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An Evaluation of the 2022 National Household Travel Surveys: A Total Survey Error Comparison of the ABS vs. the Probability-Based Panel NextGen NHTS Studies

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Evaluation Team

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Address-Based Sample (ABS) Design

- U.S. residential address sample purchased from MSG
- Stratified by Urban/Rural and Census Regions
- Recruitment mailings to 72,822 addresses, January 2022 - January 2023
- 7,893 completed households (mixture of CAWI and paper; 99+% CAWI)

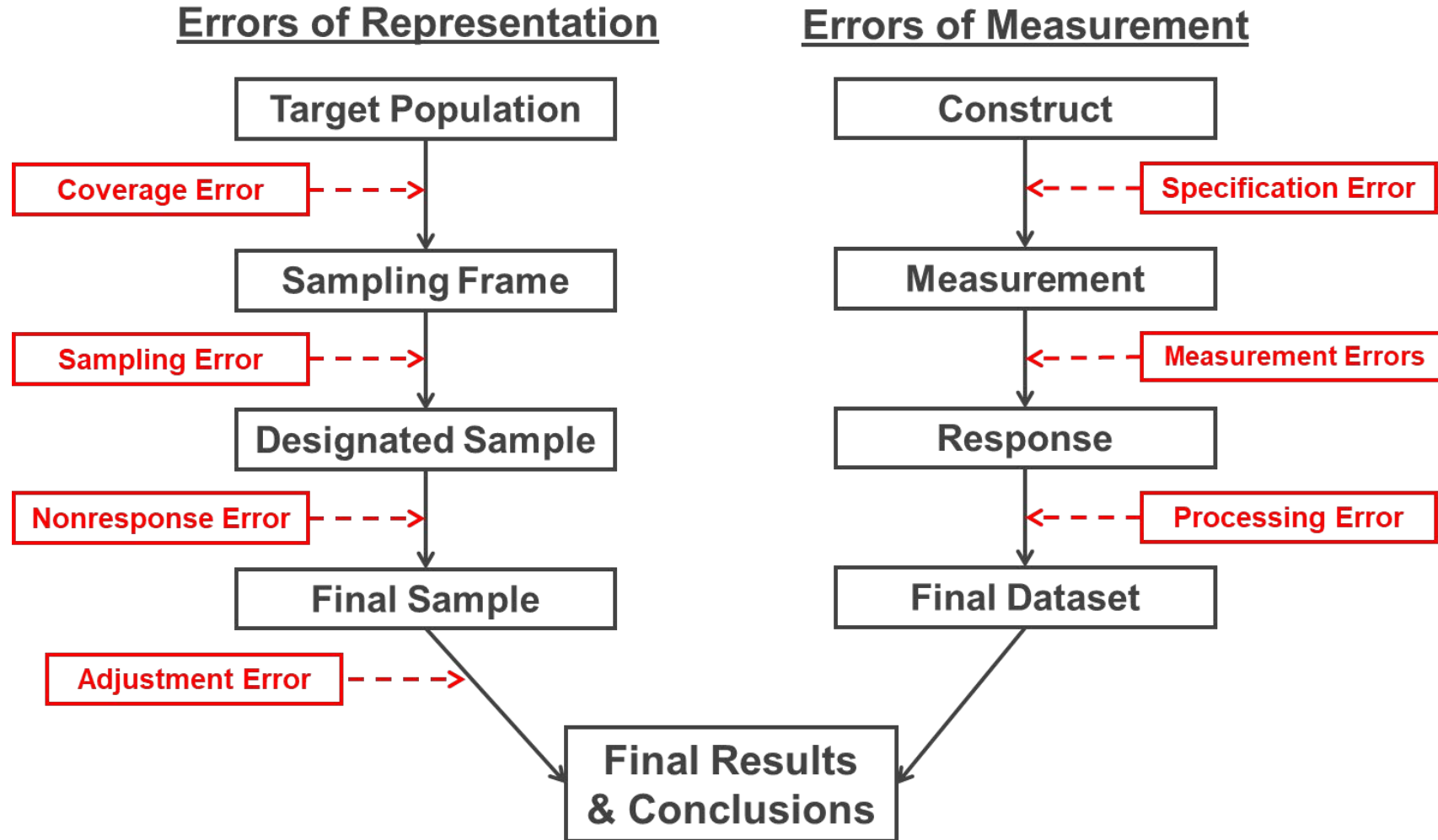
Panel Frame Sample (PFS) Design

- Sample drawn from an existing U.S. residential panel frame of the survey contractor
 - Panel built over 25 years using Landline-RDD, Dual Frame RDD, and ABS frames
- Email invitations sent to 18,161 panelists, January 2022 - January 2023
- 7,468 completed households (all CAWI)

Methodological Approach

- Guided by the TSE Framework
- Gathered detailed information about the methods used in each 2022 survey
 - Almost all requested information was provided
- Identified where differential methods and statistics were used
- Related those differential methods/statistics to meaningful differences in core attributes between the two 2022 surveys

Total Survey Error Framework



Total Survey Error Framework (continued)

- Organizes the major sources of survey error, whether in the form of bias or variance (imprecision), in a comprehensive, logical, and interrelated manner
- Errors of Representation
 - Coverage Problems and Errors
 - Sampling Design Problems and Errors
 - Nonresponse Problems and Errors
 - Adjustment Problems and Errors
- Errors of Measurement
 - Construct Specification and Errors
 - Respondent-related Measurement Problems and Errors
 - Processing Problems and Errors

Analysis Overview

- Performed using unweighted and/or weighted data, depending on the analysis question
- Performed only on data collected via the web (CAWI) questionnaire
- Comparisons made between 2022 ABS and 2022 PFS data for all analyses
 - For selected analyses, 2022 data also were compared against 2009 and/or 2017 NHTS data.
 - However, because of different data collection modes used in these survey years, some of these comparisons are confounded by the data collection mode.

NHTS Core Attributes

- Survey designs sought to ensure their statistical reliability
- Household
 - Household Size
 - Vehicle Count
 - Race of Reference Person
 - Hispanic Original of Reference Person
 - Household Income

NHTS Core Attributes (continued)

- Person
 - Age
 - Sex
 - Employment Status
 - Education Level
 - Online Purchase Deliveries
 - Reason for Fewer Trips
 - Typical Taxi Usage
 - Typical Transportation Network Company (TNC) Usage
 - Usage of New Transportation Services
 - Trip Parking Cost
 - Work from Home
 - Work from Home Frequency
 - Usual Mode to Work

NHTS Core Attributes (continued)

- Trip
 - Trip Start for Driver-Driven Trips
 - Trip End for Driver-Driven Trips
 - Duration for Driver-Driven Trips
 - Distance for Driver-Driven Trips
 - Vehicle Type
 - Trip Purpose for Driver-Driven Trips
 - Travel Party Size for Driver-Driven Trips

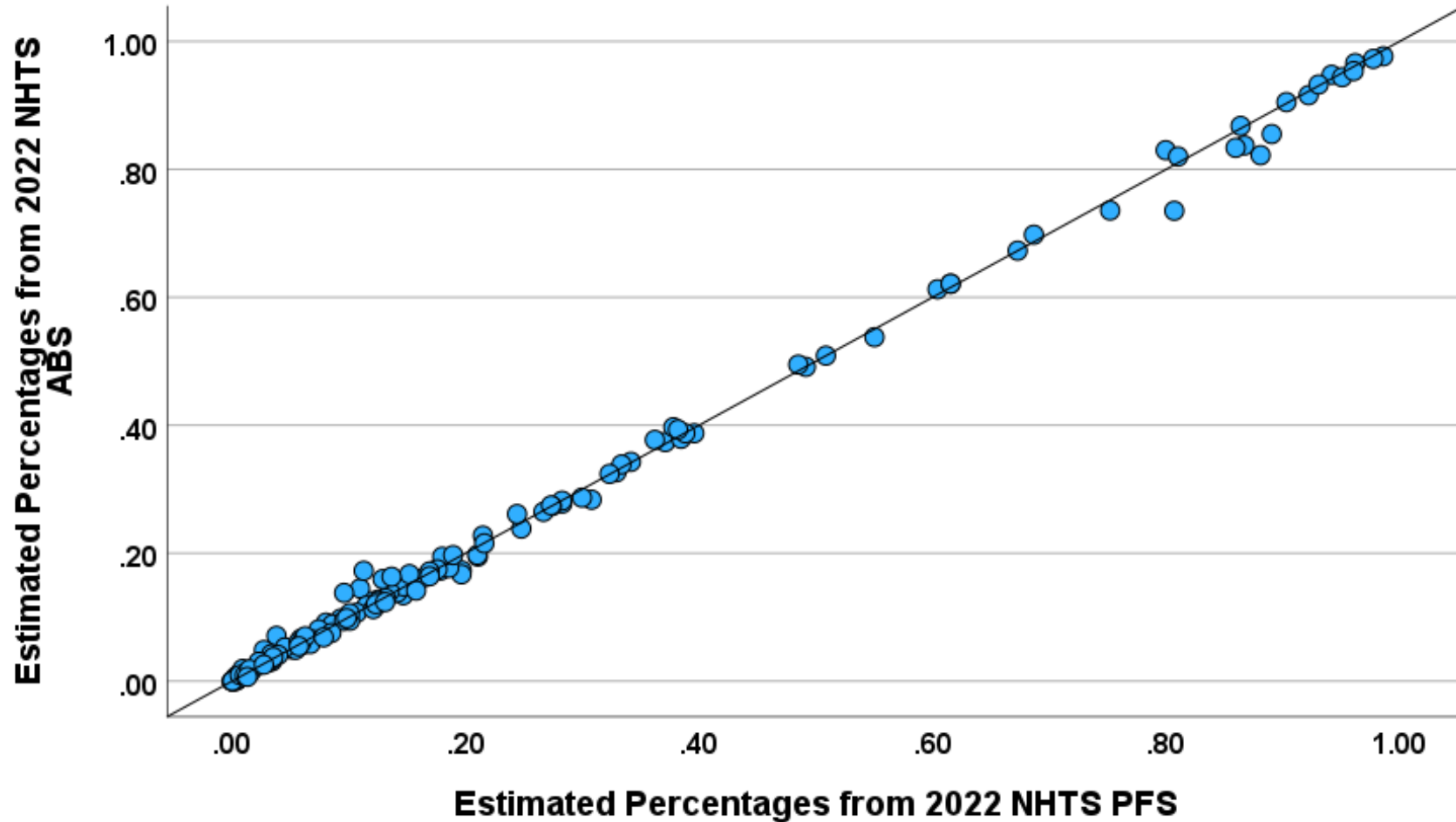
Statistical Methods

- SAS Proc SurveyMeans used to calculate core attribute sample percentages
- Percentage estimates and their related standard errors compared using z-tests to provide initial p values
- Used Bonferroni-Holm method to conservatively adjust p values for the multiple simultaneous comparisons by controlling the familywise error rate (0.05)
- Replicate weights used in standard error calculations for historical (i.e., 2009 and 2017) NHTS datasets; initial weights and strata used for 2022 ABS and PFS datasets
- Outcome estimates and their related standard errors compared using z-tests to provide initial p values. SAS Proc SurveyFreq used to provide Chi-square results for overall differences

Evaluation Findings

- Point estimates derived from the two surveys were largely consistent for the vast majority of the NHTS core attributes
 - No meaningfully statistically significant differences were seen in the travel metrics.
- The width of the resulting confidence intervals around the point estimates were generally wider, on average, for the ABS survey compared to the PFS survey.
 - For 497 of 599 (83%) estimates, the confidence interval for the ABS estimate was wider than that for the corresponding PFS estimate. Half of the ABS intervals were at least 32% wider than those from the PFS and approximately 25% of them were at least 46% wider.
 - That is, the ABS estimates were less precise than the PFS estimates.

Estimated Percentages of Core Attribute Values from the ABS Survey vs. the PFS Survey



$r \approx 0.99$

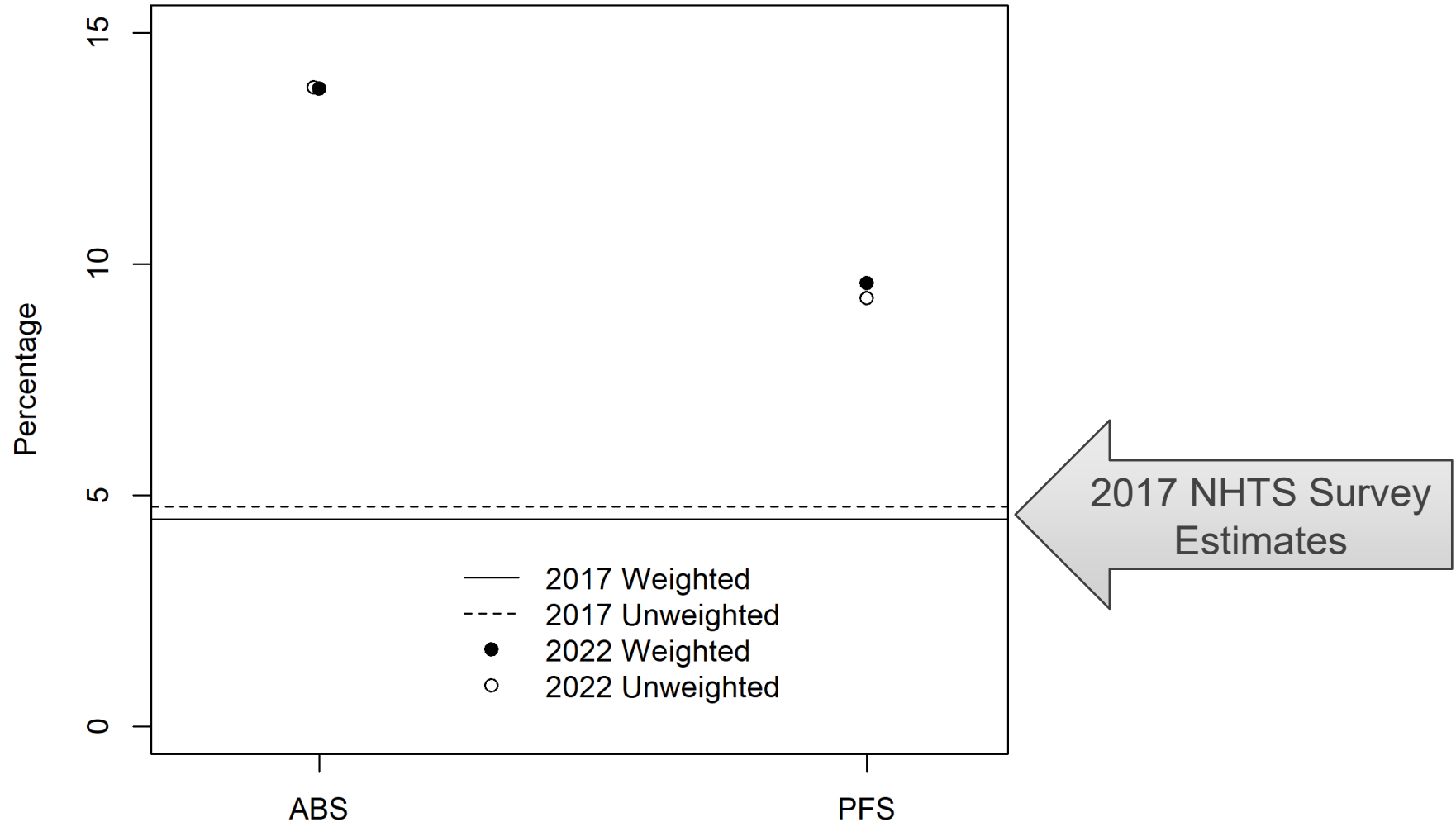
Meaningfully Statistically Significant Differences – Core Attributes

Core Attribute	Response	Estimate [percentage] (95% Confidence Interval)		ABS vs. PFS p-value	Percentage Difference (ABS vs PFS)
		2022 ABS	2022 PFS		
Race of reference person	Asian	7.08 (6.16, 7.99)	3.80 (3.34, 4.25)	<0.0001	46.34%
Race of reference person	White	73.52 (71.89, 75.15)	80.70 (79.74, 81.66)	<0.0001	-9.76%
Hispanic origin of reference person	Hispanic or Latino	14.48 (13.02, 15.95)	10.96 (10.18, 11.73)	<0.0001	24.35%
Online purchase deliveries	11+ Deliveries	30.51 (29.20, 31.83)	24.77 (23.86, 25.68)	<0.0001	18.82%
Typical TNC usage – Used rideshare in last 30 days	Yes	17.25 (16.00, 18.49)	11.27 (10.54, 11.99)	<0.0001	34.67%
Typical TNC usage – Used rideshare in last 30 days	No	82.21 (80.95, 83.47)	88.09 (87.34, 88.84)	<0.0001	-7.16%
Usage of new transportation services – EScooter	Yes	1.90 (1.51, 2.29)	0.90 (0.69, 1.10)	<0.0001	52.76%

Meaningfully Statistically Significant Differences – Online Deliveries

Number of Online Deliveries	Estimate [percentage] (95% Confidence Interval)		ABS vs. PFS p-value	Percentage Difference (ABS vs PFS)
	2022 ABS	2022 PFS		
0 Deliveries	28.36 (26.91, 29.81)	30.79 (29.79, 31.79)	0.0067	-8.59%
1-2 Deliveries	17.29 (16.21, 18.37)	19.67 (18.88, 20.46)	0.0005	-13.78%
3-5 Deliveries	23.84 (22.56, 25.13)	24.77 (23.90, 25.63)	0.2418	-3.88%
6-10 Deliveries	16.73 (15.76, 17.69)	15.18 (14.47, 15.89)	0.0117	9.23%
11+ Deliveries	13.79 (12.79, 14.79)	9.59 (8.97, 10.21)	<0.0001⁺	30.45%*

Percentage of People Reporting Receiving 11 or More Deliveries in the Past Month



Meaningfully Statistically Significant Differences – Travelers vs. Non-travelers

- ABS survey - meaningfully statistically significant differences for Vehicle Count, Household Income, Age, Employment Status, and Education
- PFS survey - meaningfully statistically significant differences for Household Size, Vehicle Count, Race of Reference Person, Hispanic Status of Reference Person, Household Income, Age, Employment Status, and Education

Evaluation Findings (continued)

- The coverage of the NHTS target population by the ABS survey was less than by the PFS survey, suggesting that noncoverage may have biased some of the ABS-measured core attributes.
- The sampling approach for the PFS survey was more constrained than that of the ABS sampling design in that it used geography plus other household variables related to travel outcomes to create the size measures used in the PPS sampling approach used to select the initial PFS sample.
- The sampling from the ABS frame appeared to yield a less representative initial ABS sample of the NHTS target population than did the PFS initial sample that resulted from the sampling of the PFS frame.
- Both surveys likely underrepresented the travel attributes of lower-SES households.

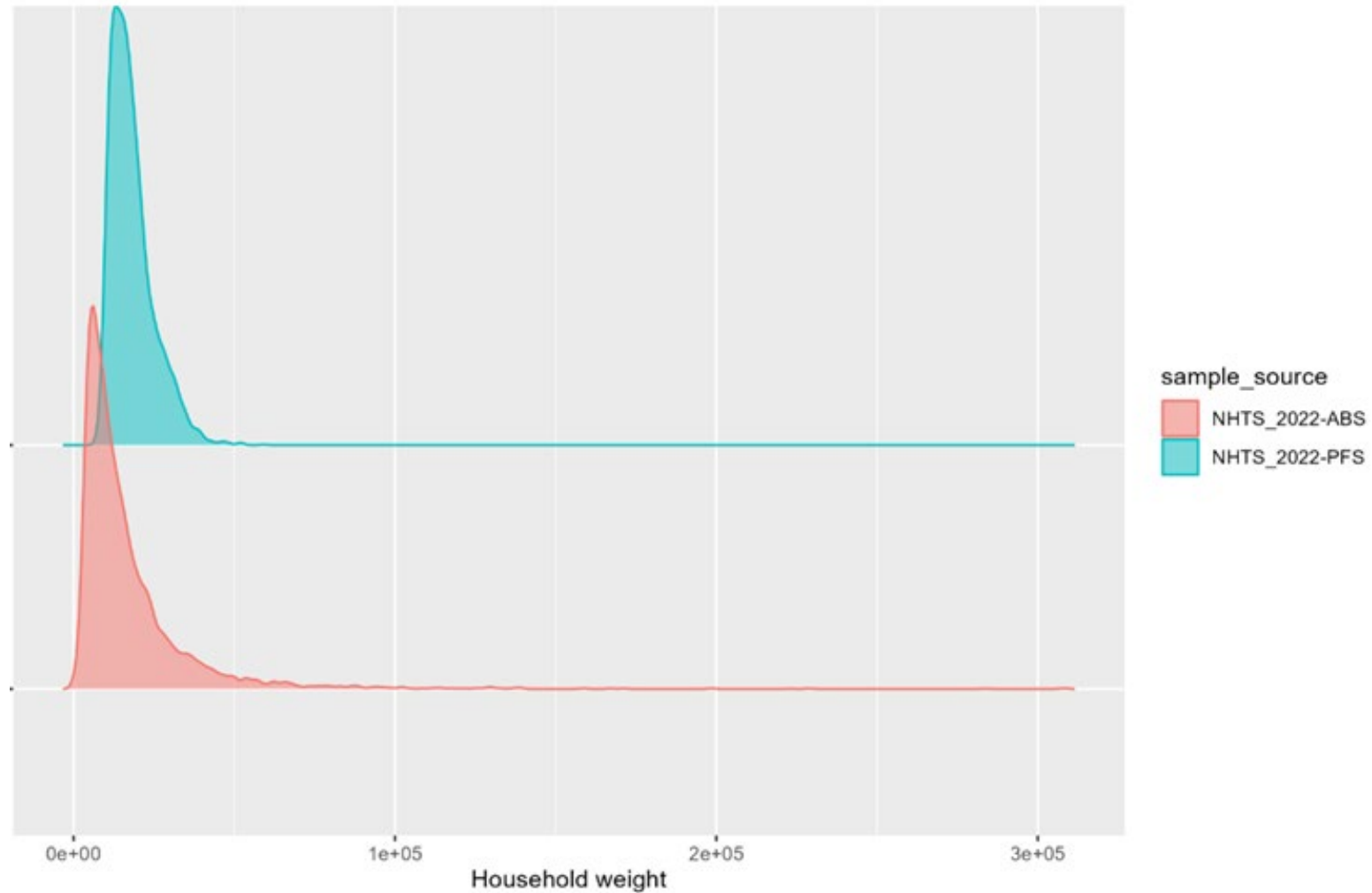
Evaluation Findings (continued)

- Nonresponse in both the ABS and PFS surveys was mostly associated with the SES of addresses/panelists in the two surveys' final samples of respondents that completed the questionnaire.
 - Because lower-SES households have different patterns of travel than higher-SES households, this logically suggests that some of the final 2022 NHTS data in both surveys were biased in their measurement of travel-related attributes, but not necessarily in the same way
- Determining, with confidence, whether the nonresponse in both surveys was associated with nonresponse bias in the surveys was not possible.

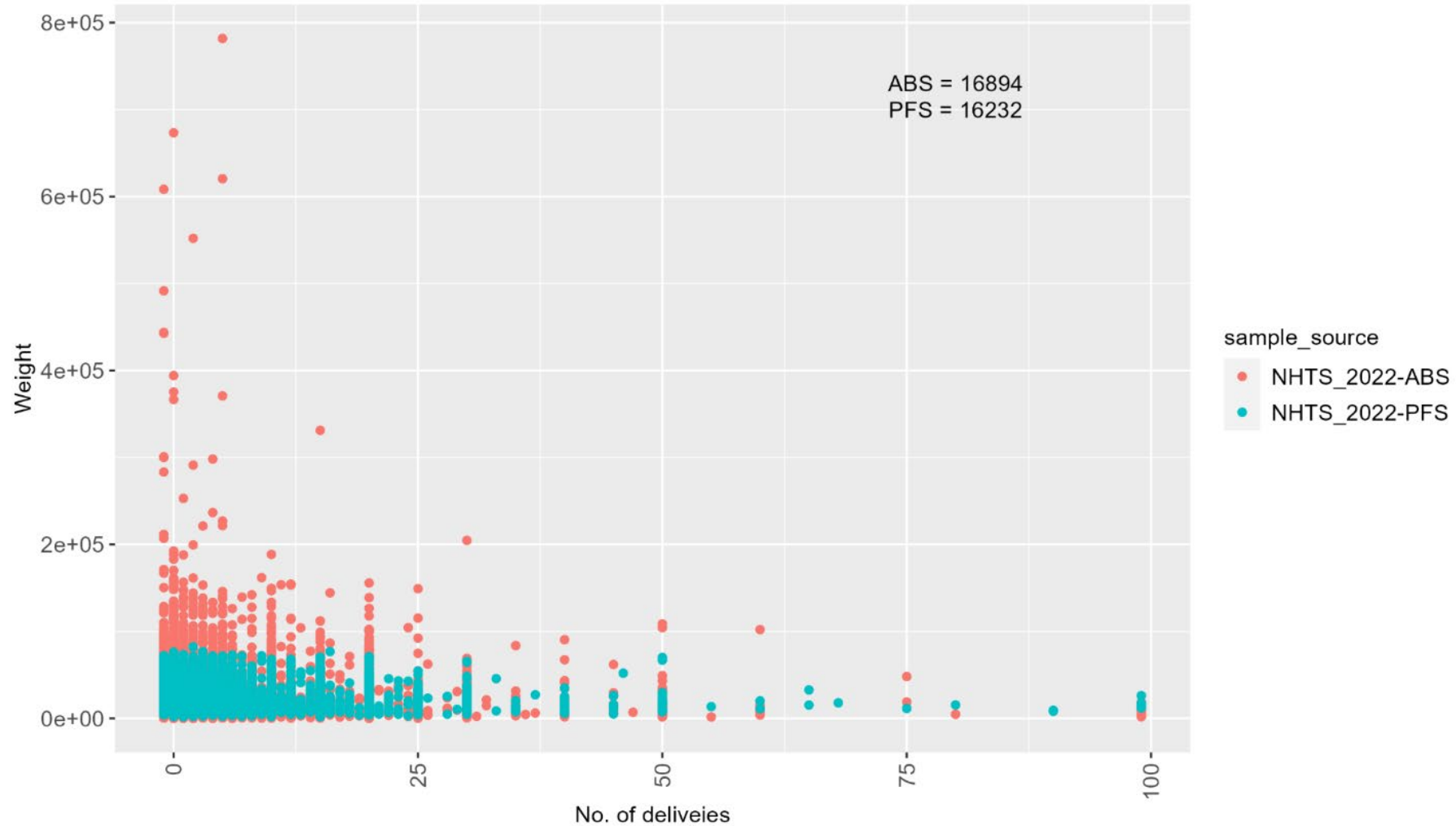
Evaluation Findings (continued)

- Although design weights were computed similarly across the two surveys, the trimming protocols did not seem to be equally applied across the two surveys.
 - PFS person weights were trimmed even though a smaller percentage of extreme weights were identified compared to the ABS person weights which were deemed to not require trimming; this led to some excessively large person (and consequently trip) weights for the ABS survey.
- Differences in mailing and replicate releases for the surveys resulted in differential adjustments by month that created relatively uniformly distributed PFS weights over the year but created higher household and person weights in the spring and summer months for the ABS survey.

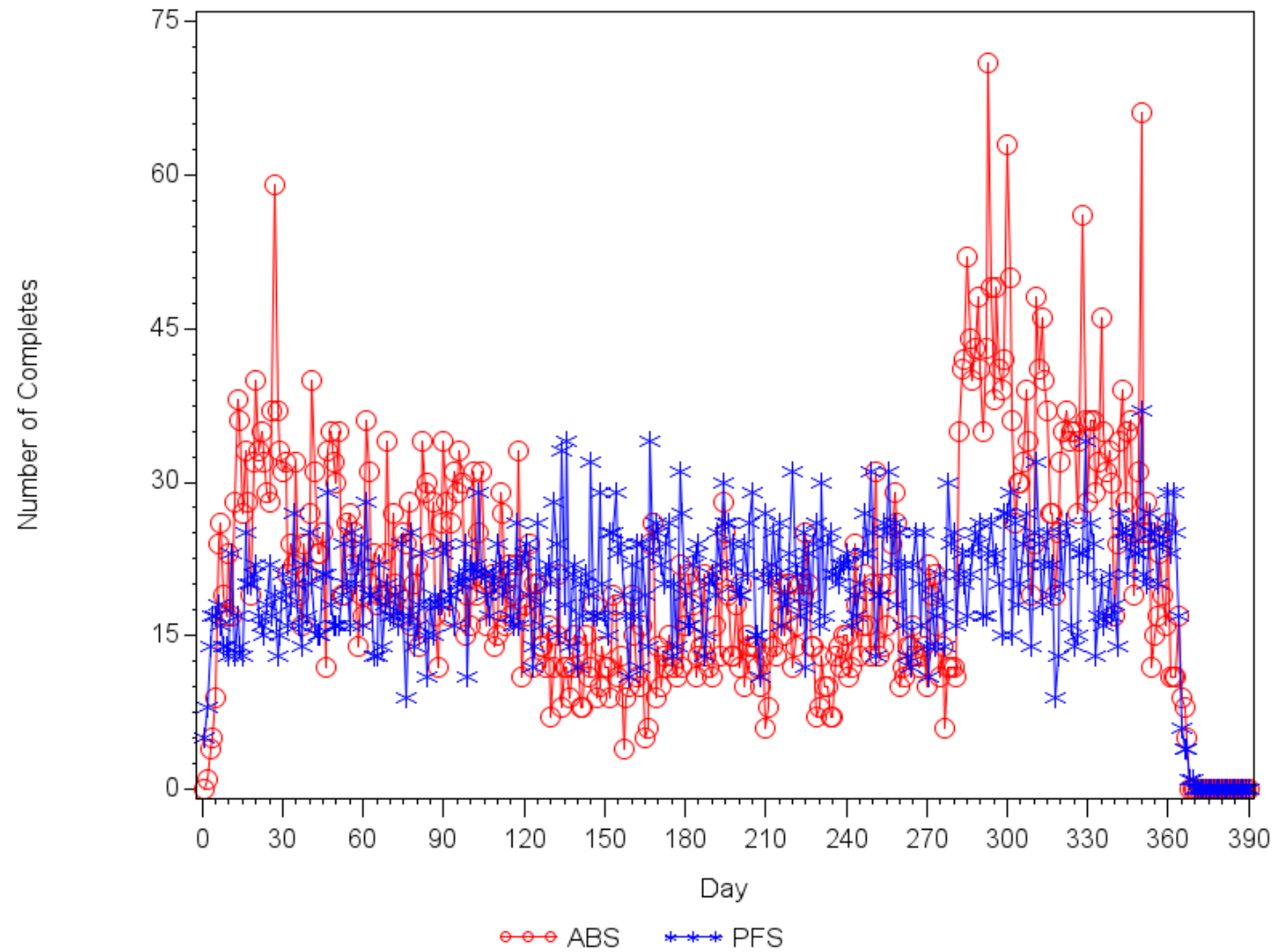
Final Household Weights as were Available for the Evaluation



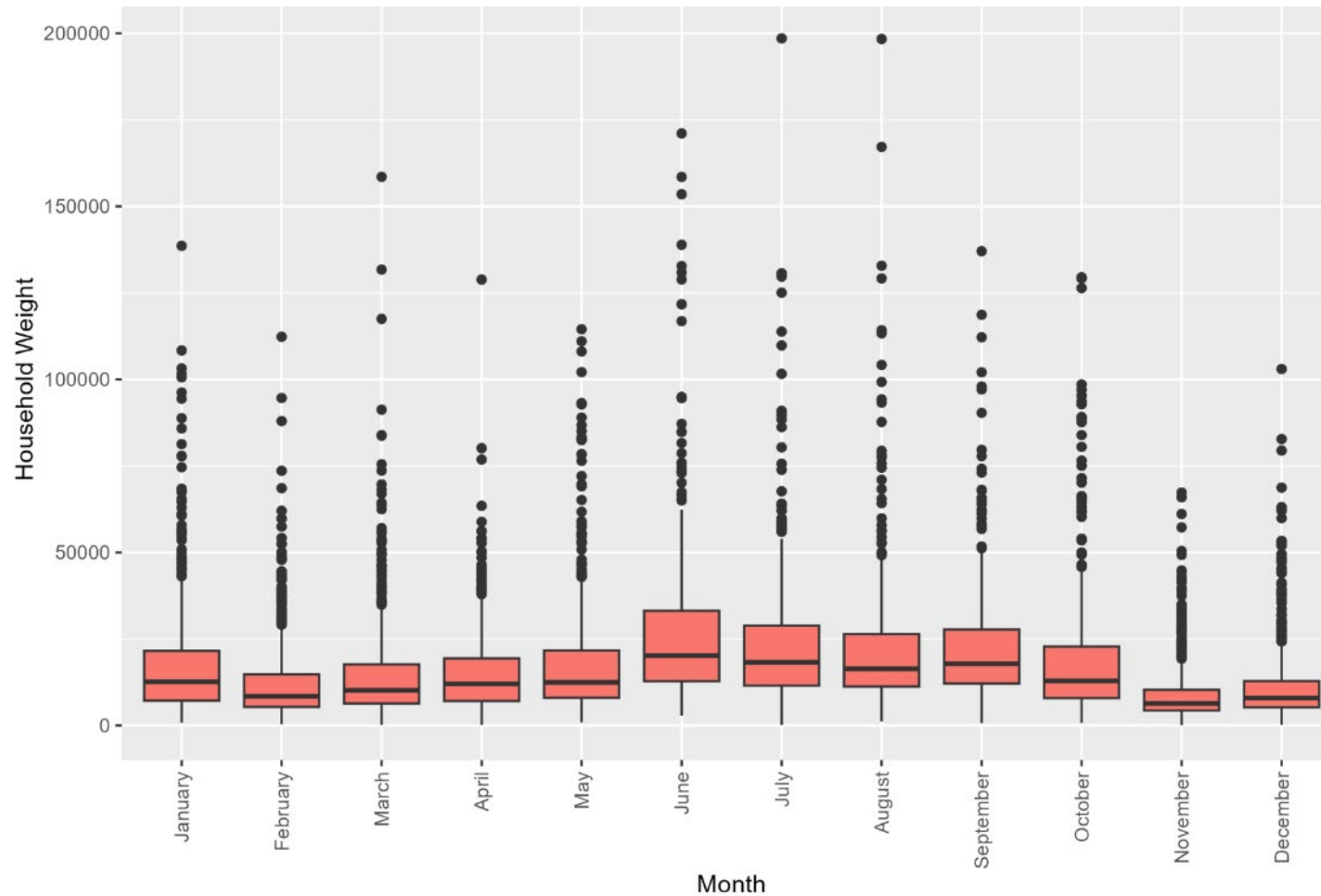
Person Weights Plotted Against the Number of Online Deliveries Reported



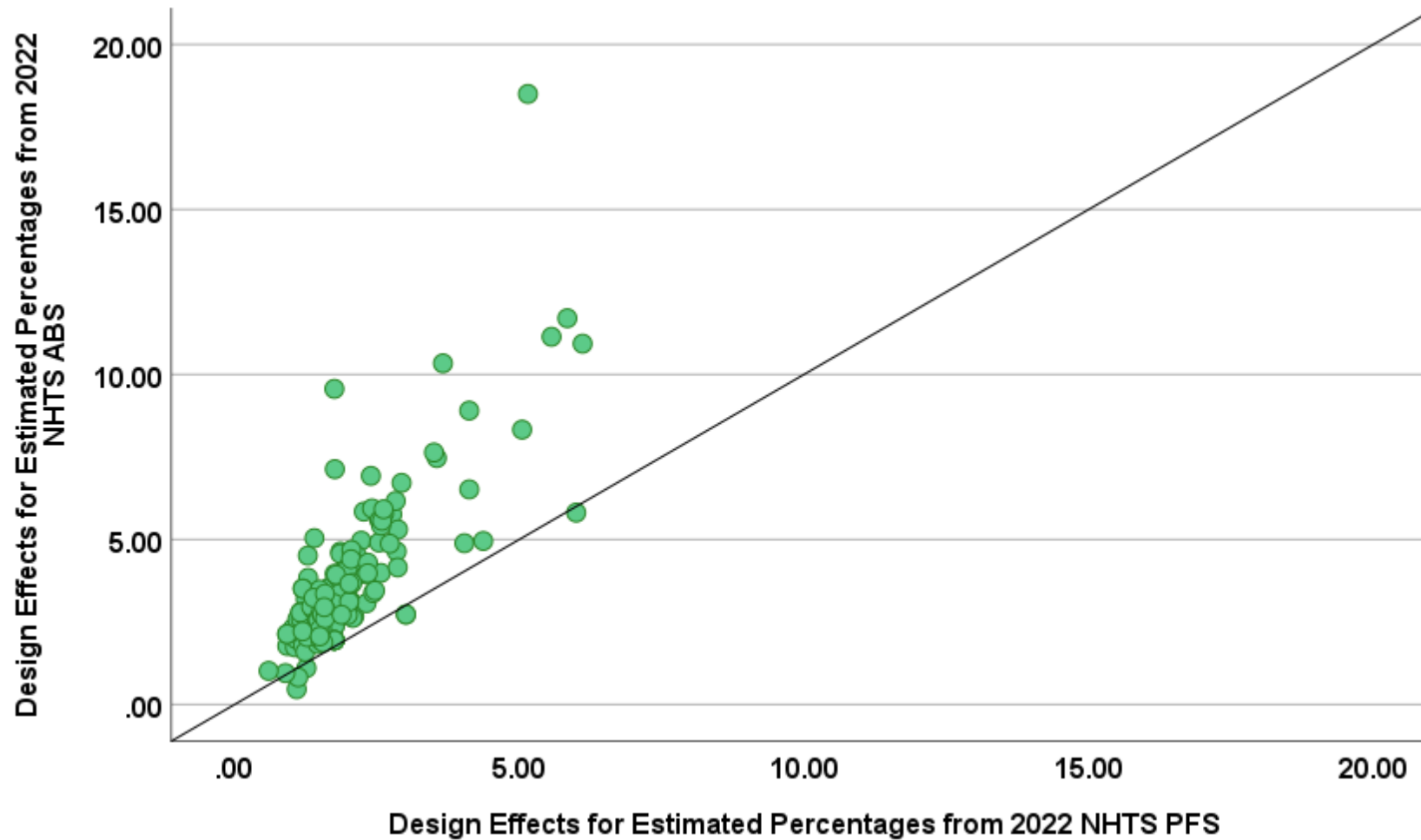
Number of Completed Cases per Day



Final Household Weights by Month for the ABS Survey



Design Effects for the Core Attribute Levels for the ABS and PFS Estimates



ABS Coverage and Related Error

- The ABS survey sample used the current MSG national frame
- It was reasoned that the amount of noncoverage in the ABS design was likely small
- However, using zip-code level 2020 census data and more recent ACS auxiliary data we found that the 2022 NHTS ABS initial sample differed from the target population by undercoverage of areas more likely to be populated by African Americans, Hispanics, young adults, those with less than a 9th grade education, and those with at least a Bachelor's degree, as well as having large residential buildings, households without vehicles, and urban dwelling units.
- The evaluation team reasoned that the amount of coverage error that the ABS frame may have contributed to its survey's findings was very small, but very likely to be greater than the amount of coverage error that the PFS frame contributed to its survey's findings.

PFS Coverage and Related Error

- The PFS survey sample came from the contractor's national panel which over its 25 years used several different national frames
- It was reasoned that the amount of noncoverage in the PFS design was negligible (likely close to zero)
- The evaluation team reasoned that the amount of coverage error that the PFS frame may have contributed to its survey's findings was very likely close to zero.

ABS and PFS Response Rates

Rate	2022 ABS NHTS	2022 PFS NHTS
AAPOR RR3	11.8%	1.9%
AAPOR COOP	12.5%	43.6%

ABS Nonresponse and Related Error

- The ABS responding sample differed from the nonresponding sample by being more likely to live in zipcodes that were:
 - less heavily populated by African Americans and Hispanics
 - less likely to be populated by those with low educational attainment
 - more likely to be populated by those with higher-SES
 - less likely to have households without vehicles
 - more likely to have residents complete the 2020 Census via the Internet.
- There were numerous meaningfully significant differences between the ABS-responding final sample and the parameters for the NHTS's target population.
- Overall, most of these differences show that the final ABS sample very likely under-represented the proportion of lower-SES households in the target population.

PFS Nonresponse and Related Error

- The PFS responding sample differed from the nonresponding sample by being more likely to live in zipcodes that were:
 - less heavily populated by African Americans and Hispanics
 - less likely to be populated by those with low educational attainment
 - more likely to be populated by those with higher-SES
 - less likely to have residents complete the 2020 Census via the Internet.
- The final PFS sample underrepresented the proportion of lower-SES households in the target population.
- However, the extent of the underrepresentation in the PFS-responding final sample was less than in the ABS-responding final sample.

Respondent-related Measurement and Related Error

- As with any panel-frame-based survey, the data that were produced by the usage of panelists in the 2022 PFS survey may have been affected by a form of respondent-related measurement error, termed “panel conditioning” (i.e., effects that affect the data quality among some long-term panelists).
 - However, this remains uncertain, as it was outside the scope of the evaluation to investigate the presence of panel conditioning in the survey contractor’s panel.
 - These possible respondent-related measurement error effects do not apply to the cross-sectional (one-time) ABS survey.

Summary

- There were very few observed statistical differences between core attributes in the NHTS 2022 ABS and PFS surveys that were judged to be “meaningfully” different
- These might be explained by the differential methods and statistics that were identified as being used in each survey that were associated with:
 - Coverage Differences
 - Sampling Design Differences
 - Nonresponse Differences
 - Weighting Differences
 - Respondent-related Measurement Differences

Conclusion

- Using a *Total Survey Quality* (Lyberg and Biemer, 2002) perspective, the evaluation team concluded that in comparison to the 2022 ABS NHTS (which produced the official statistics for residential travel in the United States for 2022), had the official statistics for the 2022 NHTS been generated via use of the 2022 PFS NHTS, there essentially would have been no important differences in results.
- Both of the 2022 NHTS designs were judged to be “Fit for Purpose” in yielding high-quality national residential travel statistics.



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