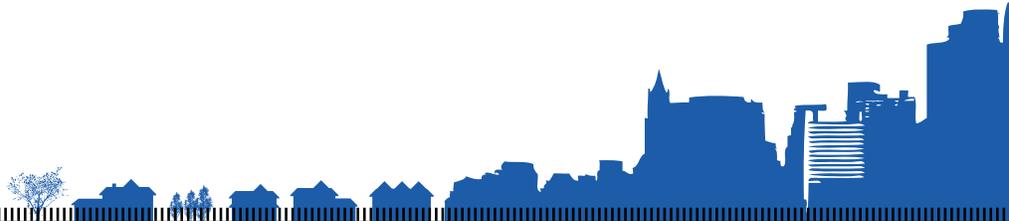


The Usefulness of the GUTREHB Variable



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INTRODUCTION

In the 2015 redesign of the American Housing Survey (AHS), a new variable, GUTREHB, was added to the questionnaire to identify owner-occupied units that had undergone transformation within the previous 10 years. The authors believed that GUTREHB could potentially provide important information on how the housing stock evolves. This paper provides background on the GUTREHB variable; uses data from the 2015, 2017, and 2019 AHS surveys to assess its reliability and usefulness; and explores possible ways to make the variable more useful.

BACKGROUND

The AHS survey, as redesigned in 2015, poses the following yes-no question to respondents in every owner-occupied unit in the sample built more than 10 years ago:

Gut rehabilitation is defined as the general replacement of the interior of a building, including the HVAC, plumbing, and electrical components. Has this housing unit undergone a gut rehabilitation in the last 10 years?

The U.S. Department of Housing and Urban Development (HUD), which sponsors the AHS, asked the U.S. Census Bureau to add the GUTREHB question for two reasons:¹

- In denser urban areas, old housing stock may be completely renovated before a sale. The AHS may miss this type of renovation because the AHS collects only housing improvement projects performed or paid for by the current owner. By asking respondents if their home was gut rehabbed, the AHS may pick up extra remodeling activity not otherwise captured when a home is sold to a new household.
- Some jurisdictions collect, and some respondents may report, the effective year built of their housing unit rather than the original year built. Effective year built is the age of the building adjusted for significant renovations—such as a gut rehab. Data on when a housing unit underwent a gut rehab can help clarify year-built inconsistencies between survey waves, such as “built in 2019” in the 2021 AHS versus “built before 1920” in the 2019 AHS for the same housing unit.

The authors became intrigued by this new variable for four reasons:

1. Gut rehabilitation goes beyond normal remodeling, and the variable identifies a set of units that underwent a major transformation.
2. As such, a gut rehabilitation fits between normal repairs and improvements and the complete transformation of a unit, such as a merger or conversion. In the latter case, the AHS considers the unit a loss and stops following it. If the answer to GUTREHB is “yes,” the AHS continues to follow a unit to the next survey. This is interesting in and of itself.
3. The authors have completed several CINCH (Components of Inventory Change) studies that track the evolution of the housing stock between adjacent AHS surveys. Units that were radically transformed by gut rehab appear to be an important part of the CINCH

¹ Emily Molfino, *GUTREHB in the American Housing Survey*, memorandum, U.S. Department of Housing and Urban Development, May 19, 2021.

story. As an event in the history of a housing unit, gut rehab ranks in importance just below a fire or splitting the unit into two units.

4. The authors analyzed the 2015 and 2017 AHS survey and found that owners of 2,322 units answered “no” to the GUTREHB question in 2015 but answered “yes” in 2017. This would seem to imply that these units underwent a major remodeling between 2015 and 2017. These sample units represent 3,750,751 units in the housing stock (using the AHS base weight, PWT [pure weight]), yet the 2015–17 CINCH study found that total additions to the housing stock (not counting these units) between 2015 and 2017 was 3,655,800 (using CINCH weights).

For those reasons, the authors proposed using GUTREHB in the 2015–17 CINCH, but HUD and the Census Bureau discouraged their suggestion because little was known about the reliability of the GUTREHB variable. The authors proposed this study to learn more about GUTREHB using information from the 2019 AHS.

THE RELIABILITY AND USEFULNESS OF THE GUTREHB VARIABLE

The authors carried out extensive analysis of GUTREHB responses from the 2015, 2017, and 2019 AHS surveys. This analysis convinced the authors that GUTREHB, in its current form, is not useful for CINCH analysis and, in general, suffers from problems that severely limit the usefulness of the variable for almost any purpose.

GUTREHB problems fall into three categories:

1. Serious inconsistencies in the responses to GUTREHB across survey years undermine user confidence in the response to GUTREHB for a given unit in any specific survey.
2. The AHS data on the total cost of rehabilitation since the previous survey often fall substantially short of what one would have anticipated from a “gut rehab.” The analysis does show that units with positive responses to GUTREHB have higher renovation costs than those with negative responses to GUTREHB, but the observed costs still appear less than expected.
3. The AHS collects data on several other variables associated with renovation, and, as with total costs, the relationship between GUTREHB and these other variables is weaker than anticipated.

This section takes each of these categories and presents the most compelling evidence of problems. The underlying research was more detailed and is reported in appendix A.

RESPONSES TO GUTREHB ARE INCONSISTENT ACROSS SURVEYS

The Item Booklet gives this language for the GUTREHB variable:

Gut rehabilitation is defined as the general replacement of the interior of a building, including the HVAC, plumbing, and electrical components. Has this housing unit undergone a gut rehabilitation in the last 10 years?

1. Yes
2. No

The question is asked only about owner-occupied units that are more than 10 years old. The 2017 Field Manual gives this added guidance:

Gut rehabilitation projects involve completely replacing or refurbishing a majority of the non-framework aspects of a home.

The analysis focused on the 2,322 sample units that answered “no” to the question in the 2015 AHS and “yes” in the 2017 AHS, under the assumption that these units were gut rehabbed between these two surveys. Presumably, the answer to this question should have then been “yes” in the 2019 survey.

Exhibit 1 contains the recorded answers from the 2019 AHS for these cases and, as applicable, indicates whether the answer was consistent with the 2015 AHS. In 60.2 percent of the cases, the 2019 answer contradicts the interpretation that the unit was gut rehabbed between 2015 and 2017. That initial interpretation is supported in only 17.1 percent of the cases.

Exhibit 1. 2019 GUTREHB Responses for Unit Owners Answering “Yes” in 2017 and ‘No’ in 2015

Answer	Count	Percent
Yes—a consistent answer	397	17.1
No—an inconsistent answer	1,399	60.2
Question not applicable	169	7.3
Question not answered	28	1.2
Unit a non-interview in 2019	329	14.2
Total	2,322	100.0

This pattern of cross-survey responses would make GUTREHB useless for CINCH purposes. If the CINCH report assumed that all 2,322 sample cases were gut rehabbed between 2015 and 2017, the amount of major rehabilitation would have been greatly overestimated, and an extra year of data would then be needed to correct the overestimate.

This pattern also seems to make GUTREHB useless for the purposes for which HUD intended to use the variable—namely, more accurately estimating remodeling activity and identifying the year of construction. If anything, GUTREHB would appear to lead to an overestimation of remodeling activity instead of correcting for an underestimate of such activity.

Conceptually, the Census Bureau could reduce the level of inconsistency by revising the question to provide the respondent with better guidance on how to answer it, including potential followup questions. GUTREHB is a good candidate for dependent interviewing—letting the interviewer probe any inconsistency between the current response and the previous response.

GUTREHB IS ASSOCIATED WITH LOW LEVELS OF REMODELING COSTS

The variable REMODAMT is the total cost of all remodeling jobs conducted in the last 2 years. Exhibit 2 lists the mean, the first quartile, the median, and third quartile of REMODAMT for three sets of sample units: all owner-occupied units in 2017 (34,512), all units answering “yes” to GUTREHB in 2017 after answering “no” in 2015 (2,322), and all units answering “yes” to GUTREHB in 2017 and 2019 after answering “no” in 2015 (397). The second group consists of the units that the authors would have presumed to have undergone gut rehabilitation between

2015 and 2017 on the basis of answers from the 2015 and 2017 AHS surveys only. The third group is the subset of the second group whose gut rehabilitation was confirmed by the 2019 survey.

Exhibit 2. Key Distributional Statistics for Total Remodeling Costs

Group	# Units	Mean (\$)	1st Q. (\$)	Median (\$)	3rd Q. (\$)
All owner occupied	34,512	6,121	0	400	5,000
All 2017 gut rehabbed	2,322	13,029	0	2,800	11,490
2019 consistent gut rehabbed	397	21,358	500	5,850	20,000

Exhibit 2 indicates that the 397 units of the consistent gut rehabbed group underwent more expensive remodeling work than either of the other two groups. What stands out after more careful consideration, however, is the low magnitude of total remodeling costs for the consistent gut rehabbed group. As an anecdote, one of the authors is renovating a single-family detached rental property that would be considered a gut rehab. With 2 months of work yet to go, total costs have exceeded \$115,000, which is much higher than the total remodeling costs of most consistent gut rehabbed cases. Only 25 percent of the consistent gut rehabbed units incurred costs greater than \$20,000, and 25 percent had costs less than \$500. The average cost for the entire group was \$21,358.

One possible explanation for the low total remodeling cost in 2017 is that the respondent was not the person incurring the costs of gut rehab—the first rationale given by HUD for the inclusion of the GUTREHB variable. Exhibit 3 provides unweighted data on the percentage of householders who moved into the sample unit during 2016 or 2017.

Exhibit 3. Percentage of Householders Who Moved in During 2016 or 2017

Group	Percent
All owner occupied	9.9
All 2017 gut rehabbed	5.1
2019 consistent gut rehabbed	6.6

Among the units judged to have most likely been gut rehabbed, only 6.6 percent of the householders were new to the unit in 2017. The overwhelming majority of the respondents reporting total remodeling costs for these units should have been aware of all the remodeling work done. The percentage of new householders was substantially higher among all owner-occupied units—9.9 versus 6.6 percent. This finding, in itself, is interesting because one may have expected a high-rate turnover of households in gut rehabbed units due to the disruption caused by gut rehabilitation.

GUTREHB IS AT BEST WEAKLY ASSOCIATED WITH OTHER RELEVANT VARIABLES

The majority of the analytical work for this project concentrated on finding evidence that GUTREHB is a reliable indicator of gut rehabilitation. In particular, are GUTREHB values consistent across surveys, and are they associated with other indicators of major remodeling? This work is detailed in appendix A.

The previous section showed that the reported total remodeling costs associated with suspected major renovation identified by GUTREHB was substantially less than what was expected. The section also showed that household turnover was also substantially less than would have been expected. This section summarizes other findings from the work reported in appendix A.

The first variable examined from 2017 AHS was REMODJOBS, the number of remodeling jobs. The maximum number of remodeling jobs reported for a given unit in 2017 was 23. The type of remodeling jobs includes 37 categories: 6 categories focus on the cause of damage (for example, earthquake), 31 project categories, and 2 “other” categories. Up to three jobs can be listed in each of the categories. Of note, a gut rehabilitation is *not* listed as a category. Thus, a gut rehabilitation would require multiple different jobs as listed. Exhibit 4 shows the number of households with two or more remodeling jobs, by GUTREHB status.

Exhibit 4. Percentage of Unit Owners Reporting Two or More Remodeling Jobs, by GUTREHB Status

Group	Percent
All 2017 owner occupied	20.5
All 2017 gut rehabbed	36.6
2019 consistent gut rehabbed	45.8

The percentage of sample units for which the owner reported two or more remodeling jobs varies markedly across the groups. Among all owner-occupied sample units in 2017, only 20.5 percent reported undertaking two or more remodeling jobs; among sample units that answered “yes” to GUTREHB in 2017 after answering “no” in 2015, the percentage was 36.6 percent. Among sample units that answered “yes” to GUTREHB in both 2017 and 2019 after answering “no” in 2015, the percentage was 45.8 percent. In the authors’ opinion, GUTREHB is identifying units with more than usual reported remodeling experiences because these units have higher rates of reporting two or more remodeling jobs. Among the most likely gut rehabbed units (the 397 units with consistent answers), though, more than one-half reported two or fewer jobs. Just as with the total cost of remodeling, a sizable percentage of units that reported undergoing a gut rehab appear to have had only minimal remodeling in the past 2 years according to the REMODJOBS variable.²

The authors assume that a gut rehabilitation would require opening or moving walls at some level. Appendix A lists 11 possible types of jobs that might have involved opening or moving walls. None of the 11 job types guarantee that the remodeling would have required breaking into existing walls; for example, adding or replacing plumbing fixtures can be accomplished without opening walls, but these 11 job types are the ones most likely to be accompanied by breaking into existing walls.

Exhibit 5 contains the percentage of sample units by group for which the owner reported at least one of these 11 jobs. As with exhibit 4, the pattern of responses leads the authors to conclude that GUTREHB identifies units with remodeling experience consistent with the adjective “gut,” but a large percentage of these units do not meet expectations. Among those sample units that are most likely to have been gut rehabbed, only 52.9 percent had remodeling work involving at least 1 of these 11 job types.

² The authors did not investigate the extent to which answers of “no” in 2017 were false.

Exhibit 5. Percentage of Unit Owners Reporting at Least 1 of the 11 Selected “Wall Opening/Moving” Jobs in 2017

Group	Percent
All 2017 owner occupied	24.4
All 2017 gut rehabbed	42.7
2019 consistent gut rehabbed	52.9

The final AHS variable used to detect changes brought about by gut rehab is the estimated market value of the unit (MARKETVAL). Presumably, owners undertake extensive renovation work to increase the market value of the unit, reduce operating costs associated with the unit, or increase the value of the housing services that the unit provides to the household. Reducing costs or increasing the value of the housing services should be reflected in the self-reported market value of the units. Exhibit 6 reports the median percentage change in estimated market value by group between 2015 and 2019 for the sample units in each group.

Exhibit 6. Median Percentage Change in Estimated Market Value Between 2015 and 2019 by Group

Group	Median Percentage Change in Estimated Market Value
All 2017 owner occupied	35.2
All 2017 gut rehabbed	38.6
2019 consistent gut rehabbed	42.2

Once again, units identified by GUTREHB appear to do better in terms of percentage change in estimated market value than all owner-occupied units. The set of sample units identified by “yes” answers to GUTREHB in both 2017 and 2019 after a “no” answer in 2015 (consistent gut rehabbed) show the greatest increase in estimated market value: 42.2 percent, which is 7 percentage points greater than the 35.2-percent increase in estimated market value for all owner-occupied units. In 2015, the median estimated value for all owner-occupied units was \$180,000. A 7-percent difference in the increase in market value by 2019 would have meant an additional \$12,600 in value.³ This difference would represent a good return on the additional \$5,850 in median remodeling costs reported in exhibit 2.

THOUGHTS ABOUT THE FUTURE OF GUTREHB

On April 8, 2021, staff from HUD and the Census Bureau and the authors of this report discussed the results reported in appendix A.⁴ The participants had previously reviewed a paper upon which appendix A is based, which gave the authors useful suggestions on how to improve the analysis and possible interpretations of the findings. The discussion only briefly touched on

³ The median percentage change reported in exhibit 6 is the median of the changes in all sample units in the respective groups, not the percentage change in the estimated value of the median unit in each group. The comparison using medians is not meant to be exact but rather to give a sense of the magnitude involved. The median estimated market value of all owner-occupied units was \$180,000 in 2015 and \$230,000 in 2019.

⁴ The participants were George Carter and Emily Molfino from HUD; Tamara Cole and Matthew Streeter from the Census Bureau; and Fouad Moumen and Fred Eggers from SP Group.

the details of the research because the participants recognized that GUTREHB has not been a useful variable, and the central question was whether and how to improve GUTREHB.

INITIAL THOUGHTS ON IMPROVING GUTREHB

The discussion on April 8 provided three ideas for improving GUTREHB:

1. The current version of GUTREHB asks respondents whether there has been any gut rehab within the previous 10 years. The 10-year timeframe may be a cause of the inconsistent answers to GUTREHB between AHS surveys. Participants believed that GUTREHB should focus strictly on what has happened to the unit since the last AHS survey.
2. Participants also thought that the requirements for units to qualify for the GUTREHB question should be made less restrictive. Currently, GUTREHB is asked only of the owners of owner-occupied units that are at least 10 years old.
 - a. The 10-year restriction could eliminate some owner-occupied units undergoing gut rehab and would be inconsistent with eliminating the “within the previous 10 years” focus of the question.
 - b. Units experiencing extensive gut rehab are likely to be vacant for a while. Incorporating a form of the GUTREHB question into the questionnaire for vacant units seems advisable.
3. The GUTREHB question is a short yes-no question, and only minimal guidance on how to answer the question is provided to the respondent. What constitutes “gut rehab” is a concept that may vary substantially among respondents. Not only should more guidance be provided to respondents but the single GUTREHB question should probably be replaced by a series of questions that depict more accurately the work performed. One might devise a list of tasks associated with what one might label “gut rehab” and require a minimal number of those tasks to be carried out before labeling the work “gut rehab.”

THE GOAL OF IDENTIFYING UNITS UNDERGOING GUT REHAB

How to improve the question ultimately depends on what HUD and the Census Bureau want the question to accomplish. The authors, HUD staff, and the staff from the Census Bureau decided to develop short papers presenting what would be appropriate goals for the GUTREHB question. The authors also solicited similar input from the remodeling experts at the Joint Center for Housing Studies of Harvard University; that input has not been received yet.

AUTHORS: THE CINCH PERSPECTIVE

The authors originally approached GUTREHB from the point of view of CINCH analysis. CINCH (Components of Inventory Change) uses AHS to track the evolution of the American housing stock between two points in time, usually, but not necessarily, two successive AHS surveys.⁵

The primary focus of CINCH is on how many new units are added to the stock and how many units leave the stock; of equal importance are the various ways additions and losses occur.

⁵ The authors do not know who coined the term, but the first known CINCH study was carried out by Duane T. McGough, assisted by Paul Burke, Connie Casey, and Iredia Irby at HUD and issued in April 1991.

CINCH analyses also focus on other ways the stock changes between surveys. Although these other aspects overlap, they can be usefully categorized as (a) how the stock is owned (for example, owned, rented, second homes, seasonal properties); (b) whom the stock serves by income, race, household composition, household size, and so forth; and (c) the condition of the stock (such as size, quality, amenities, and problems).

From an evolution of the stock perspective, units that were radically transformed by a gut rehabilitation would appear to be an important part of the CINCH story. The authors' interest in GUTREHB started with this vision, but HUD had also asked the authors to investigate how CINCH could be improved. Of particular relevance to this other study is how the redesign of the AHS sample may have affected CINCH. This second perspective has led the authors to consider a second role for GUTREHB or an alternative, broader variable.

Currently, the Census Bureau uses the Master Address File (MAF) to draw the AHS sample. Additions are drawn from new addresses in the MAF, and if the address of an AHS unit is deleted from the MAF, then the unit is treated as a loss.

Consider these cases:

1. If an AHS sample unit is split into two or more units, the pre-2015 AHS labeled this unit as a conversion and dropped the unit from the AHS as a permanent loss. The units resulting from the split were treated as additions. The 2015 redesign keeps one of these units in the sample if the unit has the old address but drops any unit from the sample if its address changes without distinguishing the unit from other permanent losses. Depending on how much renovation is done, GUTREHB might identify the unit with the unchanged address as a major renovation and could help classify it as a conversion.
2. If an AHS sampled unit is combined with one or more other units, the pre-2015 AHS labeled this unit as a merger and dropped the unit from the AHS as a permanent loss. The 2015 redesign keeps this unit in the sample if the address is unchanged but drops the unit from the sample if the address changes without distinguishing the unit from other permanent losses. Depending on how much renovation is done, GUTREHB might identify a unit with an unchanged address as a major renovation and could help classify it as a merger.
3. If an AHS sample unit is substantially enlarged, the pre-2015 AHS would record only that the unit was renovated. Under the pre-2015 AHS, if an existing housing unit *not* in the AHS sample was substantially enlarged *and* a new permit was drawn, that unit would be put into the sampling frame from which the Census Bureau would draw units to represent new construction. If the address is not changed, the 2015 and later AHS would not consider this unit as either a loss or an addition. GUTREHB *might* identify such units as major renovations, an outcome that the authors believe would enrich the CINCH story; however, the current wording of the GUTREHB question might not identify such units if the existing unit is added onto but not altered.

From a CINCH perspective, here is what the authors would like to see in rank order:

- A. A redesigned GUTREHB question that identifies units that have undergone (since the last survey) major physical changes requiring substantial changes to the existing structure. The emphasis should be on major physical changes.

- B. A broadened GUTREHB question that identifies units that have undergone (since the last survey) major physical changes even if the changes involved additions to the existing structure rather than substantial changes to the existing structure.
- C. A GUTREHB question embedded in a series of questions that identify units that were fundamentally redesigned, distinguishing among major remodeling, sizable additions, mergers, splits, and other transformations.

HUD: IDENTIFYING RADICAL TRANSFORMATIONS OF HOUSING UNITS

This section is based on the paper by Emily Molfino cited in footnote 1, *GUTREHB in the American Housing Survey*. As Molfino puts it, “HUD would like to collect information on when a sample housing unit goes under intensive renovation that substantially changes the housing unit between survey years.”

The authors called attention to situations in which a housing unit can undergo substantial growth without classic gut rehab, specifically when a large addition is appended to an existing unit. Molfino raises another important case, which she dubs a “rebuild.” A rebuild occurs when “the original housing unit structure is fully demolished before construction [of a new unit],” presumably at the same address and therefore not recognized under the 2015 and later AHS rules as either an addition or a loss.

Rebuilds are completely consistent with the CINCH perspective because a major goal of CINCH analysis is to highlight the various ways in which the housing stock can change.

Molfino thinks that a GUTREHB variable or variables that call attention to these situations could be significant for policy for at least three reasons:

- “Such data will help capture areas going under large-scale gentrification.
- “Gut rehabs/rebuilds impact housing stock by increasing the usability of existing housing.
- “Gut rehabs/rebuilds can impact housing values in an area and thus affordability of current and future residents.”

CENSUS: ELIMINATING PROBLEMS IN THE EXISTING GUTREHB VARIABLE

The Census Bureau has not yet provided a full articulation of its thoughts on GUTREHB, but HUD staff have provided some insights into their initial thinking. The Census Bureau seems to want to ensure that what is reported as gut rehab is truly gut rehab in the classic sense of the term.

Initial feedback indicates that the Census Bureau wants to scrap the existing GUTREHB question and replace it with a much more detailed module. This module will not be asked of many units, and the resulting microdata may not be included on the public use file.

APPENDIX A: RESEARCH INTO THE RELIABILITY AND USEFULNESS OF THE GUTREHB VARIABLE

The authors originally focused on the reliability and usefulness of the GUTREHB variable. Despite looking at GUTREHB from several different perspectives, the authors concluded that there were too many problems with GUTREHB to use the variable as it was reported in the 2015, 2017, and 2019 AHS surveys. To get guidance from HUD and the Census Bureau, the authors summarized the results of the research in an informal paper titled *GUTREHB Rough Draft* (January 26, 2021). Appendix A is an edited version of the rough draft; it also contains some additional findings based on comments received from HUD and the Census Bureau.

In 2015, HUD and the Census Bureau drew a new sample for the AHS and made other changes to the survey. This redesign included the addition of a new variable, GUTREHB, designed to identify sample units that had undergone major remodeling recently. This paper examines whether this new variable is potentially useful for tracking changes to the housing stock. It uses information from the 2015, 2017, and 2019 AHS surveys to explore whether GUTREHB is living up to its potential.

1) The GUTREHB Variable

The AHS survey poses the following yes-no question to respondents in owner-occupied units in the sample:

Gut rehabilitation is defined as the general replacement of the interior of a building, including the HVAC, plumbing, and electrical components. Has this housing unit undergone a gut rehabilitation in the last 10 years?

The authors were intrigued by this new variable for four reasons:

1. Gut rehabilitation goes far beyond normal remodeling, and the variable purports to identify a set of units, each of which underwent a major transformation.
2. As such, it fits between normal repairs and improvements and the complete transformation of a unit, such as a merger or conversion. In the latter case, the AHS before 2015 considered the unit a loss and stopped following it. Now, if the answer to GUTREHB is “yes,” the AHS continues to follow the unit to the next survey. This approach can deviate from previous practice, and such units are also interesting in and of themselves.
3. The authors have completed several CINCH (Components of Inventory Change) studies that track the evolution of the housing stock between adjacent AHS surveys. Units that were radically transformed by gut rehab would appear to be an important part of the CINCH story.
4. The authors analyzed the 2015 and 2017 AHS surveys and found that 2,322 unit owners answered “no” to the GUTREHB question in 2015 but answered “yes” in 2017. This finding would seem to imply that these units underwent a major remodeling between 2015 and 2017. These sample units represent 3,750,751 units in the housing stock (using the AHS base weight, PWT). The 2015–17 CINCH study found that total additions to the housing stock (not counting these units) between 2015 and 2017 was 3,655,800 (using CINCH weights).

The authors proposed using GUTREHB in the 2015–17 CINCH, but HUD and the Census Bureau discouraged this approach because little was known about the GUTREHB variable. The authors proposed this study to learn more about GUTREHB using information from the 2019 AHS.

2) GUTREHB Answers Are Not Reliable

Not using information about gut rehabilitation in the 2015–17 CINCH proved to be wise advice. The answers to the GUTREHB question in the 2019 AHS for the 2,322 cases that appeared to have been gut rehabbed in 2017 were generally inconsistent with expectations (exhibit A-1). One would have expected almost all 2,322 cases to have answered “yes” in 2019, but only 397 did.

Exhibit A-1. Answers to GUTREHB Question in 2019 After Answering “No” in 2015 and “Yes” in 2017

Answer	Count	Percent
Yes—a consistent answer	397	17.1
No—an inconsistent answer	1,399	60.2
Question not applicable	169	7.3
Question not answered	28	1.2
Unit owner a non-interview in 2019	329	14.2
Total	2,322	100.0

Consistent “yes” answers, weighted by PWT, represent 613,114 housing units. This number is still important relative to the 3.7 million total units added between 2015 and 2017; however, it is not useful for CINCH purposes because 2019 data were needed to identify the cases with consistent answers.

The authors explored whether the 169 “not applicable” cases may have been owner-occupied units that were gut rehabbed in 2017 but became rental units in 2019. (The GUTREHB question is asked only of owner-occupied units.) Of the 169 cases, 76 were rental in 2019, representing 123,625 housing units. Another 86 cases had missing information for the TENURE variable because the unit was Usual Residence Elsewhere (URE) or vacant in 2019.⁶ The “Not Applicable” TENURE answers represent another 143,681 housing units.

Of the 329 non-interview cases, 323 were type A non-interviews, including 249 refusals. The remaining 6 cases were Type B non-interviews.⁷

3) How Is GUTREHB Related to the Remodeling Experience of a Unit?

During the initial research into the GUTREHB variable, the authors were interested in the reasons why some 2019 GUTREHB answers were not the expected “yes” answers. The authors therefore looked at various groups of sample units defined by their 2019 answers (exhibit A-2). The various answers delineated seven groups—which were compared with each other and with

⁶ Seven of the 169 cases were owner occupied, suggesting that the “not applicable” GUTREHB answers were not applicable for these seven cases.

⁷ Type A non-interviews involve occupied units for which data are not reported because of refusals, language problems, and so forth. Type B non-interviews involve unoccupied units that are not in the housing market for reasons such as unfinished work, condemnations, or use for commercial purposes but could potentially be occupied in the future.

an eighth group, all owner-occupied units—which functioned as a control group. The goal was to see how well the remodeling experience of the seven groups matches the wholesale transformation envisioned by the phrase “gut rehabbed.” In the main text, the results of the analyses are reported for only the three most relevant groups: all owner-occupied units, all “yes” answers in 2017 after a “no” answer in 2015, and all “yes” answers in 2017 and 2019 after a “no” answer in 2015.

Exhibit A-2. Group Names and Sample Sizes

Group	Definition	Sample Count
A	All 2017 owner occupied	34,512
B	All 2017 gut rehabbed	2,322
C	Consistent gut rehabbed	397
D	Inconsistent answers	1,399
E	Not owner-occupied 2019 outcome	162
F	Rental 2019 outcome	76
G	Previously gut rehabbed	631
H	No recent gut rehab	12,924

a) Setting Up the Analysis—Groups

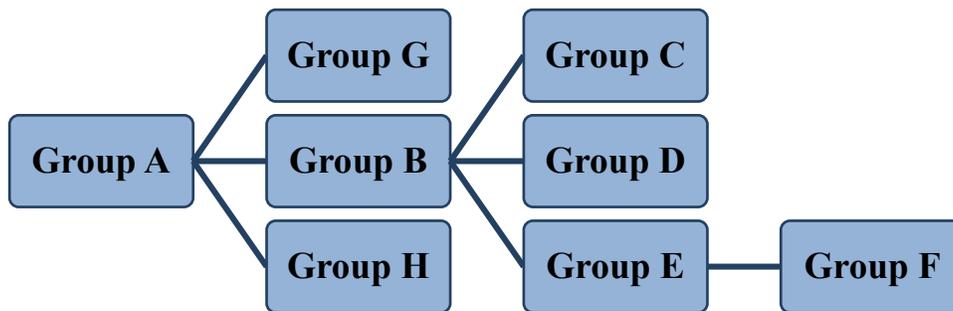
The names given to these eight groups and their unweighted sample sizes are as follows:

- Group A is the set of all owner-occupied units in the 2017 AHS survey. The rehabilitation experience of each of the other seven groups is compared with the experience of all owner-occupied units.
- Group B is the subset of group A for which the owner answered “no” to GUTREHB in 2015 and “yes” in 2017; these units were owner occupied in 2015 and 2017. If one were to use GUTREHB using just the 2015 and 2017 surveys, this is the set that would be identified as gut rehabbed.
- Group C is the subset of group B for which owners answered “yes” to GUTREHB in 2019. The authors thought this would be the group to have the most accurate answers to the GUTREHB question in 2017. Of course, if one waited until 2021, one might find some of these units have a “no” answer to GUTREHB in that survey, which would again be inconsistent with our assumption.
- Group D is the subset of group B for which owners answered “no” to GUTREHB in 2019. Units in groups C and D had to be owner occupied in 2015, 2017, and 2019. If members of this group had extensive remodeling experience in 2017, then the answers to GUTREHB in 2019 for many units would be called into question.
- Group E is the subset of group B for which owners had “not applicable” answers to GUTREHB in 2019 because they were rental, vacant, or URE units in 2019. The authors included this group to see whether it could be added to group C to increase the count of consistent GUTREHB responses.

- Group F includes units that were rentals in 2019. Group F is a subset of group E, which is a subset of group B.
- Group G comprises units for which owners answered “yes” to GUTREHB in all three surveys. Purportedly they had been gut rehabbed sometime between 2007 and 2015. The authors included this group to see whether units extensively remodeled in the past had different remodeling experiences in 2017.
- Group H consists of units for which owners answered “no” to GUTREHB in all three surveys. Groups G and H were owner occupied in all three surveys and as such are subsets of group A.

Exhibit A-3 shows how the groups are related. It is important to realize that groups B, G, and H, although mutually exclusive, are not exhaustive subsets of group A. Many units in group A were owner occupied in 2017 but not in both 2015 and 2019.⁸

Exhibit A-3. Relationships Among the Eight Groups



b) REMODAMT

Perhaps the best indication of the extent of remodeling work is the 2017 value of the variable REMODAMT, the total cost of all remodeling jobs (exhibit A-4). The behavior of this important variable varies substantially across the groups.

Exhibit A-4. Key Distributional Statistics for Total Remodeling Costs (REMODAMT) in 2017, by Group

Group	Definition	Mean (\$)	1st Q (\$)	Median (\$)	3rd Q (\$)
A	All owner occupied	6,121	0	400	5,000
B	All 2017 gut rehabbed	13,029	0	2,800	11,490
C	Consistent gut rehabbed	21,358	500	5,850	20,000
D	Inconsistent answers	11,376	0	2,600	10,100
E	Not owner occupied 2019 outcome	10,185	0	1,020	8,000
F	Rental 2019 outcome	6,819	0	1,750	8,490
G	Previously gut rehabbed	9,926	0	1,500	9,100

⁸ Groups C, D, and E do not exhaust group B because 28 units without answers to GUTREHB in 2019 are omitted, as are 7 units that were owner occupied in 2019 but had “not applicable” answers to GUTREHB in 2019.

H	No recent gut rehab	4,994	0	385	4,580
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Q = quartile.

The most important conclusion from this exhibit is that all the groups appear to contain many units that are undergoing minimal remodeling in 2017.⁹ Twenty-five percent or more of the units in seven of the eight groups incurred no remodeling costs in 2017, as shown in the 1st Q (first quartile) column. Even group C (consistent gut rehabbed) has a first quartile value of only \$500. This finding implies that GUTREHB has a significant tendency toward false positives.

A second important conclusion is that GUTREHB is clearly picking up unusual remodeling experiences. Group B and all its subsets (groups C, D, E, and F) register much higher mean remodeling costs than the all-owner-occupied control. The same is true for median and third quartile remodeling costs.

Among the four subsets listed in the preceding paragraph, group C (consistent gut rehabbed) displays the highest values for the mean and all three quartiles. Nevertheless, the \$500 first quartile value for group C indicates a substantial percentage of this group are false positives.

The 2019 remodeling cost values for GUTREHB in group D appear to contain many false negatives. Twenty-five percent or more of the units in this group paid more than \$10,000 for remodeling in 2017.

A surprising find is that group G (previously gut rehabbed) and group H (no recent gut rehab) appear to be markedly different from the control group A (all owner occupied), with group G having higher than normal remodeling costs and group H having lower than normal remodeling costs. This finding is interesting, but the authors could not see any relevance to the usefulness of GUTREHB.

Reviewers questioned whether the results presented in exhibit A-4 above would have been different if the authors had used the ratio of REMODAMT to MARKETVAL. They also wondered whether actual remodeling costs may seem more important when adjusted for the value of the unit; that is, whether the scope of possible rehab work may be limited by the size (or value) of the unit.

Exhibit A-5 repeats the analysis in exhibit A-4 using the ratio of REMODAMT to MARKETVAL in 2017, where MARKETVAL is the respondent estimate of the value of the unit.

Exhibit A-5. Key Distributional Statistics for Total Remodeling Costs as a Percentage of Market Value (REMODAMT/MARKETVAL), by Group

Group	Definition	Mean (%)	1st Q (%)	Median (%)	3rd Q (%)
A	All owner occupied	144	0.0	0.15	2.26
B	All 2017 gut rehabbed	98.20	0.0	1.22	5.32
C	Consistent gut rehabbed	32.3	0.2	2.3	7.9

⁹ The total cost of remodeling is the sum of the individual costs of each job. Low total remodeling costs could be the result of respondents not knowing the cost of individual tasks because the overall project was large and paid with a lump sum.

D	Inconsistent answers	147.8	0.0	1.1	4.9
E	Not owner occupied 2019 outcome	13.7	0.0	0.7	5.3
F	Rental 2019 outcome	22.5	0.0	1.0	7.7
G	Previously gut rehabbed	17.9	0.0	0.6	4.1
H	No recent gut rehab	72.5	0.0	0.1	2.0

Q = quartile.

Key points:

1. The means of the cost-value ratio are clearly affected by outliers.
2. The key patterns found in exhibit A-4 occur in exhibit A-5 as well. Specifically—
 - a. The consistently answered GUTREHB group (C) clearly shows more costly renovation.
 - b. The inconsistently answered group (D) and perforce the all 2017 GUTREHB group (B) show higher than normal (all owner-occupied) renovation.
 - c. The first quartile results suggest a large number of false positives—units labeled as gut rehab with minimal work.

HUD and Census Bureau reviewers also wondered whether gut rehab was often accompanied by a change in household, so that the 2017 respondent may not know the total costs of remodeling.

Exhibit A-6 reports the percentage of householders in each group who moved into the units between the 2015 and 2016 surveys. The results for the eight groups show that turnover in a household does not appear to have had a large impact on responses to GUTREHB.

Exhibit A-6. Householders That Moved in Between 2015 and 2016, by Group

Group	Definition	Sample Count	Analysis Count	Percentage of Householders Who Moved in After 2015
A	All 2017 owner occupied	34,512	34,512	9.91
B	All 2017 gut rehabbed	2,322	2,322	5.12
C	Consistent gut rehabbed	397	397	6.55
D	Inconsistent answers	1,399	1,399	3.65
E	Not owner occupied 2019 outcome	162	162	5.56
F	Rental 2019 outcome	76	76	3.95
G	Previously gut rehabbed	631	631	3.49
H	No recent gut rehab	12,924	12,924	4.81

Q = quartile.

Key points:

1. Those reporting gut rehab in 2017 (group B) had a smaller rate of turnover than all owners (group A).
2. The group that reported gut rehab consistently (group C) had roughly two-thirds the turnover of all owners (group A).
3. Only 26 of the 397 units in group C had new householders.

c) REMODJOBS

The next variable examined was REMODJOBS, the number of remodeling jobs, in 2017. Respondents could give multiple answers to this question, and the maximum number of remodeling jobs reported for a given unit in 2017 was 23. The Census Bureau identifies the jobs in a variable called JOBTYP. The type of remodeling job includes 37 categories: 6 categories focus on the cause of damage (such as an earthquake), 29 project categories, and 2 “other” categories. Up to three jobs can be listed in each of the categories. Of note, a gut rehabilitation is *not* listed as a category.

Exhibit A-7. Cumulative Percentage of Cases for Number of Remodeling Jobs Reported, by Group (Results Report for Up to 10 Jobs)

	A	B	C	D	E	F	G	H
Number of Remodeling Jobs	All Owner Occupied (%)	All 2017 Gut Rehabbed (%)	Consistent Gut Rehabbed (%)	Inconsistent Answers (%)	Not Owner Occupied 2019 Outcome (%)	Rental 2019 Outcome (%)	Previously Gut Rehabbed (%)	No Recent Gut Rehab (%)
0	43.6	27.2	20.2	27.9	34.6	28.9	33.6	43.1
1	65.9	47.9	38.0	49.0	56.2	47.4	55.9	67.4
2	79.5	63.4	54.2	64.9	70.4	65.8	71.9	81.6
3	87.4	74.8	64.2	77.3	77.2	71.1	80.2	89.7
4	92.2	82.7	73.3	85.0	85.2	81.6	85.6	94.3
5	94.9	87.4	78.8	89.5	89.5	86.8	90.0	96.8
6	96.7	90.9	83.1	92.9	92.0	90.8	92.6	98.3
7	97.8	93.3	87.2	94.8	95.1	92.1	95.1	99.0
8	98.6	95.5	91.4	96.6	96.9	94.7	97.3	99.5
9	99.1	96.9	93.5	97.8	99.4	98.7	97.8	99.7
10	99.3	97.5	94.5	98.4	99.4	98.7	98.7	99.8

Overall, very few sample units reported more than five jobs, but once again, the number of jobs reported differed substantially by group. The key features are as follows:

1. The gut rehab groups (B through F) clearly reported more jobs than any of the other groups, but even 20 percent of the consistent gut rehabbed group (group C) reported “no” jobs were

done. All five of these groups contain units that gave false positive responses to GUTREHB in 2017.

2. The inconsistent answers group (group D) appears to contain a number of units that gave false negatives to GUTREHB in 2019. Compared with the all-owner-occupied group, the cumulative percentage for group D reporting five remodeling jobs (89.5 percent) is notably lower than the percentage reported for all owner-occupied units (94.9 percent), meaning that group D contains a higher percentage of units with more than five remodeling jobs than group A. The differences are even larger for smaller numbers of remodeling jobs reported.

d) Type of Remodeling Work Reported

Next, the authors looked to see if the types of jobs reported varied across the groups. As noted, the AHS records up to 31 different types of jobs under JOBTYP. Some, such as “added/replaced carpeting, flooring, paneling, or ceiling tiles,” do not usually involve “the general replacement of the interior of a building,” as envisioned in the definition of GUTREHB. None of the 31 job types necessarily require opening internal walls. One can identify several job types, however, for which opening or moving internal walls likely would have needed to occur.

Exhibit A-8. Job Types Possibly Involving Opening or Moving Internal Walls

JOBTYP Code	Description
07	Added or converted existing space for bedroom
08	Added or converted existing space for bathroom
09	Added or converted existing space for recreation material
10	Added or converted existing space for kitchen
11	Added or converted existing space for other room
20	Added/replaced insulation
21	Added/replaced internal water pipes
22	Added/replaced plumbing fixtures
23	Added/replaced electrical wiring, fuse boxes, or breaker switchers
25	Added/replaced central air conditioning
26	Added/replaced built-in heating equipment

The thrust of the analysis is *not* that a gut rehab requires any of these activities. For example, expanding a unit to incorporate a new bedroom (number 07) can be done by changing an external wall without affecting internal walls, and replacing a fuse box (number 23) does not require opening a wall. The argument is that an owner would not have opened internal walls unless he or she wanted to use at least one of these job types.

Exhibit A-9 shows what percentage of the units in each of the eight groups reported at least 1 or more of these preceding 11 remodeling job types.

Exhibit A-9. Percentage of Units Within Each Group That Reported at Least 1 of the 11 Selected Remodeling Job Types in 2017

A	B	C	D	E	F	G	H
All 2017 Owner Occupied (%)	All 2017 Gut Rehabbed (%)	Consistent Gut Rehabbed (%)	Inconsistent Answers (%)	Not Owner Occupied 2019 Outcome (%)	Rental 2019 Outcome (%)	Previously Gut Rehabbed (%)	No Recent Gut Rehab (%)
24.4	42.7	52.9	41.0	40.1	51.3	31.7	23.4

The familiar pattern reappears in the results reported.

1. The gut rehabbed groups (B through F) all report having a higher percentage of units that report at least one of these jobs than the all-owner-occupied control group (A).
2. Still, about 47 to 60 percent of the units in these groups report having undertaken none of the 11 selected remodeling jobs (these percentages are the complements of those reported in exhibit A-9).

The authors also counted the number of potential gut rehab jobs reported by units in various groups. Although up to 11 jobs could have been reported, exhibit A-10 stopped tallying at 5 jobs (10 was the maximum number reported). The percentage reporting no jobs is the complement of the percentage reporting at least one job in exhibit A-9.

Exhibit A-10. Cumulative Percentage of Number of Potential Gut Rehab Type Jobs Reported in 2017, by Units Within Each Group

	A	B	C	D	E	F	G	H
Number of Jobs	All 2017 Owner Occupied (%)	All 2017 Gut Rehabbed (%)	Consistent Gut Rehabbed (%)	Inconsistent Answers (%)	Not Owner Occupied 2019 Outcome (%)	Rental 2019 Outcome (%)	Previously Gut Rehabbed (%)	No Recent Gut Rehab (%)
0	75.6	57.3	47.1	59.0	59.9	48.7	68.3	76.6
1	90.9	78.1	67.3	81.0	80.9	81.6	85.1	92.9
2	96.7	90.4	82.9	92.4	93.8	96.1	93.8	98.0
3	98.7	95.2	90.2	97.0	96.3	98.7	97.3	99.5
4	99.4	97.8	95.5	98.4	99.4	100.0	98.7	99.9
5	99.7	99.0	98.0	99.4	100.0	100.0	99.7	99.9

The gut rehab groups (B through F) clearly report more of the selected jobs than any of the other groups. “Gut rehab” work may have taken place that involves none of these categories of work, and having zero jobs from this set may be reporting errors, but the authors suspect that many of the “zero jobs” units may have given false positive responses to GUTREHB in 2017. All of these groups contain units that reported none of these jobs in 2017; even 47 percent of the consistent gut rehabbed group (C) report that “no” jobs from the selected list were done.

e) Relationship Between Disaster and GUTREHB

The authors thought that units experiencing a disaster, such as fire or tornado, would be much more likely to undergo gut rehab. This presumption proved to be wrong.

The first six response options for the JOBTYP variable are shown in exhibit A-11:

Exhibit A-11. Response Options for JOBTYP

JOBTYP Code	Description
01	Earthquake damage required extensive repairs to house
02	Tornado, hurricane, etc. damage required extensive repairs to house
03	Landslide damage required extensive repairs to house
04	Lighting or fire damage required extensive repairs to house
05	Flood damage required extensive repairs to house
06	Other natural disaster damage required extensive repairs to house

In the 2017 AHS, 664 owner-occupied units reported experiencing one or more of these types of extensive damage—1.9 percent of all owner-occupied units. Exhibit A-12 shows that these units, which were extensively damaged by disasters, were overrepresented but not concentrated in the gut rehabbed groups.

Exhibit A-12. Percentage of Units in Group Reporting Extensive Damage from Disasters

A	B	C	D	E	F	G	H
All 2017 Owner Occupied (%)	All 2017 Gut Rehabbed (%)	Consistent Gut Rehabbed (%)	Inconsistent Answers (%)	Not Owner Occupied 2019 Outcome (%)	Rental 2019 Outcome (%)	Previously Gut Rehabbed (%)	No Recent Gut Rehab (%)
1.9	3.3	3.8	3.4	3.1	3.9	2.7	1.7

f) Possible Effect of Do-It-Yourself Work on False Positives

Using the 397 cases in group C (consistent gut rehabbed), the authors looked at the possibility that do-it-yourself work could explain the false positives. These cases were split into two subsets: the 198 cases that had total rehab costs less than \$5,850 (the median) and the remaining 199 cases. Fifty-three of the below-median cases reported 1 or more of the 11 jobs potentially involving breaking into walls; 26 of these (49 percent) involved some do-it-yourself work. Of the remaining 199 cases, 157 had one or more jobs that potentially involved breaking into walls; of these, 46 (29 percent) involved some do-it-yourself work. Although do-it-yourself was relatively more important among the below-median cases, it does not appear to have a major impact on the false positives. Fifty-three of the below-median cases reported no work recorded in any of the 11 categories that were consistent with breaking into walls.

For group A (the comparison group of all owner-occupied units), the median for REMODAMT was \$400; 17,246 units fell into this subset. Only 4 percent reported work on any of the 11 categories, and more than one-half of these (56 percent) involved do-it-yourself labor. Of the

remaining 17,299 owner-occupied units, 45 percent reported some work among the 11 categories, and 36 percent of those reporting work also reported do-it-yourself work.

4) Why Remodeling Was Done

The remodeling section of the AHS records why the work was undertaken, listing three possibilities: to make the unit more accessible, to improve energy efficiency, or to sell the unit. Exhibit A-13 compares the reasons given by the six largest groups.

Exhibit A-13. Percentage of Units by Group Giving Reasons for Remodeling Work (Percentage of “Yes” Responses Among Those Units Giving a Response)

Reason Given for Remodeling	A	B	C	D	G	H
	All 2017 Owner Occupied (%)	All 2017 Gut Rehabbed (%)	Consistent Gut Rehabbed (%)	Inconsistent Answers (%)	Previously Gut Rehabbed (%)	No Recent Gut Rehab (%)
To improve accessibility	6.6	8.6	9.2	9.1	7.9	6.2
To improve energy efficiency	31.1	45.0	52.5	43.8	40.7	30.0
To sell unit	3.7	4.0	2.8	4.2	2.4	3.2

Improving energy efficiency is by far the reason most frequently given for remodeling. Very little remodeling work is done to sell an owner-occupied unit. These row comparisons are interesting but not relevant to understanding the usefulness of GUTREHB.

The differences across columns do not appear to be informative.

5) Effects of Remodeling Work

The final AHS variable used to detect changes brought about by gut rehab is the estimated market value of the unit (MARKETVAL). Presumably, owners undertake extensive renovation work to increase the market value of the unit, reduce operating costs associated with the unit, or increase the value of the housing services that the unit provides to the household. Reducing costs or increasing the value of the housing services should also be reflected in the estimated market value of the units. Exhibit A-14 reports the median percentage change in estimated market value by group between 2015 and 2019 for the sample units in each group.

Exhibit A-14. Median Percentage Change in Estimated Market Value Between 2015 and 2019, by Group¹⁰

Group	Definition	Median Percentage Change
A	All owner occupied	35.2
B	All 2017 gut rehabbed	38.6

¹⁰ Estimated market value is not reported for rental units (group F), and removing this subset from group E left only 56 units reporting in group E.

C	Consistent gut rehabbed	42.2
D	Inconsistent answers	37.0
E	Not owner occupied 2019 outcome	41.6
F	Rental 2019 outcome	N/A
G	Previously gut rehabbed	34.5
H	No recent gut rehab	34.3

Exhibit A-14 is the one case in which units identified by GUTREHB appear different. Group C units have the highest median percentage and are 7 percentage points higher than the all-owner-occupied group (group A). All the remaining groups, except for the 56 units in group E, have median percentage changes that are similar to that of all owner-occupied units. The authors did not attempt to see whether any of the observed differences are statistically significant.

The set of sample units identified by “yes” answers to GUTREHB in both 2017 and 2019 after a “no” answer in 2015 (consistent gut rehabbed) show the greatest increase in estimated market value, 42.2 percent, which is 7 percentage points greater than the 35.2-percent increase in estimated market value for all owner-occupied units. In 2015, the median estimated value for all owner-occupied units was \$180,000; a 7-percent difference in the increase in market value by 2019 would have meant an additional \$12,600 in value.¹¹ This difference would represent a good return on the additional \$5,850 in median remodeling costs reported in exhibit A-4.

¹¹ The median percentage change reported in exhibit A-14 is the median of the changes in all sample units in the respective groups, not the percentage change in the estimated value of the median unit in each group. The comparison using medians is not meant to be exact but rather to give a sense of the magnitude involved. The median estimated market value of all owner-occupied units was \$180,000 in 2015 and \$230,000 in 2019.

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