

Is Homeownership Actually Rising and Vacancy Falling? Understanding Housing Vacancy Survey Estimates for 2020

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Abstract

Rising COVID-19 case counts in early 2020 led to changes in the data collection procedures used for the Current Population Survey/Housing Vacancy Survey (CPS/HVS), an important source of information about vacancy rates and the homeownership rate in the United States. On March 20th, 2020, the Census Bureau suspended in-person data collection attempts and shifted all data collection operations to telephone-based attempts, a change that remained in place through July 2020, when in-person data collection was gradually reintroduced in some areas of the country. This paper examines the implications of these data collection changes for CPS/HVS estimates. First, the paper presents a series of non-response analyses that use supplemental data sources to describe differences between responding and non-responding housing units, as well as the change in these differences over time. The non-response analyses find significant changes in these non-response outcomes beginning in the second quarter of 2020. Second, the paper develops an alternative non-response weighting adjustment factor and examines the implications for CPS/HVS estimates of the homeownership rate, rental vacancy rate, homeowner vacancy rate, and gross vacancy rate. The results suggest that the observed changes in non-response outcomes likely contributed to the historically large increase in the homeownership rate for the second quarter of 2020. While the vacancy rate estimates are not similarly sensitive to the alternative non-response weighting adjustment, the results illustrate the potential for the CPS/HVS vacancy rates in 2020 to underestimate the actual levels of vacancy due to the CPS/HVS weighting methodology's assumption that all non-responding housing units are occupied. These results suggest that the CPS/HVS estimates of vacancy rates and the homeownership rate should be interpreted with caution until data collection operations return fully to their standard procedures.

* This report is released to inform interested parties of ongoing research and to encourage discussion. Any views expressed on statistical, methodological, technical, or operational issues are those of the authors and not necessarily those of the U.S. Census Bureau. The U.S. Census Bureau reviewed this data product for unauthorized disclosure of confidential information and approved the disclosure avoidance practices applied to this release. CBDRB-FY21-POP001-0056.

Introduction

In response to rising COVID-19 case counts in the United States, the Census Bureau on March 20th, 2020, suspended in-person interview attempts for its ongoing surveys, including the Current Population Survey's Housing Vacancy Survey supplement (CPS/HVS). This paper examines the implications of this change in data collection procedures for the CPS/HVS estimates, which include closely watched measures of the rental vacancy rate, the homeowner vacancy rate, and the homeownership rate.¹

In-person interview attempts—termed ‘personal visits’—are the primary mode of data collection for CPS/HVS, which relies on these visits to accurately identify vacant and non-residential properties as well as to complete household interviews. Following the suspension of personal visits, CPS/HVS interviewers made extensive efforts to replace personal visits with telephone-based contact attempts. Despite these efforts, the CPS/HVS response rate declined from 83 percent on average in 2019 to 79 percent in the first quarter of 2020 and 67 percent in the second quarter of 2020.

These decreases in the response rate raise questions about the extent to which the changing patterns of non-response were randomly distributed across sample housing units or concentrated among specific types of households or housing units. Decreases in the response rate do not necessarily reduce the accuracy of survey estimates if the changes in non-response are random or otherwise independent of the variables used to produce estimates. However, the response rate decreases may affect the CPS/HVS estimates to the extent that the suspension of personal visits reduced the response rates of some groups more than others—e.g., vacant versus occupied units, rental versus homeowner units, etc.

Assessing these patterns of non-response is therefore necessary to understand the extent to which the CPS/HVS estimates may be affected by the changes in data collection procedures. For example, the CPS/HVS estimate of the homeownership rate in the second quarter of 2020 is 67.9 percent, compared to the estimate of 65.3 percent in the first quarter of 2020. The difference between quarters of 2.6 percentage points marks the largest quarter-to-quarter change in the homeownership rate in the CPS/HVS historical series dating back to 1964.² Because the changes in data collection procedures affected the response rates in the first and second quarters of 2020, it is unclear to what extent this increase may be due to the data collection changes rather than the actual changes in homeownership that occurred during the initial months of the pandemic.

This paper pursues two research objectives in the attempt to better understand the potential impacts of the changes in data collection procedures on the CPS/HVS estimates. First, the paper conducts a series of non-response analyses that describe the differences between responding and non-responding housing units and examines changes in these non-response patterns over time. These analyses document the extent to which non-response was nonrandom in 2019 prior to the onset of the coronavirus pandemic and the changes in data collection procedures. They then describe the size and

¹ The rental vacancy rate and homeowner vacancy rate are produced from the data collected by the Housing Vacancy Survey supplement, whereas the homeownership rate is produced from the occupied units in the Current Population Survey. For ease of notation, this paper uses the CPS/HVS label to refer to the combined set of vacancy rate and homeownership rate estimates. Additional information about the quarterly CPS/HVS estimates is available at: <https://www.census.gov/housing/hvs/index.html>

² U.S. Census Bureau. Housing Vacancies and Homeownership (CPS/HVS). Table 14. Homeownership Rates for the U.S. and Regions: 1964 to Present." Published October 27th, 2020.

nature of the changes in non-response patterns that appeared in 2020, showing significant changes in non-response patterns in the first three quarters of 2020.³

Second, the paper develops a non-response weighting adjustment factor and examines the implications of its use for the CPS/HVS estimates of the homeownership rate, rental vacancy rate, homeowner vacancy rate, and gross vacancy rate. The analyses use a propensity-score-based approach to develop a non-response weighting adjustment factor and apply it to the CPS/HVS weights. The results suggest that the observed changes in sample composition may have contributed to the historically large increase in the homeownership rate estimate for the second quarter of 2020. In contrast, the vacancy rates are not significantly affected by the use of the non-response adjustment factor; however, the results describe the potential for the vacancy rate estimates to underestimate the actual levels of vacancy in 2020 due to the CPS/HVS weighting methodology's assumption that all non-responding housing units are occupied.

Changes to HVS Data Collection Procedures

In response to rising numbers of COVID-19 cases in the United States, the Census Bureau suspended personal visits for the CPS/HVS on March 20th, 2020. The suspension of personal visits continued in all areas of the United States for the CPS/HVS data collection periods in April, May, June, and July 2020. Beginning in August, personal visits began to be reintroduced in a subset of localities, with ongoing review and updates each month in response to local conditions. During this period, the Census Bureau continued to collect the CPS/HVS by telephone, making efforts to collect telephone interviews for all sample units including vacant units and ineligible units.

The standard CPS/HVS data collection procedures use personal visits as the primary mode of data collection but allow telephone interviews when certain conditions are met. The CPS/HVS sample design is a rotating panel that collects data on sample housing units for eight separate months. Once selected, a housing unit is in the sample for four consecutive months, out for eight months, and then in the sample for four months. Under the standard CPS/HVS data collection procedures, the first and fifth interviews are required to be collected through personal visits. In other months, a telephone interview can be completed with HVS-eligible sample housing units if the unit was HVS-eligible in the previous month, the unit is located geographically distant from the interviewer's home and other remaining interviews, and the name and telephone number of a reliable respondent is available and a telephone interview is acceptable to that person.⁴

The suspension of in-person interviews during the first quarter of 2020 meant that telephone contact attempts replaced in-person interview attempts for all housing units in the sample, regardless of their month in sample. These telephone contacts relied on phone numbers identified through multiple sources. For housing units with a completed interview in a previous month, interviewers attempted to contact the occupant or knowledgeable proxy interviewed during the previous month. Additionally, interviewers were encouraged to use the resources available to them to identify contact information for sample housing units and/or knowledgeable proxy respondents. These resources included internal resources such as purchased third-party telephone lookup databases, as well as public records databases such as tax assessor records. Interviewers could also use online searches to identify leasing

³ Use of the term statistically significant in the text of this paper indicates that a finding is significant at the 90 percent level or higher. All tables report significance at the 90, 95 and 99 percent levels.

⁴ For additional information, see the Current Population Survey Interviewing Manual (2015): https://www.census.gov/housing/hvs/methodology/CPS_Manual_April2015.pdf

offices or telephone contacts with knowledgeable local sources such as real estate agents, neighbors, and postal workers who might be able to identify vacant units, provide contact information for the property owner, or complete a proxy interview.

In each month, CPS/HVS data collection generally begins at the start of the week containing the 19th and closes out early the following week. The suspension of personal visits on March 20th, 2020 occurred on the Friday during the week of data collection. While interviewers were able to make at least one personal visit attempt to most sample units prior to the suspension of personal visits, the suspension of personal visits occurred prior to the completion of data collection activities for March 2020—and therefore prior to the completion of data collection for the first quarter 2020.

While interviewers made extensive efforts to complete data collection using telephone-based contact attempts, response rates declined following the suspension of personal visits. Response rates declined from 83 percent in February 2020 to 73 percent in March, 70 percent in April, 67 percent in May, 65 percent in June, and 66 percent in July. They then rebounded to 69 percent in August as personal visits were reintroduced in some areas and to 79 percent in September as personal visits were allowed in all areas. For comparison, the monthly response rates in 2019 ranged between 80 percent and 84 percent across months.⁵

Table 1 displays the share of sample housing units recorded as Type A non-responses in each quarter of the analysis period. Using CPS/HVS terminology, Type A non-responses include housing units that are eligible for an occupied interview but for which no data is collected (e.g., refusals). The Type A shares in Table 1 show the ratio of these Type A non-responses to the full sample of housing units, which additionally includes completed interviews of occupied units, HVS-eligible Type B vacant units, other Type B units, and Type C ineligible units.⁶ For example, the figures in the top row of Table 1 indicate that the share of sample housing units recorded as Type A non-responses increased from approximately 14-15 percent of sample housing units in each quarter of 2019 to 28 percent in the second quarter of 2020.

The remaining rows of Table 1 show the share of Type A non-responses across month-in-sample (MIS) groups. These patterns show that the highest non-response rate appears in the second quarter of 2020 for month-in-sample 1, which includes the housing units that are rotating into the sample for the first time and that do not have any stored contact information from interviews in previous months. While higher response rates in the MIS 1 group isn't necessarily problematic for the CPS/HVS estimates, it may raise concerns to the extent that the availability of telephone contact information from previous interview months is correlated with vacancy, tenure, or other estimated outcomes.

Implications of Unit Non-Response for Survey-Based Estimates

The recent changes to CPS/HVS data collection in response to COVID-19 and the resulting drop in response rates have occurred against longer-term trends in survey non-response. Since the 1990s,

⁵ The CPS/HVS response rates are calculated as the ratio of completed occupied interviews to the total of completed occupied interviews and Type A non-interviews, excluding HVS-eligible Type B vacant units, other Type B units, and Type C ineligibles. The denominator for the response rates therefore differs from the Type A non-response rates shown in Table 1, which are calculated with respect to the full set of sample housing units including Type B and Type C units.

⁶ Additional information about the technical definitions of each of these groups is available in Chapter 3-2 of CPS Technical Paper 77 (U.S. Census Bureau 2019).

survey non-response has increased across almost all household surveys, including large government surveys (Czajka and Beyler 2016). Declines in survey response rates are concerning because the foundation of household surveys rests on probability sampling, in which samples of a target population are drawn from a sampling frame, which includes all of the households that compose the target population (Groves 2006; Brick and Williams 2013). The main assumption of this strategy is that for the sample to be representative of the target population, there must be complete response to all survey measures on the survey instrument. When missing data are present, this introduces the potential for estimates to be biased.

However, non-response alone is not sufficient to create bias in survey estimates. When data are missing at random, meaning the missing data are not correlated with the survey measure of interest, non-response does not bias the resulting survey estimate for the survey measure (Groves and Peytcheva 2008). This suggests a weak correlation between non-response rates and survey measure bias where a low response rate does not indicate the presence of bias nor a high response rate the absence of bias. Survey estimate bias may also vary across survey estimates on the same survey more than estimates across different surveys (Groves and Peytcheva 2008; Peytcheva and Groves 2009; Yan and Curtin 2010). Assessing bias is an item-specific process that involves looking at the relationships between the characteristics of respondents and non-respondents, non-response, and each survey measure of interest.

Since survey non-response and concerns over survey bias have received considerable attention in recent years, most surveys employ at least minimal strategies to decrease or correct for potential issues related to non-response. Strategies for assessing and mitigating bias created by non-response vary by the type of missing data at hand. These include unit non-response, item non-response, incomplete coverage of populations, and partial non-response in panel surveys (Groves and Peytcheva 2008). All of these types of missing data are worthwhile subjects of research, but, in this paper, we focus on unit non-response, or when an interviewer is unable to obtain sufficient survey measures for a sample unit.

A common method of combating unit non-response bias is to use post-survey weighting adjustments.⁷ These methods use outside information, called auxiliary data, on both respondents and non-respondents to adjust survey weights to correct for potential bias on survey estimates. Auxiliary data may take the form of data from the sampling frame, administrative records, and survey paradata such as field representative observations (Groves and Peytcheva 2008; Kreuter and Olson 2011).

The two primary methods for creating weighting adjustments for unit non-response are adjustment cell weighting and response propensity weighting. The purpose of each of these strategies is to use auxiliary variables with information on both respondents and non-respondents to predict the probability of response to a survey or for a given survey measure and reduce or eliminate non-response bias. Each of

⁷Other strategies to increase survey response rates include follow-up interviews, administering the survey in multiple modes, and prioritizing some cases over others when attempting interview (Fowler 2013; Groves 2006). These strategies are most effective when carefully tailored to balance non-response across sampled units with different characteristics. If a strategy for increasing response rates results in non-random increases in response patterns across some sampled units, this could actually increase bias on survey measures. Because changes to the survey mode for HVS/CPS had to be made quickly, using one of the aforementioned strategies was not an option and this paper necessarily focuses on post-survey weighting adjustments.

these methods has advantages and disadvantages, and the decision of which one to use is dependent on the available auxiliary data and the survey measure of interest.

Adjustment cell weighting involves creating cells by cross-tabulating auxiliary variables of interest for respondents and non-respondents and then calculating the probability of response in the different cells. Because cell weighting is a non-parametric method, it provides some protection against model misspecification, nonlinear estimates, and interactions between variables that may occur in parametric modeling. This is useful especially when dealing with continuous variables (Haziza and Lesage 2016). One disadvantage, depending on the amount of data available, is that some cells in this method may have a limited number of cases, resulting in unstable probabilities. A technique for overcoming this issue is to combine cells with small sample sizes that have similar probabilities. A more sophisticated version of adjustment cell weighting, the chi-square automatic interaction detection (CHAID) algorithm, is used when the number of variables is large. This method merges and collapses the created cells until the data are grouped by similar response probabilities (Chen et. al. 2015).

In response propensity weighting, a series of covariates is used to predict a group receiving or not receiving a treatment using logistic regression (Rosenbaum and Rubin 1983). As this method has been applied to survey non-response, the term “response propensity weighting” was developed to explain how the probability of response, a proxy for response propensity in surveys, is predicted using auxiliary variables that are associated with both non-response and the survey measure of interest. The resulting probabilities are used to adjust survey weights and correct for unit non-response bias. Response propensity weighting is more complicated than the adjustment cell method, but avoids the issues related to small cell sizes and unreliable cell probabilities (Brick 2013; Chen et. al. 2015).

Chen et. al. (2015) describe two limitations of response propensity weighting and offer a potential solution. The first limitation is that response propensity weighting is dependent on correctly specifying the model, as poor model fit will yield biased coefficients. For the second limitation, response propensity weighting sometimes yields very small propensities for small samples, and these groups can then receive very large weights. Chen et. al. (2015) reference the work of Little (1986) on the response propensity stratification method, in which the resulting response propensities are then used to form adjustment cells. Using this method reduces issues with poor model fit and/or small propensities.

An additional criticism of past work using response propensity weighting is that researchers often assume that the propensity to respond is fixed for a sample unit rather than variable across survey conditions—e.g., the number of attempts by interviewers to obtain a response.⁸ One proposed way to avoid this issue is to directly model survey conditions by having a vector of predictors include data collection attempts, such as numbers of call attempts, survey mode, incentives, and refusal conversion attempts (Brick 2013; Olsen and Groves 2012; Schouten et. al. 2011). Using data collection measures has proven useful in propensity score modeling experiments aimed at case prioritization for a large government survey (Tolliver et. al. 2019).

Often response propensity weighting and adjustment cell weighting methods are combined with additional techniques to adjust the weights according to known population totals. For example, many government surveys take a two-step approach of using adjustment cell weighting to correct for non-response bias combined with raking to calibrate the resulting weights against existing population totals

⁸ This criticism is just as valid for cell adjustment methods that ignore data collection attempts in estimating response propensities.

(Haziza and Lesage 2016). In these methods, data on respondents and non-respondents are used in combination with independent housing unit and/or population estimates to adjust survey weights to account for potential non-response bias (Bethlehem 2002).

No single weighting adjustment strategy has been demonstrated to be superior to others in reducing non-response bias (Chen et.al. 2015; Brick 2013). What appears to be most important is to have powerful auxiliary variables that predict both non-response and the survey measure of interest and selecting a strategy that best takes advantage of these data. Strategies that limit the amount of auxiliary data that can be incorporated may be less beneficial (Brick 2013). Conversely, the incorporation of supplemental data sources beyond what is available from the survey itself can be valuable to the extent that such data broadens the set of auxiliary variables available to predict non-response.

In recent years, researchers have developed linking methods to broaden the set of auxiliary data available for non-response analyses of Census Bureau surveys (Brummet 2014; Wagner and Layne 2014). These efforts initially focused on understanding the consequences of non-response patterns prior to the COVID-19 pandemic in the CPS's Annual Social and Economic Supplement (Bee et.al. 2015), the Survey of Income and Program Participation (Eggleston and Westra 2020), and the Consumer Expenditure Survey (Brummet et.al. 2018; Sabelhaus et.al. 2015). More recently, Rothbaum and Bee (2020) examine the consequences of changing non-response patterns for income estimates in the 2020 CPS ASEC collected during the early months of the pandemic, and Berchick et.al. (2020) examine 2020 CPS ASEC estimates of health insurance for evidence of non-response bias. While several of these prior analyses use auxiliary data to examine non-response bias in the CPS, the current study to our knowledge is the first to apply these methods to the Housing Vacancy Survey.

Data and Methodology

The analyses in this paper pursue two research objectives. First, we conduct a series of non-response analyses that compare the characteristics of responding versus non-responding housing units over time, measuring the extent to which CPS/HVS non-response patterns changed following the suspension of personal visits in March 2020. Second, the analyses develop and apply a non-response weighting adjustment factor to explore the extent to which the observed changes in non-response patterns affected the CPS/HVS estimates. In both analyses, the availability of supplemental data that contain information about both responding and non-responding households is central to the research design.

The base dataset for the analyses is the monthly sample of housing units for CPS/HVS data collection. We append the monthly datasets from January 2019 through September 2020, categorizing the data into seven quarters to match the CPS/HVS quarterly releases. We then supplement this data with information from multiple sources. First, information from the 2010 Decennial Census, property records from Black Knight Inc., and postal information from the National Change of Address (NCOA) database are each merged to the base sample at the housing unit level, using the Census Bureau's master address file identifier (MAFID) to conduct the merge (Brummet 2014). The 2010 Decennial Census contains information about the vacancy status, tenure, and other attributes of the unit at the time of the 2010 Census. The vendor data from Black Knight Inc. contain information about the housing unit compiled from county tax assessor records and other sources. The postal data from the NCOA database contain information about change of address requests associated with the housing unit. Additionally, neighborhood attributes measured at the census tract level are added from the American Community Survey's 2018 5-year estimates. Table 2 contains a summary of the data sources and variables added from each source. Because none of the supplementary data sources contains complete coverage of all

housing units in the base sample, the analyses add indicator variables for whether a match cannot be found as additional covariates.

The non-response analyses use this information to compare the characteristics of responding versus non-responding housing units. For each quarter, the analyses test whether the characteristics of non-responding units are statistically different from the characteristics of housing units with a completed response. Using CPS terminology, the analyses compare the characteristics of Type A non-responses to the characteristics of the pooled sample of completed interviews, Type B vacant/unoccupied units, and Type C ineligible units. These initial comparisons describe the extent to which differential non-response is present in the CPS/HVS sample, capturing both longstanding response patterns and any changes that occurred following the suspension of personal visits.

The second step in the non-response analyses is to compare the differences between responding and non-responding units across quarters. These comparisons test whether the size of the differences changed significantly in each quarter of 2020 compared to the same quarter in 2019. These comparisons have the potential to shed light on how the changes in data collection procedures affected response patterns. However, these comparisons may also reflect the effects of any other confounding factors that altered the likelihood of non-response among the observed subgroups during this period. The comparisons across quarters should therefore be interpreted as the combined effect of the data collection changes and all other factors that affected non-response patterns during this period.

The results of these analyses inform the development of an alternative weight using a propensity-score-based adjustment for non-response. Under the current methodology, the CPS/HVS weights adjust for non-response in two ways. First, the CPS household weight applied to occupied units includes a non-response weighting adjustment factor that adjusts for differences in response across primary sampling units (PSUs) and central city location status. The non-response adjustment factor groups PSUs within the same state that are similar in metropolitan status and size and then splits these clusters based on central city and non-central-city location to form the adjustment cells. This non-response adjustment factor is incorporated into the CPS household weights applied to occupied units; however, the HVS supplement weights applied to vacant units do not have any similar adjustment for non-response.⁹ Second, the process of controlling the weights to independent population totals may also reduce the effects of differential non-response to the extent that non-response is correlated with the demographic subgroups used in the population controls. A more detailed description of the weighting components included in the standard methodology is available in CPS Technical Paper 77 (U.S. Census Bureau 2019).

An important feature of the current methodology is its assumption that all Type A non-responses are occupied units and that none are vacant. This feature is implicit in the application of the non-response adjustment factor to occupied units but not to vacant units. By calculating the non-response adjustment factor as the inverse of the ratio of completed interviews to the sum of complete interviews plus Type A non-responses within each adjustment cell, the non-response adjustment factor weights the completed responses up to the total universe of completed interview and Type A non-responses. This adjusted total of occupied units is then combined with the vacant responses when the population control totals are applied to weight the units up to the total number of housing units in U.S. This sequence of steps relies on the assumption that all vacant units will be identified during the in-person data collection attempts. To the extent that vacant units are not identified by the in-person data collection attempts and are

⁹ The HVS supplement weights are indirectly affected by the CPS household weights through the denominator of the regional housing unit adjustment, which includes the CPS estimate of the total count of occupied units.

instead coded as Type A non-responses, the CPS/HVS estimates of vacancy rates will be biased downward. Moreover, any changes in the likelihood that vacant units are not identified by the in-person data collection attempts may limit the validity of comparisons of the CPS/HVS estimates of vacancy rates across quarters.

The analyses in this paper therefore examine the sensitivity of CPS/HVS estimates to the use of an alternative weighting approach that uses the supplemental data sources to develop a propensity-score-based adjustment for non-response. The propensity scores are constructed by estimating logistic regressions with the following form:

$$(1) \quad \text{Log}(\text{Pr}(Y_i / (1 - \text{Pr}(Y_i))) = \alpha + X_i\beta_1 + G_i\beta_2 + M_i\beta_3$$

Where Y_i is an indicator for whether the housing unit didn't respond, X_i is a vector of covariates from the supplemental data sources described above, G_i is a set of fixed effects that interact the 51 states with 3 metropolitan status categories, and M_i is a set of fixed effects that interact the three metropolitan status categories with eight month-in-sample categories.¹⁰ Equation 1 is estimated separately for each quarter using logistic regressions on the pooled sample of all housing units in the CPS monthly basic files for each quarter.¹¹

These regressions are then used to calculate the predicted probability of response for each sample housing unit in each quarter. The alternative non-response weighting adjustment factor is calculated as the inverse of the predicted probability of response, and the alternative weights are constructed by multiplying this alternative non-response adjustment factor by the base weights to account for differences in response propensities. As described in CPS Technical Paper 77, the base weights are sufficient to produce unbiased estimates of vacancy rates and the homeownership rate under strong assumptions about ideal survey conditions such as zero frame error, zero non-sampling error, and non-response patterns that are independent of the variables used to produce the estimates (U.S. Census Bureau 2019). The alternative non-response weighting adjustment relaxes the last assumption, requiring only that the non-response patterns are independent of the unobservable factors not controlled for in the logistic regressions. However, it does not relax any concerns about frame error or other sources of non-sampling error.

Results and Discussion

Tables 3-6 present the results of the non-response analyses comparing the characteristics of responding and non-responding housing units for each quarter of 2020 compared to the comparable quarter of 2019. All statistics are calculated using a base weight that adjusts for differences in sampling probabilities, and the standard errors are calculated using replicate weights. The significance levels report the results of t-tests of the difference in means between the Type A non-responding units and the other units in the sample (labeled "completes"). These comparisons provide insight into whether non-responding units were randomly distributed across the sample in each quarter by testing whether the mean attributes of non-responding housing units are statistically different from the mean attributes of responding units.

An initial finding from the output shown in Tables 3-6 is that the results for each of the quarters in 2019 show multiple significant differences between the mean attributes of responding versus non-responding

¹⁰ See Appendix A for additional information about the model specification process along with model fit statistics.

¹¹ This sample includes all housing units in the CPS monthly basic file, including completed interviews, Type A non-responses, Type B vacants, and Type C ineligible.

housing units, suggesting that non-responding housing units were not randomly distributed in 2019 prior to the suspension of personal visits. For example, the results in Table 5 (for Q3 2019) show that 17.1 percent of responding housing units were located in the non-metropolitan areas, compared to 9.9 percent among non-responding units—and that the 7.2 percentage-point difference between these values is statistically significant. A similar pattern appears in each of the other quarters of 2019, with non-responding Type A units including lower shares of housing units in non-metropolitan areas.

The results for 2019 also show significant differences between the mean attributes of responding and non-responding housing units for multiple other variables. For example, the 2010 Decennial Census attributes suggest that the set of non-responding housing units contain fewer seasonally vacant units; more rental units and fewer units owned with a mortgage; more units in multi-family buildings and fewer trailers, or other dwelling types; fewer households with heads age 65 or over and more households with heads younger than age 35; and more households headed by a Black householder. The neighborhood characteristics from the 2014–2018 American Community Survey mirror several of these findings, showing that higher shares of non-responding housing units are located in neighborhoods with lower vacancy rates; lower homeownership rates; lower population shares age 55 or over; and lower population shares of persons in the White alone race category. Taken together, these differences suggest that non-response was not randomly distributed in 2019, prior to the onset of the COVID-19 pandemic.

The middle columns in Tables 3, 4, and 5 report similar comparisons for Q1, Q2, and Q3 2020 following the suspension of personal visits. In each table, the final columns report the change between the differences observed in 2019 and 2020—calculated as the difference in 2020 minus the difference in 2019. This measure describes the extent to which the differences in non-response observed in 2020 are different from the differences observed in the corresponding quarter of 2019. In each quarter, the differences are calculated as the mean value for Type A non-responding units minus the mean value for responding units, so positive values on the measure of year-over-year change in differences reflect attributes that became more common among non-respondents in 2020—and therefore less represented in the CPS/HVS sample in 2020. These difference-in-difference measures focus on identifying the attributes whose incidence of non-response changed significantly over time.

The additional columns in Table 4 show several significant changes in the difference-in-difference measures—and these changes all appear among attributes that did not show existing differences between responding and non-responding units in 2019. Among the attributes that showed significant differences between responding versus non-responding units in 2019, many continue to show significant differences between responding versus non-responding units in the same quarter of 2020; however, none show significant changes in these differences from 2019 to 2020. Instead, the significant changes appear among other attributes. For example, Table 4 shows that the share of responding units in month-in-sample 1 (MIS 1) in the second quarter of 2019 was 12.8 percent, which is not significantly different from the share of non-responding units in MIS 1 in that quarter. Conversely, the share of responding units in MIS 1 in the second quarter of 2020 was 9.7 percent, which is 11.3 percentage points lower than the share of non-responding units in MIS 1—a difference that is statistically significant. Moreover, the change measure shows that these figures represent a significant increase of 9.7 percentage points from 2019 to 2020 in the difference between non-responding and responding units. Similarly, the change measures show a significant increase in the differences for MIS 2, and significant decreases in the differences for MIS 7 and MIS 8.

Additionally, the change measures suggest that the set of non-responding units in the second quarter of 2020 increasingly included fewer units that were owned free and clear in the 2010 Decennial Census; fewer units identified as owner-occupied by Black Knight's measure; more units that could not be matched to Black Knight data; and more units in neighborhoods with high poverty rates in the ACS data. Except for the MIS 1 variable, these changes are only significant in Table 4, which compares the second quarter of 2020 to the second quarter of 2019. In contrast, the changes in the first and third quarters of 2020 from the same quarter of 2019 are smaller in magnitude and not statistically significant (Tables 3 and 5).

To supplement these comparisons, Table 7 presents the results of similar difference-in-difference estimates if the difference between non-responding and responding units in each quarter is instead compared to the first quarter of 2019. A separate difference-in-difference model is estimated for each variable using ordinary least squares (OLS) on the pooled sample for all seven quarters. For each variable, the covariates in the OLS model include an indicator for whether the housing unit responded, a series of six indicator variables for each quarter from the second quarter of 2019 to the third quarter of 2020, and a series of six interaction terms that interact the response indicator with the indicator for each quarter. The estimates reported in Table 7 are the coefficients from the interaction terms, which are equivalent to the year-over-year change estimates reported in Tables 3-6 but use the first quarter of 2019 as the comparison group for all subsequent quarters. The coefficients in Table 7 for the first quarter of 2020 are therefore identical to the year-over-year estimates of change in Table 3, which compare the first quarter of 2020 to the first quarter of 2019.

One additional finding from Table 7 is that the estimates for the second, third, and fourth quarters of 2019 do not show any statistically significant changes from the first quarter of 2019. This result indicates that the differences between non-responding and responding units found in each quarter of 2019 were stable and did not change significantly in later quarters of 2019. This result highlights that, while several significant differences existed in 2019 between the attributes of respondents and non-respondents, these non-response outcomes were stable across quarters in 2019 prior to the onset of the pandemic. This stability contrasts with the appearance of significant coefficients beginning in the second quarter of 2020. Taken together with the year-over-year change estimates in Tables 3-6, these results suggest that CPS/HVS non-response outcomes changed in meaningful ways in the second and third quarters of 2020.

In addition to presenting the results of the non-response analyses, a second analysis objective is to develop a propensity-score-based non-response weighting adjustment factor and to examine its implications for CPS/HVS estimates of the homeownership rate and vacancy rates. Table 8 documents the coefficient estimates of the series of logit regressions used to model the likelihood that a housing unit responded. A separate logit regression is estimated for each quarter. Each model regresses an indicator of whether the unit responded on a selected subset of the attributes from the prior non-response analyses, as well as two sets of fixed effects. The first set of fixed effects interacts each state by the three metropolitan status indicators (principal city, other MSA/CBSA, and non-metropolitan). The second interacts the eight month-in-sample categories by the three metropolitan status indicators. Together, these fixed effects are designed to capture variation in non-response associated with differences in data collection activities across different geographies and for different MIS groups. The coefficients from these models are then used to generate predicted likelihoods of non-response for each sample housing unit, which are then converted into the non-response adjustment factor and the adjusted weight using the procedures described in the Data and Methodology section.

Table 9 reports estimates of the homeownership rate, rental vacancy rate, homeowner vacancy rate, and gross vacancy rate using the propensity-score-based non-response weighting adjustment described above (labeled the “PB” estimates). For comparison, Table 9 also includes estimates using the CPS base weight and the CPS base weight multiplied by the current non-response adjustment factor (labeled the “BW” and “CM” estimates, respectively). For ease of review, Figures 1A-1D visualize these estimates in line charts, along with the published figures that rely on the CPS/HVS final weight.

The homeownership rate estimates in Table 9 and Figure 1A show that applying the alternative non-response adjustment to the CPS base weights significantly reduces the homeownership rate estimate in each quarter. For example, in the first quarter of 2019, the PB estimate of the homeownership rate was 65.5 percent, compared to the BW estimate of 66.4 percent and the CM estimate of 66.1 percent. Similarly, the PB estimates for the remaining quarters of 2019 each fall below the BW estimate by between 0.8 and 1.2 percentage points. In contrast, the difference between the PB and BW estimates subsequently increases to 3.2 percentage points in the second quarter of 2020 and 2.7 percentage points in the third quarter of 2020.

The results also suggest that correcting for observed sample composition changes using the alternative non-response adjustment factor significantly reduces the size of the homeownership rate increases estimated for the second and third quarters of 2020. The year-over-year increase in the PB estimate of the homeownership rate is 2.0 percentage points in the second quarter of 2020, which is significantly smaller than the 4.4 percentage-point increase in the BW estimates. Similarly, the year-over-year increase in the PB estimate for the third quarter of 2020 is 1.5 percentage points, which is significantly smaller than the 3.2 percentage-point increase in the BW estimates. Comparing the PB estimates to the CM estimates, the year-over-year increases in the PB estimates for the second and third quarters of 2020 are also significantly smaller than the increases in the CM estimates, suggesting that the PB estimates correct for sample composition changes that are not addressed by the existing non-response adjustment.

While these results suggest that the homeownership rate increases in the second and third quarters of 2020 are influenced by the observed changes in sample composition in addition to changes in the true homeownership rate, there are important caveats. First, the alternative non-response weighting adjustment factor applied to the PB estimates adjusts only for differences in observed attributes, and there may be important additional changes in sample composition that are unobserved. Second, drawing inferences about the implications of these results for the published estimates based on the CPS/HVS final weight is more complicated than comparisons between the PB estimates and the BW or CM estimates. In addition to the difference in non-response adjustment factors, comparison of the PB and published estimates must also consider the additional adjustment factors and population controls applied to the published estimates. Interpretation of the published estimates in Figure 1A must therefore be done with caution, considering the additional weighting components used to construct the final weights.

Table 9 and Figures 1B-1D present similar estimates for the rental vacancy rate, homeowner vacancy rate, and gross vacancy rate. In contrast to the results for the homeownership rates, the PB estimates for the vacancy rates closely track the BW estimates in all quarters. The differences between the PB estimate and the BW estimate are less than 0.1 percentage points in all quarters for the rental vacancy rate and the homeowner vacancy rate, and less than 0.3 percentage points in all quarters for the gross vacancy rate. Moreover, none of the PB estimates of any vacancy rate is statistically different from the BW estimates. One possible explanation for these results is that the observed changes in non-response

captured by the regressions in Table 8 are not strongly correlated with vacancy—and therefore that adjusting for these changes does not substantially alter the vacancy rate estimates. However, an important caveat is that the covariates included in the logistic regressions may omit important attributes so that the non-response adjustment factor does not correct for the relevant changes in non-response patterns.

An additional finding from Table 9 and Figures 1B-1D is that the BW and CM estimates of the vacancy rates diverged in 2020 after moving roughly in tandem throughout 2019. For example, the difference between the BW and CM estimates of the rental vacancy rate was either 1.3 or 1.4 percentage points in each quarter of 2019 before increasing to 2.7 percentage points by the second quarter of 2020. Similarly, the difference between the BW and CM estimates of the gross vacancy rate was between 2.0 and 2.2 percentage points in each quarter of 2019 before increasing to 4.1 percentage points in the second quarter of 2020. Because the only difference between the BW and CM estimates is the choice of weights, these outcomes are due to changes over time in the effects of the non-response adjustment factor applied to occupied units in the current methodology. Specifically, they reflect the current methodology's assumption that all vacant units will be identified during in-person data collection attempts, so all Type A non-responses are occupied units.

As described in the Data and Methodology section, the current CPS/HVS weighting methodology calculates the non-response weighting adjustment using the pooled set of completed interviews and Type A non-responses, excluding Type B vacants and Type C ineligible. The resulting non-response weighting adjustment therefore weights up the occupied interviews to account for Type A non-responses but does not include a similar non-response adjustment for the vacant units. The result is that any vacant unit that cannot be identified and is instead coded as a Type A non-response will increase the CPS/HVS estimate of occupied units and decrease the estimate of vacant units. Under normal conditions, interviewers make multiple in-person data collection attempts with the goal of identifying as many vacant units as possible and minimizing the effect of this assumption on CPS/HVS estimates. Additionally, comparisons of the CPS/HVS estimates across quarters are made under the assumption that the effects of any remaining misclassifications are approximately constant across quarters, allowing for valid comparisons over time.

The suspension of in-person data collection attempts in early 2020 has the potential to violate these assumptions, increasing the risks that vacant units might be missed and altering the data collection procedures used in different quarters. The consequence is that the CM and FW estimates of each vacancy rate will underestimate the true vacancy rate to the extent that higher numbers of vacant units were missed. The divergence between the CM and BW estimates in Table 9 illustrates the extent to which these issues affected the CPS/HVS vacancy rate estimates for the second and third quarters of 2020 and must be considered when interpreting the estimates for that period.

Summary and Conclusions

The onset of the COVID-19 pandemic in early 2020 led to changes in the data collection procedures used for the Housing Vacancy Survey, an important source of information about vacancy rates and the homeownership rate in the U.S. On March 20th 2020, the Census Bureau suspended in-person data collection attempts and shifted all data collection operations to telephone-based attempts, a change that remained in place through July 2020, when in-person data collection began to be gradually reintroduced in some areas of the country. This paper pursues two research objectives in the attempt to better understand the implications of these data collection changes for CPS/HVS estimates. First, the

paper presents a series of non-response analyses that use supplemental data sources to describe differences between responding and non-responding housing units, as well as the change in these differences over time. Second, the paper develops an alternative non-response weighting adjustment factor and examines the implications for CPS/HVS estimates of the homeownership rate, rental vacancy rate, homeowner vacancy rate, and gross vacancy rate.

The non-response analyses show several significant changes in the relative attributes of non-responding versus responding housing units in the second quarter of 2020. These changes suggest that, compared to prior quarters, the difference between the attributes of non-responding versus responding units showed more units in month-in-sample 1 and 2 and fewer units in month-in-sample 7 and 8; fewer units that were owned free and clear in the 2010 Decennial Census; fewer units identified as owner-occupied by Black Knight's measure and more units that could not be matched to Black Knight data; and more units in neighborhoods with high poverty rates. Moreover, the non-response analyses did not find any significant changes in the relative attributes of responding versus non-responding housing units across quarters in 2019 or in the first quarter of 2020, suggesting that these changes in sample composition occurred in the months after the suspension of in-person data collection attempts in early 2020. The onset of the COVID-19 pandemic led to myriad changes during this period, so these changes cannot be attributed solely to the changes in data collection procedures and may reflect other confounding factors as well. Nonetheless, these changes document significant changes in the CPS/HVS sample composition in the second quarter of 2020 relative to prior quarters.

The alternative non-response weighting adjustment presented in this paper explores the extent to which these changes in sample composition may affect CPS/HVS estimates of vacancy rates and the homeownership rate. The results for the homeownership rate suggest that the observed changes in sample composition likely contributed to the homeownership rate's historically large increases in early 2020. For example, the homeownership rate's year-over-year change in the second quarter of 2020 is 2.0 percentage points when estimated using the alternative non-response weighting adjustment, compared to a 4.4 percentage-point increase using the CPS base weights. The difference between the estimates based on the alternative non-response weighting adjustment and the CPS base weights also increases significantly in the second and third quarters of 2020, after remaining approximately constant throughout 2019. There are important caveats in extrapolating from these findings to the published CPS/HVS estimates, as such comparisons must consider the additional adjustment factors and population controls used to produce the final weights for the published estimates. However, unless these additional weighting components indirectly account for the changes in non-response, the published estimates are likely to also be sensitive to the alternative non-response weighting adjustment.

The findings for the vacancy rate do not produce any evidence that the CPS/HVS vacancy rate estimates are sensitive to the changes in non-response described by the non-response analyses. The vacancy rate estimates produced using the non-response weighting adjustment are not significantly different than the estimates using the CPS base weights in any quarter. However, comparison of the vacancy rate estimates using the CPS base weights and the CPS/HVS final weights illustrates the potential for the suspension of in-person data collection attempts to violate a key assumption of the current weighting methodology for the vacancy rate estimates. Specifically, the current weighting methodology assumes that all vacant units can be identified during data collection, so that all Type A non-responses can be treated as occupied units. The result is that the CPS/HVS estimates underestimate the true vacancy rates to the extent that vacant units are not identified during data collection. While this assumption may have relatively small effects under normal data collection procedures, when interviewers can make multiple in-person visits to identify vacant units, the suspension of in-person data collection following the onset

of the COVID-19 pandemic poses greater risks. The vacancy rate estimates presented in this paper suggest that this assumption was violated in the second and third quarters of 2020. The consequence is that caution should be applied when interpreting the CPS/HVS vacancy rate estimates in 2020, with attention given to both the potential for the CPS/HVS vacancy rates to underestimate the actual vacancy rates and for the magnitude of the bias to vary across quarters.

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Tables and Figures

Table 1: Non-response (Type A) Share of Sample Housing Units by Quarter and Month in Sample.

	Q1 2019	Q2 2019	Q3 2019	Q4 2019	Q1 2020	Q2 2020	Q3 2020
Total	15%	15%	14%	15%	18%	28%	24%
MIS 1	16%	16%	16%	16%	22%	45%	31%
MIS 2	14%	14%	14%	14%	17%	37%	28%
MIS 3	14%	14%	14%	13%	16%	28%	26%
MIS 4	14%	14%	14%	13%	16%	22%	25%
MIS 5	17%	16%	16%	17%	20%	27%	22%
MIS 6	15%	15%	14%	15%	18%	25%	21%
MIS 7	15%	15%	14%	15%	17%	23%	20%
MIS 8	14%	15%	14%	13%	16%	20%	19%

Source: U.S. Census Bureau. Current Population Survey and Housing Vacancy Survey Supplement data for 2019-2020.

Note: The Type A share shown in the table is calculated as the ratio of Type A non-responses to the total number of housing units in the sample in each quarter, which also includes completed interviews, Type B vacants and Type C ineligible.

Table 2: Supplemental Data Sources and Variable Definitions.

Variable	Definition
<u>Current Population Survey & Housing Vacancy Survey Supplement</u>	
mis1-8	Month-in-sample (MIS) group for data collection. 1=MIS 1 ... 8=MIS 8.
metro1-3	Metropolitan status: 1=Principal city; 2=Metropolitan area outside principal city; 3=Nonmetropolitan area.
<u>2010 Decennial Census</u>	
decmis	Sample unit cannot be matched to 2010 Decennial housing units using MAFID.
vacant1-7	Vacant unit: 1=For rent; 2=Rented, not occupied; 3=For sale only; 4=Sold, not occupied; 5=For seasonal/recreational use; 6=For migrant workers; 7=Other vacant.
tenure1-4	Tenure status: 1=owned free and clear; 2=owned with a mortgage; 3=rented; 4=occupied without payment of cash rent
bld	Building type: s=single-family home; m=multifamily structure; to=mobile home or other building type
hht1-7	Household type: 1=family, married; 2=family, male reference person, no spouse; 3=family, female reference person, no spouse; 4=nonfamily, male reference person, living alone; 5=nonfamily, male reference person, not living alone; 6=nonfamily, female reference person, living alone; 7=nonfamily, female reference person, not living alone.
hhldrage	Age of the householder, continuous
age	Age of the householder: indicators for <34, 35-49, 50-64, & 65+
hispanic	Hispanic origin of the householder: 1=Hispanic; 0=Non-Hispanic
white	Race of the householder: 1=white
black	Race of the householder: 1=black
aian	Race of the householder: 1=American Indian or Alaska Native
asian	Race of the householder: 1=Asian
nhopi	Race of the householder: 1=Native Hawaiian or Pacific Islander
other	Race of the householder: 1=Other race
<u>Black Knight Inc. Records Pulled in 2018.</u>	
bkmis	Sample unit cannot be matched to units in Black Knight data pulled in 2018.
bkowner	Black Knight's measure of owner-occupancy: 1=owner-occupied
bkrenter	Black Knight's measure of owner-occupancy: 1=renter-occupied
<u>2014-18 American Community Survey 5-Year Estimates</u>	
acsmis	Census tract of the sample unit cannot be matched to tracts in 2014-2018 American Community Survey 5-year estimates
medval	Median home value in the tract.
medinc	Median household income in the tract.
phhpov	Percent of tract households with income below the poverty-level.
pvacs	Percent of tract housing units that are vacant.
pmover	Percent of tract population age 1 and over who moved during the previous year.
pown	Percent of tract housing units that are owner-occupied.
pa17	Percent of tract population age 17 or younger.
pa18	Percent of tract population age 18-34.
pa35	Percent of tract population age 35-54.
pa55	Percent of tract population age 55-74
pa75	Percent of tract population age 75 or older
phis	Percent of tract population: Hispanic
pnhw	Percent of tract population: Non-Hispanic white
pnhb	Percent of tract population: Non-Hispanic black
pnha	Percent of tract population: Non-Hispanic asian
poth	Percent of tract population: Non-Hispanic other race
pcol	Percent of tract population age 25 and older with a 4-year college degree or higher
pcit	Percent of tract population with U.S. citizenship.
ppho	Percent of tract households with telephone access in the home (including cell phones)
<u>U.S. Postal Service National Change of Address Database</u>	
recentfrom0	Change of address request for move from the property in the survey month.
recentfrom1	Change of address request for move from the property in the month prior.
recentfrom23	Change of address request for move from the property in the 2-3 months prior.
recentto0	Change of address request for move to the property in the survey month.
recentto1	Change of address request for move to the property in the month after.
recentto23	Change of address request for move to the property in the 2-3 months after.

Table 3: Comparison of the Attributes of Non-responding versus Responding Housing Units, Q1 2019 & Q1 2020.

	Q1 2019				Q1 2020				Year-Year Change	
	Completes		Type A - Complete		Completes		Type A - Complete		Q1 2020 – Q1 2019	
	Mean	(S.E.)	Diff	(S.E.)	Mean	(S.E.)	Diff	(S.E.)	Diff	(S.E.)
<i>Current Population Survey & Housing Vacancy Survey</i>										
mis1	0.127	0.008	0.016	0.017	0.124	0.009	0.041	0.018**	0.026	0.027
mis2	0.125	0.007	-0.003	0.014	0.126	0.007	-0.007	0.014	-0.003	0.023
mis3	0.126	0.007	-0.011	0.013	0.127	0.007	-0.016	0.014	-0.005	0.020
mis4	0.126	0.007	-0.008	0.013	0.126	0.007	-0.015	0.014	-0.007	0.021
mis5	0.123	0.008	0.018	0.016	0.121	0.007	0.023	0.016	0.005	0.026
mis6	0.124	0.008	0.002	0.014	0.124	0.008	-0.002	0.014	-0.004	0.021
mis7	0.124	0.007	-0.002	0.014	0.125	0.007	-0.007	0.013	-0.005	0.020
mis8	0.125	0.006	-0.012	0.013	0.127	0.007	-0.018	0.014	-0.006	0.020
metro1	0.312	0.029	0.057	0.034*	0.312	0.027	0.054	0.033*	-0.003	0.036
metro2	0.518	0.040	0.004	0.037	0.519	0.040	0.002	0.037	-0.002	0.035
metro3	0.170	0.045	-0.061	0.032*	0.170	0.045	-0.057	0.031*	0.005	0.026
<i>2010 Decennial Census</i>										
decmis	0.080	0.011	0.003	0.018	0.097	0.013	0.000	0.019	-0.003	0.021
vacant	0.099	0.012	-0.026	0.018	0.096	0.013	-0.023	0.018	0.003	0.018
vactype1	0.025	0.004	0.004	0.010	0.025	0.004	0.006	0.009	0.002	0.012
vactype2	0.002	0.001	0.000	0.002	0.001	0.001	-0.001	0.001	0.000	0.003
vactype3	0.013	0.003	0.002	0.007	0.013	0.003	-0.001	0.006	-0.003	0.008
vactype4	0.003	0.001	0.000	0.003	0.003	0.001	-0.001	0.002	-0.001	0.003
vactype5	0.034	0.011	-0.024	0.010**	0.033	0.011	-0.022	0.011**	0.002	0.009
vactype6	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.001	0.000	0.001
vactype7	0.023	0.004	-0.006	0.009	0.021	0.004	-0.004	0.007	0.003	0.010
tenure1	0.382	0.017	-0.002	0.029	0.378	0.016	-0.025	0.029	-0.023	0.035
tenure2	0.166	0.011	-0.043	0.021**	0.165	0.012	-0.042	0.019**	0.000	0.022
tenure3	0.258	0.017	0.071	0.029**	0.250	0.016	0.091	0.028***	0.020	0.032
tenure4	0.015	0.003	-0.004	0.006	0.014	0.003	-0.002	0.005	0.002	0.007
blds	0.657	0.023	-0.047	0.034	0.653	0.020	-0.061	0.032*	-0.014	0.036
bldm	0.205	0.019	0.067	0.029**	0.195	0.017	0.079	0.026***	0.012	0.032
bldto	0.058	0.010	-0.023	0.012*	0.055	0.009	-0.018	0.011	0.005	0.014
hht1	0.408	0.016	-0.032	0.032	0.402	0.015	-0.042	0.028	-0.010	0.037
hht2	0.039	0.005	0.004	0.012	0.038	0.004	0.009	0.011	0.005	0.014
hht3	0.104	0.009	0.028	0.019	0.101	0.009	0.026	0.016*	-0.002	0.021
hht4	0.096	0.008	0.008	0.018	0.092	0.007	0.015	0.017	0.007	0.021
hht5	0.031	0.004	0.004	0.010	0.032	0.005	0.005	0.011	0.001	0.013
hht6	0.119	0.009	0.006	0.020	0.118	0.010	0.005	0.019	-0.002	0.024
hht7	0.024	0.004	0.005	0.010	0.024	0.004	0.004	0.009	-0.001	0.010
hhldrage	42.08	0.89	-1.80	1.62	41.39	0.95	-1.89	1.46	-0.09	1.71
age0134	0.158	0.011	0.045	0.022**	0.155	0.012	0.055	0.022**	0.010	0.028
age3549	0.232	0.012	0.042	0.027	0.228	0.012	0.034	0.023	-0.008	0.032
age5064	0.244	0.013	-0.013	0.024	0.241	0.013	-0.018	0.023	-0.006	0.028
age6599	0.187	0.012	-0.052	0.023**	0.183	0.012	-0.049	0.018***	0.003	0.025
hispanic	0.094	0.011	0.008	0.018	0.092	0.010	0.023	0.020	0.015	0.025
white	0.645	0.018	-0.030	0.034	0.635	0.018	-0.036	0.029	-0.006	0.037
black	0.094	0.011	0.045	0.025*	0.094	0.011	0.041	0.020**	-0.005	0.028
aian	0.009	0.003	0.001	0.006	0.009	0.003	0.001	0.005	0.000	0.007
asian	0.035	0.006	0.002	0.011	0.033	0.006	0.004	0.010	0.002	0.013
nhopi	0.002	0.001	0.001	0.003	0.001	0.001	0.001	0.002	0.000	0.003
other	0.036	0.007	0.004	0.012	0.035	0.006	0.012	0.012	0.008	0.013
<i>Black Knight Inc.</i>										
bkmis	0.379	0.023	0.029	0.030	0.379	0.024	0.052	0.031*	0.023	0.034
bkowner	0.491	0.021	-0.019	0.028	0.490	0.022	-0.045	0.033	-0.026	0.033
bkrenter	0.130	0.014	-0.010	0.020	0.131	0.015	-0.007	0.019	0.003	0.024
<i>2014-2018 ACS 5-Year Estimates</i>										
acsmis	0.022	0.006	0.001	0.009	0.018	0.006	0.001	0.009	0.001	0.012
medval	235400	10770	1684	15640	238160	11078	-3560	12300	-5200	16390
medinc	49840	1268	198	1660	49990	1290	-264	1530	-460	1826
phhpov	0.133	0.006	0.001	0.007	0.132	0.005	0.005	0.007	0.004	0.009
pvacs	0.119	0.011	-0.017	0.009*	0.120	0.011	-0.015	0.009*	0.003	0.007
pmover	0.143	0.005	0.005	0.006	0.143	0.005	0.006	0.006	0.001	0.008
pown	0.628	0.013	-0.029	0.016*	0.634	0.013	-0.039	0.016**	-0.010	0.020
pa17	0.215	0.004	0.004	0.005	0.215	0.004	0.004	0.005	0.001	0.006
pa18	0.224	0.006	0.011	0.008	0.224	0.006	0.013	0.007*	0.003	0.008
pa35	0.250	0.003	0.004	0.004	0.251	0.003	0.002	0.004	-0.001	0.005
pa55	0.222	0.005	-0.012	0.006**	0.223	0.006	-0.014	0.006**	-0.002	0.006
pa75	0.068	0.003	-0.007	0.003**	0.069	0.003	-0.007	0.003**	0.000	0.004

phis	0.151	0.011	0.007	0.016	0.150	0.012	0.019	0.014	0.012	0.015
pnhw	0.632	0.017	-0.044	0.022**	0.636	0.017	-0.055	0.022**	-0.011	0.025
pnhb	0.115	0.010	0.031	0.017*	0.115	0.010	0.030	0.015**	-0.001	0.018
pnha	0.047	0.004	0.004	0.006	0.047	0.004	0.004	0.006	0.000	0.008
poth	0.033	0.003	0.001	0.003	0.033	0.003	0.001	0.003	0.000	0.003
pcol	0.326	0.013	0.010	0.016	0.327	0.012	0.004	0.012	-0.006	0.016
pcit	0.859	0.009	-0.012	0.012	0.863	0.009	-0.016	0.012	-0.005	0.015
ppho	0.957	0.006	-0.001	0.009	0.960	0.006	-0.002	0.009	-0.001	0.011
<i>National Change of Address Database</i>										
recentfrom0	0.012	0.002	0.001	0.005	0.013	0.002	0.000	0.005	-0.001	0.007
recentfrom1	0.011	0.002	0.000	0.005	0.011	0.002	0.001	0.005	0.002	0.006
recentfrom23	0.013	0.002	0.002	0.006	0.012	0.002	0.005	0.006	0.003	0.008
recentto0	0.012	0.002	0.000	0.005	0.012	0.002	0.003	0.005	0.003	0.007
recentto1	0.008	0.002	0.001	0.005	0.007	0.002	0.003	0.004	0.002	0.006
recentto23	0.008	0.002	0.002	0.005	0.005	0.001	0.003	0.003	0.001	0.005

Source: U.S. Census Bureau. Current Population Survey and Housing Vacancy Survey Supplement data for 2019-2020 linked to each supplemental data source identified in the table.

Note: This table shows the mean value of each attribute among completed cases (complete interviews, Type B vacants, and Type C ineligible), the difference between Type A non-responding units and completed cases, and the change in these differences from 2019 to 2020 along with the standard errors for each estimate.

*** p<.01; ** p<.05; * p<.10. Asterisks are shown only for the differences between non-responders and responders and for the change in these differences from 2019 to 2020.

Table 4: Comparison of the Attributes of Non-responding versus Responding Housing Units, Q2 2019 & Q2 2020.

	Q2 2019				Q2 2020				Year-Year Change	
	Completes		Type A - Complete		Completes		Type A - Complete		Q2 2020 - Q2 2019	
	Mean	(S.E.)	Diff	(S.E.)	Mean	(S.E.)	Diff	(S.E.)	Diff	(S.E.)
<i>Current Population Survey & Housing Vacancy Survey</i>										
mis1	0.128	0.008	0.015	0.017	0.097	0.009	0.113	0.015***	0.097	0.022***
mis2	0.125	0.007	-0.003	0.013	0.110	0.008	0.051	0.012***	0.055	0.019***
mis3	0.125	0.008	-0.006	0.015	0.125	0.009	-0.002	0.011	0.004	0.020
mis4	0.125	0.009	-0.007	0.015	0.136	0.011	-0.040	0.013***	-0.032	0.021
mis5	0.124	0.008	0.008	0.016	0.128	0.010	-0.009	0.012	-0.017	0.021
mis6	0.124	0.007	0.001	0.014	0.131	0.008	-0.025	0.010**	-0.026	0.018
mis7	0.124	0.007	-0.002	0.014	0.135	0.007	-0.036	0.011***	-0.034	0.019*
mis8	0.125	0.008	-0.006	0.015	0.139	0.009	-0.051	0.011***	-0.046	0.019**
metro1	0.312	0.029	0.046	0.034	0.303	0.027	0.064	0.030**	0.018	0.038
metro2	0.518	0.038	0.021	0.038	0.524	0.039	-0.017	0.035	-0.038	0.037
metro3	0.171	0.045	-0.067	0.034*	0.174	0.045	-0.047	0.029	0.020	0.029
<i>2010 Decennial Census</i>										
decmis	0.081	0.011	0.007	0.021	0.094	0.012	0.006	0.016	-0.001	0.023
vacant	0.099	0.012	-0.027	0.018	0.099	0.015	-0.015	0.016	0.011	0.019
vactype1	0.026	0.004	0.003	0.009	0.023	0.004	0.011	0.008	0.009	0.011
vactype2	0.001	0.001	0.000	0.002	0.001	0.001	0.000	0.002	0.001	0.003
vactype3	0.013	0.003	0.001	0.007	0.013	0.003	-0.001	0.005	-0.002	0.007
vactype4	0.003	0.001	-0.001	0.003	0.003	0.002	0.000	0.002	0.001	0.003
vactype5	0.034	0.011	-0.024	0.010**	0.037	0.012	-0.024	0.012**	0.001	0.008
vactype6	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.001
vactype7	0.022	0.004	-0.004	0.008	0.022	0.004	-0.002	0.007	0.003	0.009
tenure1	0.379	0.018	0.004	0.027	0.390	0.020	-0.059	0.024**	-0.063	0.031**
tenure2	0.168	0.011	-0.051	0.021**	0.173	0.012	-0.049	0.017***	0.002	0.024
tenure3	0.259	0.017	0.071	0.027***	0.230	0.014	0.119	0.024***	0.048	0.034
tenure4	0.014	0.003	-0.004	0.006	0.014	0.003	-0.001	0.006	0.003	0.007
blds	0.656	0.019	-0.052	0.032	0.669	0.020	-0.089	0.027***	-0.038	0.035
bldm	0.205	0.016	0.068	0.029**	0.185	0.015	0.089	0.025***	0.021	0.036
bldto	0.058	0.010	-0.023	0.013*	0.053	0.010	-0.006	0.012	0.017	0.014
hht1	0.406	0.016	-0.034	0.030	0.409	0.017	-0.060	0.022***	-0.027	0.031
hht2	0.040	0.005	0.005	0.012	0.036	0.005	0.011	0.010	0.006	0.013
hht3	0.103	0.009	0.020	0.017	0.097	0.009	0.033	0.015**	0.013	0.020
hht4	0.096	0.008	0.010	0.018	0.092	0.009	0.014	0.015	0.004	0.021
hht5	0.031	0.004	0.008	0.010	0.029	0.005	0.009	0.009	0.001	0.012
hht6	0.121	0.010	0.005	0.021	0.121	0.009	-0.002	0.016	-0.008	0.025
hht7	0.024	0.004	0.006	0.010	0.023	0.004	0.006	0.008	0.000	0.011
hhldrage	42.08	0.93	-2.15	1.56	41.95	1.04	-2.97	1.11***	-0.82	1.67
age0134	0.160	0.011	0.049	0.023**	0.144	0.012	0.066	0.019***	0.017	0.027
age3549	0.230	0.011	0.048	0.027*	0.224	0.013	0.031	0.020	-0.017	0.029
age5064	0.242	0.012	-0.020	0.026	0.245	0.014	-0.032	0.019*	-0.013	0.032
age6599	0.189	0.012	-0.057	0.022*	0.194	0.013	-0.055	0.017***	0.002	0.025
hispanic	0.095	0.011	0.013	0.021	0.084	0.010	0.033	0.018*	0.020	0.026
white	0.644	0.020	-0.033	0.031	0.644	0.021	-0.054	0.026**	-0.021	0.037
black	0.094	0.013	0.041	0.024*	0.089	0.012	0.042	0.020**	0.001	0.026
aian	0.009	0.003	0.001	0.006	0.009	0.003	0.003	0.005	0.002	0.007
asian	0.035	0.006	0.002	0.011	0.034	0.006	0.002	0.009	0.000	0.013
nhopi	0.002	0.001	0.000	0.002	0.001	0.001	0.000	0.002	0.000	0.003
other	0.036	0.006	0.009	0.013	0.031	0.006	0.016	0.011	0.008	0.014
<i>Black Knight Inc.</i>										
bkmis	0.381	0.022	0.035	0.033	0.360	0.022	0.102	0.029***	0.067	0.035*
bkowner	0.489	0.022	-0.019	0.032	0.512	0.022	-0.105	0.029***	-0.086	0.035**
bkrenter	0.130	0.014	-0.016	0.021	0.128	0.015	0.004	0.019	0.020	0.024
<i>2014-2018 ACS 5-Year Estimates</i>										
acsmis	0.021	0.006	0.002	0.010	0.017	0.006	-0.004	0.006	-0.006	0.011
medval	234600	9167	3536	13560	241100	9966	-9661	11930	-13200	16520
medinc	49920	1135	200	1708	50310	1261	-971	1445	-1171	1925
phhpov	0.133	0.005	-0.002	0.007	0.128	0.006	0.017	0.007**	0.019	0.009**
pvacs	0.119	0.010	-0.020	0.009**	0.120	0.011	-0.010	0.008	0.010	0.007
pmover	0.142	0.004	0.005	0.006	0.141	0.004	0.011	0.005**	0.007	0.007
pown	0.630	0.013	-0.030	0.017*	0.645	0.013	-0.052	0.014***	-0.022	0.020
pa17	0.215	0.004	0.004	0.005	0.215	0.004	0.007	0.004	0.003	0.006
pa18	0.223	0.006	0.011	0.007	0.221	0.006	0.018	0.006***	0.007	0.008
pa35	0.250	0.003	0.004	0.004	0.252	0.003	0.002	0.004	-0.002	0.005
pa55	0.222	0.005	-0.013	0.005**	0.226	0.006	-0.015	0.005***	-0.002	0.006
pa75	0.069	0.003	-0.007	0.003**	0.070	0.003	-0.007	0.003**	0.000	0.003

phis	0.151	0.011	0.011	0.015	0.143	0.011	0.029	0.013**	0.018	0.018
pnhw	0.633	0.017	-0.044	0.023*	0.647	0.018	-0.068	0.019***	-0.024	0.024
pnhb	0.115	0.012	0.025	0.016	0.111	0.012	0.037	0.014***	0.011	0.018
pnha	0.046	0.004	0.005	0.006	0.048	0.004	0.003	0.005	-0.002	0.008
poth	0.033	0.004	0.000	0.003	0.033	0.003	0.002	0.004	0.002	0.004
pcol	0.325	0.010	0.013	0.016	0.334	0.011	-0.009	0.013	-0.022	0.017
pcit	0.859	0.008	-0.015	0.013	0.866	0.010	-0.013	0.009	0.001	0.014
ppho	0.957	0.006	-0.002	0.010	0.962	0.006	0.002	0.006	0.004	0.011
<i>National Change of Address Database</i>										
recentfrom0	0.015	0.002	-0.002	0.005	0.009	0.002	0.001	0.003	0.003	0.006
recentfrom1	0.013	0.002	-0.001	0.005	0.012	0.002	0.008	0.004*	0.008	0.007
recentfrom23	0.023	0.003	0.002	0.007	0.020	0.003	0.015	0.007**	0.013	0.010
recentto0	0.014	0.002	0.000	0.005	0.008	0.002	0.004	0.004	0.004	0.006
recentto1	0.013	0.002	0.001	0.005	0.011	0.002	0.008	0.005*	0.008	0.007
recentto23	0.022	0.003	0.003	0.008	0.019	0.003	0.012	0.006*	0.008	0.010

Source: U.S. Census Bureau. Current Population Survey and Housing Vacancy Survey Supplement data for 2019-2020 linked to each supplemental data source identified in the table.

Note: This table shows the mean value of each attribute among completed cases (complete interviews, Type B vacants, and Type C ineligible), the difference between Type A non-responding units and completed cases, and the change in these differences from 2019 to 2020 along with the standard errors for each estimate.

*** p<.01; ** p<.05; * p<.10. Asterisks are shown only for the differences between non-responders and responders and for the change in these differences from 2019 to 2020.

Table 5: Comparison of the Attributes of Non-responding versus Responding Housing Units, Q3 2019 & Q3 2020.

	Q3 2019				Q3 2020				Year-Year Change	
	Completes		Type A - Complete		Completes		Type A - Complete		Q3 2020 – Q3 2019	
	Mean	(S.E.)	Diff	(S.E.)	Mean	(S.E.)	Diff	(S.E.)	Diff	(S.E.)
<i>Current Population Survey & Housing Vacancy Survey</i>										
mis1	0.128	0.007	0.016	0.016	0.115	0.008	0.056	0.016***	0.040	0.024*
mis2	0.125	0.007	0.000	0.015	0.117	0.007	0.030	0.015**	0.030	0.021
mis3	0.125	0.008	-0.007	0.014	0.119	0.008	0.018	0.014	0.025	0.021
mis4	0.125	0.008	-0.008	0.017	0.122	0.009	0.006	0.014	0.013	0.024
mis5	0.123	0.007	0.012	0.016	0.129	0.008	-0.014	0.012	-0.025	0.020
mis6	0.124	0.007	-0.003	0.014	0.132	0.007	-0.026	0.013**	-0.023	0.021
mis7	0.124	0.007	0.000	0.015	0.132	0.009	-0.031	0.012***	-0.031	0.020
mis8	0.125	0.007	-0.009	0.015	0.134	0.009	-0.038	0.013***	-0.029	0.020
metro1	0.313	0.029	0.061	0.036*	0.311	0.027	0.052	0.030*	-0.009	0.043
metro2	0.516	0.035	0.011	0.037	0.518	0.035	-0.008	0.035	-0.019	0.041
metro3	0.171	0.044	-0.072	0.032**	0.170	0.044	-0.044	0.028	0.028	0.030
<i>2010 Decennial Census</i>										
decmis	0.086	0.013	0.005	0.019	0.096	0.012	0.007	0.016	0.002	0.022
vacant	0.098	0.013	-0.017	0.018	0.099	0.013	-0.015	0.014	0.003	0.019
vactype1	0.026	0.004	0.008	0.010	0.025	0.005	0.010	0.008	0.002	0.012
vactype2	0.001	0.001	0.000	0.003	0.001	0.001	0.001	0.002	0.001	0.003
vactype3	0.013	0.003	0.001	0.007	0.013	0.004	0.000	0.006	-0.002	0.008
vactype4	0.003	0.002	-0.001	0.003	0.003	0.002	-0.001	0.002	0.000	0.004
vactype5	0.034	0.011	-0.023	0.012*	0.035	0.012	-0.023	0.011**	0.000	0.009
vactype6	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.001
vactype7	0.021	0.004	-0.004	0.008	0.022	0.004	-0.002	0.006	0.002	0.009
tenure1	0.376	0.016	-0.011	0.029	0.383	0.018	-0.050	0.023**	-0.039	0.034
tenure2	0.167	0.012	-0.050	0.023**	0.171	0.012	-0.049	0.018***	0.002	0.024
tenure3	0.259	0.016	0.077	0.028***	0.237	0.016	0.107	0.023***	0.030	0.032
tenure4	0.014	0.003	-0.003	0.007	0.014	0.003	-0.001	0.005	0.002	0.008
blds	0.653	0.020	-0.063	0.037*	0.660	0.021	-0.084	0.028***	-0.021	0.040
bldm	0.204	0.018	0.081	0.033**	0.192	0.018	0.083	0.025***	0.001	0.035
bldto	0.057	0.011	-0.023	0.011**	0.053	0.010	-0.005	0.011	0.018	0.015
hht1	0.404	0.014	-0.040	0.033	0.407	0.016	-0.054	0.025**	-0.014	0.035
hht2	0.039	0.005	0.006	0.013	0.036	0.005	0.010	0.010	0.004	0.015
hht3	0.103	0.009	0.026	0.020	0.097	0.008	0.033	0.016**	0.007	0.026
hht4	0.095	0.008	0.006	0.018	0.093	0.008	0.012	0.015	0.006	0.020
hht5	0.031	0.004	0.007	0.012	0.031	0.005	0.005	0.008	-0.002	0.014
hht6	0.119	0.008	0.003	0.021	0.120	0.009	-0.003	0.017	-0.006	0.024
hht7	0.024	0.004	0.004	0.010	0.023	0.004	0.004	0.007	0.000	0.010
hhldrage	41.81	0.96	-2.58	1.57	41.72	1.00	-2.87	1.24**	-0.29	1.67
age0134	0.159	0.012	0.050	0.025*	0.148	0.011	0.060	0.019***	0.011	0.029
age3549	0.229	0.011	0.044	0.028	0.223	0.013	0.027	0.020	-0.017	0.032
age5064	0.241	0.013	-0.021	0.025	0.242	0.013	-0.025	0.020	-0.004	0.028
age6599	0.187	0.012	-0.060	0.022***	0.192	0.013	-0.054	0.018***	0.006	0.025
hispanic	0.093	0.011	0.021	0.020	0.083	0.010	0.036	0.017**	0.015	0.024
white	0.641	0.019	-0.048	0.030	0.642	0.021	-0.055	0.024**	-0.007	0.033
black	0.095	0.012	0.041	0.023*	0.089	0.012	0.043	0.017**	0.001	0.025
aian	0.009	0.003	0.001	0.006	0.008	0.003	0.003	0.005	0.002	0.006
asian	0.033	0.006	0.008	0.012	0.033	0.006	0.002	0.009	-0.006	0.014
nhopi	0.002	0.001	0.000	0.002	0.002	0.001	0.000	0.002	0.000	0.003
other	0.036	0.006	0.010	0.013	0.032	0.006	0.015	0.011	0.005	0.014
<i>Black Knight Inc.</i>										
bkmis	0.379	0.020	0.049	0.033	0.367	0.021	0.092	0.029***	0.043	0.037
bkowner	0.488	0.020	-0.037	0.033	0.504	0.022	-0.096	0.028***	-0.059	0.037
bkrenter	0.133	0.014	-0.012	0.022	0.129	0.014	0.005	0.018	0.016	0.026
<i>2014-2018 ACS 5-Year Estimates</i>										
acsmis	0.023	0.007	0.003	0.010	0.015	0.006	-0.001	0.006	-0.004	0.011
medval	233700	9984	3227	12580	241200	10220	-14861	12750	-18090	16180
medinc	49860	1172	-75	1692	50510	1188	-1301	1427	-1226	1953
phhpov	0.132	0.006	0.003	0.008	0.130	0.006	0.016	0.007**	0.013	0.010
pvacs	0.119	0.011	-0.018	0.009**	0.120	0.011	-0.011	0.008	0.007	0.008
pmover	0.143	0.005	0.007	0.007	0.143	0.005	0.010	0.005*	0.004	0.008
pown	0.629	0.012	-0.041	0.018**	0.640	0.012	-0.049	0.014***	-0.008	0.019
pa17	0.214	0.004	0.002	0.005	0.215	0.004	0.007	0.004	0.005	0.006
pa18	0.224	0.006	0.015	0.009*	0.224	0.007	0.016	0.007**	0.001	0.010
pa35	0.249	0.003	0.002	0.004	0.252	0.003	0.001	0.004	-0.002	0.005
pa55	0.222	0.006	-0.015	0.006**	0.225	0.006	-0.015	0.005***	-0.001	0.007
pa75	0.069	0.003	-0.008	0.003**	0.070	0.003	-0.008	0.003***	0.001	0.004

phis	0.150	0.011	0.017	0.015	0.144	0.011	0.030	0.013	0.013	0.017
pnhw	0.633	0.017	-0.058	0.023**	0.646	0.017	-0.069	0.018***	-0.011	0.025
pnhb	0.115	0.012	0.030	0.016*	0.112	0.011	0.036	0.012***	0.006	0.018
pnha	0.047	0.004	0.007	0.006	0.048	0.004	0.002	0.006	-0.005	0.007
poth	0.033	0.003	0.000	0.004	0.033	0.003	0.001	0.005	0.001	0.005
pcol	0.326	0.011	0.013	0.015	0.336	0.011	-0.014	0.014	-0.027	0.018
pcit	0.858	0.008	-0.020	0.013	0.865	0.009	-0.013	0.010	0.007	0.014
ppho	0.956	0.007	-0.003	0.010	0.963	0.006	-0.001	0.006	0.003	0.011
<i>National Change of Address Database</i>										
recentfrom0	0.015	0.002	0.001	0.005	0.009	0.002	0.004	0.004	0.004	0.007
recentfrom1	0.015	0.002	0.001	0.005	0.013	0.002	0.004	0.005	0.004	0.007
recentfrom23	0.026	0.004	0.000	0.008	0.023	0.003	0.012	0.007*	0.012	0.011
recentto0	0.014	0.002	0.001	0.005	0.008	0.002	0.006	0.004	0.005	0.007
recentto1	0.013	0.002	0.004	0.006	0.011	0.002	0.006	0.005	0.002	0.008
recentto23	0.025	0.003	0.002	0.008	0.023	0.003	0.008	0.007	0.006	0.011

Source: U.S. Census Bureau. Current Population Survey and Housing Vacancy Survey Supplement data for 2019-2020 linked to each supplemental data source identified in the table.

Note: This table shows the mean value of each attribute among completed cases (complete interviews, Type B vacants, and Type C ineligible), the difference between Type A non-responding units and completed cases, and the change in these differences from 2019 to 2020 along with the standard errors for each estimate.

*** p<.01; ** p<.05; * p<.10. Asterisks are shown only for the differences between non-responders and responders and for the change in these differences from 2019 to 2020.

Table 6: Comparison of the Attributes of Non-responding versus Responding Housing Units, Q4 2019.

Q4 2019				
	Completes		Type A - Complete	
	Mean	(S.E.)	Diff	(S.E.)
<i>Current Population Survey & Housing Vacancy Survey</i>				
mis1	0.127	0.006	0.020	0.017
mis2	0.125	0.005	-0.003	0.013
mis3	0.126	0.005	-0.011	0.015
mis4	0.126	0.007	-0.013	0.015
mis5	0.122	0.007	0.023	0.015
mis6	0.124	0.005	0.004	0.014
mis7	0.124	0.005	-0.003	0.013
mis8	0.126	0.006	-0.016	0.015
metro1	0.315	0.027	0.070	0.037*
metro2	0.515	0.037	-0.005	0.040
metro3	0.170	0.044	-0.065	0.033**
<i>2010 Decennial Census</i>				
decmis	0.092	0.014	0.001	0.019
vacant	0.097	0.012	-0.022	0.017
vactype1	0.024	0.005	0.005	0.009
vactype2	0.002	0.001	0.000	0.003
vactype3	0.013	0.003	0.001	0.008
vactype4	0.003	0.001	-0.001	0.003
vactype5	0.034	0.011	-0.023	0.011*
vactype6	0.000	0.000	0.000	0.001
vactype7	0.021	0.004	-0.004	0.008
tenure1	0.377	0.015	-0.021	0.031
tenure2	0.169	0.011	-0.045	0.022**
tenure3	0.251	0.016	0.088	0.030***
tenure4	0.015	0.003	-0.001	0.007
blds	0.655	0.019	-0.062	0.035*
bldm	0.195	0.017	0.084	0.031**
bldto	0.057	0.009	-0.023	0.012**
hht1	0.406	0.015	-0.046	0.030
hht2	0.039	0.005	0.005	0.012
hht3	0.100	0.009	0.030	0.020
hht4	0.092	0.008	0.019	0.018
hht5	0.031	0.005	0.007	0.012
hht6	0.118	0.009	0.009	0.021
hht7	0.024	0.005	-0.001	0.009
hhldrage	41.67	0.88	-1.87	1.34
age0134	0.156	0.012	0.048	0.025*
age3549	0.228	0.011	0.039	0.028
age5064	0.241	0.012	-0.011	0.023
age6599	0.187	0.012	-0.055	0.019***
hispanic	0.092	0.010	0.021	0.020
white	0.641	0.017	-0.046	0.030
black	0.092	0.010	0.049	0.023*
aian	0.009	0.003	0.001	0.007
asian	0.033	0.005	0.007	0.011
nhopi	0.001	0.001	0.001	0.002
other	0.036	0.006	0.010	0.014
<i>Black Knight Inc.</i>				
bkmis	0.376	0.021	0.047	0.033
bkowner	0.492	0.020	-0.040	0.033
bkrenter	0.132	0.014	-0.008	0.024
<i>2014-2018 ACS 5-Year Estimates</i>				
acsmis	0.022	0.006	0.001	0.009
medval	235300	9188	3248	13270
medinc	49990	1185	-27	1572
phhpov	0.132	0.006	0.002	0.007
pvacs	0.119	0.010	-0.017	0.008**
pmover	0.142	0.005	0.007	0.007
pown	0.631	0.013	-0.040	0.018**
pa17	0.214	0.004	0.003	0.005
pa18	0.223	0.006	0.015	0.008*
pa35	0.250	0.003	0.003	0.004
pa55	0.222	0.006	-0.014	0.006**
pa75	0.069	0.003	-0.007	0.003**
phis	0.149	0.010	0.016	0.014

pnhw	0.635	0.016	-0.060	0.021**
pnhb	0.113	0.010	0.033	0.015*
pnha	0.047	0.004	0.008	0.007
poth	0.033	0.003	0.001	0.005
pcol	0.327	0.011	0.010	0.015
pcit	0.859	0.007	-0.019	0.012
ppho	0.956	0.006	-0.001	0.009

National Change of Address Database

recentfrom0	0.008	0.002	0.000	0.004
recentfrom1	0.013	0.002	0.000	0.005
recentfrom23	0.027	0.003	0.000	0.007
recentto0	0.008	0.001	0.000	0.004
recentto1	0.011	0.002	0.002	0.005
recentto23	0.024	0.003	0.004	0.008

Source: U.S. Census Bureau. Current Population Survey and Housing Vacancy Survey Supplement data for 2019-2020 linked to each supplemental data source identified in the table.

Note: This table shows the mean value of each attribute among completed cases (complete interviews, Type B vacants, and Type C ineligible) and the difference between Type A non-responding units and completed cases, along with the standard errors for each estimate.

*** p<.01; ** p<.05; * p<.10. Asterisks are shown only for the differences between non-responders and responders.

Table 7: Difference-in-Difference Estimates Comparing the Difference in Attributes of Non-responding versus Responding Units in Each Quarter to the Difference in Q1 2019.

	Q2 2019		Q3 2019		Q4 2019		Q1 2020		Q2 2020		Q3 2020	
	Coef.	(S.E.)	Coef.	(S.E.)	Coef.	(S.E.)	Coef.	(S.E.)	Coef.	(S.E.)	Coef.	(S.E.)
<i>Current Population Survey & Housing Vacancy Survey</i>												
mis1	0.000	0.025	0.000	0.023	0.005	0.024	0.026	0.027	0.097	0.022***	0.041	0.024*
mis2	0.000	0.020	0.003	0.020	0.000	0.020	-0.003	0.023	0.055	0.019***	0.034	0.021
mis3	0.005	0.019	0.004	0.019	-0.001	0.020	-0.005	0.020	0.008	0.017	0.028	0.020
mis4	0.001	0.022	0.000	0.023	-0.005	0.021	-0.007	0.021	-0.032	0.020	0.014	0.018
mis5	-0.010	0.023	-0.006	0.023	0.005	0.024	0.005	0.026	-0.027	0.021	-0.032	0.019*
mis6	-0.002	0.021	-0.006	0.020	0.001	0.020	-0.004	0.021	-0.028	0.018	-0.029	0.020
mis7	0.000	0.020	0.002	0.018	-0.001	0.017	-0.005	0.020	-0.035	0.018*	-0.030	0.018
mis8	0.006	0.023	0.003	0.019	-0.004	0.019	-0.006	0.020	-0.040	0.018**	-0.026	0.019
metro1	-0.011	0.039	0.004	0.043	0.013	0.042	-0.003	0.036	0.007	0.042	-0.005	0.044
metro2	0.017	0.041	0.007	0.042	-0.009	0.042	-0.002	0.035	-0.022	0.041	-0.013	0.044
metro3	-0.005	0.023	-0.011	0.026	-0.003	0.025	0.005	0.026	0.015	0.032	0.017	0.030
<i>2010 Decennial Census</i>												
decmis	0.003	0.024	0.001	0.027	-0.002	0.024	-0.003	0.021	0.003	0.023	0.004	0.024
vacant	-0.001	0.022	0.009	0.024	0.004	0.021	0.003	0.018	0.010	0.020	0.011	0.020
vactype1	-0.001	0.013	0.004	0.015	0.001	0.012	0.002	0.012	0.007	0.013	0.006	0.013
vactype2	0.000	0.003	0.000	0.003	0.000	0.003	0.000	0.003	0.001	0.003	0.001	0.003
vactype3	-0.001	0.009	0.000	0.010	-0.001	0.009	-0.003	0.008	-0.003	0.008	-0.002	0.009
vactype4	-0.001	0.003	0.000	0.004	-0.001	0.004	-0.001	0.003	0.000	0.004	0.000	0.004
vactype5	0.000	0.009	0.002	0.011	0.002	0.010	0.002	0.009	0.001	0.011	0.002	0.011
vactype6	0.000	0.001	0.000	0.001	0.000	0.001	0.000	0.001	0.000	0.001	0.000	0.001
vactype7	0.002	0.010	0.003	0.012	0.003	0.011	0.003	0.010	0.005	0.011	0.004	0.010
tenure1	0.006	0.033	-0.009	0.040	-0.019	0.039	-0.023	0.035	-0.057	0.035*	-0.047	0.038
tenure2	-0.008	0.025	-0.008	0.033	-0.002	0.031	0.000	0.022	-0.006	0.026	-0.006	0.028
tenure3	-0.001	0.035	0.006	0.039	0.017	0.038	0.020	0.032	0.047	0.035	0.036	0.038
tenure4	0.000	0.007	0.001	0.010	0.003	0.009	0.002	0.007	0.003	0.009	0.003	0.009
blds	-0.005	0.038	-0.016	0.048	-0.016	0.043	-0.014	0.036	-0.042	0.040	-0.037	0.044
bldm	0.001	0.037	0.014	0.044	0.018	0.039	0.012	0.032	0.022	0.035	0.016	0.040
bldto	0.000	0.015	0.000	0.016	0.000	0.015	0.005	0.014	0.018	0.016	0.018	0.016
hht1	-0.001	0.036	-0.007	0.042	-0.013	0.042	-0.010	0.037	-0.028	0.037	-0.022	0.041
hht2	0.001	0.015	0.002	0.018	0.001	0.015	0.005	0.014	0.007	0.015	0.007	0.017
hht3	-0.008	0.022	-0.002	0.028	0.001	0.025	-0.002	0.021	0.005	0.024	0.005	0.024
hht4	0.002	0.024	-0.002	0.025	0.011	0.024	0.007	0.021	0.006	0.021	0.004	0.023
hht5	0.004	0.012	0.003	0.016	0.003	0.016	0.001	0.013	0.005	0.012	0.001	0.014
hht6	-0.001	0.025	-0.003	0.030	0.003	0.026	-0.002	0.024	-0.009	0.026	-0.009	0.025

hht7	0.001	0.012	-0.001	0.013	-0.006	0.013	-0.001	0.010	0.001	0.013	-0.001	0.013
hhldrage	-0.36	-1.82	-0.79	-2.30	-0.08	-1.98	-0.09	-1.71	-1.18	-1.83	-1.07	-2.02
age0134	0.004	0.027	0.005	0.033	0.003	0.032	0.010	0.028	0.021	0.027	0.015	0.028
age3549	0.005	0.034	0.002	0.039	-0.003	0.036	-0.008	0.032	-0.011	0.033	-0.015	0.034
age5064	-0.007	0.031	-0.009	0.033	0.002	0.032	-0.006	0.028	-0.020	0.030	-0.012	0.032
age6599	-0.005	0.024	-0.008	0.033	-0.003	0.029	0.003	0.025	-0.003	0.027	-0.002	0.030
hispanic	0.005	0.024	0.013	0.026	0.013	0.026	0.015	0.025	0.025	0.025	0.028	0.020
white	-0.003	0.036	-0.018	0.043	-0.016	0.042	-0.006	0.037	-0.024	0.042	-0.025	0.041
black	-0.004	0.030	-0.004	0.033	0.004	0.030	-0.005	0.028	-0.003	0.033	-0.003	0.031
aian	0.000	0.007	0.000	0.008	0.000	0.008	0.000	0.007	0.002	0.007	0.002	0.007
asian	0.000	0.013	0.007	0.017	0.005	0.015	0.002	0.013	0.001	0.014	0.001	0.013
nhopi	0.000	0.002	0.000	0.003	0.000	0.003	0.000	0.003	0.000	0.003	0.000	0.003
other	0.005	0.014	0.006	0.017	0.006	0.017	0.008	0.013	0.012	0.015	0.011	0.016

Black Knight Inc.

bkmis	0.006	0.039	0.019	0.042	0.018	0.043	0.023	0.034	0.072	0.039*	0.062	0.042
bkowner	0.000	0.037	-0.018	0.041	-0.021	0.039	-0.026	0.033	-0.086	0.038**	-0.077	0.039**
bkrenter	-0.006	0.022	-0.001	0.031	0.003	0.029	0.003	0.024	0.014	0.027	0.015	0.027

2014-2018 ACS 5-Year Estimates

acsmis	0.001	0.011	0.003	0.014	0.000	0.012	0.001	0.012	-0.004	0.010	-0.002	0.011
medval	1852	17180	1543	21150	1565	17960	-5248	16390	-11340	19660	-16550	20230
medinc	3	1953	-273	2392	-224	2079	-462	1826	-1168	2113	-1499	2223
phhpov	-0.003	0.008	0.002	0.009	0.002	0.009	0.004	0.009	0.016	0.010*	0.015	0.009
pvacs	-0.003	0.008	-0.001	0.009	0.000	0.008	0.003	0.007	0.007	0.008	0.006	0.009
pmover	0.000	0.007	0.002	0.009	0.003	0.008	0.001	0.008	0.007	0.008	0.005	0.008
pown	-0.001	0.020	-0.012	0.023	-0.011	0.024	-0.010	0.020	-0.023	0.022	-0.020	0.020
pa17	0.000	0.006	-0.001	0.007	-0.001	0.007	0.001	0.006	0.003	0.006	0.003	0.006
pa18	0.000	0.008	0.004	0.011	0.004	0.010	0.003	0.008	0.007	0.010	0.005	0.010
pa35	0.000	0.005	-0.001	0.006	-0.001	0.005	-0.001	0.005	-0.002	0.005	-0.003	0.005
pa55	-0.002	0.006	-0.003	0.008	-0.002	0.007	-0.002	0.006	-0.004	0.006	-0.004	0.006
pa75	0.000	0.004	-0.001	0.005	0.000	0.004	0.000	0.004	0.000	0.004	-0.001	0.004
phis	0.004	0.017	0.010	0.020	0.009	0.017	0.012	0.015	0.022	0.019	0.023	0.019
pnhw	0.001	0.026	-0.013	0.030	-0.016	0.027	-0.011	0.025	-0.024	0.027	-0.025	0.028
pnhb	-0.005	0.019	-0.001	0.022	0.003	0.021	-0.001	0.018	0.006	0.022	0.005	0.021
pnha	0.001	0.006	0.003	0.007	0.004	0.008	0.000	0.008	-0.001	0.007	-0.002	0.008
poth	-0.001	0.003	-0.001	0.005	0.000	0.006	0.000	0.003	0.001	0.005	0.001	0.006
pcol	0.003	0.019	0.003	0.021	0.000	0.018	-0.006	0.016	-0.019	0.020	-0.024	0.020
pcit	-0.003	0.013	-0.008	0.016	-0.007	0.016	-0.005	0.015	-0.002	0.014	-0.001	0.015
ppho	-0.001	0.011	-0.003	0.013	0.000	0.012	-0.001	0.011	0.003	0.010	0.000	0.011

<i>National Change of Address Database</i>												
recentfrom0	-0.003	0.007	0.000	0.008	-0.001	0.007	-0.001	0.007	0.000	0.006	0.003	0.006
recentfrom1	0.000	0.007	0.001	0.007	0.000	0.007	0.002	0.006	0.008	0.006	0.005	0.007
recentfrom23	0.001	0.009	-0.001	0.010	-0.002	0.010	0.003	0.008	0.013	0.009	0.011	0.009
recentto0	0.000	0.007	0.001	0.007	0.000	0.007	0.003	0.007	0.004	0.006	0.006	0.007
recentto1	-0.001	0.006	0.003	0.008	0.000	0.007	0.002	0.006	0.007	0.006	0.005	0.007
recentto23	0.002	0.008	0.000	0.009	0.003	0.009	0.001	0.005	0.010	0.008	0.006	0.008

Source: U.S. Census Bureau. Current Population Survey and Housing Vacancy Survey Supplement data for 2019-2020 linked to each supplemental data source identified in the table.

Note: This table shows the results of OLS difference-in-difference estimates that compare the difference between the mean value of the variable for non-responders versus responders to the same difference in the first quarter of 2019. For example, the OLS difference-in-difference estimates for Q1 2020 in this table are identical to the year-year change column in Table 3 since both comparisons use Q1 2019 as the reference category.

*** p<.01; ** p<.05; * p<.10. Asterisks are reported for all estimates.

Table 8: Logistic Regressions Modeling Type A Non-response versus Response on Selected Covariates (1=Response; 0=Type A Non-response).

	Q1 2019		Q2 2019		Q3 2019		Q4 2019		Q1 2020		Q2 2020		Q3 2020	
	Coef.	(S.E.)	Coef.	(S.E.)	Coef.	(S.E.)	Coef.	(S.E.)	Coef.	(S.E.)	Coef.	(S.E.)	Coef.	(S.E.)
Intercept	1.894	1.592	1.965	1.552	1.588	1.570	1.833	1.661	1.823	1.418	1.490	1.286	1.228	1.287
decmis	0.129	0.370	0.179	0.335	0.229	0.325	0.154	0.351	0.169	0.299	0.140	0.274	0.116	0.251
vactype1	0.089	0.448	0.183	0.410	0.075	0.376	0.068	0.419	0.013	0.392	-0.056	0.310	0.019	0.351
vactype2	0.339	1.677	0.601	2.042	0.313	1.979	0.344	1.983	0.804	1.801	0.057	1.098	-0.016	1.341
vactype3	0.052	0.539	0.169	0.550	0.109	0.549	0.072	0.625	0.225	0.566	0.266	0.433	0.128	0.522
vactype4	0.286	1.384	0.569	1.332	0.311	1.450	0.557	1.514	0.533	1.170	0.279	0.935	0.320	0.918
vactype5	1.125	0.641*	1.131	0.676*	0.955	0.663	0.935	0.674	0.985	0.594*	1.003	0.500**	0.914	0.489*
tenure2	0.069	0.214	0.142	0.204	0.102	0.225	0.044	0.222	0.032	0.192	0.039	0.157	0.068	0.185
tenure3	-0.144	0.205	-0.090	0.206	-0.067	0.201	-0.148	0.197	-0.213	0.183	-0.262	0.156*	-0.167	0.168
tenure4	0.202	0.560	0.239	0.538	0.150	0.700	-0.040	0.514	0.026	0.440	-0.007	0.449	0.077	0.428
bldm	-0.139	0.239	-0.135	0.213	-0.164	0.233	-0.175	0.228	-0.124	0.191	-0.085	0.159	-0.191	0.181
bldto	0.220	0.344	0.157	0.335	0.160	0.320	0.160	0.312	0.136	0.300	-0.004	0.280	0.008	0.255
hht2	-0.089	0.305	-0.088	0.311	-0.133	0.333	-0.103	0.315	-0.187	0.270	-0.217	0.254	-0.220	0.277
hht3	-0.186	0.195	-0.134	0.181	-0.170	0.230	-0.191	0.213	-0.145	0.172	-0.179	0.160	-0.176	0.175
hht4	-0.126	0.217	-0.161	0.215	-0.097	0.250	-0.220	0.226	-0.192	0.196	-0.152	0.180	-0.119	0.189
hht5	-0.070	0.328	-0.183	0.320	-0.137	0.373	-0.118	0.362	-0.102	0.335	-0.145	0.264	-0.046	0.295
hht6	-0.161	0.224	-0.186	0.228	-0.149	0.246	-0.177	0.211	-0.152	0.199	-0.085	0.191	-0.059	0.195
hht7	-0.142	0.390	-0.166	0.368	-0.061	0.391	0.131	0.427	-0.094	0.360	-0.130	0.329	-0.058	0.331
rhhldrage	0.007	0.004*	0.008	0.004**	0.008	0.004*	0.007	0.004*	0.007	0.004*	0.008	0.003**	0.006	0.003*
hispanic	0.015	0.278	0.008	0.308	-0.077	0.275	-0.089	0.265	-0.050	0.264	-0.068	0.226	-0.176	0.241
black	-0.188	0.237	-0.216	0.251	-0.175	0.239	-0.197	0.273	-0.128	0.231	-0.081	0.197	-0.125	0.180
aian	-0.160	0.686	-0.186	0.687	-0.133	0.642	-0.121	0.649	-0.104	0.599	-0.166	0.523	-0.143	0.492
asian	0.024	0.332	0.035	0.341	-0.134	0.348	-0.044	0.310	-0.023	0.337	-0.031	0.265	-0.066	0.299
nhopi	-0.220	1.250	-0.110	1.333	-0.230	1.220	-0.224	1.206	-0.230	1.245	-0.150	1.237	-0.118	1.115
other	-0.037	0.402	-0.157	0.394	-0.052	0.398	-0.042	0.383	-0.083	0.349	-0.125	0.337	0.019	0.309
bkmis	0.060	0.222	-0.027	0.242	-0.010	0.220	0.054	0.244	0.041	0.197	-0.022	0.182	0.001	0.181
bkowner	-0.031	0.199	-0.073	0.214	-0.006	0.234	0.017	0.230	0.006	0.193	0.172	0.188	0.185	0.169
acsmis	0.222	1.556	0.178	1.540	0.264	1.591	0.155	1.595	0.034	1.536	0.069	1.371	0.176	1.312
medval	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
medinc	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
phhpov	0.755	1.017	1.092	1.167	0.506	1.062	1.047	1.148	0.751	1.081	-0.131	1.033	0.038	1.015
pvacs	0.792	0.887	0.964	0.971	0.937	0.847	0.775	0.887	0.620	0.888	0.734	0.720	0.913	0.761
pmover	0.156	1.378	0.232	1.252	-0.086	1.415	-0.223	1.429	-0.085	1.280	-0.356	1.256	-0.137	1.123
pown	0.128	0.532	0.258	0.583	0.134	0.603	0.092	0.581	0.177	0.535	0.162	0.558	0.121	0.447
pa17	0.227	1.516	-0.079	1.685	0.609	1.963	0.267	1.797	-0.096	1.827	-0.708	1.732	-0.500	1.521

pa18	0.160	1.717	-0.120	1.621	0.343	1.658	0.076	1.732	0.022	1.688	0.007	1.473	0.032	1.396
pa35	-0.232	2.168	-0.482	2.206	-0.025	2.204	-0.102	2.338	-0.340	1.978	-0.298	1.874	0.086	1.882
pa75	1.277	2.703	0.938	2.972	1.734	2.903	0.968	2.913	1.047	3.033	0.533	2.700	1.035	2.518
phis	-0.196	0.536	-0.210	0.555	-0.295	0.636	-0.268	0.531	-0.253	0.494	-0.132	0.502	-0.176	0.497
pnhb	-0.525	0.528	-0.476	0.468	-0.494	0.539	-0.618	0.486	-0.495	0.474	-0.363	0.445	-0.321	0.426
pnha	-0.297	1.009	-0.322	1.020	-0.287	0.953	-0.535	1.008	-0.235	0.968	-0.198	0.919	-0.125	0.923
poth	-1.012	1.379	-0.582	1.414	-0.823	1.726	-0.678	1.946	-0.597	1.217	-0.907	1.141	-0.725	1.498
State x Metro FE	Yes		Yes		Yes		Yes		Yes		Yes		Yes	
MIS x Metro FE	Yes		Yes		Yes		Yes		Yes		Yes		Yes	

Source: U.S. Census Bureau. Current Population Survey and Housing Vacancy Survey Supplement data for 2019-2020 linked to the supplemental data sources identified in Table 2.

Note: This table reports the results of logistic regressions that model an indicator for Type A non-response on the set of covariates identified in the table. The dependent variable is defined so that positive coefficients correspond to increased likelihood of response (0=Type A Non-response; 1=Completed interview, Type B, or Type C). Separate logistic regressions are estimated for each quarter.

*** p<.01; ** p<.05; * p<.10. Asterisks are reported for all estimates.

Table 9: Estimates of the Homeownership Rate, Rental Vacancy Rate, Homeowner Vacancy Rate, and Gross Vacancy Rate using Alternative Weighting Approaches.

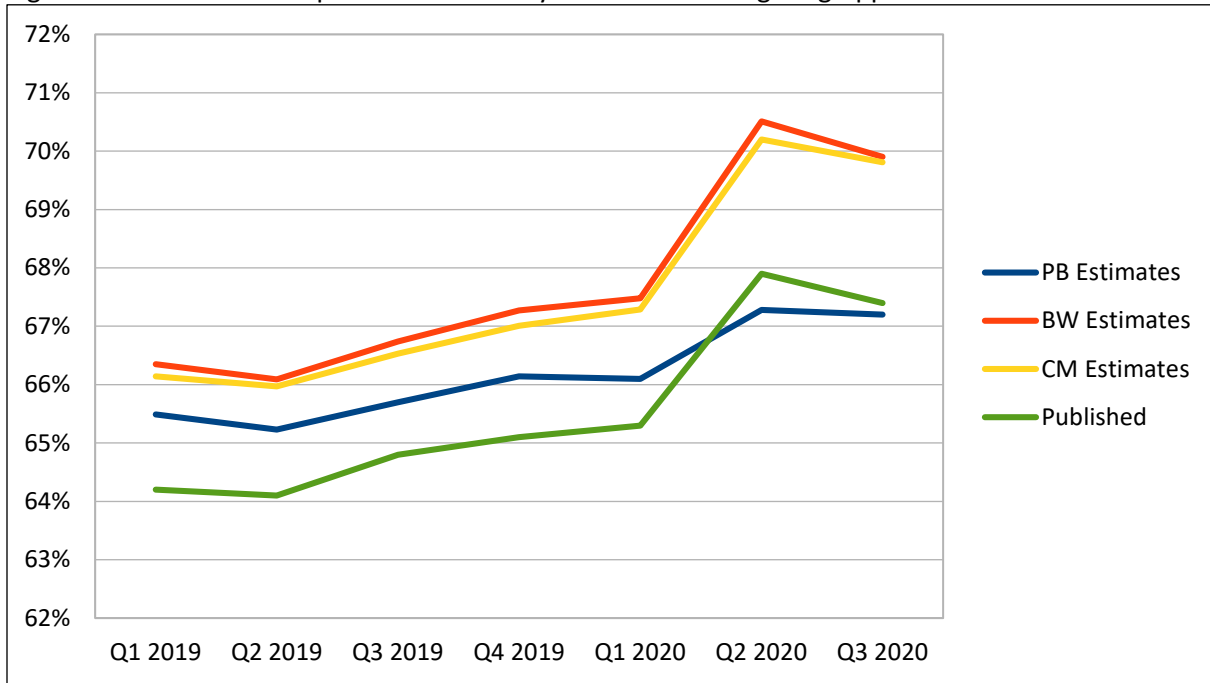
	Estimates							Year-Over-Year Change		
	Q1 2019	Q2 2019	Q3 2019	Q4 2019	Q1 2020	Q2 2020	Q3 2020	Q1 2020 – Q1 2019	Q2 2020 – Q2 2019	Q3 2020 – Q3 2019
<i>Homeownership Rate</i>										
PB Estimates	0.655	0.652	0.657	0.661	0.661	0.673	0.672	0.006	0.021	0.015
(S.E.)	0.019	0.018	0.019	0.018	0.020	0.018	0.019	0.018	0.019	0.020
BW Estimates	0.664**	0.661**	0.667***	0.673***	0.675***	0.705***	0.699***	0.011	0.044***	0.032***
(S.E.)	0.020	0.018	0.019	0.018	0.020	0.017	0.019	0.018	0.019	0.020
CM Estimates	0.661*	0.660**	0.665**	0.670**	0.673***	0.702***	0.698***	0.012	0.042***	0.033***
(S.E.)	0.020	0.018	0.019	0.019	0.020	0.017	0.019	0.018	0.019	0.020
<i>Rental Vacancy Rate</i>										
PB Estimates	0.086	0.084	0.084	0.080	0.085	0.089	0.093	-0.001	0.005	0.009
(S.E.)	0.014	0.012	0.013	0.013	0.015	0.018	0.016	0.019	0.020	0.017
BW Estimates	0.086	0.084	0.083	0.080	0.085	0.087	0.093	-0.001	0.004	0.009
(S.E.)	0.015	0.013	0.013	0.014	0.016	0.017	0.015	0.019	0.019	0.017
CM Estimates	0.072***	0.070***	0.070***	0.067***	0.069***	0.060***	0.068***	-0.004	-0.010**	-0.002**
(S.E.)	0.012	0.011	0.011	0.012	0.013	0.012	0.012	0.016	0.015	0.014
<i>Homeowner Vacancy Rate</i>										
PB Estimates	0.016	0.015	0.017	0.016	0.014	0.013	0.013	-0.002	-0.002	-0.004
(S.E.)	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.006	0.005	0.005
BW Estimates	0.016	0.015	0.017	0.016	0.014	0.013	0.013	-0.002	-0.003	-0.004
(S.E.)	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.005	0.005	0.005
CM Estimates	0.013***	0.013***	0.014***	0.014***	0.011***	0.008***	0.009***	-0.002	-0.004	-0.005
(S.E.)	0.003	0.003	0.003	0.004	0.003	0.003	0.003	0.004	0.004	0.004
<i>Gross Vacancy Rate</i>										
PB Estimates	0.139	0.140	0.140	0.132	0.136	0.139	0.134	-0.003	-0.001	-0.007
(S.E.)	0.013	0.014	0.013	0.014	0.014	0.016	0.014	0.012	0.012	0.011
BW Estimates	0.142	0.143*	0.142	0.134	0.139	0.139	0.135	-0.003	-0.004	-0.007
(S.E.)	0.014	0.015	0.014	0.014	0.016	0.017	0.015	0.012	0.013	0.011
CM Estimates	0.120***	0.121***	0.121***	0.115***	0.113***	0.098***	0.100***	-0.007**	-0.023***	-0.021***
(S.E.)	0.012	0.013	0.012	0.013	0.013	0.013	0.012	0.010	0.010	0.009

Source: U.S. Census Bureau. Current Population Survey and Housing Vacancy Survey Supplement data for 2019-2020 linked to the supplemental data sources identified in Table 2.

Note: This table reports estimates of each outcome using the propensity-score-based non-response adjustment developed in this paper (PB Estimates), the CPS base weights (BW Estimates), and the CPS base weights multiplied by the existing non-response adjustment factor (CM Estimates).

*** $p < .01$; ** $p < .05$; * $p < .10$. The asterisks reflect significance tests that compare the BW Estimates and CM Estimates, respectively, to the PB Estimates for the same outcome and quarter.

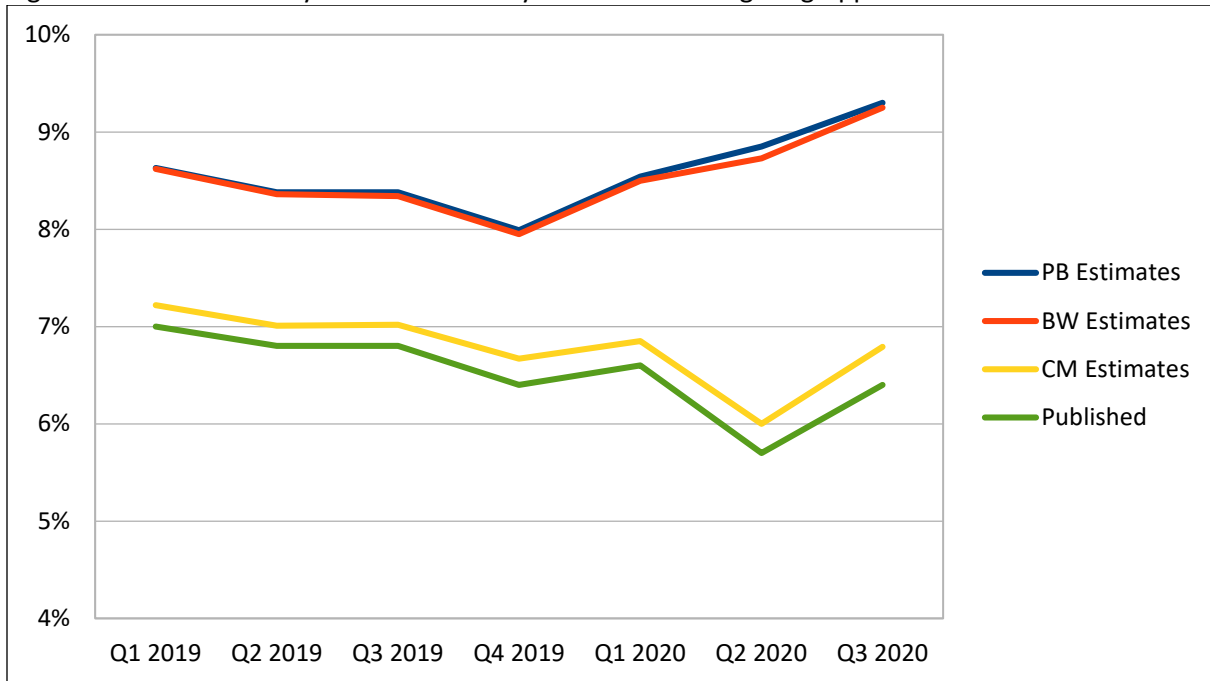
Figure 1A: Homeownership Rate Estimates by Quarter and Weighting Approach.



Source: U.S. Census Bureau. Current Population Survey and Housing Vacancy Survey Supplement data for 2019-2020 linked to the supplemental data sources identified in Table 2.

Note: This figure visualizes the alternative estimates reported in Table 9, along with the published CPS/HVS estimates using the final weights.

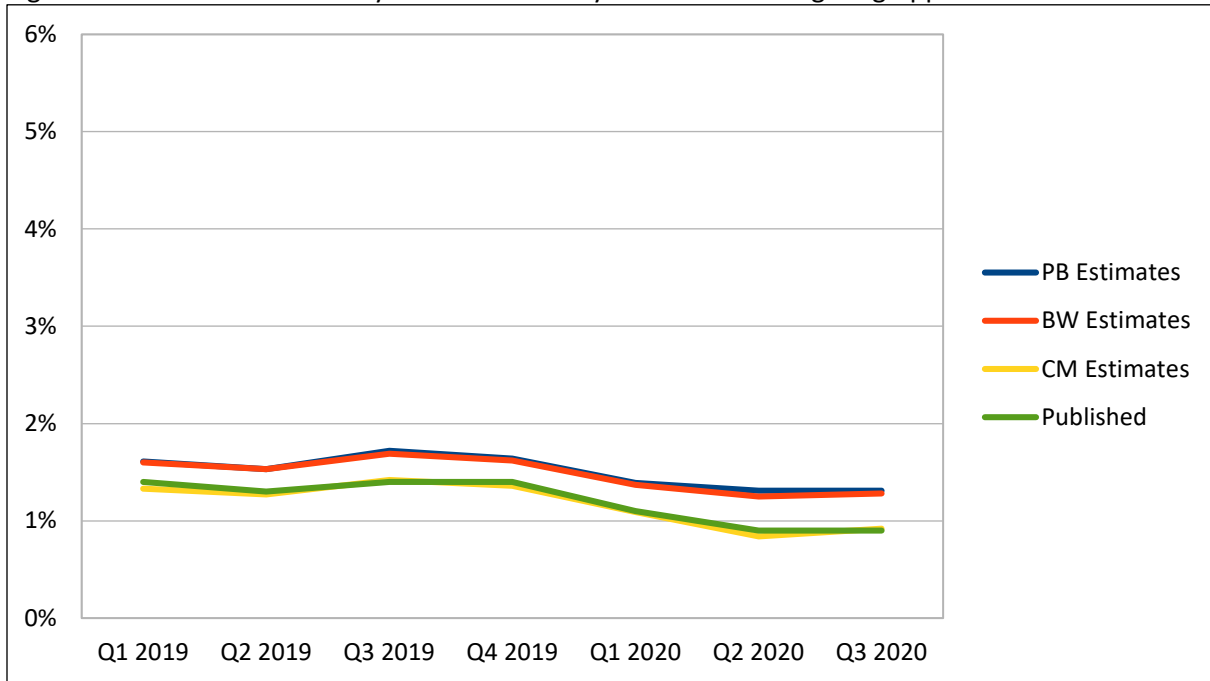
Figure 1B: Rental Vacancy Rate Estimates by Quarter and Weighting Approach.



Source: U.S. Census Bureau. Current Population Survey and Housing Vacancy Survey Supplement data for 2019-2020 linked to the supplemental data sources identified in Table 2.

Note: This figure visualizes the alternative estimates reported in Table 9, along with the published CPS/HVS estimates using the final weights.

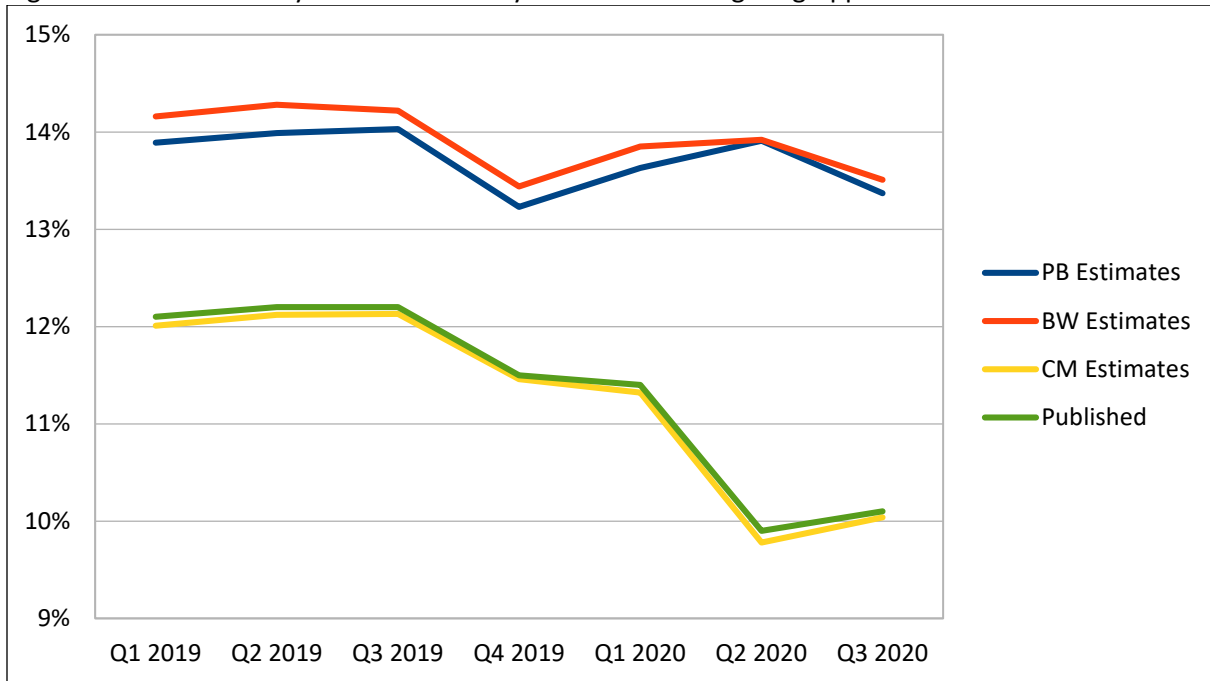
Figure 1C: Homeowner Vacancy Rate Estimates by Quarter and Weighting Approach.



Source: U.S. Census Bureau. Current Population Survey and Housing Vacancy Survey Supplement data for 2019-2020 linked to the supplemental data sources identified in Table 2.

Note: This figure visualizes the alternative estimates reported in Table 9, along with the published CPS/HVS estimates using the final weights.

Figure 1A: Gross Vacancy Rate Estimates by Quarter and Weighting Approach.



Source: U.S. Census Bureau. Current Population Survey and Housing Vacancy Survey Supplement data for 2019-2020 linked to the supplemental data sources identified in Table 2.

Note: This figure visualizes the alternative estimates reported in Table 9, along with the published CPS/HVS estimates using the final weights.

Appendix: Model Specification

The propensity-score model used to produce the alternative non-response adjustment factor is specified using a selected subset of the variables available from the supplemental data sources. To determine the model specification, the authors started with the set of attributes that show either a significant difference between non-respondents versus respondents or a significant change over time in these differences, as shown in Tables 3-7. Two analysts then independently developed specifications using logistic regressions with Akaike Information Criterion (AIC) as a measure of model performance and using OLS with r-squared as a measure of performance. The two resulting specifications were then compared and consolidated into the preferred specification used in Table 8 using similar metrics.

Appendix Table A-1 provides a summary of the AIC values for models that incrementally add the state by metro fixed effects, the month-in-sample by metro fixed effects, and the additional covariates. For example, the model labeled Add MIS x Metro Fixed Effects includes both the state by metro fixed effects and the month-in-sample by metro fixed effects, and the model labeled Add Covariates includes both sets of fixed effects and adds the additional covariates shown in Table 8. These model fit statistics show the reductions in AIC values that accompany the addition of each additional set of covariates.

Appendix Table A-2 contains sensitivity analyses that report CPS/HVS estimates when the alternative non-response adjustment factor is produced using each of the models in Appendix Table A-1. These estimates highlight that the estimates are sensitive to the inclusion of the additional covariates in the last model. While few of the coefficients for these covariates reach statistical significance in Table 8, these estimates show that they nonetheless contribute to performance of the model in capturing the observed changes in non-response outcomes.

Appendix Table A1: AIC Values for Alternative Model Specifications.

	Q1 2019	Q2 2019	Q3 2019	Q4 2019	Q1 2020	Q2 2020	Q3 2020
Intercept Only	115200000	115700000	113900000	114400000	130300000	168000000	156800000
Add State x Metro Fixed Effects	112600000	112600000	110400000	110800000	127400000	165200000	154200000
Add MIS x Metro Fixed Effects	112400000	112500000	110300000	110600000	126900000	160500000	152500000
Add Covariates	110900000	110700000	108700000	108900000	125000000	156200000	149000000

Source: U.S. Census Bureau. Current Population Survey and Housing Vacancy Survey Supplement data for 2019-2020 linked to the supplemental data sources identified in Table 2.

Note: AIC values are rounded to four significant digits.

Appendix Table A2: Sensitivity Analysis of CPS/HVS Estimates to Alternative Model Specifications.

	Q1 2019	Q2 2019	Q3 2019	Q4 2019	Q1 2020	Q2 2020	Q3 2020
<u>Homeownership Rate</u>							
Base weight only (no model)	0.664	0.661	0.667	0.673	0.675	0.705	0.699
Add State x Metro Fixed Effects	0.663	0.661	0.667	0.673	0.675	0.705	0.699
Add MIS x Metro Fixed Effects	0.663	0.661	0.667	0.673	0.675	0.705	0.699
Add Covariates	0.655	0.652	0.657	0.661	0.660	0.671	0.672
<u>Rental Vacancy Rate</u>							
Base weight only (no model)	0.086	0.084	0.083	0.080	0.085	0.087	0.093
Add State x Metro Fixed Effects	0.086	0.084	0.083	0.080	0.085	0.087	0.093
Add MIS x Metro Fixed Effects	0.086	0.084	0.083	0.080	0.085	0.087	0.093
Add Covariates	0.086	0.083	0.083	0.079	0.085	0.087	0.092
<u>Homeowner Vacancy Rate</u>							
Base weight only (no model)	0.016	0.015	0.017	0.016	0.014	0.013	0.013
Add State x Metro Fixed Effects	0.016	0.015	0.017	0.016	0.014	0.013	0.013
Add MIS x Metro Fixed Effects	0.016	0.015	0.017	0.016	0.014	0.013	0.013
Add Covariates	0.016	0.015	0.017	0.016	0.014	0.013	0.013
<u>Gross Vacancy Rate</u>							
Base weight only (no model)	0.142	0.143	0.142	0.134	0.139	0.139	0.135
Add State x Metro Fixed Effects	0.142	0.143	0.142	0.134	0.139	0.139	0.135
Add MIS x Metro Fixed Effects	0.142	0.143	0.142	0.134	0.139	0.139	0.135
Add Covariates	0.139	0.140	0.140	0.132	0.136	0.138	0.134

Source: U.S. Census Bureau. Current Population Survey and Housing Vacancy Survey Supplement data for 2019-2020 linked to the supplemental data sources identified in Table 2.

Note: This table reports estimates of each outcome using the propensity-score-based nonresponse adjustment described in the methodology section. The models incrementally add each additional set of covariates so that the last estimates labeled Add Covariates reflect the model specification used in Table 8.