sold in U.S. were electric vehicles (EV)—both plug-in hybrid electric vehicles (PHEV) like the Chevy Volt and the Toyota Prius Prime and battery-electric vehicles (BEV) like the Nissan Leaf and Tesla Model S. However this is a 26 percent increase from 2016, and the trend is expected to continue, according to environmental advocates and EV industry experts.

According to a 2015-2016 study from the International Council on Clean Transportation, markets in several U.S. cities showed charging station growth of 30-80 percent that correlated with a doubling of their EV uptake. Consumer research over the past four years shows the decision to buy an EV is directly related to the availability of this kind of infrastructure.

Currently, New York State offers a \$2,000 rebate for the purchase or lease of a new PHEV. Earlier this year, Governor Andrew Cuomo announced a \$250 million EV expansion initiative called EVolve NY in partnership with the New York Power Authority. New York City’s goal is to reach 20 percent of cars sold for use in the city to be electric by 2025, up from less than 1 percent today.

The adoption of large numbers of electric vehicles (EVs) offers many benefits for cities, including cleaner air and the opportunity to reduce greenhouse gas emissions. However the infrastructure requirements are significant and investment in charging stations are required. The National Renewable Energy Laboratory estimates that 1-5 public fast chargers and 36 non-residential Level 2 chargers are necessary for every 1,000 electric vehicles. EV status and charger requirements in 10 cities are shown in Figure 65.

Figure 65. Estimated Number of Public Plugs Needed in City Limits by 2030, by Type

City	Number of EVs Estimated In City Limits by 2030	Estimated Number of Public Plugs Needed In City Limits by 2030, by Type				Current Number of Public Plugs In City Limits (2017)
		Level 2 Plugs In Workplaces Needed	Level 2 Plugs In Public Places Needed	Public Fast Charger Plugs (DCFC) Needed	Total L2 and DCFC Plugs Needed	Total L2 and DCFC Plugs Currently
Austin, TX	29,000	650	405	45	1,100	495
Cleveland, OH	9,000	202	126	14	342	18
Denver, CO	36,000	807	502	56	1,365	161
Hartford, CT	4,000	90	56	7	153	52
Jersey City, NJ	5,000	112	70	8	190	20
Los Angeles, CA	348,000	6,312	3,730	201	10,243	1,456
Miami, FL	14,000	314	196	22	532	50
Philadelphia, PA	34,000	869	579	44	1,492	96
San Diego, CA	139,000	2,341	1,405	141	3,887	776
Seattle, WA	47,000	744	447	75	1,266	401

Source: National Renewable Energy Laboratory

In order to be successful, cities will need to develop comprehensive solutions to accommodate electric vehicles, including convenient opportunities for charging:

- Expanding access to electric vehicle charging for residents without off-street parking, by dramatically increasing the number of charging stations in residential areas.
- Partnering with businesses and public entities (like schools, community centers and municipal offices) to use their existing parking infrastructure while providing EV charging.
- Facilitating and encouraging electric shared mobility options like carsharing, ridesharing and bikesharing.
- Directing municipal utilities to install charging infrastructure and coordinating closely with investor-owned utilities to maximize opportunities.
- Considering a demand-based and shared system for parking.

While the expansion of the EV market may decrease demand for gas, it could cause additional stress on power sources. According to the Bloomberg New Energy Finance report, nine percent of total global electricity demand by 2050 will come from vehicles. Given some high-speed charging stations are able to charge an EV within 30 minutes (generating enough power to operate 300 homes), many utilities and their power grids will need to expand their resources in the near future.

Autonomous Vehicles

Autonomous Vehicles (self-driving) that use sensors and software to control, navigate and operate are under development by many companies including Google, Uber, Tesla, General Motors, Ford and Nissan. Many cars have autonomous elements (remote starters, cruise control, or app-operated capacity to move short distances), but there are no legally operating fully autonomous cars in the United States (Union of Concerned Scientists, 2018).

Beyond the obvious safety concerns, the impacts of the widespread use of self-driving cars are largely hypothetical and are both positive and negative. They could enable individuals who cannot drive themselves due to physical limitations, however they would thus encourage additional trips and increase vehicle miles traveled. In addition, the evolution of the technology could displace existing workers employed as drivers, in both personal and freight service industries.

The status of delivery of a fully operational fleet is uncertain, with manufacturers pulling back on previously estimated dates. For example, as of April 10, 2019, Ford CEO Jim Hackett stated that the company still expects its first self-driving car fleet to be launched in 2021, but it will be strictly limited in use, “its applications will be narrow, what we call geo-fenced, because the problem is so complex (Khalid, 2019).

Short Distance Unmanned Aerial Delivery Vehicles

Short distance unmanned aerial delivery vehicles (UAVs), in conjunction with smart lockers, are being tested by a number of shippers and carriers. Existing UAVs for public use can carry loads of up to 15 pounds, and could be used for last-mile delivery to secure lockers at publicly accessible sites. Use would be curtailed by current distance and weight limitations (1 mile and 15 pounds, respectively), but as the technology develops, UAVs could be used to eliminate truck delivery trips, especially in more densely populated areas.

Significant planning would be required to create smart locker space in public areas as well as to establish regulations for flight and landings.

Unmanned Terrestrial Delivery Vehicles

Unmanned terrestrial delivery vehicles (UTVs) are being used in pilot programs by Kroger Grocery Stores in conjunction with NURO, the developing technology company. Current vehicles can carry up to 12 standard bags of groceries. These limited capacity autonomous vehicles never carry human passengers, and as such do not have the programming dilemma of whether to protect riders or pedestrians/other cars.

Currently in use in Phoenix, AZ; Kroger/NURO announced that autonomous deliveries will begin in Houston, TX as of Fall 2019.

Smart Cities

Urban areas that use different application of the Internet of Things (IoT) sensors to collect data and then use that data to manage resources more efficiently are referred to as Smart Cities. Examples of these include:

Smart Homes and Intelligent Residential Districts – Appliances, heating, air conditioning, lighting, entertainment systems, and security systems are connected and can be activated remotely or on a time schedule. There are many examples of small scale uses of this including programmable thermostats or the various Google, Amazon and Apple electronics controllers including “Alexa” and “Siri”.

Waste Management- Intelligent waste containers are installed to track waste load levels to optimize garbage processing and reduce potential pollution.

Smart Streetlights - An example of smart streetlights is the Smart City Project in Padova, Italy, where public street lighting is monitored through wireless nodes which check lighting levels to optimize lighting energy cost.

Traffic Managements – Among the first uses of the IoT for enabling smart cities is the replacement of the current traffic management system of fragmented and unreliable self-reporting of traffic conditions by drivers with a comprehensive system that provides accurate, real-time information about traffic dispersion, making it easier for drivers to be guided to other roads or for autonomous vehicles to simply reroute on their own. Parking automation is another developing area.

Smart architecture and energy management- Everything from the shape and structure of buildings to the lighting in them is currently being geared toward being greener and having minimal impact on the environment, especially since energy efficiency has a major effect on building value.

Security and privacy- IoT has been implemented to improve security in urban areas via video surveillance, which allows for the police to monitor live feeds from across an entire city, relying on AI systems to detect and report incidences of crime or the sighting of wanted persons or vehicles.

When used on a community-wide scale, the sensors that capture data are not voice activated, but instead capture data at many levels and in real time as sensors, cameras, kiosks and nodes, along with radio-frequency identification (RFID) and Bluetooth devices, constantly relay information that is translated into data. For large scale smart city projects, there are cost concerns of installing the sensors in question, but many businesses are more than willing to help shoulder the costs in order to gain access to the data. The greatest disincentive for wide-scale smart city use stems from concern about privacy and ownership of the collected data.

Local Impacts and Model Adjustments

In the draft version of this technical memorandum distributed on April 23, 2019, NYMTC sought feedback and input from the NYMTC Socioeconomic and Demographic Forecasting Working Group (FWG) regarding the anticipated or likely influence the identified trends, infrastructure changes, and transformational technologies will have, and to what extent, on the constituent counties of the NYMTC Region. To this end, the SurveyMonkey platform was used to provide a summary of each qualitative issue in conjunction with a survey asking the FWG members to rate each issue by the anticipated level of impact (on a scale of 0 to 10) it will likely have on the member's area of representation, when it is anticipated that impact will be felt, as well as any further comment on the topic. The resulting anticipated level of influence ranges (high, medium, low) and estimated peak impacts are summarized in Figure 66.

Figure 66. Local Impacts Survey Results Ranked by Anticipated Level of Influence

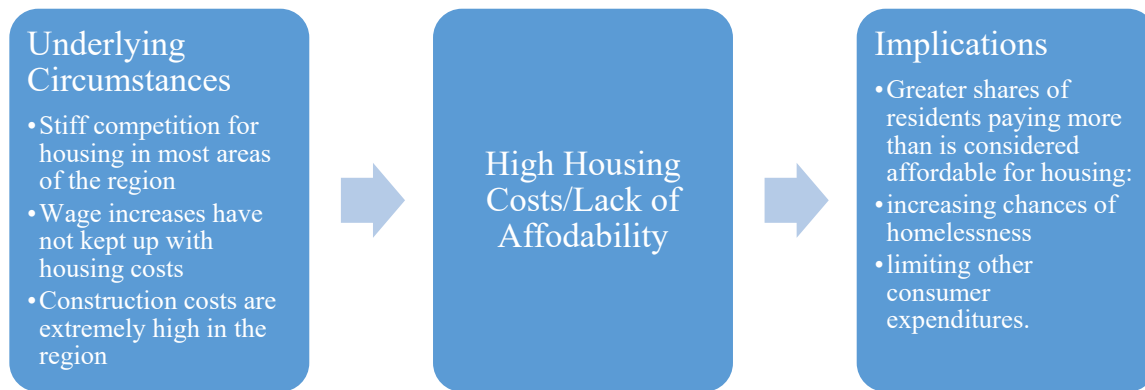
Topic	High/Med/Low Influence	Average Year for Height of Impact (2020-2050)
High housing costs/ lack of affordability	High	2025
Sea level rise and climate change will have on your area.	High	2030
Senior housing choices	High	2030
Building boom	High	2030
Aging populations	Medium	2030
NYC congestion pricing	Medium	2025
E-commerce	Medium	2030
Shifting industry mix	Medium	2030
Millennial housing choices will have on your area	Medium	2025
Ridesharing	Medium	2025
Changing regional malls	Medium	2030
Increasing sewer access	Medium	2030
Expansion of the freight industry	Medium	2030
Smart cities	Medium	2035
Reinventing office parks	Medium	2025
Electric vehicles	Medium	2030
Headquarters relocation's	Medium	2030
Coworking spaces	Medium	2030
Declining housing value	Low	2030
Golf course conversions	Low	2030
Autonomous vehicles	Low	2040
Slow growth of GDP	Low	2030
Autonomous terrestrial delivery vehicles	Low	2040
Short distance aerial delivery vehicles	Low	2035
Moratorium on Con-Ed Gas hookups/infrastructure constraints	Low	2030

Source: Survey of NYMTC Forecast Working Group Members April/May 2019

Responses will help to shape FWG discussion and influence adjustments and enhancements to the weights applied to various characteristics in the existing Population, Employment and TAZ distribution models. This section provides the issues/questions graphic for each question, a summary of responses received, and potential adjustments to the weighting factors of the existing models or recommendations for alterations of future models.

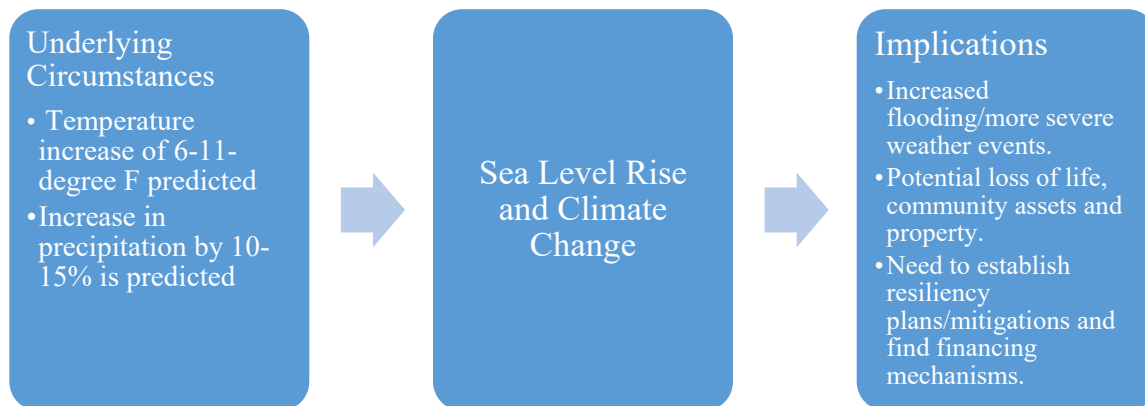
The topics are grouped as they were for the May 9, 2019 FWG meeting by “Items of Concern”, “Items That Vary in Importance Geographically”, and “Non-issues”.

Items of Concern



Seen as an immediate issue of great concern to the majority of FWG, housing costs and lack of affordability will have impacts on household size as well as choice of place of residence, especially for newcomers to the region.

Model recommendation: Currently, the TAZ model incorporates a housing price variable in the Zonal Allocation Model; however, the variable used is median housing value as determined from the Census' American Community Survey. The model may be better served by either current asking price data drawn from multiple listing services and/or housing costs instead.



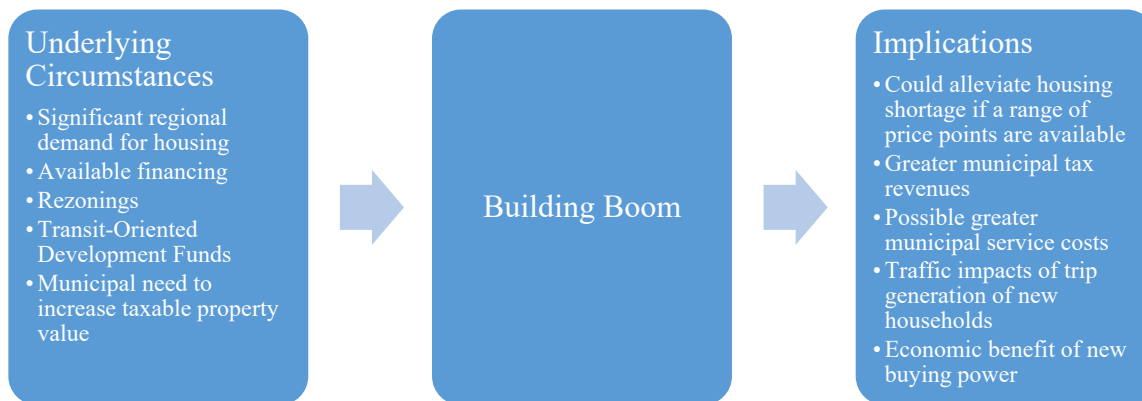
An immediate issue with impacts already being seen in coastal areas and anticipated exacerbation into later forecast years, the issue of sea level rise and climate change was considered of high influence among FWG members.

Model recommendation: Incorporate assumptions for loss of available land area due to sea level rise by TAZ in each cohort year using existing flood maps and modeling.



Directly tied to the aging population, Senior Housing Choices is anticipated to have a high impact and involves both available housing stock as well as housing costs. Senior housing choices influence development with the proliferation of age-restricted communities, as well as changing household size through the creation of multi-generational households in areas where appropriate stock is unavailable.

Model recommendation: The Population model includes headship rate controls using varying rates based on decennial census data. Based on continuing changes, additional controls should be added to reflect more recent rates.

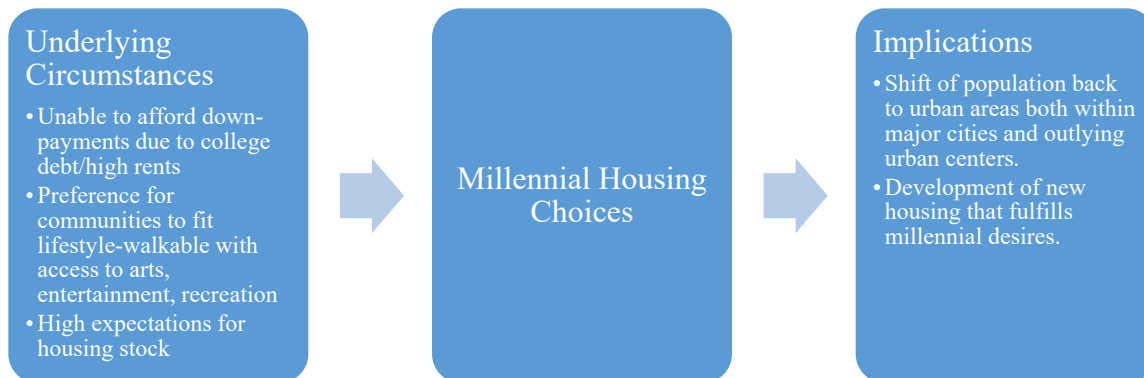


While the current building boom has not reached historic levels and in built out areas, much is infill and reuse, recent growth is having impacts on traffic and transit, and is considered of relatively high importance among FWG members. Despite this growth, housing is still not meeting demand in many areas. As is, the Zonal Allocation Model accounts for these changes in density.



With relative moderate level of anticipated importance, the majority of the region is seeing the impacts of aging populations now, with increasing effects through the end of the forecast period, with potential impacts on housing and transportation system demand. To a large extent, the impacts are counteracted in NYC by in-migration.

Model recommendation: The Population model's sub-regional cohort component sections account for trend in aging quite well, however incorporating more detailed weighting on foreign and domestic migration would be valuable.

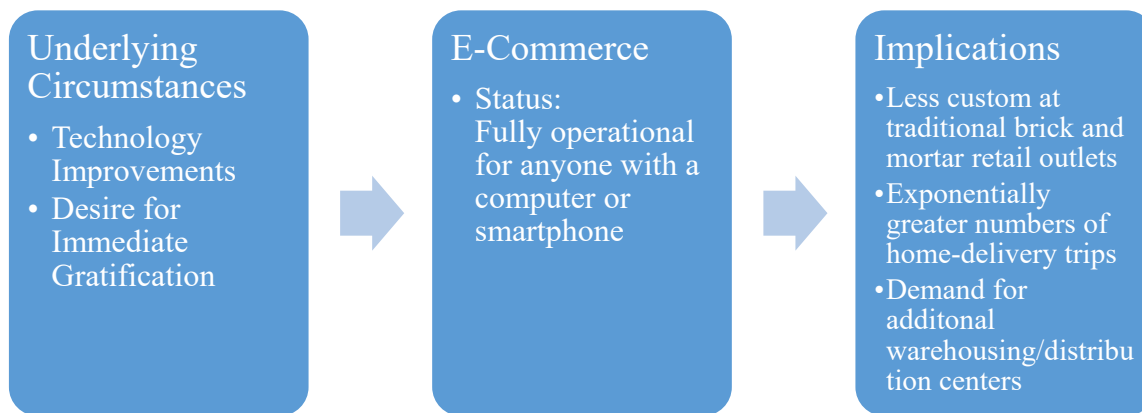


While not considered as impactful as seniors, millennial housing choices had a moderate level of importance, as they are influencing development toward apartments/TODs, as well as increasing average household size through the growth in multi-generational and creation of non-family households.

Model recommendation: Consider incorporating a family/non-family component into the sub-regional household models.

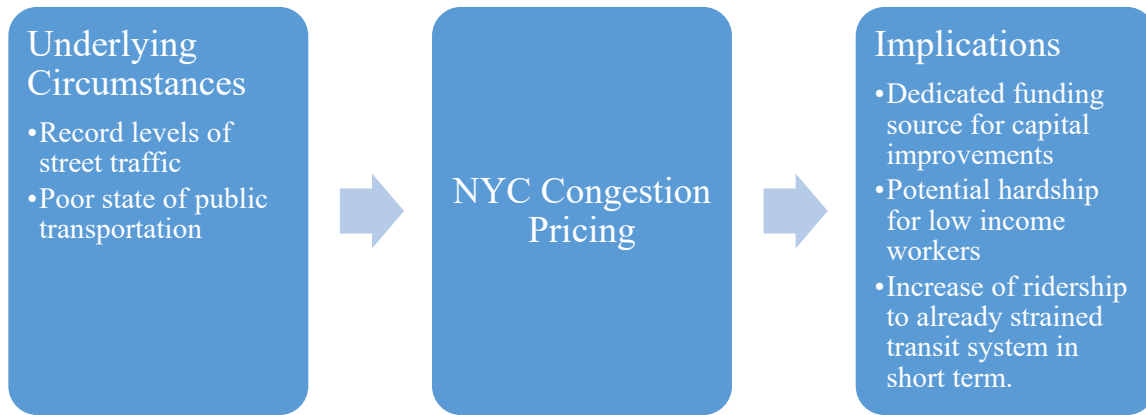


Considered moderately important, shifting industry mix is underway throughout the region at varying levels and is seen as a particularly important issue among most transportation agency representatives; however the ultimate implications on commutation are unclear. There are no recommendations for changing the models at this time.



Viewed as moderately important, these impacts are being felt currently throughout the region, and evidenced by the industry expansion of freight facilities and last mile deliveries. E-commerce is also driving the reinvention of brick and mortar retail locations as entertainment and hospitality venues.

Model recommendation: Tied in to industry share in the employment model and proximity to highways in the zonal allocation model, this shift in retail employment will likely have impacts on the BPM.



While the overall view of New York City’s Congestion Pricing was considered moderately influential in terms of impact, it is expected to be a one-time shift in the modeling that will be evident in the next complete round of forecasts.



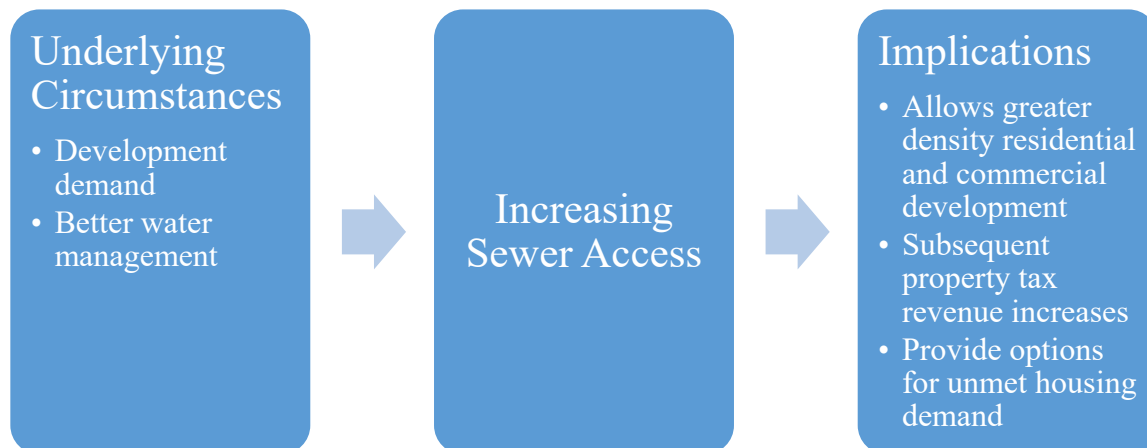
Considered of moderate influence, ridesharing/ride-hailing is peaking in most of the non-rural areas throughout the region. In the areas where it is available, there are increases in traffic and decreases in transit ridership. There are no inputs to the SED models that correlate directly to this activity.

Items that vary in importance geographically



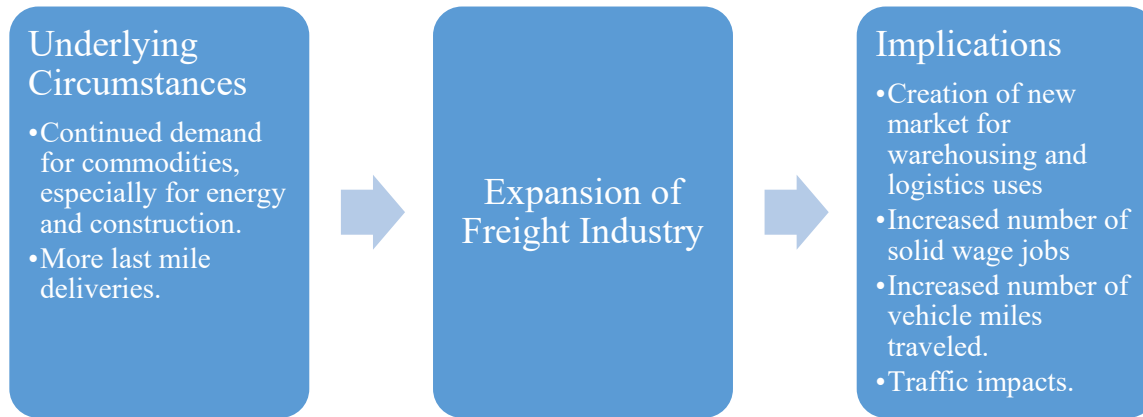
The regional malls are changing in different ways depending on the area of the Region. Nassau and Dutchess counties have already seen consolidation and closing of malls, while Orange County has seen conversion to service and entertainment uses. New York City, on the other hand is seeing expansion of malls due to population density and record numbers of tourists.

Model recommendation: While there are both employment and land use implications for these changes, they will be reflected in future forecast existing conditions inputs, However, abrupt and significant changes in use and employment may cause inconsistencies in Zonal Allocation Model outputs that will raise questions. It is suggested that a change of use flag be incorporated into the database whenever a TAZ demonstrates significant differences in land use from the land use inputs of the previous model.

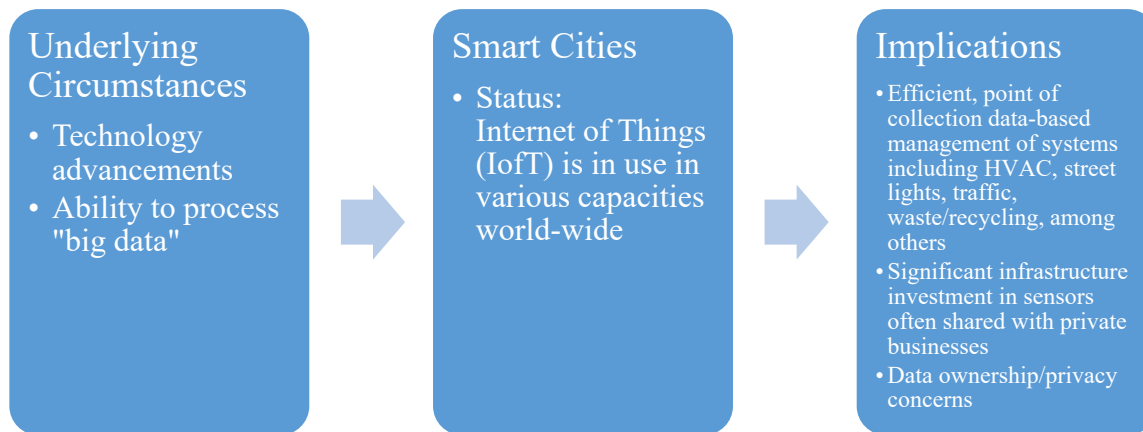


Increasing Sewer Access is expected to have particular impacts on areas of Long Island and Orange County where expansion of the existing sewer systems may be possible given available funding and environmental conditions. In addition, New York City DCP noted that improvements to the City's water and sewer infrastructure could affect growth potential.

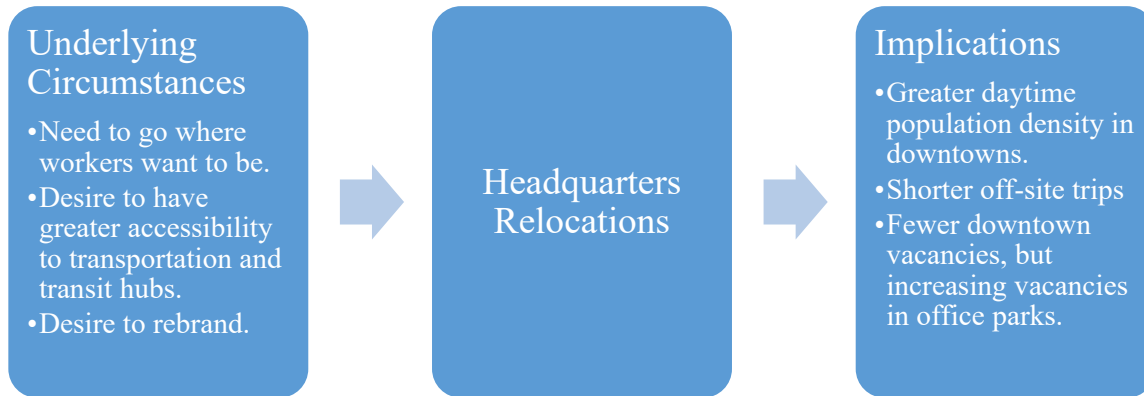
Model recommendation: In the existing Zonal Allocation Model, new sewer access is an input to the “pro-growth” environmental weight. It is recommended that significant capacity improvements also be included in the weighting.



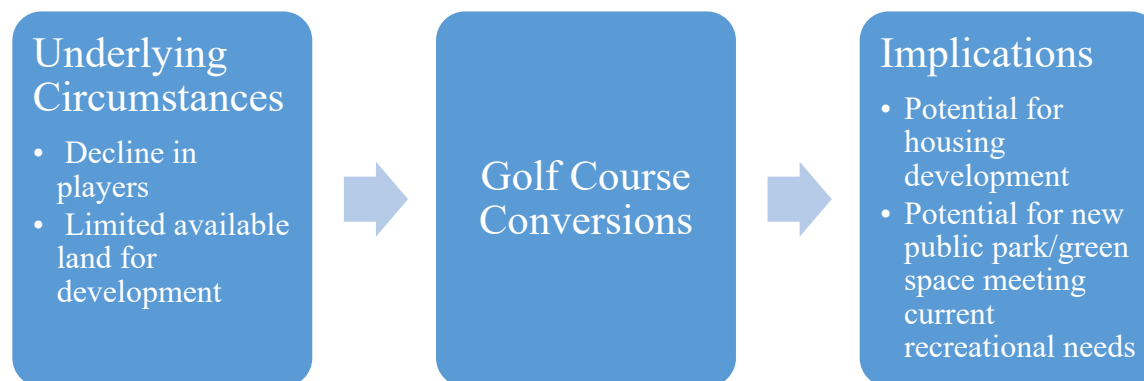
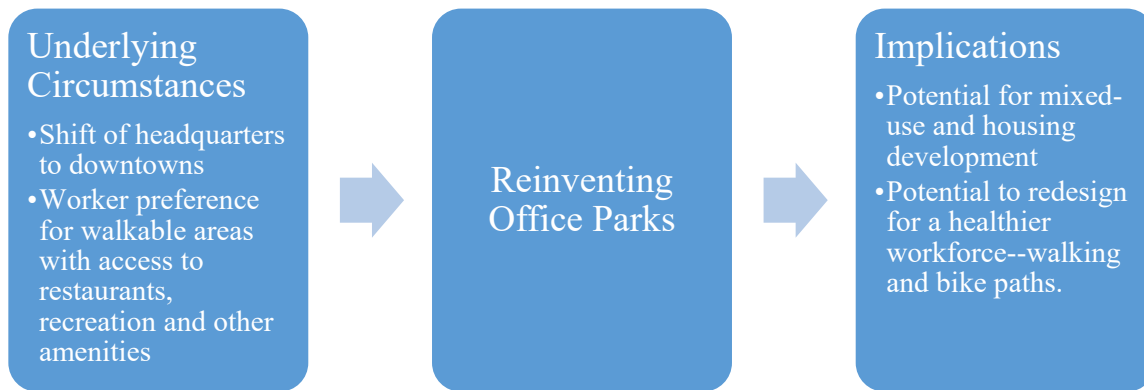
The expansion of the freight industry is anticipated to have moderate impact in the area. Warehouse/logistics expansion along highway corridors, as well as same-day/last mile delivery in urban areas is having traffic impacts. Areas that do not fall within these parameters are seeing little affect. Employment implications will be picked up in changing NAICs inputs.

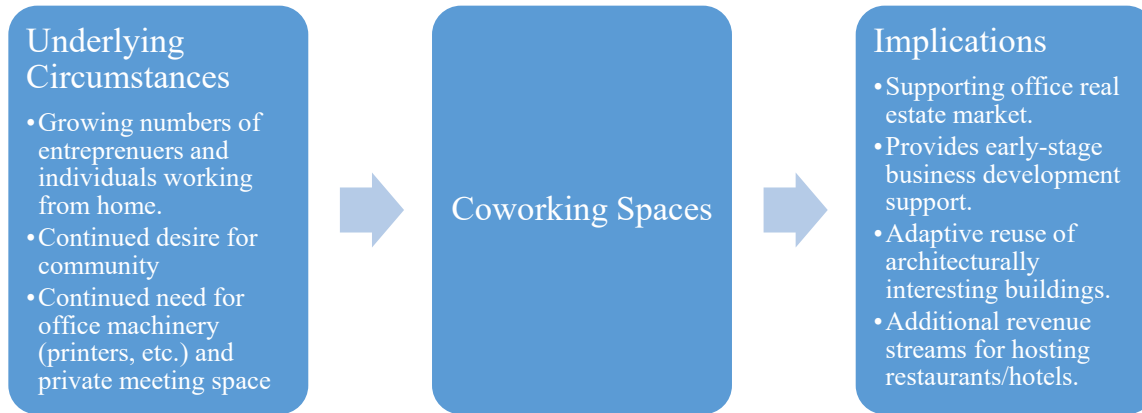


Smart Cities IoT technologies are in use in varying degrees from urban centers to rural areas. While these technologies do have employment implications, they are likely to be reflected in overall employment trends.

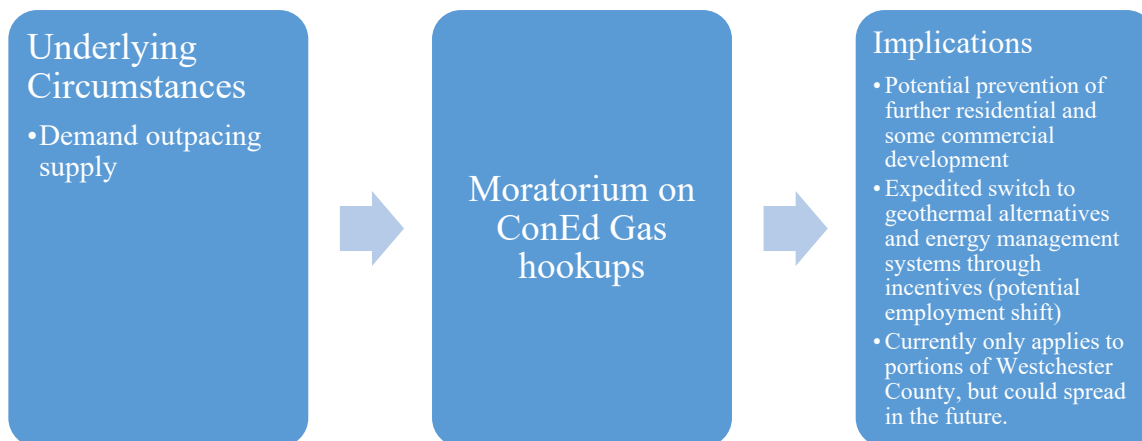


Headquarters relocations), the Reinvention of Office Parks, and Conversions of Golf courses, have had impacts in portions of Long Island and the Mid-Hudson sub-regions; however, in many areas these conversions have already happened and are therefore already incorporated into the land use distribution of the Zonal Allocation Model.





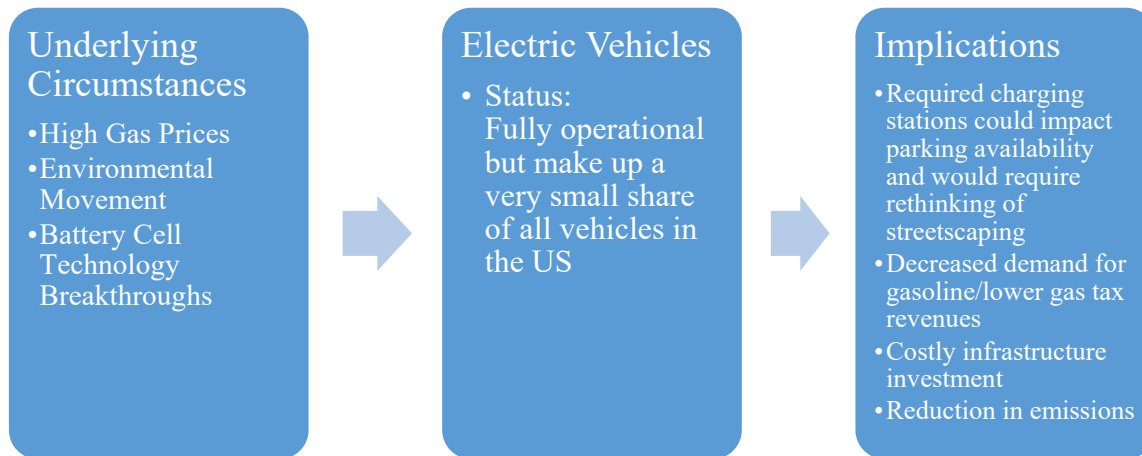
New York City, Nassau County, Western CT, and to a lesser extent, Westchester County and the NJ sub-region are seeing shifts in office occupancy that hypothetically correspond to the greater number of self-employed.



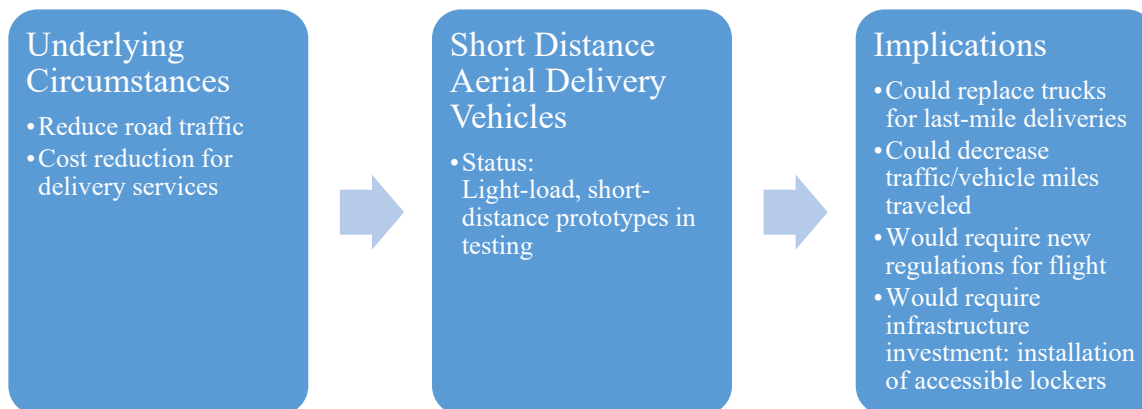
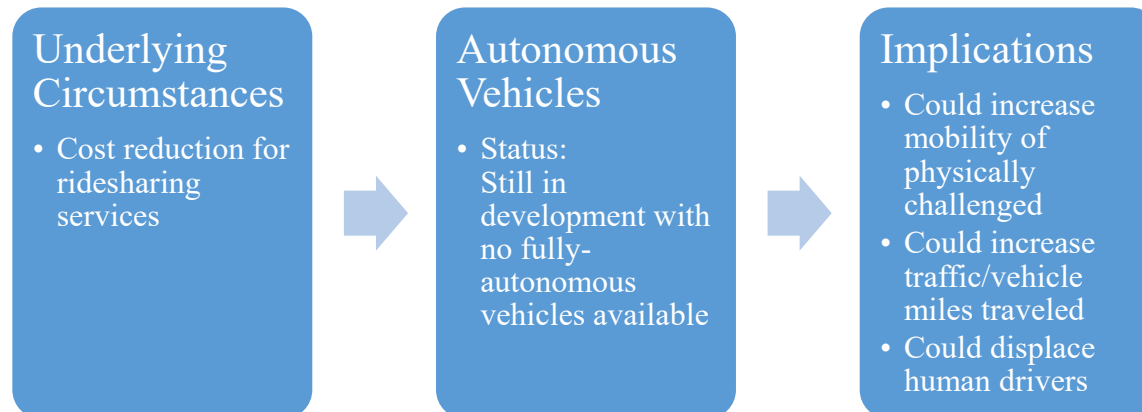
The moratorium on ConEd Gas hookups is obviously of concern for portions of Westchester County. However, this may be an example of future energy and/or other infrastructure limitations and utilities constraints.

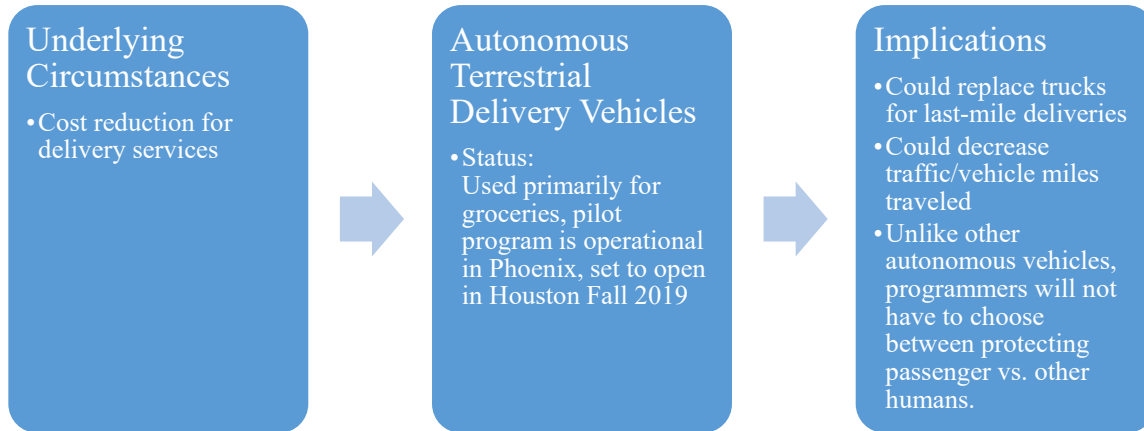
Model recommendation: Consider an additional infrastructure “low-growth” weight that would correspond to the “pro-growth” weights that include infrastructure improvements such as sewer expansions.

Non-issues

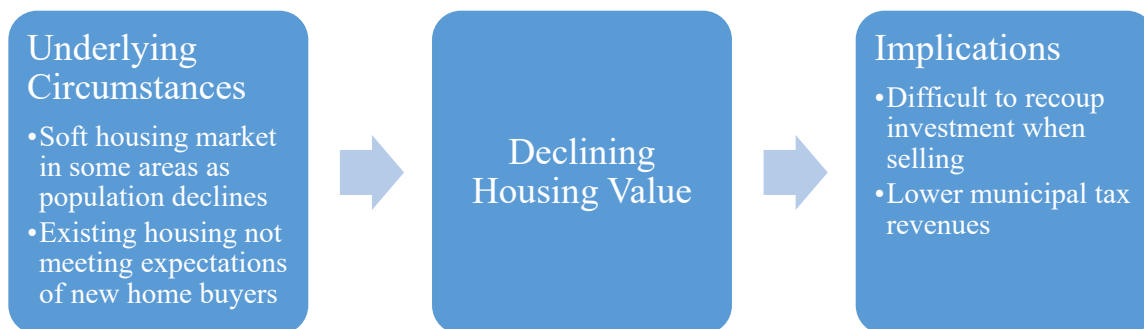


While there are potential land use implications for infrastructure, the general impression of the FWG is that these will not be significant enough to shift the forecast results.

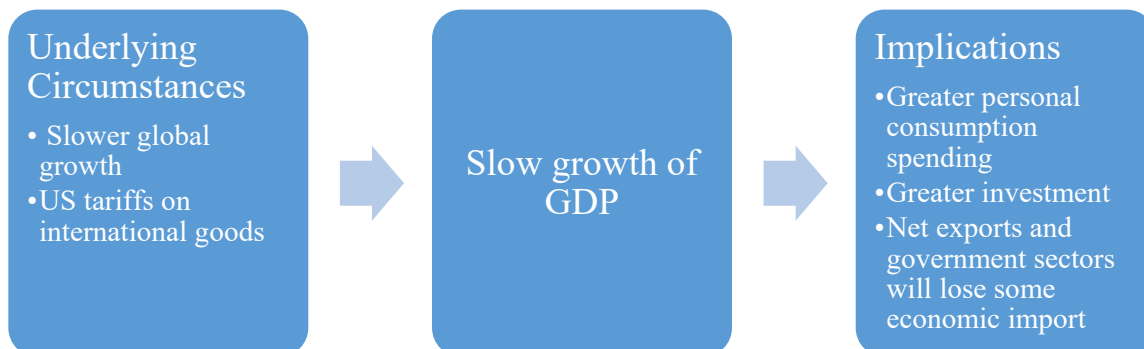




Autonomous, and both aerial and terrestrial delivery vehicles are considered to be well beyond the forecast range in terms of widespread use, and at this time are not significant enough to tie in to the modeling.



Generally seen in areas with aging population, little new development, and distant from employment centers, this is not an issue for the majority of the region.



Most respondents feel that land use and labor force availability are greater constraints than tariffs.

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