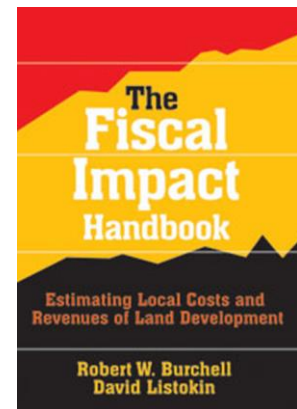# 2017 - Demographic Multipliers
Technical Appendix

May 2019

The purpose of this appendix is to provide technical information and reference to supplement the 2017 Custom Demographic School Multipliers for the region surrounding Princeton, New Jersey containing 8 PUMAs.

Traditional Residential Demographic Multipliers

In 1978, Professors Robert Burchell and David Listokin first formalized a method to develop demographic multipliers, using the Census Bureau raw records for the long form questionnaire (SF3), as well as American Housing Survey data. In 2006, funded by the Fannie Mae Foundation, Burchell and Listokin released a series of residential multipliers for each state. In the same year, Listokin et al. published several editions of *"Who Lives in New Jersey Housing?* (WLNJH)"* which produced demographic multipliers at a regional, sub-state level. Both the Fannie Mae series and WLNJH utilize the 2000 census Public Use Microdata Sample (PUMS) records. Also, they both report three multipliers: AVHH (average size of household), SAC (school age children) and PSAC (public school age children). As noted, while the Fannie Mae series provides statewide multipliers, the WLNJH provides demographic multipliers for New Jersey, both statewide multipliers and three sub-state regions. It also contains sections of age-restricted communities, affordable housing, and non-residential multipliers.

Community Data Analytics Demographic Multipliers

Community Data Analytics (CDA) has developed demographic multipliers using the 5-Year American Community Survey Public Use Microdata Sample (ACS-PUMS). The ACS-PUMS records are released every year, enabling CDA to update multipliers each year. Since the current CDA multipliers use the 2013-2017 ACS release, they reflect recent demographic changes. In contrast, both the Fannie Mae series and WLNJH base multiplier characteristics of households and housing units on data from the 1990s.

The PUMS records are reported at a level of geography called Public Use Microdata Area (PUMA) which is a geographical unit of at least 100,000 people. The usual population size ranges from 120,000 to 190,000. These records contain detailed responses by householders on each person in the household and the housing units in the ACS survey. CDA is able to apply variables for the time the householder moved in the unit, the year the unit was built, the age of each person, the grade level of students, and other attributes to develop samples and prepare a variety of demographic multipliers and planning ratios.

CDA also advances the methods of developing demographic multipliers at the local level. WLNJH attempted to provide locally specific multipliers by reporting three sets of multipliers by Northern, Central and Southern Jersey. However, because WLNJH samples recently built units, called the Recently Built Units Sample, its ability to provide statistically valid multipliers for smaller geographic units is limited by sample size issues. The sample size is particularly insufficient during the period of the housing recession. Since the late 2000s, housing starts have dropped significantly and only recovered slowly in recent years.

To overcome the sampling problem, CDA developed a more significant sample based on household movement, called the Newly Moved-In Household Sample. This sample relies on the fact that relocating households can move into newly built units or older units, but in either case, these households are looking for similar housing services. These CDA multipliers are based on the Newly Moved-In Household Sample. That is, households that moved into their current housing unit less than four years ago for the 2013-2017 PUMS, the earliest moving year is 2009, i.e., four years before 2013. This newly moved-in household sample also includes housing units recently built. Since this sample is several times bigger than the recently built units, it makes the development of multipliers at the PUMA or PUMA aggregate level possible for most popular housing configurations.
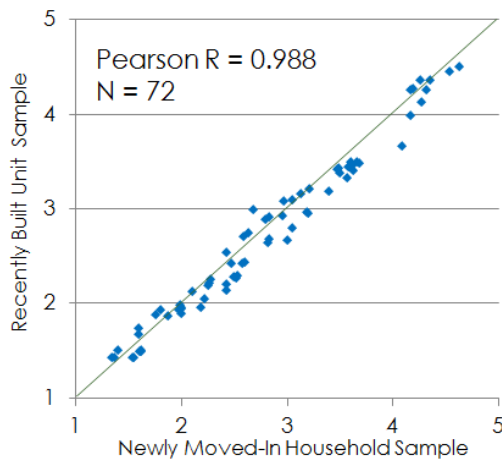
2014 New Jersey State Level Scatterplot
Sources: Community Data Analytics (2017), based on 2000 Census and 2010-2014 5-Year ACS-PUMS

Also, the Newly Moved-In Household Sample has other advantages. Because it is less affected by housing market fluctuation than the Recently Built Unit Sample, the statistical validity of the multipliers is better. Second, multipliers from the Newly Moved-In Household sample show a more stable, long-term effect than those from the Recently Built Unit sample. Over time, units "recently" built will age and will be occupied by incoming households when the first occupying household moves out. The Newly Moved-In Household Samples better reflect the characteristics of the successive, replacement households.

The empirical test to examine the difference or similarity between the estimated multipliers from these two samples indicates that they are almost identical. The Pearson R of 72 pairs of multipliers for 2014 New Jersey data is 0.988.

Demographic Shifts

Over the last two decades, America has experienced a real estate bubble and a deep recession that have transformed the homebuilding industry and home buying preferences. America is also aging as baby-boomers are retiring and moving away from big suburban homes. Concurrently, echo-boomers have all been entering the labor market and in their prime time of family formation.

At the national level, between 2000 and 2010, the average size of households (AVHH) for all occupied units declined in 40 states and DC but grew in Nevada, California, Florida, Delaware, and Texas. It remained unchanged in New Jersey, Maryland, Virginia, Oklahoma, and Tennessee.

For example, in New Jersey, the estimated AVHH for all occupied units as reported in the 2015 1-Year ACS is 2.75, in comparison with 2.68 reported in the 2010 Census. The average SAC for all occupied units is almost identical between 2010 and 2015. In other words, New Jersey did not follow most states, which experienced a declining trend in AVHH and SAC. We also note that at the state level; the absolute number of SAC has been slightly declining. The constant ratio of SAC per all occupied units indicates that the number of households is growing more slowly than the majority of other states.

The chart on the right illustrates the changes in New Jersey SAC overtime. The chart shows that even if the overall SAC may not change, there is significant reconfiguration among housing types. SAC ratio for either 2 or 3 bedroom townhomes is growing, in contrast to the decline in single-family detached units. There are increases in 2-bedroom multi-family (2-4 units) structures as well as 3-bedroom rented multi-family (5+ units) structures.
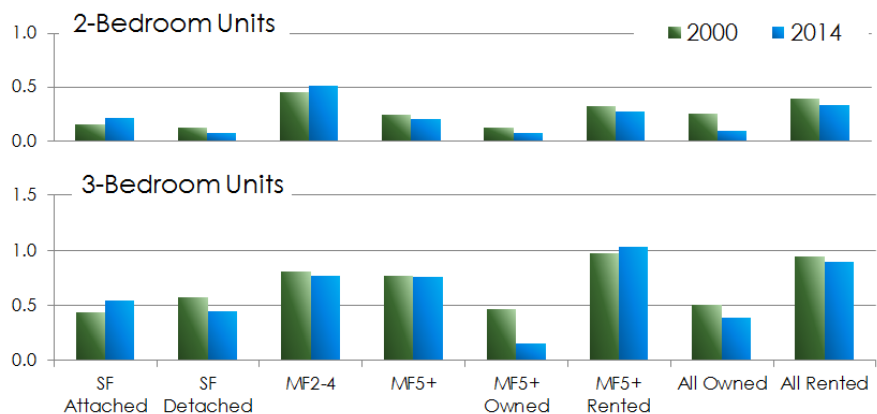
School-Age Children per Unit, Recently Built Unit Sample
Sources: Community Data Analytics (2017), based on 2000 Census and 2010-2014 5-Year ACS-PUMS
Fannie Mae Foundation (2006), Residential Demographic Multipliers, New Jersey Table 2

Public School-Age Children, Public School Children, or Public School Attendees?

The terms Public School-Age Children (PSAC) and Public School Children (PSC) deserve a technical discussion. The WLNJH and the Fannie Mae series report PSAC or PSC with grade cohort differentiation at the state level. However, the public school participation rate is specific to local school districts. Many factors affect the local rate, including the quality of the public school service, the religious and faith preference, and the income of the residents. Thus, a statewide PSAC or PSC ratio has one fundamental assumption that public school participation rate is uniform throughout the state. Impact analysts should avoid using the statewide PSAC or PSC to minimize estimation biases. While not ideal, a better method is to apply the local public school participation rate to the statewide SAC ratio for the relevant housing configuration.

Estimation bias can be reduced if the PSAC or PSC ratio is computed only for a small geography. As a result, CDA factors the local – not the statewide – public school participation rate into the multipliers. So far, only CDA can provide demographic multipliers at the very local level.

The technical documentation of the WLNJH and the Fannie Mae series does not provide a detailed specification of the PUMS variables used in deriving PSAC and PSC. Because WLNJH and the Fannie Mae multipliers are grade cohort differentiated, public school attendance and grade level variables were likely used. However, it is unclear if the WLNJH and the Fannie Mae series restrict estimates of public school attendees just to SAC, defined as age 5 to 17. Because a school age child can be home-schooled, attending private or parochial school, public school, or for other reasons, not in the school systems, a public school attendee can be outside the age range of 5 to 17. For example, in rare cases, a public school system may serve students over 18 years old.

To accurately estimate the full school impact, CDA uses local Public School Attendees (PSA) instead of PSAC or SAC. Consequently, CDA captures the full impact on the public school system.

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Variables in Analysis

Public School Age Children (NJ 8-PUMA region)

- Public school age children
    - Kindergarten – Grade 5
    - Grade 6 – Grade 8
    - Grade 9 – Grade 12
- Housing Configurations
    - Single family owner-occupied townhomes
        - 2 bedrooms
        - 3 bedrooms
        - 4 bedrooms
    - Rental Apartments
        - 1 bedroom
        - 2 bedrooms
        - 3 bedrooms
    - LMI Apartments
        - 1 bedroom
        - 2 bedrooms
        - 3 bedrooms

PUMAs in Analysis

- NJ 800: Hunterdon County
- NJ 902: Middlesex County (Southwest)
- NJ 1001: Somerset County (North & West)
- NJ 1002: Somerset County (South)
- NJ 1102: Monmouth County (Southwest)--Freehold Borough
- NJ 1106: Monmouth County (Central)
- NJ 1502: Morris County (West)
- NJ 2302: Mercer County (North)--Princeton Borough