

Small Area Data Aggregation

Lessons from New York City's ACS Aggregation Tool

**Presentation for
American Community Survey
Data Users Conference**

May 12, 2015

Joel A. Alvarez & Joseph J. Salvo

Population Division

NYCPLANNING
DEPARTMENT OF CITY PLANNING CITY OF NEW YORK



Geographic Data Source

Show Data by:

- Census Tract
- Neighborhood Tabulation Area

Search for a Location

SEARCH TYPE

Address

ADDRESS NUMBER

STREET NAME

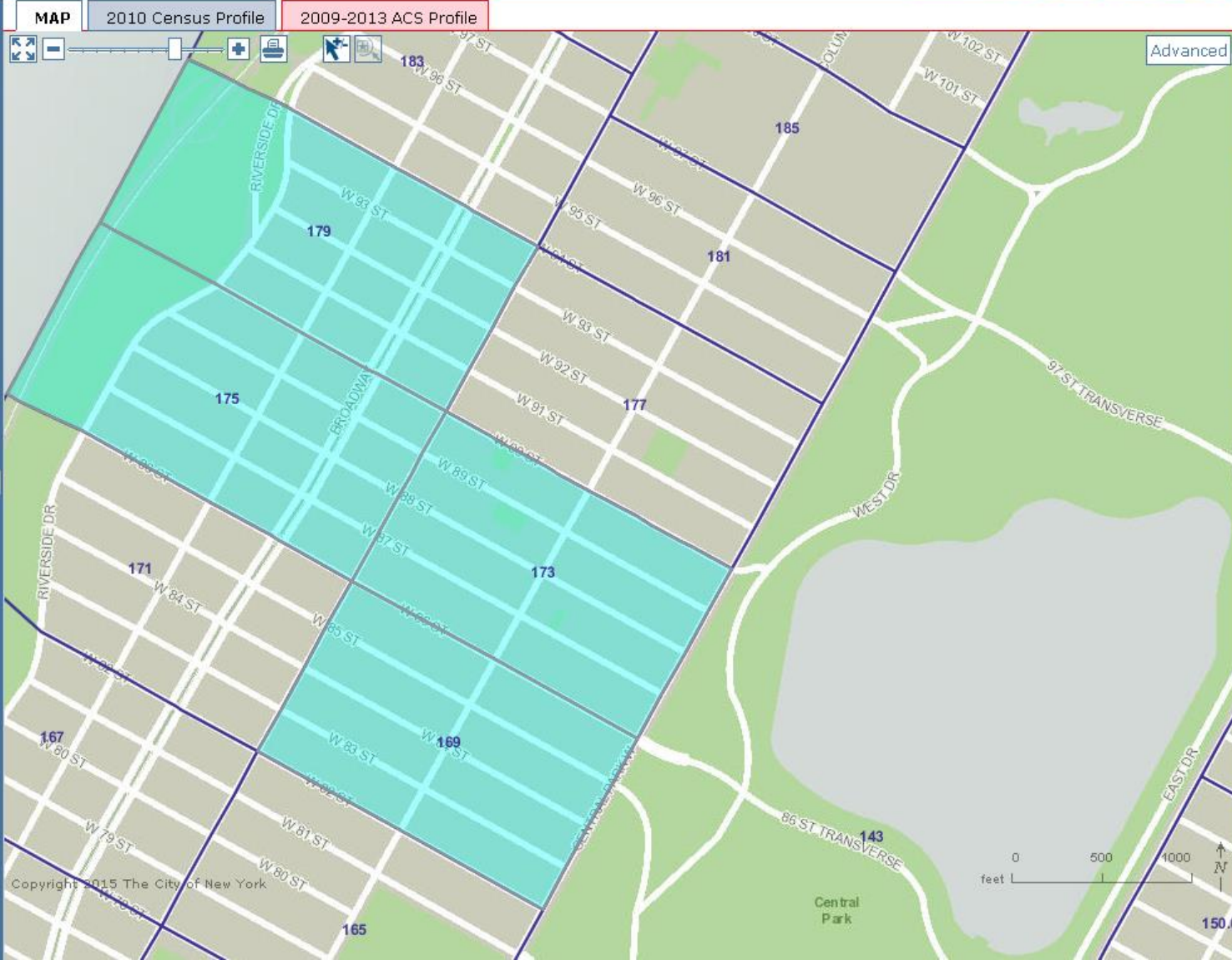
BOROUGH

Find

Selected Census Tract(s):
Manhattan 179, 175, 173, 169

Show Additional Data on Map:

- Community District
- City Council
- State Senate
- State Assembly
- None



Geographic Data Source

Show Data by:

-
- Census Tract
-
-
- Neighborhood Tabulation Area

[MAP](#) [2010 Census Profile](#) [2009-2013 ACS Profile](#)

Selected Tracts: Manhattan 179, 175, 173, 169

Search for a Location

SEARCH TYPE

 Address

ADDRESS NUMBER

STREET NAME

BOROUGH

 Selected Census Tract(s):
 Manhattan 179, 175, 173, 169

[Demographics](#) [Demographic Change](#)


| Demographic Change | Selected Tracts | | | |
|------------------------------------|-----------------|---------------|-------------------|--------------|
| | 2000 | 2010 | Change, 2000-2010 | |
| | Number | Number | Number | Percent |
| RACE/HISPANIC ORIGIN | | | | |
| Total population | 37,854 | 37,160 | -694 | -1.8% |
| White nonhispanic | 28,119 | 27,706 | -413 | -1.5% |
| Black/African American nonhispanic | 2,269 | 1,914 | -355 | -15.6% |
| Asian nonhispanic | 1,665 | 2,148 | 483 | 29.0% |
| Some other race nonhispanic | 221 | 190 | -31 | -14.0% |
| Nonhispanic of two or more races | 668 | 684 | 16 | 2.4% |
| Hispanic origin | 4,912 | 4,518 | -394 | -8.0% |
| SEX AND AGE | | | | |
| Female | 19,929 | 19,830 | -99 | -0.5% |
| Male | 17,925 | 17,330 | -595 | -3.3% |
| Under 5 years | 1,945 | 2,051 | 106 | 5.4% |
| 5 to 9 years | 1,408 | 1,588 | 180 | 12.8% |
| 10 to 14 years | 1,161 | 1,437 | 276 | 23.8% |
| 15 to 19 years | 1,018 | 1,157 | 139 | 13.7% |
| 20 to 24 years | 1,715 | 1,642 | -73 | -4.3% |
| 25 to 29 years | 3,941 | 3,344 | -597 | -15.1% |
| 30 to 34 years | 4,718 | 3,274 | -1,444 | -30.6% |
| 35 to 39 years | 4,009 | 3,038 | -971 | -24.2% |
| 40 to 44 years | 3,314 | 2,917 | -397 | -12.0% |
| 45 to 49 years | 2,969 | 2,801 | -168 | -5.7% |
| 50 to 54 years | 3,010 | 2,697 | -313 | -10.4% |
| 55 to 59 years | 2,202 | 2,617 | 415 | 18.9% |

 Sources: US Census Bureau, 2000 and 2010 Censuses, SF1
 Population Division - New York City Department of City Planning

Geographic Data Source
[MAP](#) [2010 Census Profile](#) [2009-2013 ACS Profile](#)
Selected Census Tracts: Manhattan 169, 173, 175, 179

 Show Data by:
 Census Tract
 Neighborhood Tabulation Area

[Demographics](#) [Social](#) [Economic](#) [Housing](#)
Reliability Data
 Show Hide

Search for a Location

 SEARCH TYPE
 Address
 ADDRESS NUMBER

 STREET NAME

 BOROUGH

 Selected Census Tract(s):
 Manhattan 179, 175, 173, 169

Selected Economic Characteristics
 (Grayed values denote less reliable estimates*)

 Selected Tracts

| | Number | | | Percent | |
|---|---------------|------------|------------|--------------|-----|
| | Estimate | MOE | CV* | Estimate | MOE |
| INCOME AND BENEFITS | | | | | |
| Total households | 18,049 | 592 | 2.0 | 100.0 | |
| Less than \$10,000 | 1,224 | 320 | 15.9 | 6.8 | 1.8 |
| \$10,000 to \$14,999 | 524 | 216 | 25.1 | 2.9 | 1.2 |
| \$15,000 to \$24,999 | 531 | 204 | 23.3 | 2.9 | 1.1 |
| \$25,000 to \$34,999 | 914 | 253 | 16.8 | 5.1 | 1.4 |
| \$35,000 to \$49,999 | 1,555 | 345 | 13.5 | 8.6 | 1.9 |
| \$50,000 to \$74,999 | 2,085 | 381 | 11.1 | 11.6 | 2.1 |
| \$75,000 to \$99,999 | 1,729 | 313 | 11.0 | 9.6 | 1.7 |
| \$100,000 to \$149,999 | 3,166 | 480 | 9.2 | 17.5 | 2.6 |
| \$150,000 to \$199,999 | 2,071 | 401 | 11.8 | 11.5 | 2.2 |
| \$200,000 or more | 4,250 | 461 | 6.6 | 23.5 | 2.4 |
| Median household income (dollars) | 105,560 | 4,796 | 2.8 | | |
| Mean household income (dollars) | 177,843 | 8,486 | 2.9 | | |
| With Supplemental Security Income | 699 | 241 | 21.0 | 3.9 | 1.3 |
| With cash public assistance income | 232 | 128 | 33.7 | 1.3 | 0.7 |
| With Food Stamp/SNAP benefits in the past 12 months | 966 | 306 | 19.3 | 5.4 | 1.7 |
| Families | 8,220 | 574 | 4.2 | 100.0 | |
| Less than \$10,000 | 209 | 138 | 40.2 | 2.5 | 1.7 |
| \$10,000 to \$14,999 | 77 | 81 | 63.6 | 0.9 | 1.0 |
| \$15,000 to \$24,999 | 212 | 173 | 49.5 | 2.6 | 2.1 |
| \$25,000 to \$34,999 | 222 | 112 | 30.7 | 2.7 | 1.3 |
| \$35,000 to \$49,999 | 316 | 133 | 25.5 | 3.8 | 1.6 |
| \$50,000 to \$74,999 | 525 | 198 | 22.9 | 6.4 | 2.4 |
| \$75,000 to \$99,999 | 655 | 218 | 20.2 | 8.0 | 2.6 |
| \$100,000 to \$149,999 | 1,617 | 377 | 14.2 | 19.7 | 4.4 |
| \$150,000 to \$199,999 | 1,263 | 361 | 17.4 | 15.4 | 4.3 |
| \$200,000 or more | 3,124 | 399 | 7.8 | 38.0 | 4.1 |
| Median family income (dollars) | 160,965 | 10,655 | 4.0 | | |

Searched Locations

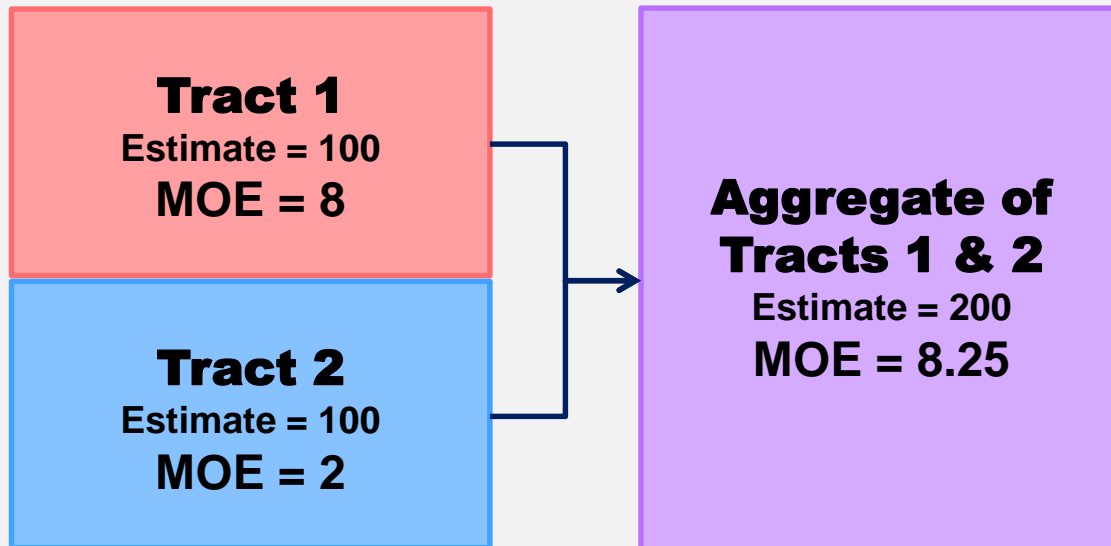
Four Approaches to Error Estimation

| <u>Aggregate MOE Calculated for:</u> | <u>Method of Calculation</u> |
|---|--|
| 1. Count estimates | General approximation formula |
| 2. Percent estimates | General approximation formula and published percent formula |
| 3. Median estimates | Modified ACS PUMS formula |
| 4. Mean estimates | Generalized Variance Functions (GVFs) |

Aggregating Margins of Error (MOEs) Using General Approximation Formula

$$\text{MOE}_{\text{aggregate}} = \sqrt{\sum (\text{MOE}^2 + \text{MOE}^2 + \dots)}$$

Formula = Square root of the sum of the squared MOEs



MoE Calculation

$$= \sqrt{(8^2 + 2^2)}$$

$$= \sqrt{(64 + 4)}$$

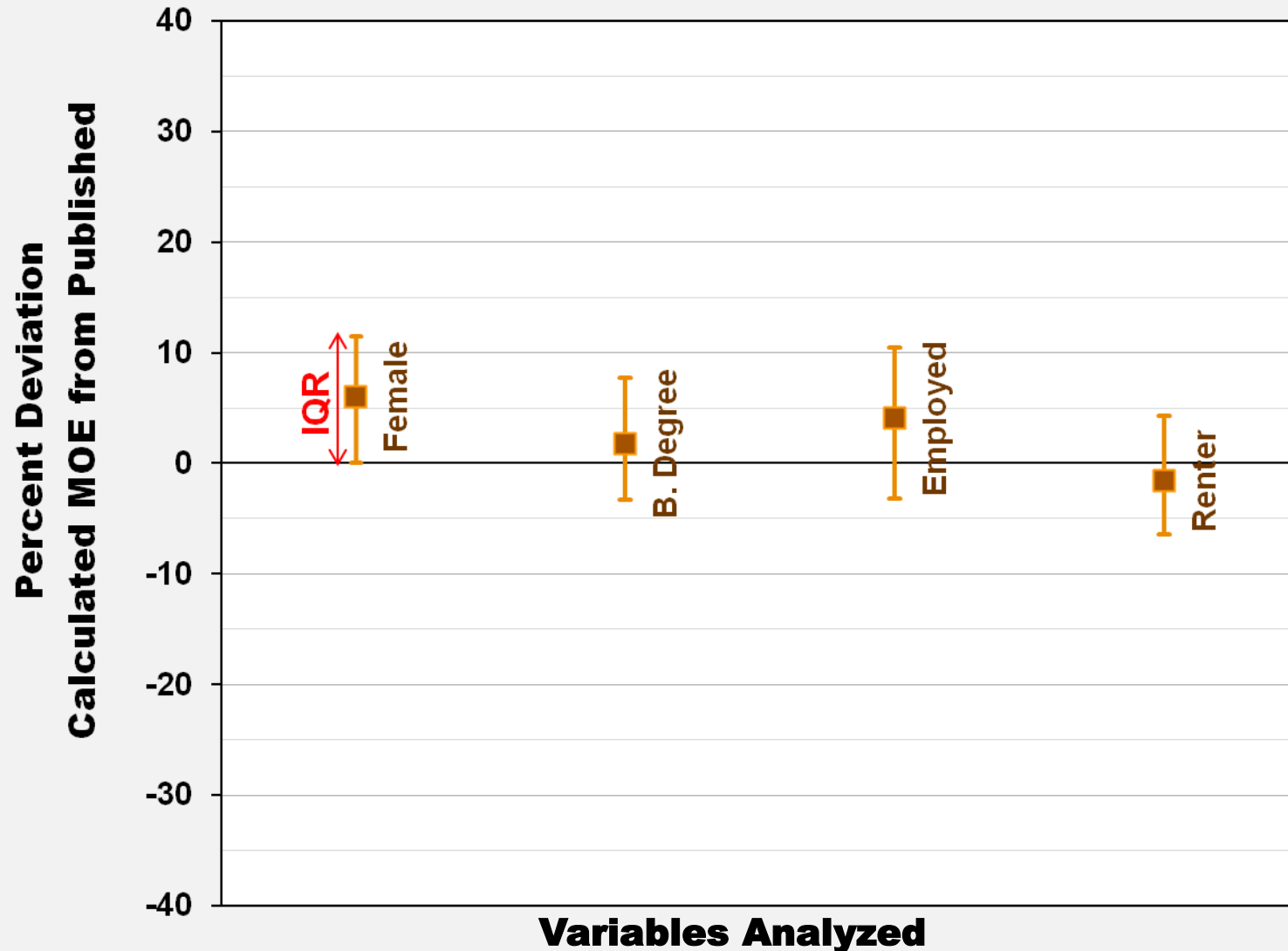
$$= \sqrt{(68)}$$

$$= 8.25$$

Median Percent Deviation from Published MOEs

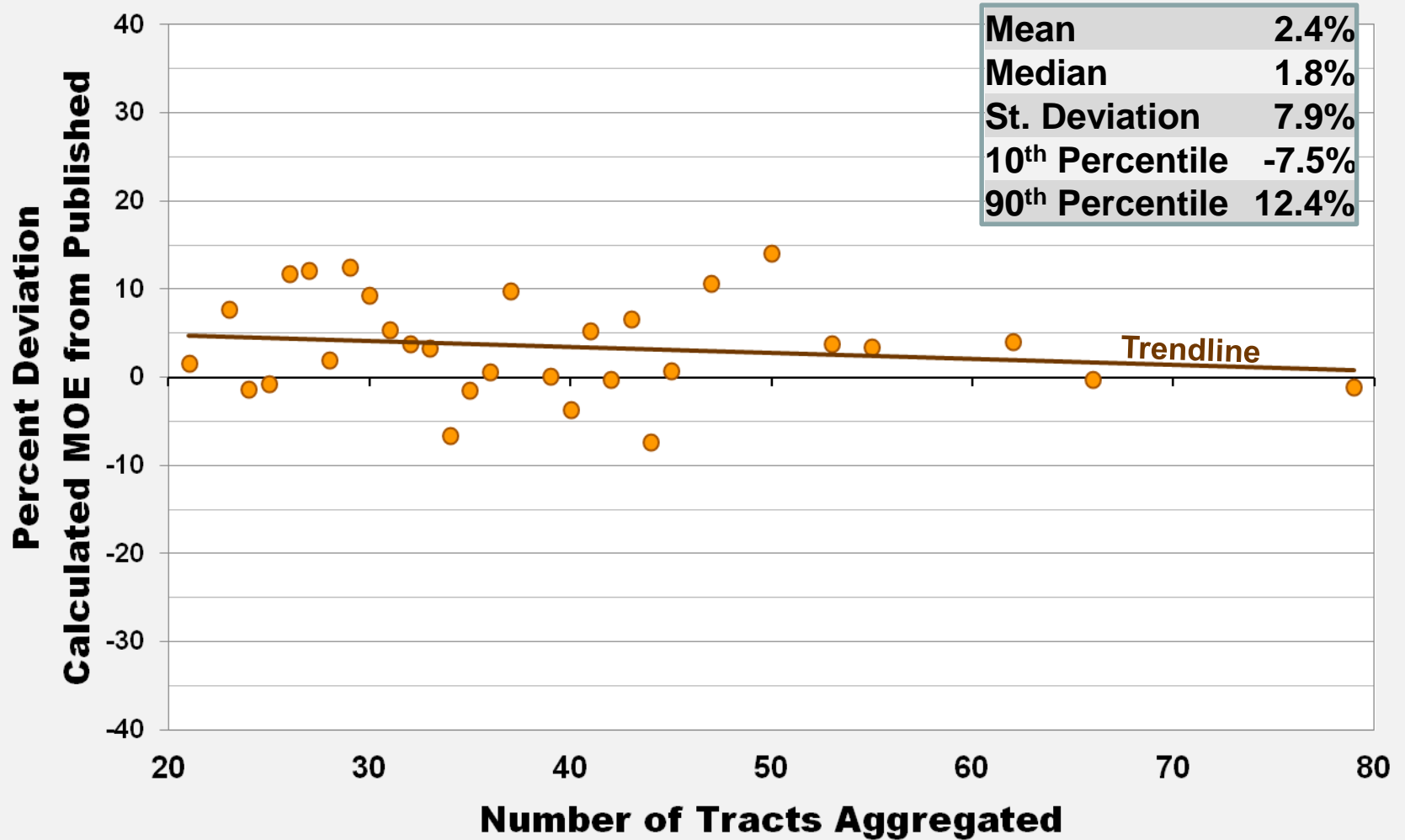
Count Estimates Calculated in NYC Census FactFinder

New York City Tracts to PUMAs, 2009-2013 ACS Summary File



Note: MOEs associated with estimates of zero were omitted.

Average Percent Deviation from Published MOEs Count Estimates for Bachelor's Degree Variable New York City Tracts to PUMAs, 2009-2013 ACS Summary File



Note: MOEs associated with estimates of zero were omitted.

Aggregate Margins of Error for Percentages

General Approximation Formula

$$\text{MOE}_{\text{aggregate}} = \sqrt{\sum (\text{MOE}^2 + \text{MOE}^2 + \dots)}$$

Along with

Percent MOE Formula

Let:

$$P = \frac{A}{B}$$

$$SE(P) = \frac{1}{B} \sqrt{SE(A)^2 - P^2 \times SE(B)^2}$$

If the value under the square root sign is negative, then instead use:

$$SE(P) = \frac{1}{B} \sqrt{SE(A)^2 + P^2 \times SE(B)^2}$$

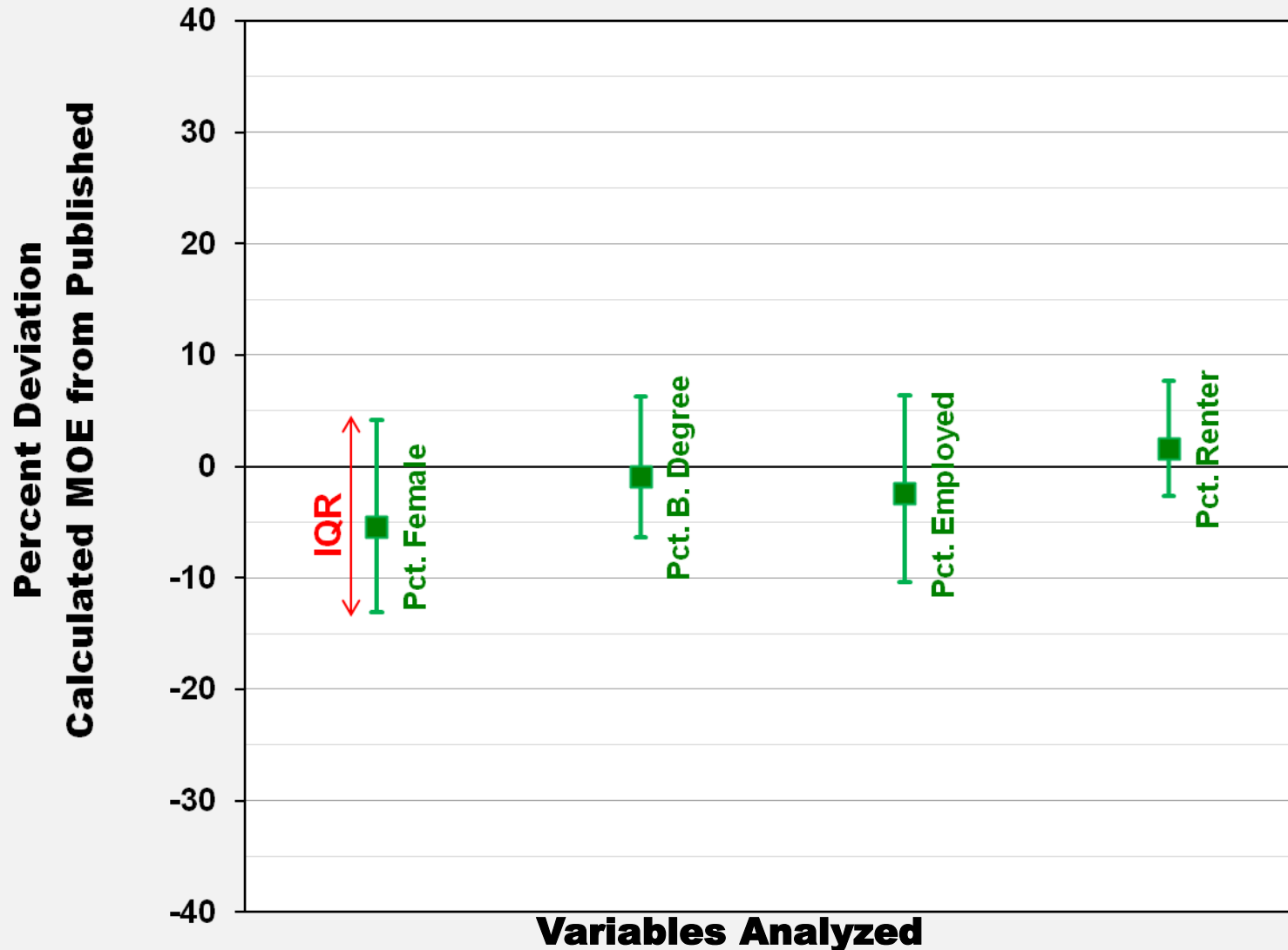
If $P = 1$ then use

$$SE(P) = \frac{SE(A)}{B}$$

Median Percent Deviation from Published MOEs

Percent Estimates Calculated in NYC Census FactFinder

New York City Tracts to PUMAs, 2009-2013 ACS Summary File



Note: MOEs associated with estimates of zero were omitted.

Variables Requiring Modified ACS PUMS Formula to Produce Margins of Error

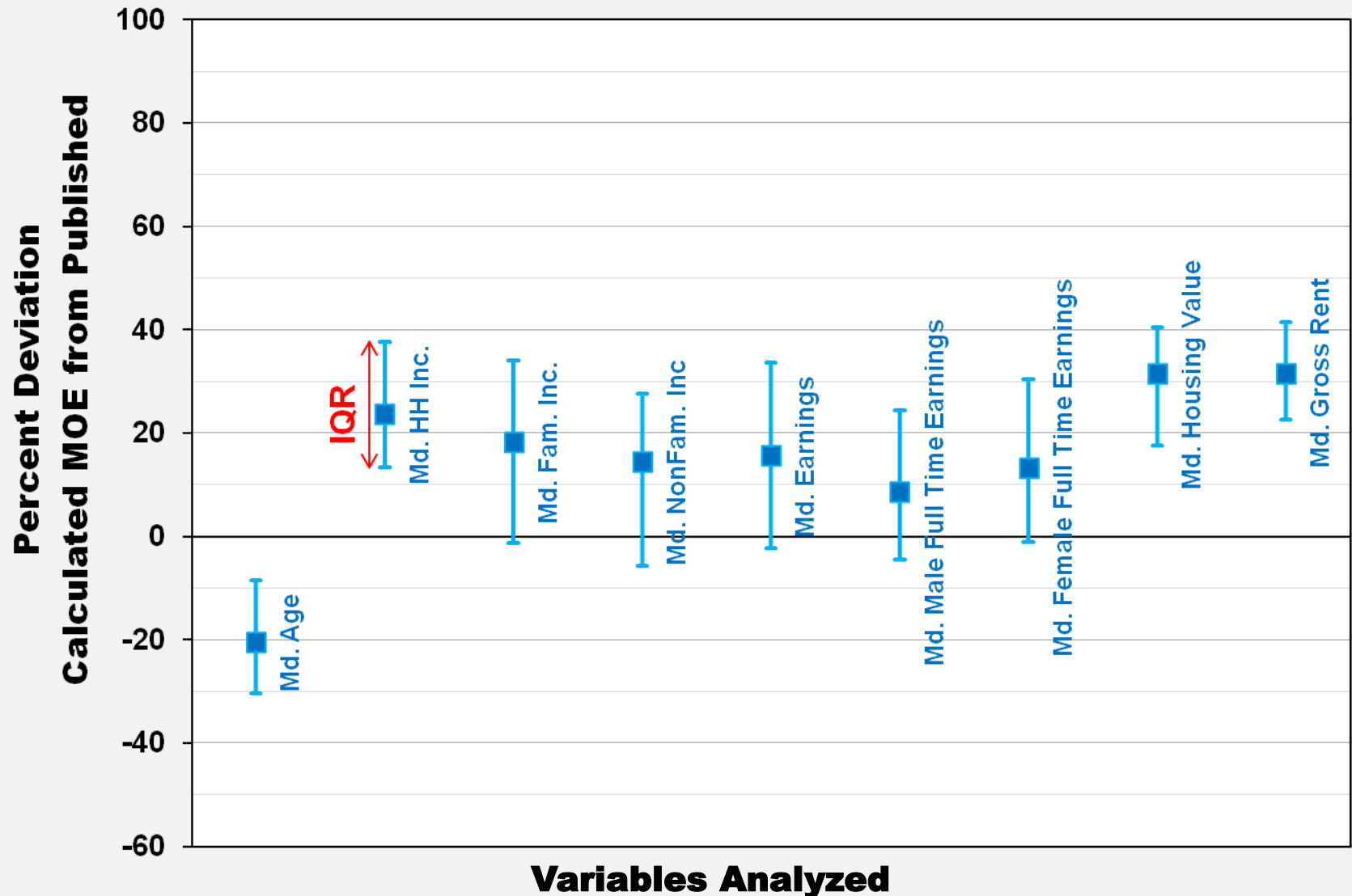
Medians

- 1. Median age (years)**
- 2. Median household income (dollars)**
- 3. Median family income (dollars)**
- 4. Median nonfamily income (dollars)**
- 5. Median earnings for workers (dollars)**
- 6. Median earnings for male full-time, year-round workers (dollars)**
- 7. Median earnings for female full-time, year-round workers (dollars)**
- 8. Median value of owner-occupied units (dollars)**
- 9. Median gross rent of occupied units paying rent (dollars)**

Median Percent Deviation from Published MOEs

Median Estimates Calculated in NYC Census FactFinder

New York City Tracts to PUMAs, 2009-2013 ACS Summary File

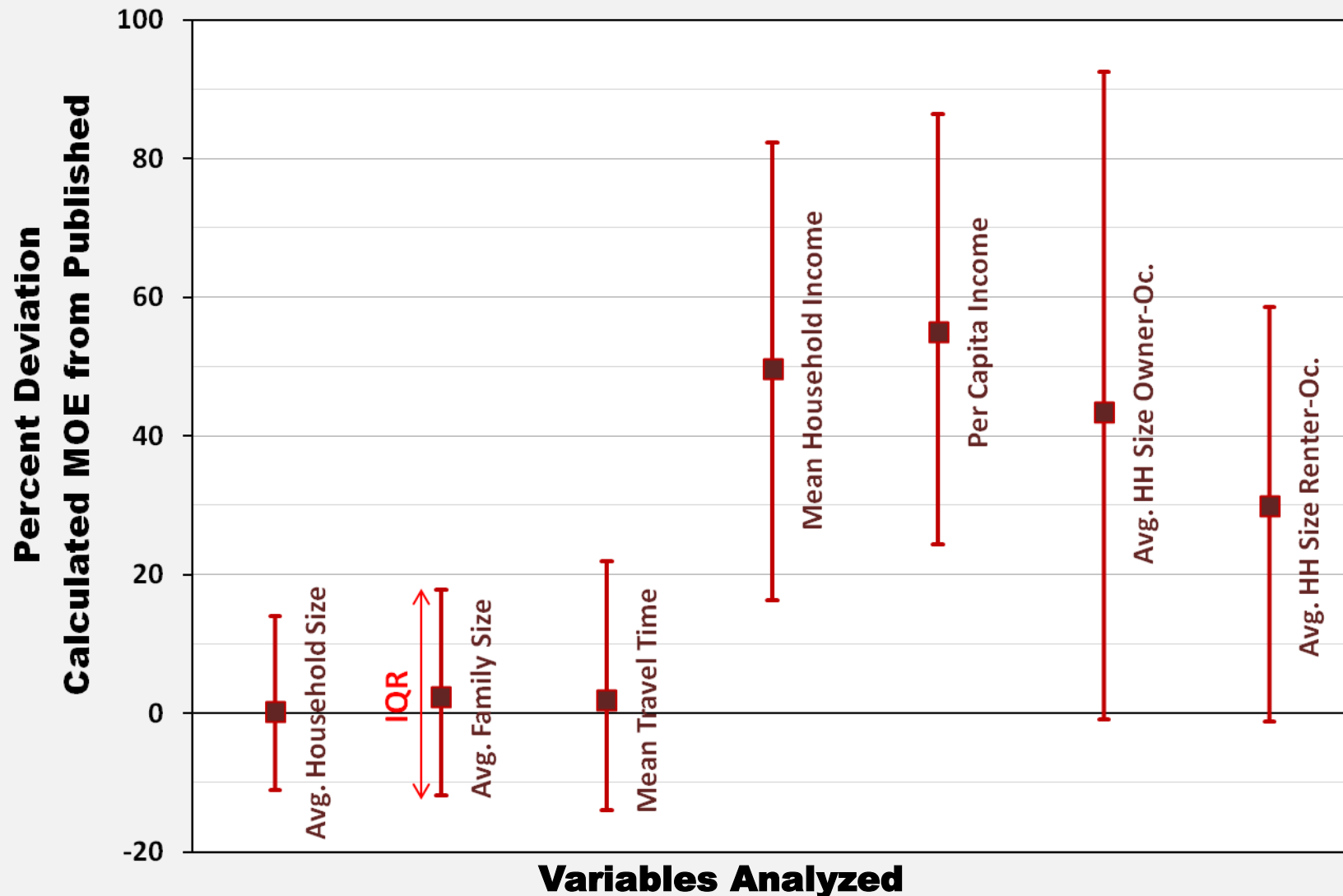


Variables Requiring Generalized Variance Functions (GVFs) to Produce Margins of Error

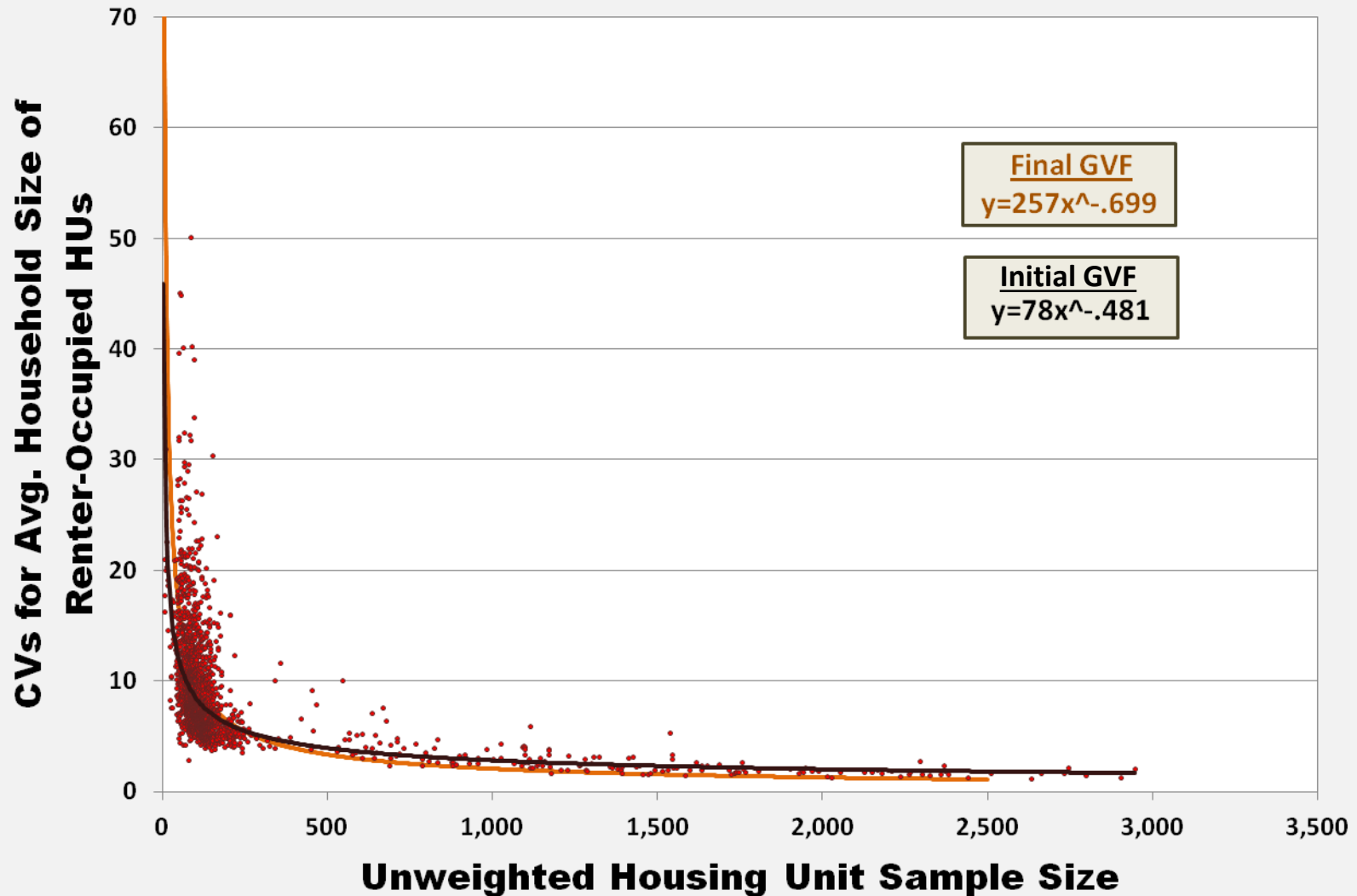
Means

- 1. Average household size**
- 2. Average family size**
- 3. Mean travel time to work (minutes)**
- 4. Mean household income (dollars)**
- 5. Per capita income (dollars)**
- 6. Average household size of owner-occupied unit**
- 7. Average household size of renter-occupied unit**

Median Percent Deviation from Published MOEs Mean Estimates Calculated in NYC CFF New York City Tracts & ZCTAs, 2009-2013 ACS Summary File



Coefficient of Variation (CV) for Average Household Size of Renter Occupied Housing Units by Housing Unit Sample Size New York City Tracts and ZCTAs, 2009-2013 ACS



Conclusions

- **Count estimate MOEs produced using the general approximation formula do not vary greatly from published MOEs in New York City**
- **There is little correlation between number of tracts aggregated and deviation from published MOEs**
- **MOEs for percents using general approximation and percent MOE formulas do not vary greatly from published MOEs**
- **Alternatives to general approximation formulas, including Generalized Variance Functions and modified PUMS formulas, can be used to produce reasonably reliable error estimates**
- **These approaches to MOE estimation can be used with confidence in aggregating ACS data, but we encourage further research that evaluates these approaches in other geographies**

Web Links

- **New York City Department of City Planning Population Division website:**
www.nyc.gov/population
- **New York City Census FactFinder:**
maps.nyc.gov/census/

