Should we change how we measure change? Longitudinal versus serial cross-sectional data from a NYC housing survey

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MEASUREMENT ERROR IN LONGITUDINAL DATA WORKSHOP
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Two basic ways to measure net change over time:

Repeated cross-sections
- Representative at a given timepoint
- More accurate picture of changing populations
- But cannot distinguish between compositional changes (people moving out of or into an area) and changes within a constant composition (increases in wages for a given sampled household, or increases in rent for a single unit);

Longitudinal/panel data
- Measures change at an individual level (not just aggregate)
- Allows causal models and deeper understanding of social and economic processes
- But not necessarily representative at any given timepoint
  - (Non-random?) attrition, which grows over time
  - Doesn't capture newer additions (unless refreshed)

New York City Housing and Vacancy Survey (NYCHVS)

- Longest running housing survey in US, conducted about every three years by the US Census Bureau since 1965

- Representative survey that collects information about NYC housing stock and population

- Allows either approach to measuring change

- Complex, longitudinal sample design that follows the same **housing units** throughout a decade with sample additions/updates each cycle

- Each cycle (1991, 1993, 1996, 1999) is designed to be a representative cross-section
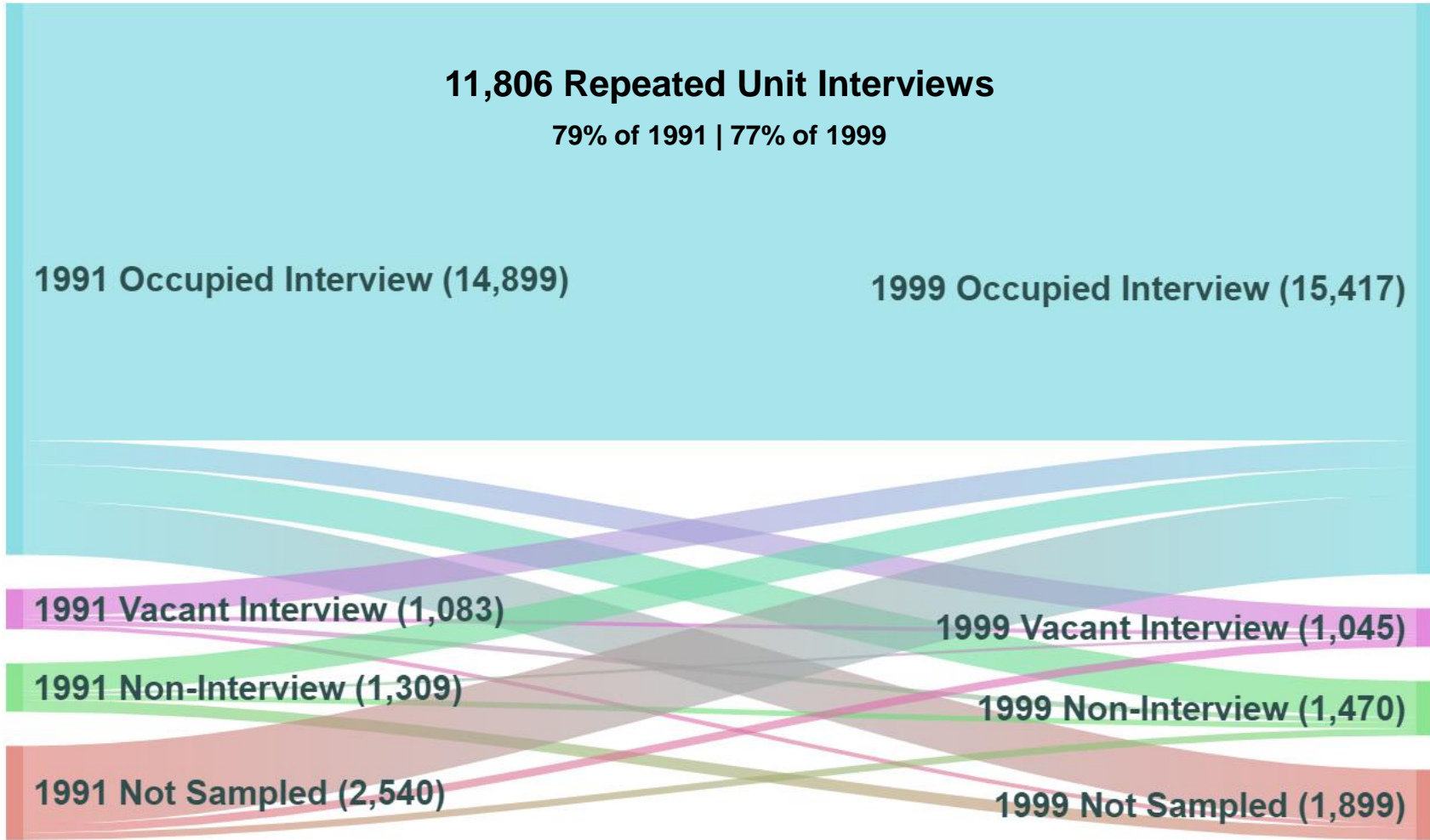
Motivation

- NYCHVS users often at various geographies by comparing cross-section point estimates from different survey cycles.

- Other NYCHVS users exploit the panel structure to measure change within units/households over time.
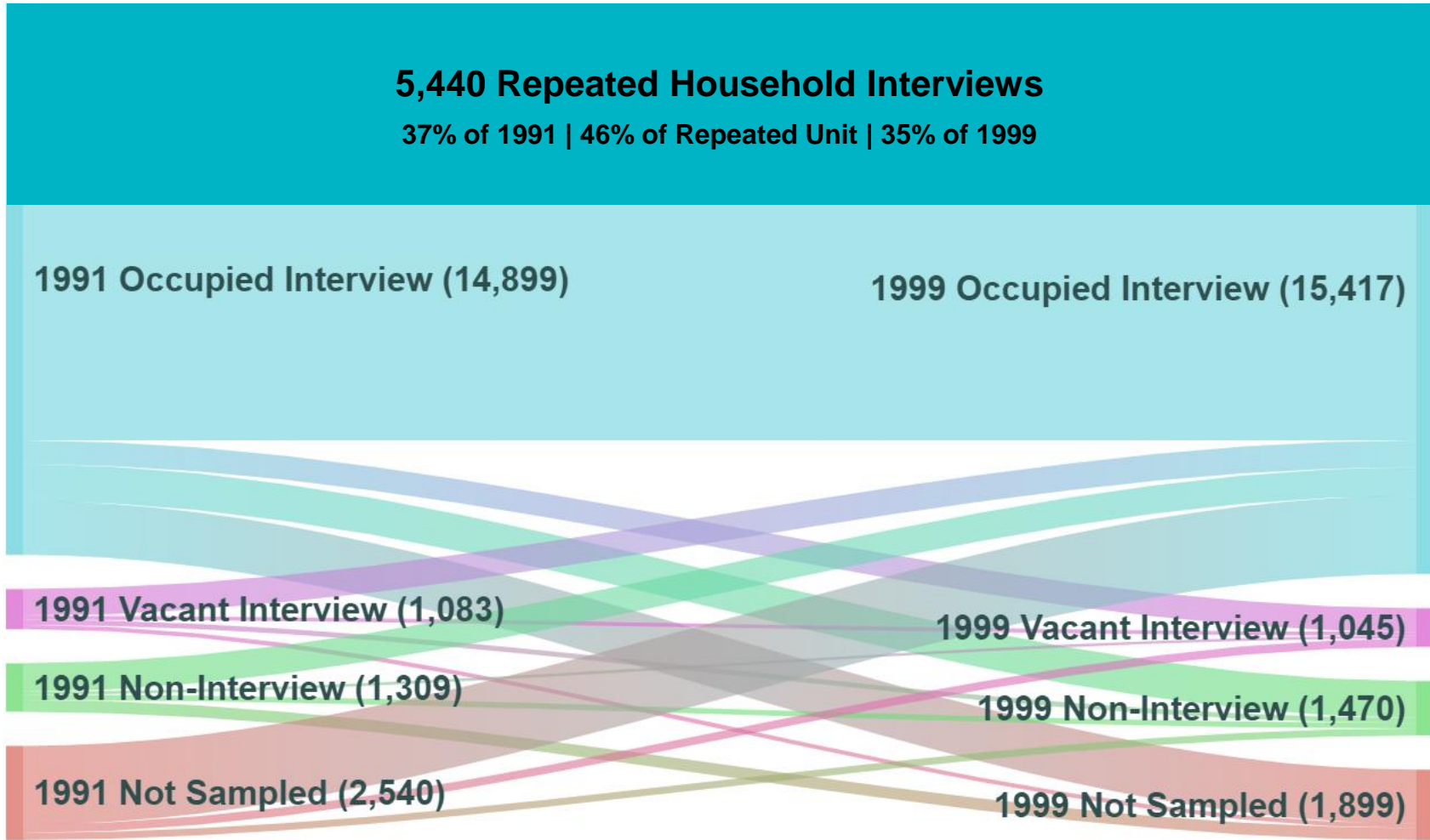
- But are these panel units representative?

Research Questions

1. Does restricting representative cross-sectional data to the subset that comprise the panel produce different estimates?

2. Do estimates of change vary when measured as an average of individual panel differences as compared to the difference of repeated cross-sectional averages?

3. How sensitive are estimates of change to the composition of the panel?

11,806 Repeated Unit Interviews

79% of 1991 | 77% of 1999

1991 Occupied Interview (14,899)

1999 Occupied Interview (15,417)

1991 Vacant Interview (1,083)

1999 Vacant Interview (1,045)

1991 Non-Interview (1,309)

1999 Non-Interview (1,470)

1991 Not Sampled (2,540)

1999 Not Sampled (1,899)

5,440 Repeated Household Interviews

37% of 1991 | 46% of Repeated Unit | 35% of 1999

1991 Occupied Interview (14,899)

1999 Occupied Interview (15,417)

1991 Vacant Interview (1,083)

1999 Vacant Interview (1,045)

1991 Non-Interview (1,309)

1999 Non-Interview (1,470)

1991 Not Sampled (2,540)

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Unit Characteristics

- Number of rooms

- Renter-occupied

- Monthly rent (top-coded)

Household Characteristics

- Household Size
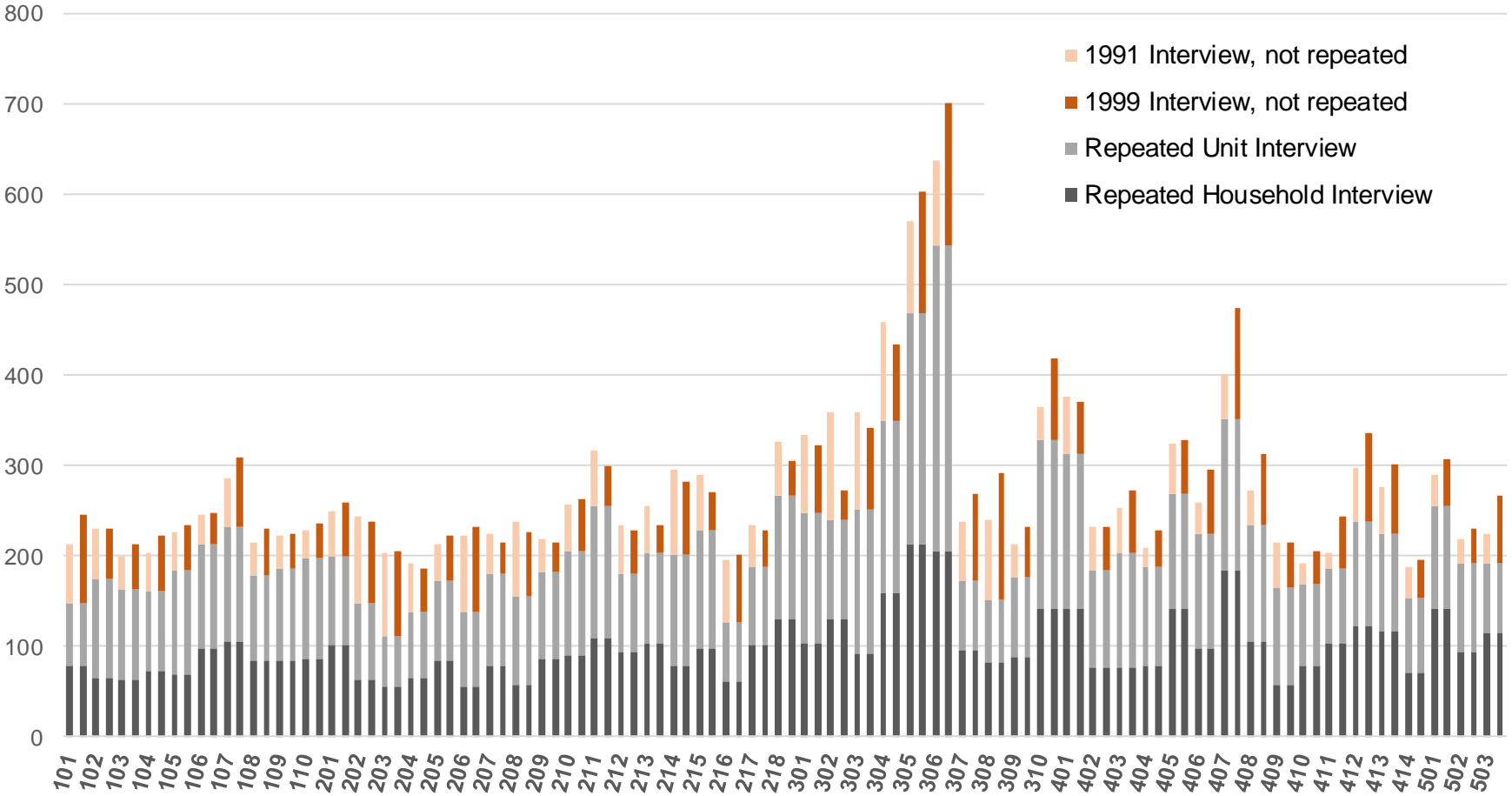
- Living with partner

- Household Income

Data: Neighborhood Sample Sizes

Number of Observations,
by Sub-Borough Area and Survey Cycle

■ 1991 Interview, not repeated
■ 1999 Interview, not repeated
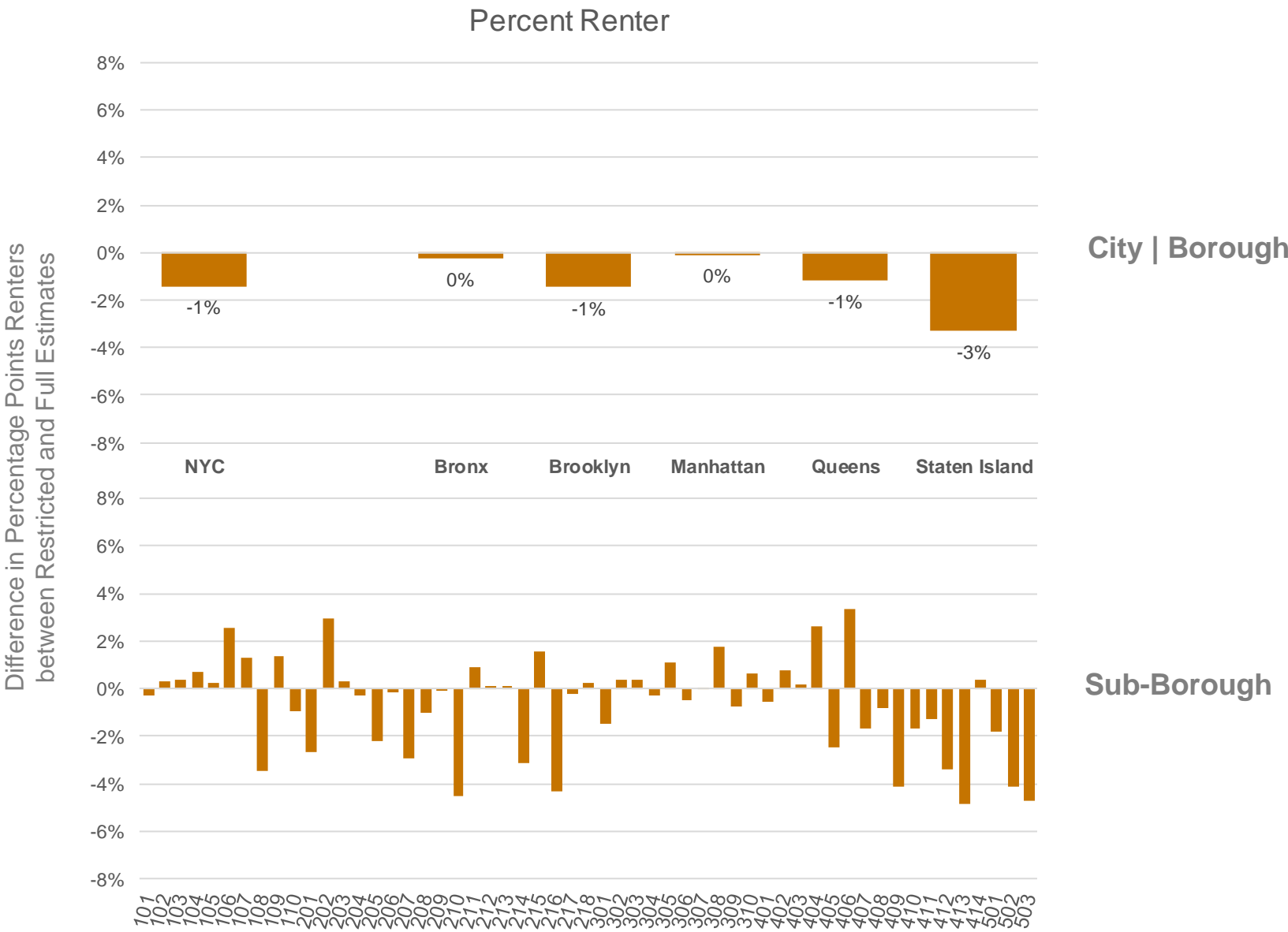■ Repeated Unit Interview
■ Repeated Household Interview

Full vs. Restricted Estimates

1. Does restricting representative cross-sectional data to the subset that comprise the panel produce different estimates?

2. Do estimates of change vary when measured as an average of individual panel differences as compared to the difference of repeated cross-sectional averages?

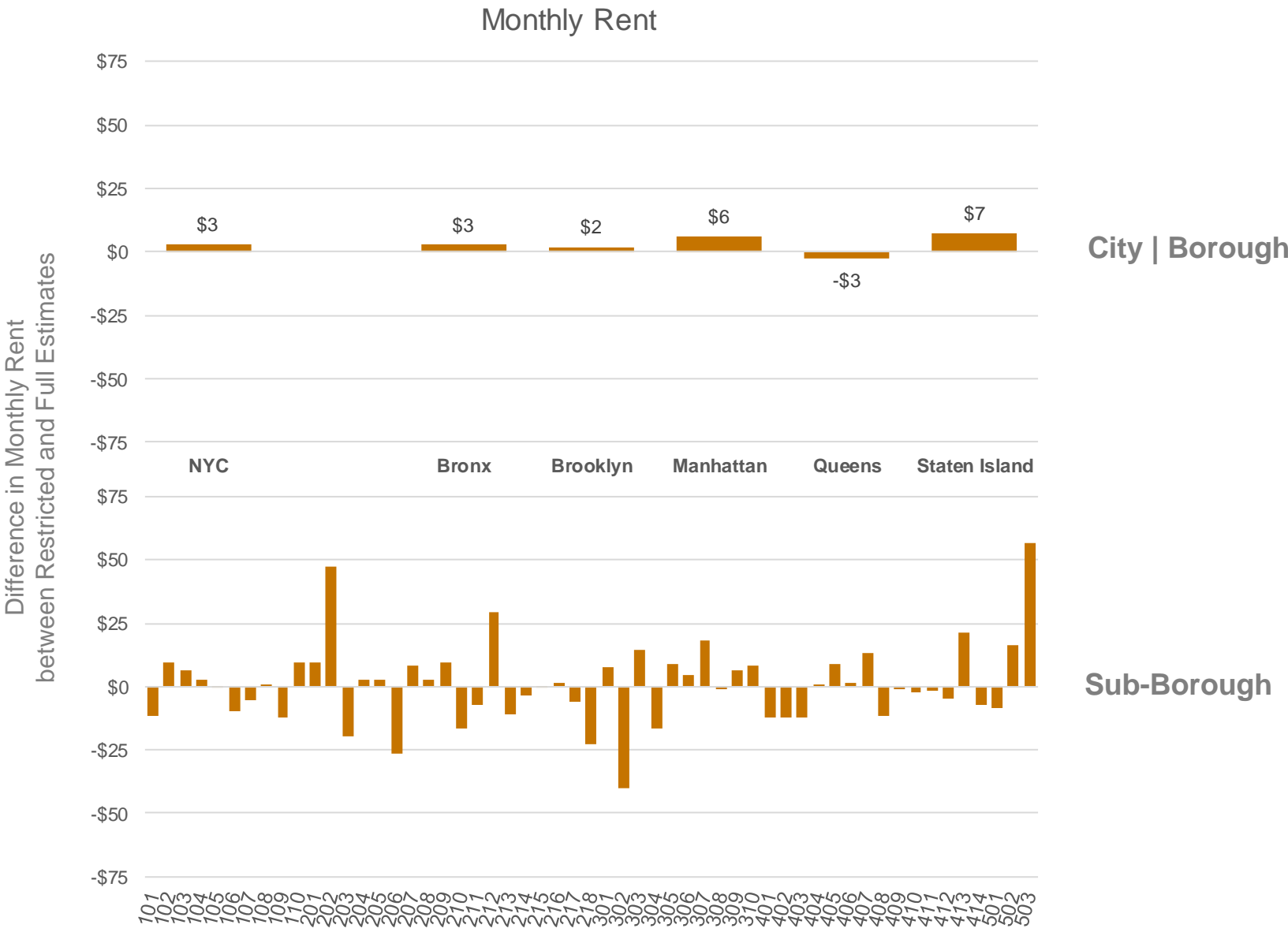3. How sensitive are estimates of change to the composition of the panel?
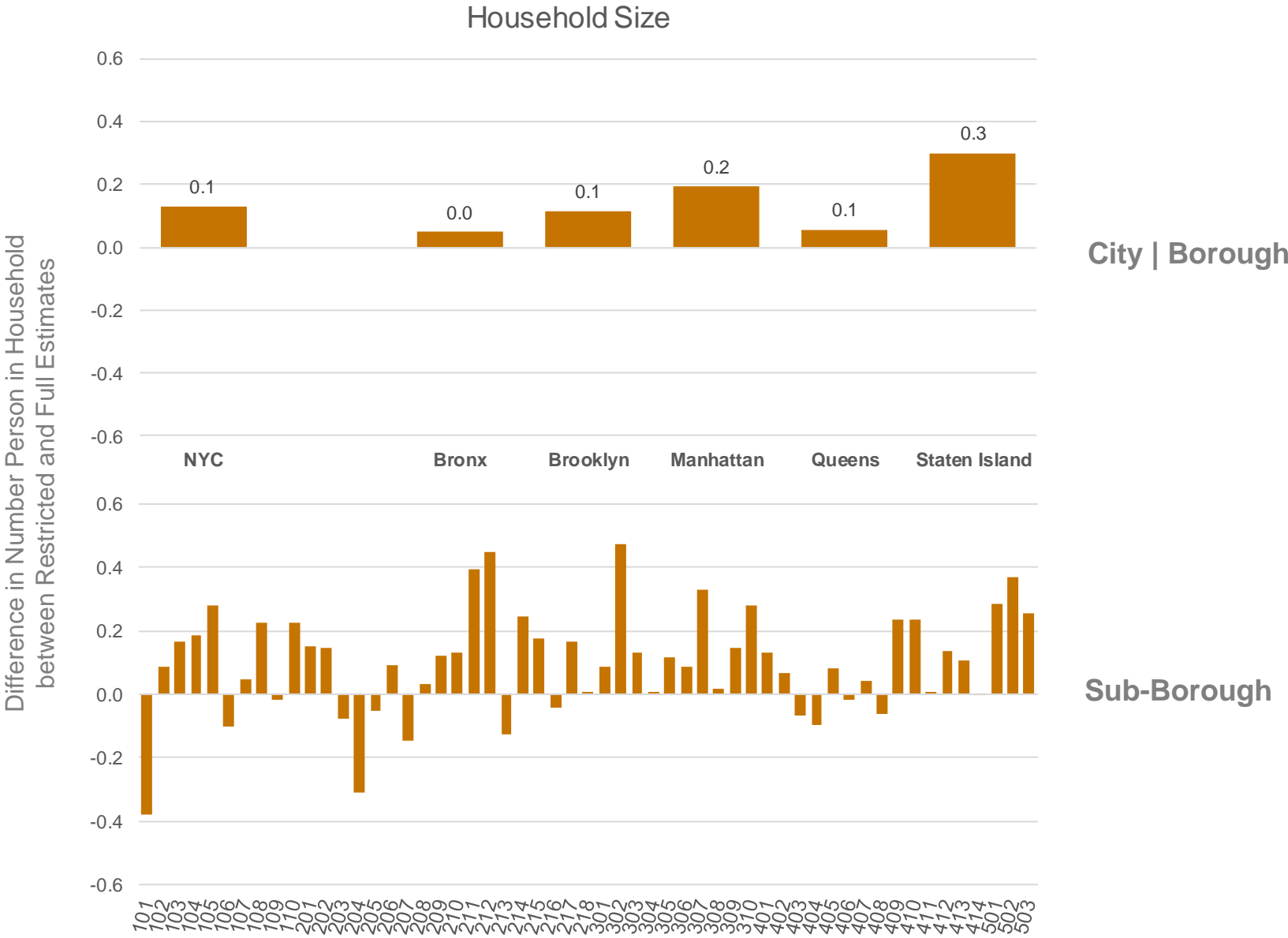
Full vs. Restricted Estimates, Unit

Number of Rooms

Full vs. Restricted Estimates, Unit
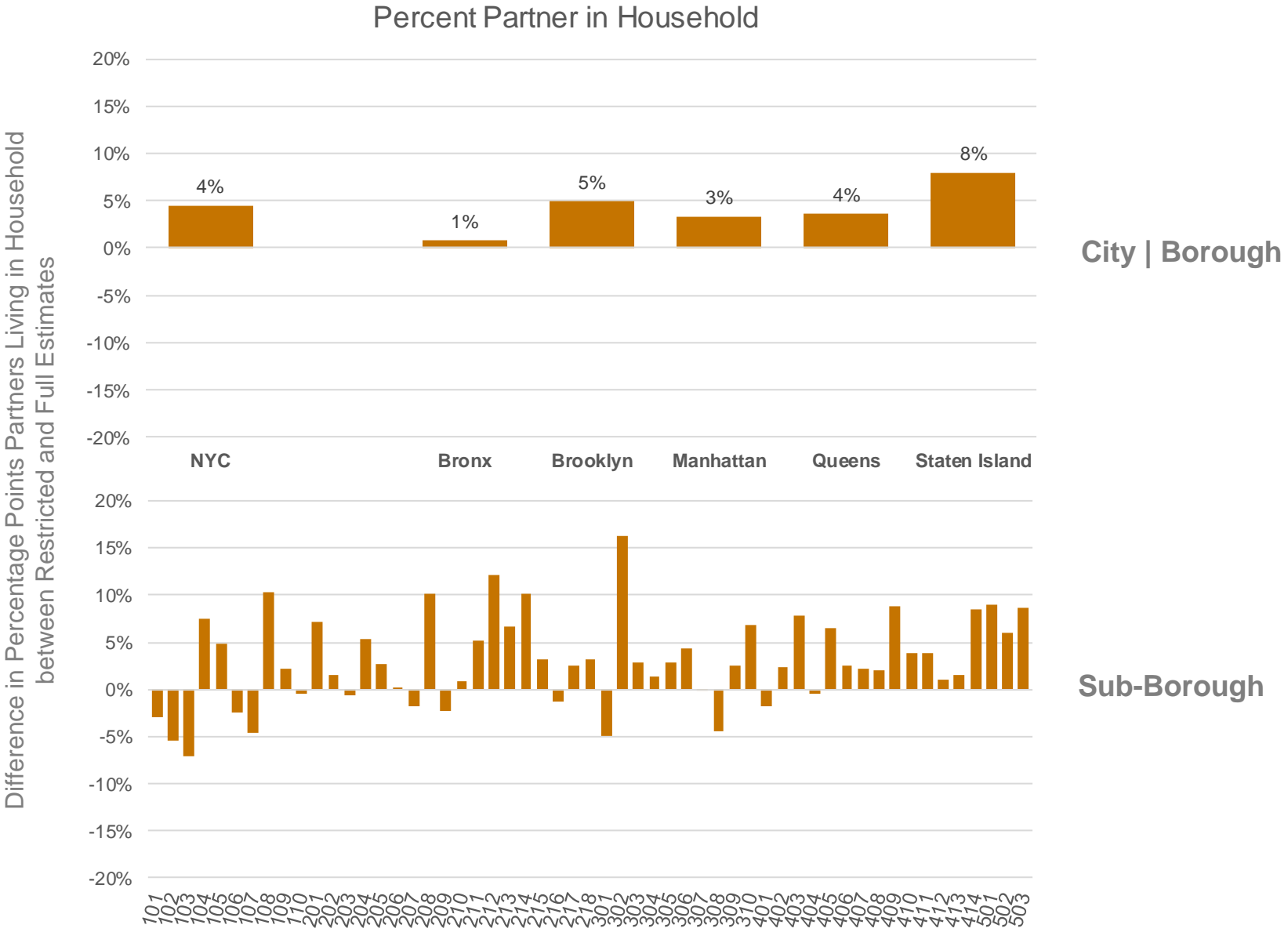

Percent Renter

Full vs. Restricted Estimates, Unit

Monthly Rent

Difference in Monthly Rent between Restricted and Full Estimates

City | Borough: NYC $3, Bronx $3, Brooklyn $2, Manhattan $6, Queens -$3, Staten Island $7

Sub-Borough

Full vs. Restricted Estimates, Household

Household Size

Full vs. Restricted Estimates, Household

Percent Partner in Household

Difference in Percentage Points Partners Living in Household between Restricted and Full Estimates

City | Borough

NYC: 4%
Bronx: 1%
Brooklyn: 5%
Manhattan: 3%
Queens: 4%
Staten Island: 8%

Sub-Borough

Full vs. Restricted Estimates, Household

Household Income

Difference in Household Income (1991 $) between Restricted and Full Estimates

City | Borough

| NYC	Bronx	Brooklyn	Manhattan	Queens	Staten Island
$1,736	$2,023	$1,990	-$2,726	$2,647	$5,924

Sub-Borough

Full vs. Restricted Estimates

- At NYC- and borough-level, estimates restricted to **unit panel** cases interviewed again in 1999 are relatively congruent with full cross-section.

- But smaller area neighborhood estimates can be rather different when restricted.

- Restricting even further to **panel households** interviewed again, estimates are less congruent.

- Estimating representative change using longitudinal panel may be possible—at least City- or borough-wide, particularly for **unit characteristics**.
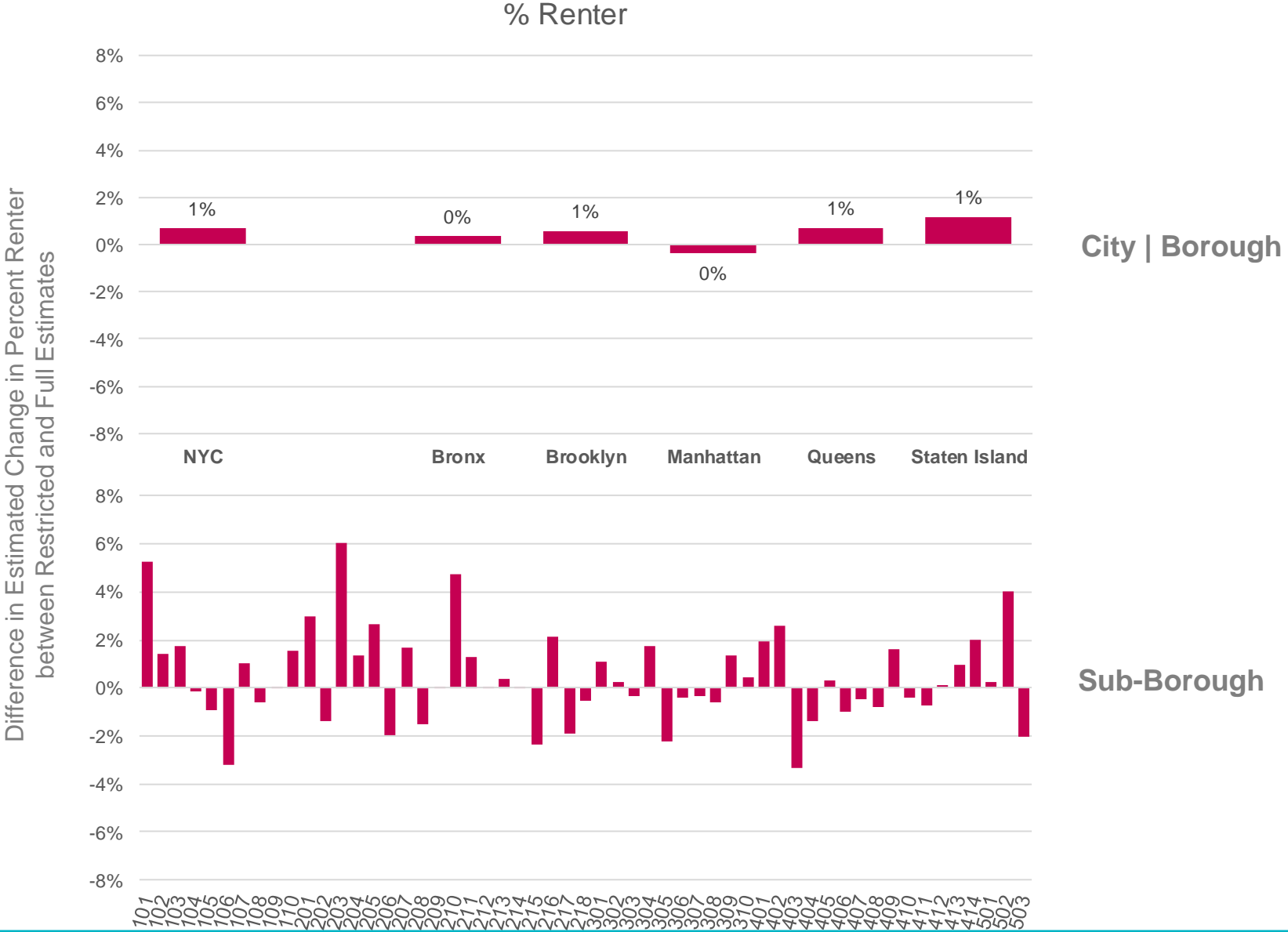
Differences in Panel Estimates of Change

1. Does restricting representative cross-sectional data to the subset that comprise the panel produce different estimates?

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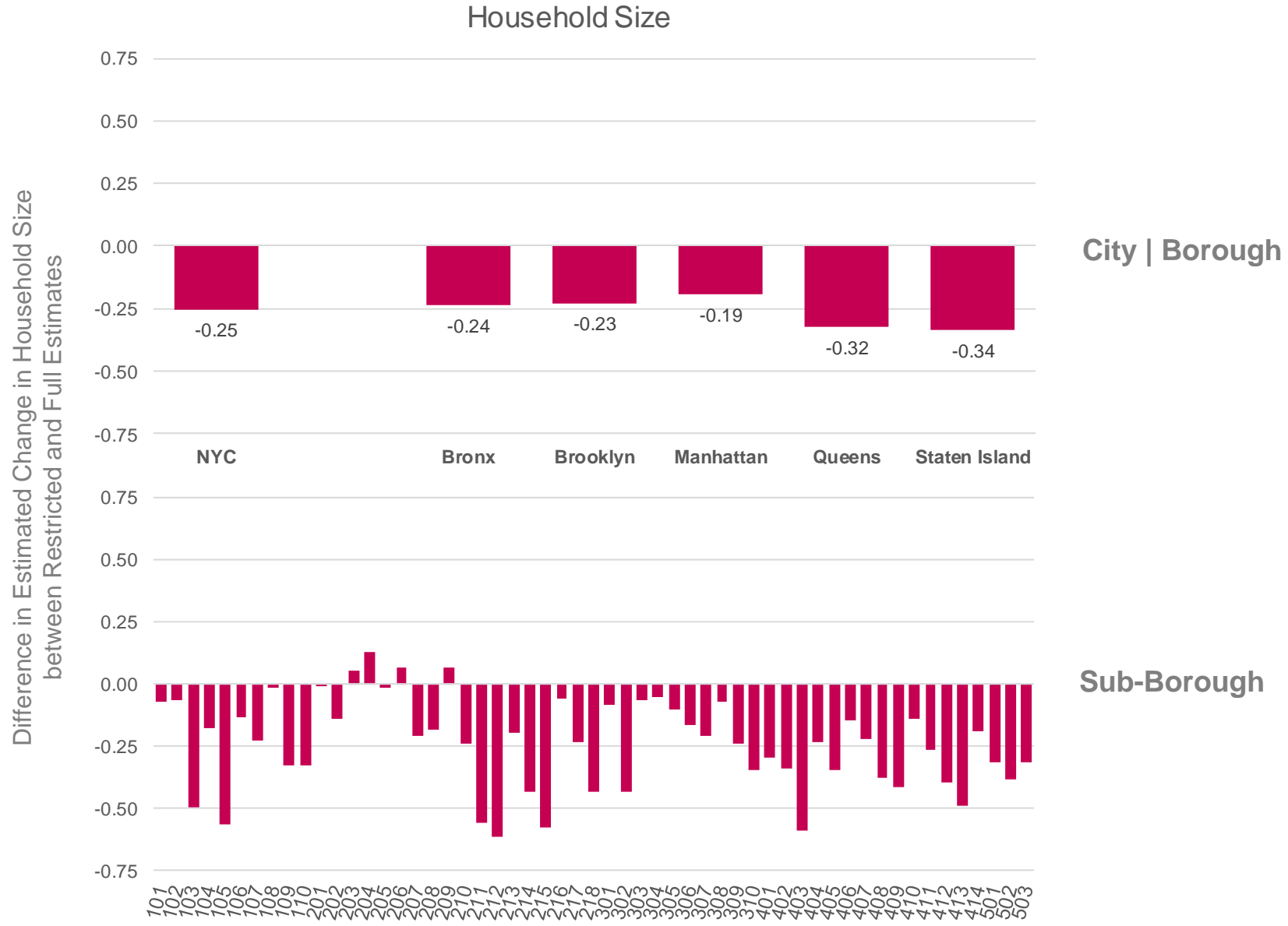
Differences in Unit Panel Estimates of Change
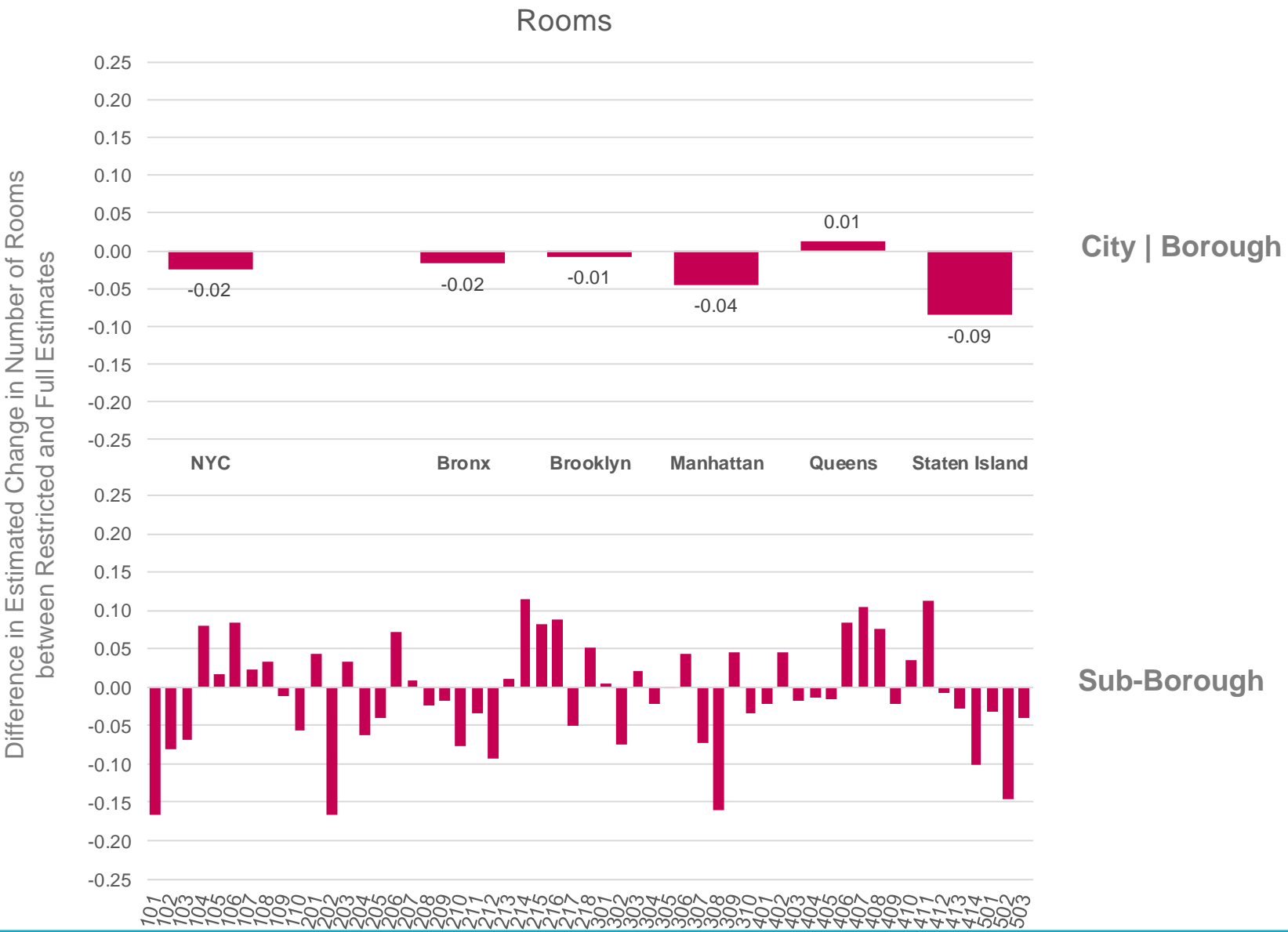
Rooms

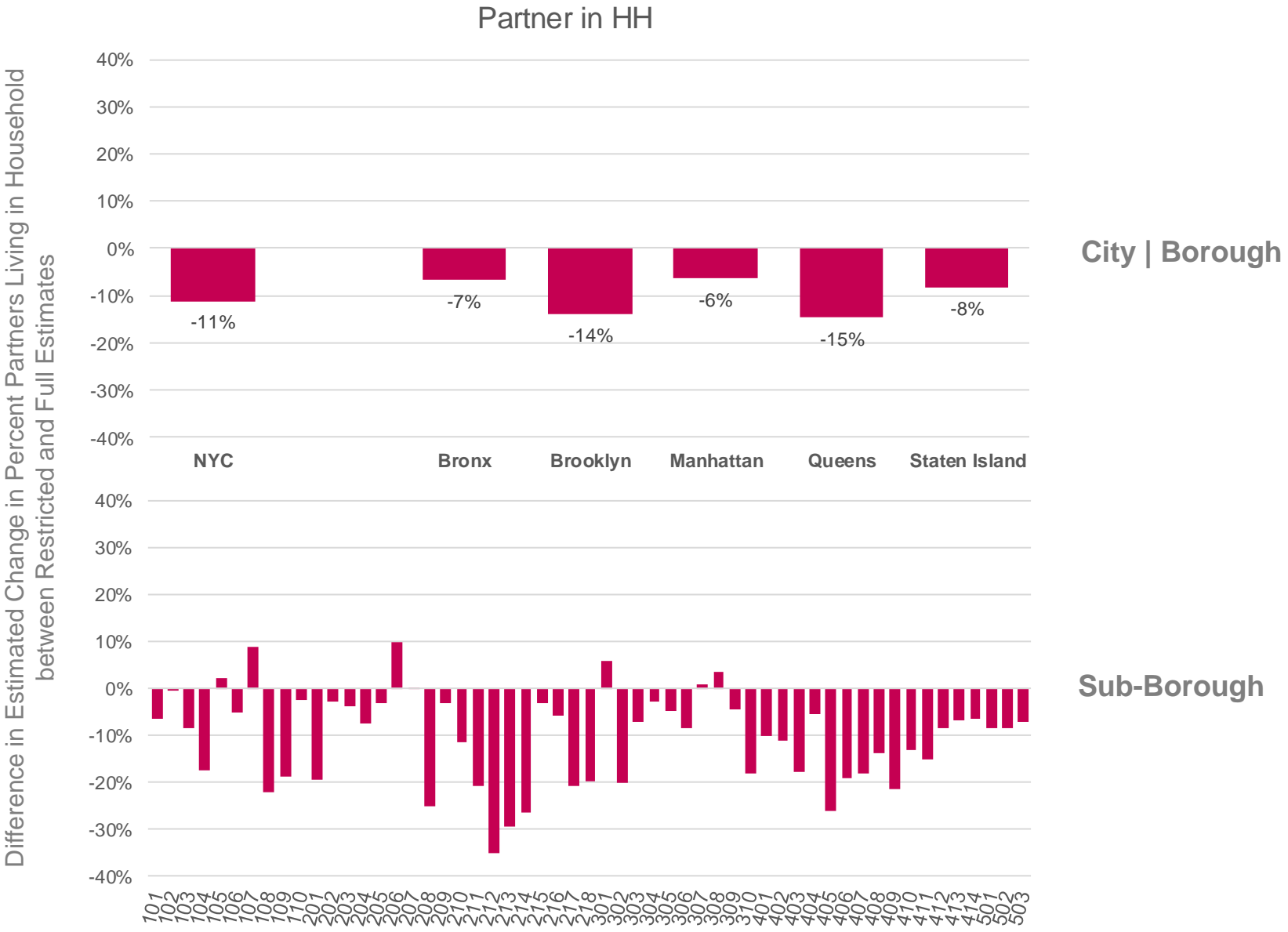# Differences in Unit Panel Estimates of Change

% Renter

Differences in Unit Panel Estimates of Change

Rent

Differences in Household Panel Estimates of Change

Household Size

Differences in Household Panel Estimates of Change

Partner in HH

City | Borough

Sub-Borough

Difference in Estimated Change in Percent Partners Living in Household between Restricted and Full Estimates

NYC -11%
Bronx -7%
Brooklyn -14%
Manhattan -6%
Queens -15%
Staten Island -8%

Differences in Household Panel Estimates of Change

Household Income

Difference in Estimated Change in Household Income (nominal $) between Restricted and Full Estimates

City | Borough

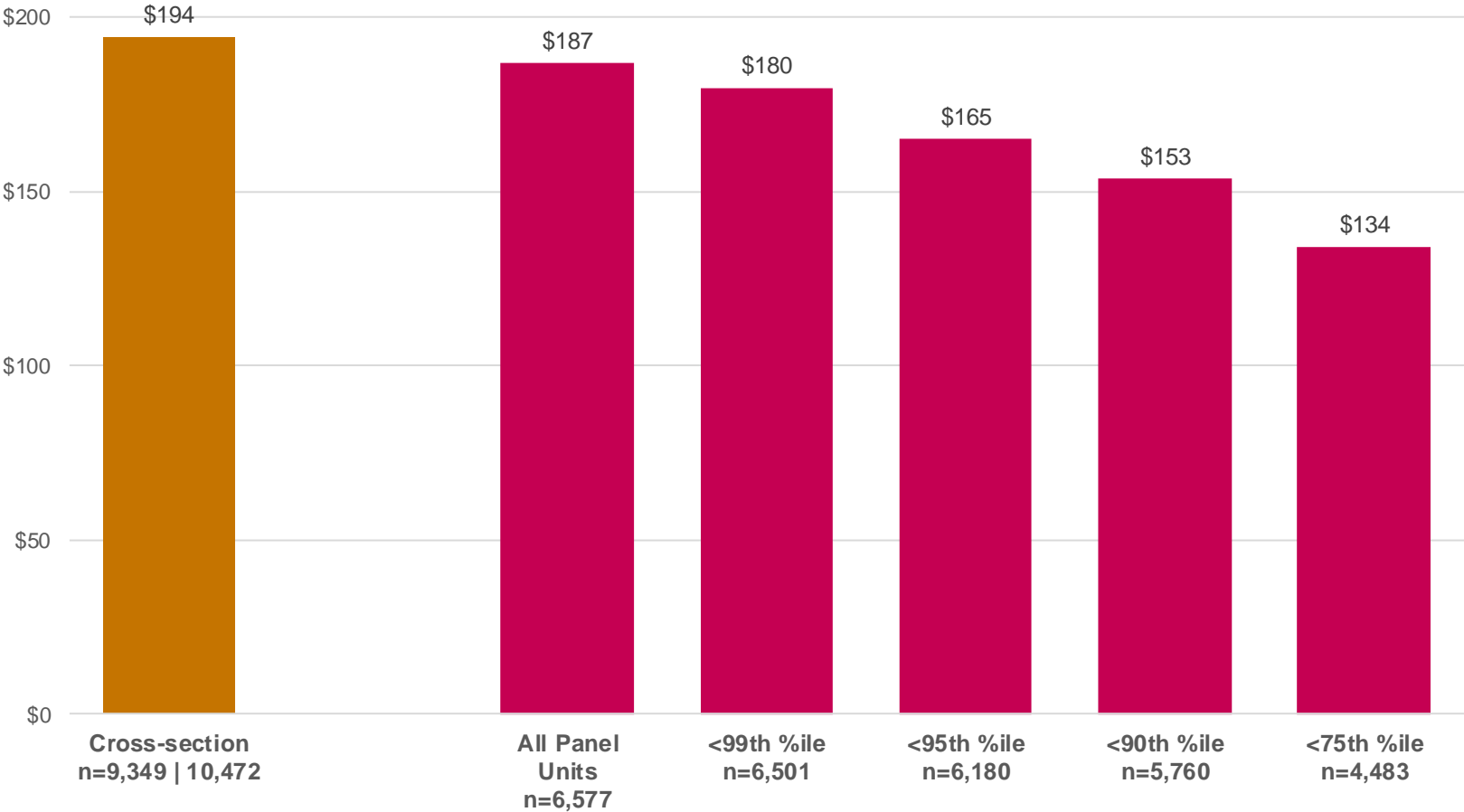Sub-Borough
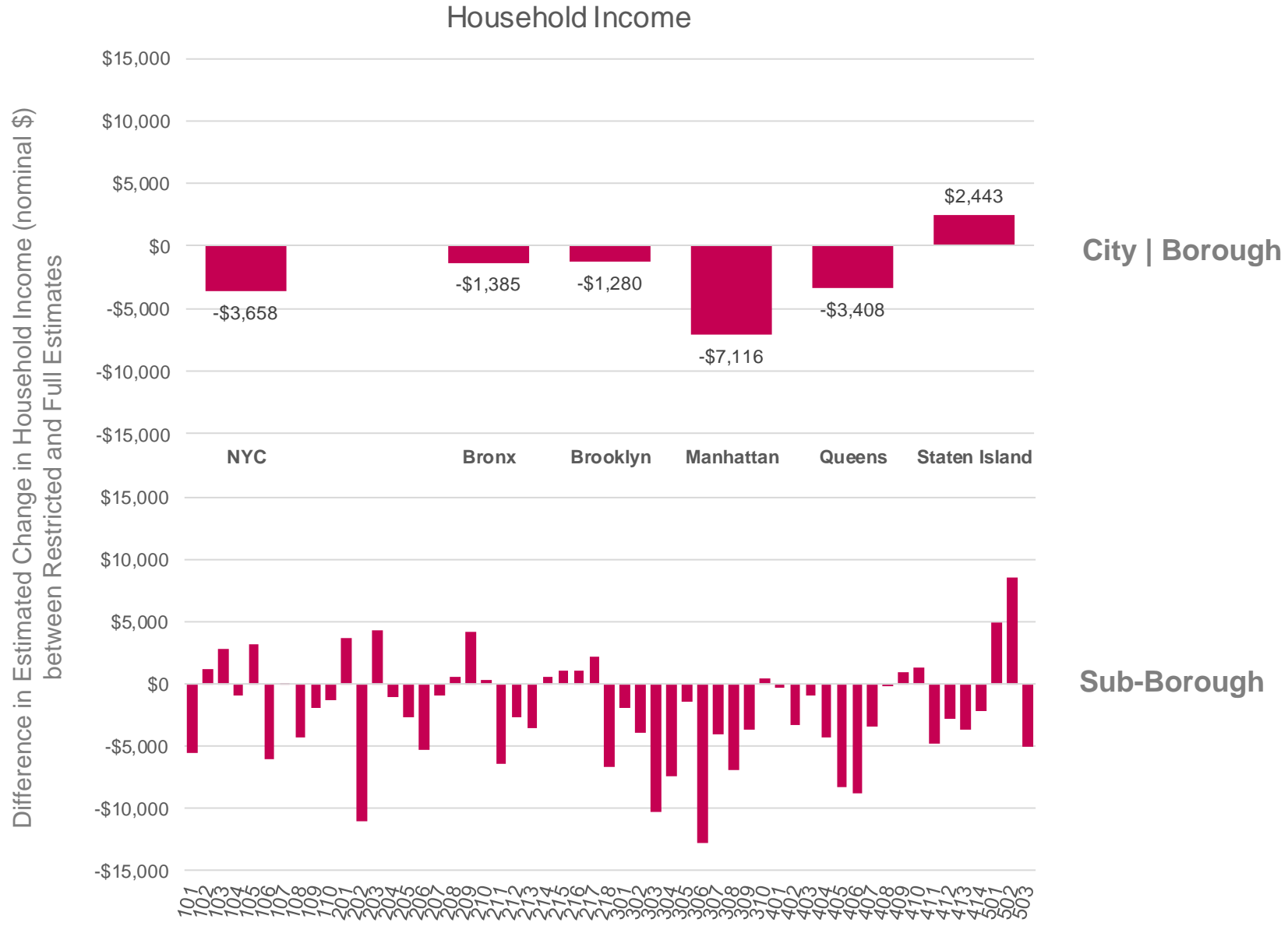
Differences in Panel Estimates of Change

- At NYC- and (generally) borough-level, whether estimating change via serial cross-section or **panel units**, results are essentially the same.

- Different methods of estimating change at the neighborhood level can yield different results.

- **Household panel** change estimates generally not congruent with overall cross-section estimates at all geographies.
  - May be because of non-representativeness in panel composition or because actual household change is obscured in aggregate

- Some assurance that using **unit panel** may be relatively representative of the full cross-section.

Sensitivity of Differences in Panel Estimates of Change

1. Does restricting representative cross-sectional data to the subset that comprise the panel produce different estimates?

2. Do estimates of change vary when measured as an average of individual panel differences as compared to the difference of repeated cross-sectional averages?

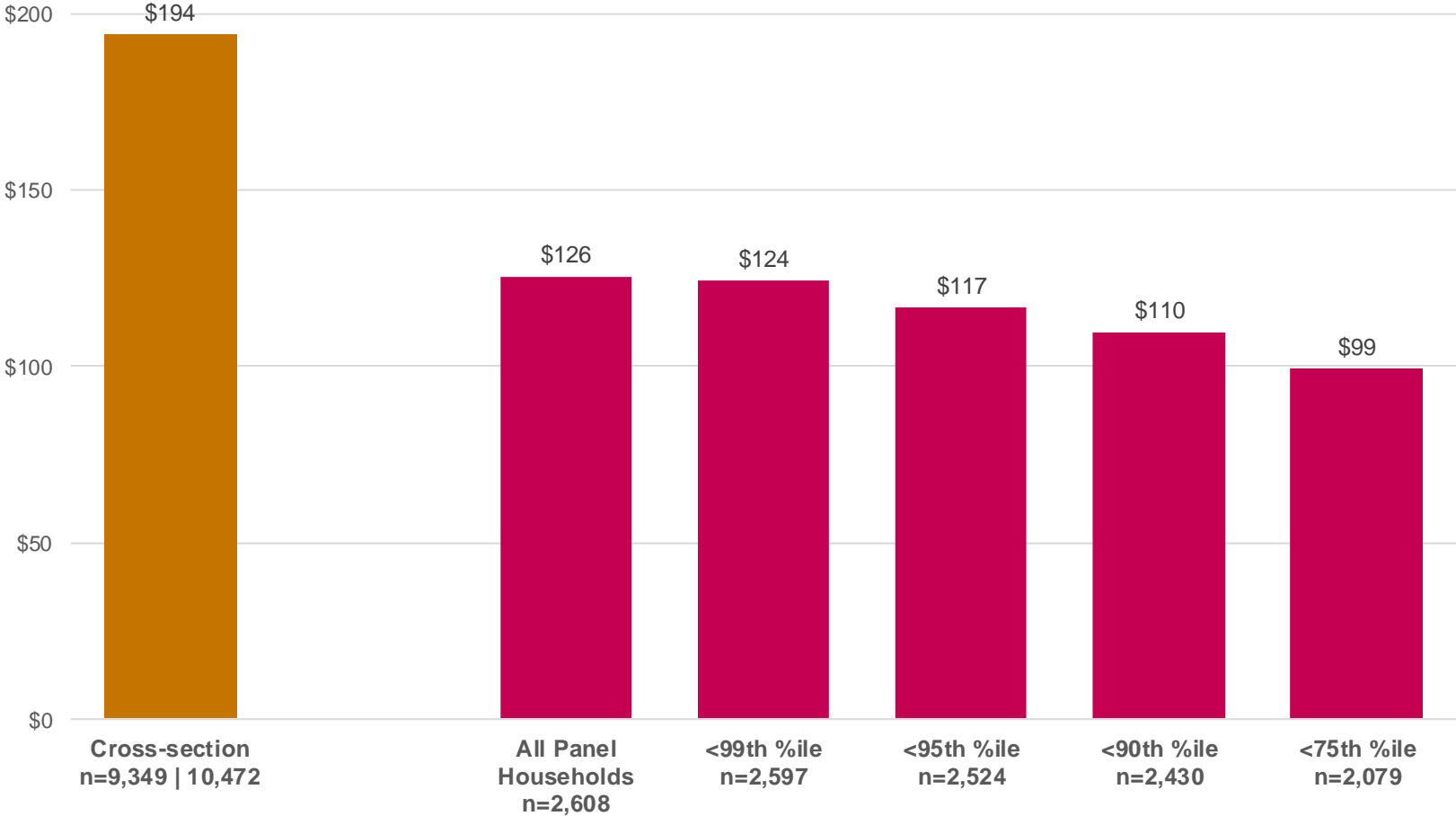3. How sensitive are estimates of change to the composition of the panel?

Sensitivity of Differences in Panel Estimates of Change

Average Increase in Monthly Rent among Panel Units

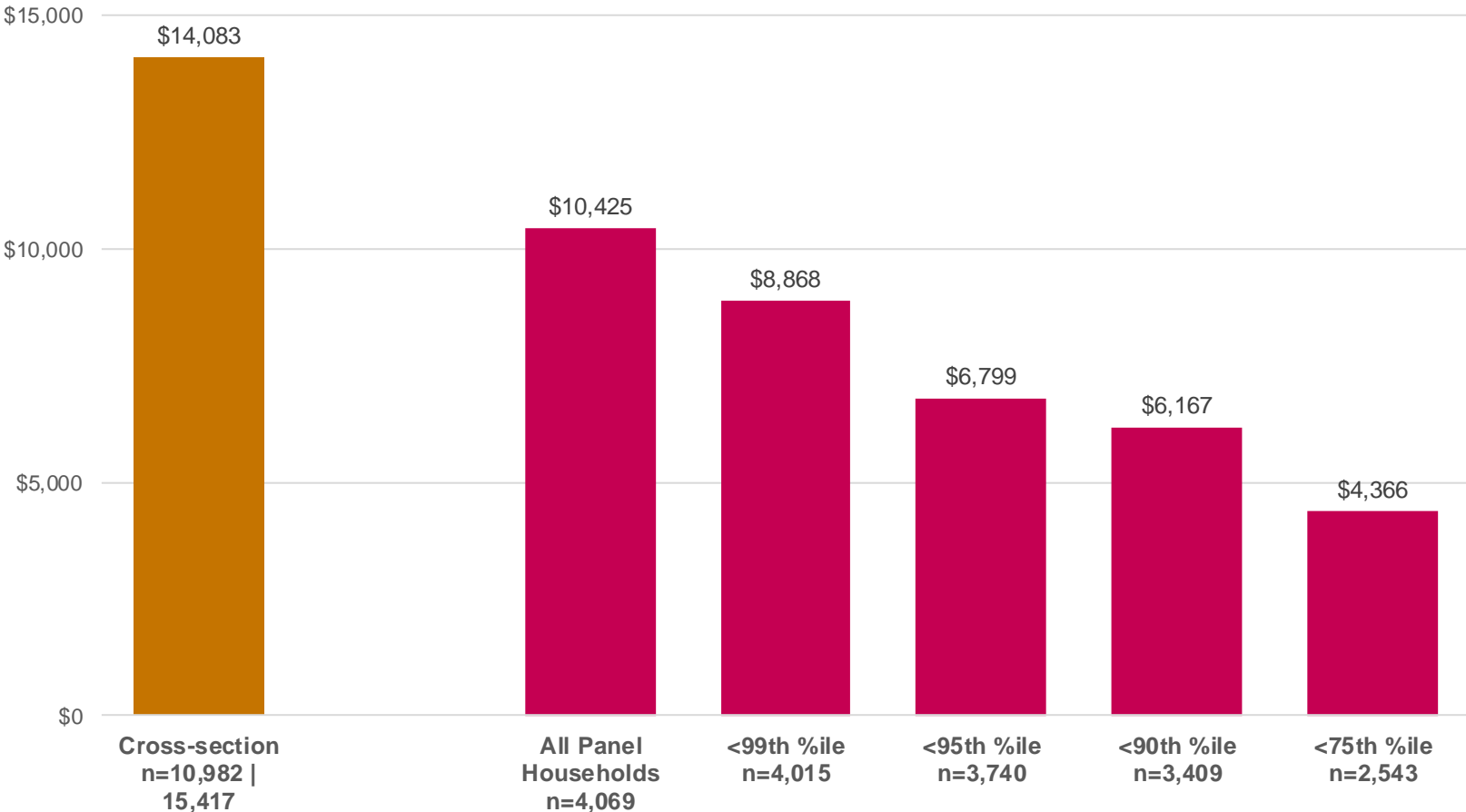|	Value
Cross-section n=9,349 | 10,472	$194
All Panel Units n=6,577	$187
<99th %ile n=6,501	$180
<95th %ile n=6,180	$165
<90th %ile n=5,760	$153
<75th %ile n=4,483	$134

Sensitivity of Differences in Panel Estimates of Change

Average Increase in Monthly Rent
among Panel Households

Sensitivity of Differences in Panel Estimates of Change

Average Increase in HH Income
among Panel Households

$14,083	$10,425	$8,868	$6,799	$6,167	$4,366
Cross-section n=10,982 | 15,417	All Panel Households n=4,069	<99th %ile n=4,015	<95th %ile n=3,740	<90th %ile n=3,409	<75th %ile n=2,543

Sensitivity of Differences in Panel Estimates of Change

- Estimates of change (e.g., rent and income) can be highly sensitive to the composition of the panel.

- Lower response propensity associated with characteristic of interest (missing not at random, MNAR) may dramatically underestimate (or overestimate) change over time.

Takeaways

- Statistical power is a big issue—for large samples, the central tendency seems okay, but small samples may be sensitive to attrition and variability;

- Panels subset within repeated cross-sections may need larger samples to overcome these issues;

- Important to think clearly specifically about what change is of interest and how it's being measured;

- More research necessary to understand and ideally correct for potential bias introduced by MNAR non-response/attrition.

Limitations and Future Work

- Top codes (and changes between cycles) make it difficult to assess even net change; this likely artificially flattens any measurable change.
- More stringent disclosure avoidance procedures (top codes, swapping, formal privacy) leaves how to measure change even less certain.

- Explore weighting and modeling techniques to correct for error in the panel.
- To what extent are aggregate cross-sectional estimates of change over/underestimated when a large proportion of observations are repeated?