Implementing a Mixed-Mode Design for Collecting Administrative Records: Striking a Balance between Quality and Burden

1. Introduction

While administrative records are not new to the field of survey research, relatively limited research has been conducted on the methods for collecting them because they are primarily kept and used by the same entity. Many government agencies that utilize administrative records are also the keeper of those records and have full access and control, i.e. records associated with participation in federal programs. This paper explores an example where the records user and keeper are separate entities, so the user must collect the administrative records, similar to conducting a traditional survey. The "keeper" of the records for the survey analyzed in this paper is a heterogeneous population of non-government establishments. This paper will specifically focus on decisions made before field work about the data collection mode. The survey uses a non-traditional self-administered mixed-mode approach, allowing respondents to self-select their response mode. This paper explores the effect of mode on the administrative record data obtained. Do the response modes have differing levels of data quality? Why did respondents choose to report in one mode as opposed to another? What implications does this have for decisions about the data collection of administrative records in the future?

Administrative records are increasingly becoming relevant as they are seen as opportunities to reduce burden and lower survey costs. Many federal statistical agencies, including the Census Bureau and the Bureau of Labor Statistics, have invested extensive resources for developing ways to utilize administrative records to enhance, replace, or evaluate survey data. The Census Bureau, in their Long Range Research Plan for Administrative Records (1999), specifically cites decreased funding for federal programs and increased public resistance or reluctance to surveys as motivations for increasing reliance on administrative records for data collection, estimation, and evaluation. The National Academy of Sciences' Committee on National Statistics (2012), commissioned by EIA to assess its programs, recently released a report with recommendations to expand administrative records for uses such as developing sampling frames and decreasing respondent burden. In addition, administrative records may be used as a substitute for survey data when the latter is insufficient, unreliable, or inadequate. But administrative records, like survey data, have their drawbacks; namely, susceptibility to coverage, response, and processing errors (Lyberg and Kasprzyk, 1991). The applicability and magnitude of these errors are largely affected by the keeper of the records; more specifically, their purpose in obtaining the records, the alignment of that purpose to survey goals, and their resources. The keeper of the records has domain over the quality of the records, as it pertains to updating, coding, recording, processing, and checking (Lyberg and Kasprzyk, 1991).

When the user and keeper are separate, such as the example used in this paper, the user can only control factors which pertain to the collection of the data from the keeper and data processing. The user controls the mode and method of collecting the administrative records, the variables and records requested, the method and effort of mapping constructs, the timing of the request, and post-collection and processing

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quality control. Decisions about mode in traditional surveys can result in differences in response rates, and even survey results (Lyberg and Kasprzyk, 1991). The Federal Committee on Statistical Methodology (2001) cites several considerations when deciding the mode of data collection: survey goals and purpose, funding, questionnaire content, respondent characteristics, expected response rates, length of field period, and the expected precision of measurements. An exhaustive discussion about the relevance of these factors to the collection of administrative records is beyond the scope of this paper. In short, many concerns that arise in using self-administered questionnaires (SAQ) vs. in-person interviews, such as the advantages of interviewer probes or interviewer control over the instrument, are less relevant to the collection of administrative records. In addition, allowing for a mixed-mode approach has the potential for increased response rates, opportunities for cost savings, and increased respondent perception of survey legitimacy (Dillman, 2000). But does the mixed-mode approach affect the quality of the administrative records?

With the increase in administrative records use, the data collection methods for collecting administrative records deserve more research. Many government agencies invest in and make use of in-house administrative record keeping systems; but in addition, non-government entities maintain useful administrative records as well. Limiting administrative records usage to only those in-house minimizes the potential of administrative records to complement survey data.

2. Data

The Residential Energy Consumption Survey (RECS) is a national area probability survey of occupied housing units periodically conducted by the U.S. Energy Information Administration (EIA) to measure energy-related characteristics, consumption, and expenditures in U.S. homes. Trained interviewers visit sampled housing units and collect data from adult respondents about features of the housing unit, household characteristics, and energy sources and uses. As a part of this visit, the interviewer also records the names of the energy suppliers of the housing unit (for all suppliers of electricity, natural gas, propane, fuel oil, and kerosene), and ideally scans a recent bill from each one.

During a follow-on survey, the Energy Supplier Survey (ESS), consumption and expenditures data are collected from the energy suppliers of the sampled housing units. The ESS uses a network sample design, where the frame of energy companies is assembled from information collected during the household interviews. Energy billing data are collected from the energy supplier because households have difficulty reporting 20 months of energy data. For example, in 2009 only 53% of respondents were able to produce an energy bill during the household interview. Furthermore, many of these bills did not include all data items collected by the ESS.

Like many of EIA's surveys of energy companies, the ESS is a mandatory data collection. Historically, the ESS has used a mail SAQ. The survey forms required companies to report usage and cost for each of the housing units for the year covered by the household interview, plus a short period of time before and after. After ESS data collection, the consumption and expenditures data were combined with the household characteristics data in a statistical model that estimates energy usage and cost for space heating, water heating, air conditioning, and other end-uses. These end-use estimates are the most important product for RECS data users, and necessitate special attention to the quality and collection of ESS data.

EIA must consider characteristics of the administrative record systems when planning ESS data collection procedures. Energy companies maintain records for the purpose of customer accounting and billing. Although there may be commonalities across companies, the records of each company are separately structured and feature unique data items. The primary data items requested by the ESS (date of billing period or delivery, consumption, and expenditures) may or may not be easily available from the records of each responding company.

The 2009 RECS collected data from 12,083 households, more than twice the largest sample size to date. To prepare for the increased size of the ESS, EIA conducted cognitive interviews with previous and potential ESS respondents, who indicated internet data collection would be preferred because of its convenience. EIA opted to construct a website for the 2009 ESS data collection, with the goals of reducing costs and burden by facilitating electronic submission of a large number of records, as well as improving the quality of the data.

3. Methods

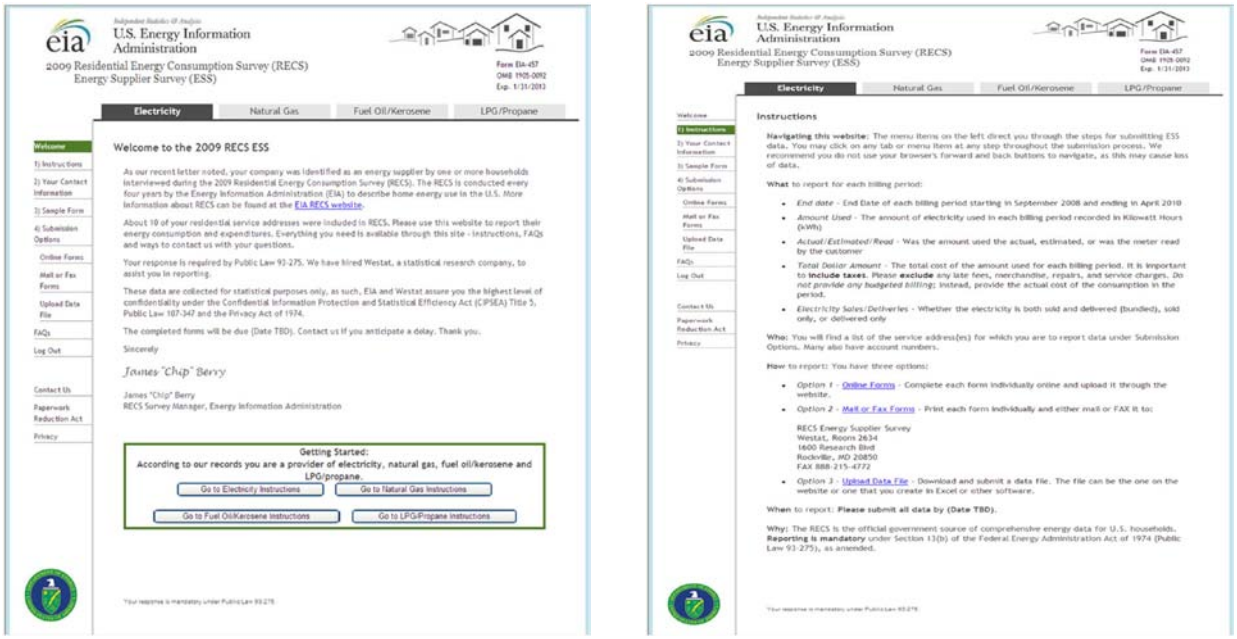
3.1 Field procedures

As suggested by Dillman (2000), pre-telephone contacts with heterogeneous establishment populations are critical for finding the "right person" to complete the survey request. For this reason, the ESS data collection protocol included first calling companies to introduce the survey and locate the appropriate respondent. This task took more than an hour per company to complete, but was necessary for a high response rate. After successful phone contact was made, follow-up information about how to access the ESS data collection website, including the URL, User ID, and temporary password, was sent via Federal Express.

Once a respondent logged in to the secure ESS website, the welcome screen on the left in Figure 1 was presented to all companies. Figure 1 shows the functionality and navigation of the website. The welcome screen included a letter from EIA's survey manager followed by buttons linked to the applicable instructions for the energy source(s) provided by each company. Respondents could also use the navigation bar on the left-side of the screen to view the instructions, edit their contact information, view a sample form, and access the response mode options.

The instructions page on the right in Figure 1 provided information about navigating the ESS website, the data items the ESS survey required, the deadline for completing the ESS, and presented and explained the response mode options. A variety of follow-up contacts were made via phone call and email at scheduled intervals during the data collection period to ensure respondents had received the mailing, accessed the ESS website, and understood the survey request and the response mode options. Additionally, contact information for both EIA and the data collection contractor were available to all respondents, and many took advantage of this by calling or emailing with their questions or concerns.

Figure 1. 2009 RECS ESS website welcome screen (left) and electricity instructions (right)



Electricity and natural gas companies, which typically are large, highly integrated, and cover large service areas, had an average data request of 41 cases. In contrast, propane, fuel oil, and kerosene companies, which typically are small independent retail operations, had an average data request of two cases. Because of these differences in company size and organization, electricity and natural gas companies were offered three response mode options: paper forms, online forms, or to upload a populated Excel template, while propane, fuel oil, and kerosene companies were only offered paper forms and online forms. Although there are necessary differences in the survey forms by fuel (for example, the units of measurement), the forms are similarly formatted and collect mostly the same data items. Data items were requested for 20 months from September 2008 to April 2010. For each billing period or delivery, three primary data items were requested: end date or delivery date, amount used, and total dollar amount (including taxes). In addition to these primary data items, additional information was collected about each billing period or delivery: whether the amount used was the actual, estimated, or reported amount, whether the energy source was sold only, delivered only, or both sold and delivered, and what units the amount used were reported in (for natural gas and propane).

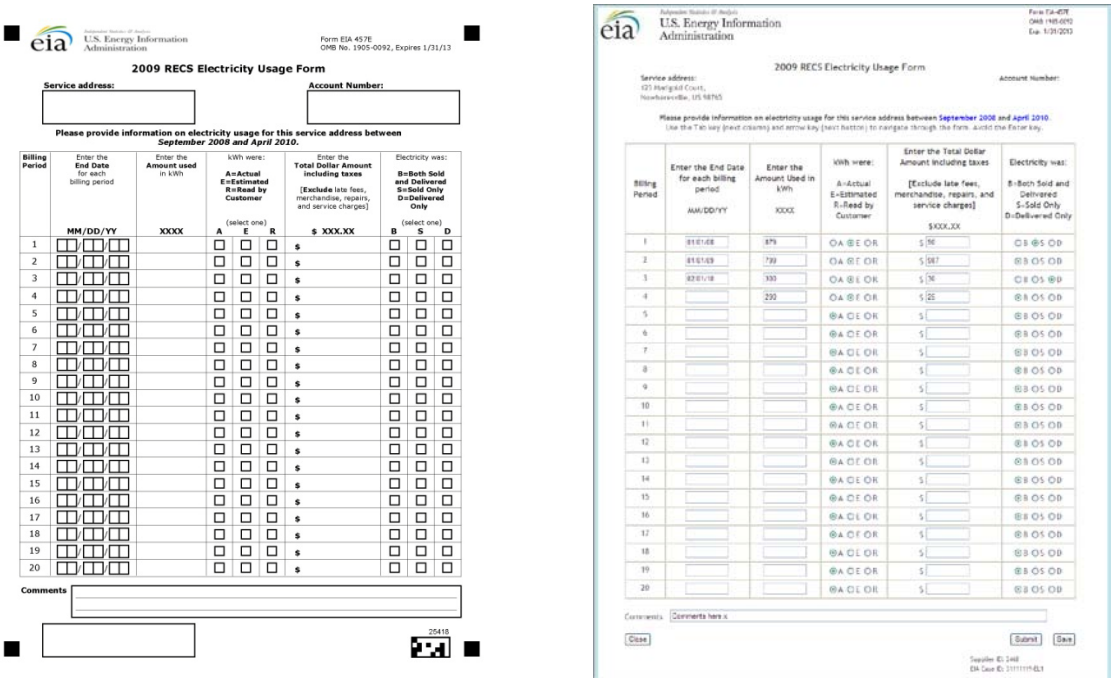
3.2 Paper form

With few updates, the 2009 paper form closely resembled the paper forms used in earlier ESS cycles. One form was required to be submitted for each requested case. Through the ESS website, respondents were able to view an online list of addresses and account numbers (if available) for all of their cases, and could click on each address to print a paper form pre-filled with that case's information. Companies could mail or fax the completed forms.

3.3 Online form

EIA designed the online fillable form to closely resemble the paper form, although a few changes were made to accommodate the web collection (for example, radio buttons were used in the place of check boxes). As with the paper form, one form was required for each case. The online form had a limited number of instrument edits, such as requiring data entered in date fields to be formatted as a date. The online forms were pre-filled with the address and account number (if available). Once a respondent viewed an online form, they could choose to either *submit* at that point in time, or *save* for later before submitting. Even if an online form had been submitted for a particular case, respondents were allowed to return to the online form to view or make changes at any time during the data collection period.

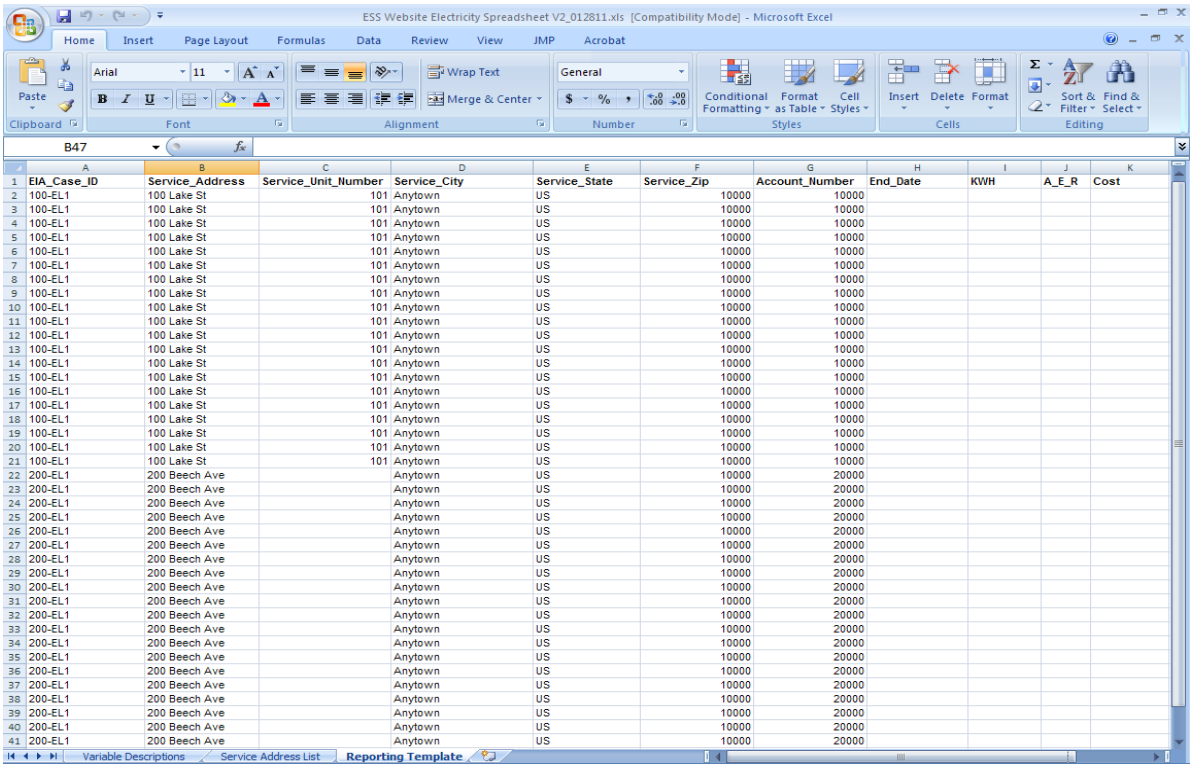
Figure 2. 2009 RECS ESS electricity paper form (left) and online form (right)



3.4 Excel template

In addition to the two modes described above, electricity and natural gas companies were allowed to download an Excel template, populate it, and then upload and submit it online. Additionally, companies could submit other electronic files using this interface as well. The Excel template provided by EIA included three tabs: variable descriptions of the data items needed for each case, a list of the cases' addresses and account numbers (if available), and a reporting template with 20 rows for each case's data and columns for each required data item.

Figure 3. 2009 RECS ESS electricity Excel template



EIA_Case_ID	Service_Address	Service_Unit_Number	Service_City	Service_State	Service_Zip	Account_Number	End_Date	KWH	A_E_R	Cost
100-EL1	100 Lake St	101	Anytown	US	10000	10000				
200-EL1	200 Beech Ave		Anytown	US	10000	20000				

3.5 Post-data collection editing

Submitted data was reviewed by EIA and its data collection contractor to ensure data quality. To identify cases that needed manual review, edit programs flagged cases with missing data, outliers, inconsistent data patterns, or respondent comments. For each ESS case that was flagged, an edit report was generated which listed all edit failures and comments. Editors used a variety of tools in reviewing cases: ESS respondent comments, scanned bills collected during the household interview, and data from the household survey including main heating fuel, square footage of the housing unit, geographic location, and household respondent comments. After reviewing the submitted data, edit failures, and all appropriate editing tools for each case, editors determined whether any data changes were necessary.

3.6 Response rate and mode selection

The response rate was 90% for the 2009 ESS, a significant increase from 80% in 2005. In addition to the new data collection method and response mode options, the increased response rate may have been related to data collection effort, as well as exogenous factors like changes in the energy industry and the way energy companies interact with government agencies.

As expected, most companies chose the new web response modes. Table 1 shows the number and percent of ESS companies and cases by response mode. While online forms were the most common response mode for companies, they were only used for submitting about one-third of all cases. In contrast, about half of all ESS cases were submitted by Excel template, although only one-eighth of all companies used this mode. While not explicitly offered to companies, 7% of cases were submitted by other electronic files

(such as PDF files) or non-standard printouts. Due to the significant use of these non-standard modes, they are included in subsequent analyses.

Table 1. Number and percent of ESS companies and cases by response mode

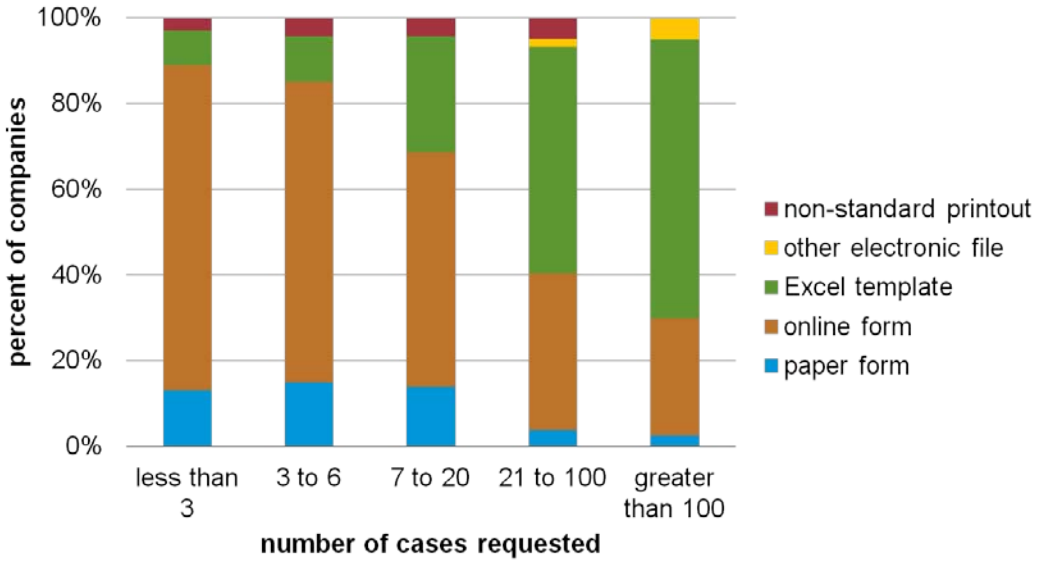
mode	ESS companies		ESS cases	
	n	%	n	%
paper form	257	21	965	5
online form	771	63	6,701	38
Excel template	149	12	8,762	49
other electronic file	5	0	599	3
non-standard printout	37	3	721	4
other	8	1	22	0
total	1,227	100	17,770	100

4. Results

4.1 Factors in mode selection

Table 1 suggests an association between the number of cases requested and a company's choice of mode, as evidenced by 12% of companies submitting 49% of cases via Excel template. Figure 4 shows the relationship between the number of cases requested, henceforth referred to as "size", and the mode chosen by the respondent. Categories were constructed roughly based on the size distribution among companies. The figure shows that a company with a larger number of administrative records requested is more likely to use a mode that will allow them to report in batches, while a company with fewer records requested is more likely to pick a mode where cases are reported individually. The largest companies, those with greater than 100 cases, most often reported via the Excel template with 65%; while only 8% of the smallest companies, those with less than 3 records, reported via the Excel template. The smallest companies reported mostly via the online form with76%, while the largest companies only used this mode 28% of the time. This preference among larger reporters towards electronic batch reporting carried over to the non-standard modes as well, with larger companies more likely to submit other electronic files and smaller companies more likely to submit printouts.

Figure 4. Response mode selected by number of cases requested



The comparison of respondent "access", characterized by the job title of the respondent, and mode yielded a much weaker relationship. Mode and access were hypothesized to be related because each response mode requires different resources to be utilized to complete the task. Two underlying assumptions of this analysis are 1) that the person whose job title was provided was the person who actually reported the data and 2) that the reporter of the data decided which response mode to use.

Respondents who identified themselves as "managers" mostly chose to use the online form at 65%, followed by the Excel template at 26%, and the paper form at 8%. The "manager" category may be more likely to violate assumption one above as they may delegate the task to a secondary respondent. Respondents who identified themselves as "analysts" overwhelmingly used the Excel template at 83%, the online form at 9%, and the paper form at 1%. Out of all the job title categories, they had the strongest preference to a particular mode. The other categories examined: administrative assistant, billing/customer service, and subject matter specialist were comparably distributed among modes, with larger percentages of each choosing the Excel template, followed by the online form and paper form.

It's important to note that access could also interact with size, for example, a company with fewer employees is probably less likely to have a team of analysts. Additionally, there may be other confounding variables, such as the format of the company's records. The format of a company's records may vary depending on the size of the company, while the format of the records may also play a role in the mode the respondent chooses. Since respondents were able to self-select mode, the observed relationship between size and chosen mode suggest a strong preferential relationship, but not necessarily causation. A randomized assignment with controls would be better suited to make such an inference.

4.2 Data quality evaluation

Data quality can be evaluated by: 1) the completeness of the data, in terms of unit and item non-response; and 2) the correctness of the data, in terms of the share of cases with detectable and correctable errors.

Figure 5 shows that unit non-response (companies with less than 100% of requested cases submitted) was most prevalent in the other electronic file and Excel template modes. However, the opposite is true for companies with less than 75% of requested cases submitted: respondents who batch-reported almost always submitted most of their cases. In other words, batch-reporting companies generally submitted the vast majority of their cases, but not all. Companies who batch-report tend to be larger and therefore: 1) have larger data requests making it more likely to "miss" cases, and 2) may be less likely to search manually for records, or check for missing records, if electronic processes did not extract them from the database.

Figure 5. Company-level unit response rate by response mode

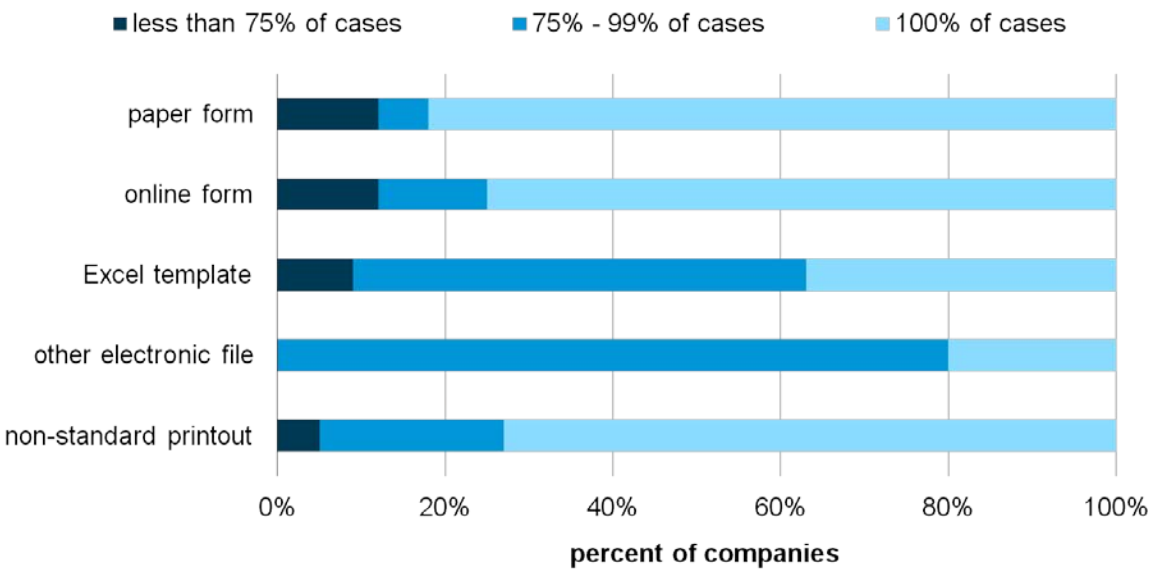


Figure 6 shows clear differences in item non-response between companies who used standard (or offered) modes: the paper form, online form, and Excel template; and non-standard modes: the other electronic file and non-standard printout. Those using non-standard modes most often submitted cases with partial data, whereas the rate of partial data for the standard modes was much lower. Partial data cases, as defined in this analysis, have missing billing records or months of data. These holes in the data make it more difficult to annualize the monthly billing records to produce yearly estimates. Those who submitted in standard modes were much better at sending the full data requested for each case. This is a likely result since the standard modes were clearly formatted for reporting 20 months of billing/delivery data. Those submitting in standard modes conformed to the requested data modes, and therefore the formats, whereas those submitting in the non-standard modes conformed to neither.

Post-data collection edits flagged slightly more than half of the cases submitted in the paper form, online form, and Excel template. In contrast, the other electronic file submissions were least likely to be flagged with 38%. To dissect the large number of flagged cases, the edit failure rate for each mode was categorically evaluated by the size of the submission: less than 3 cases, 3 to 6, 7 to 20, 21 to 100, and greater than 100.

Figure 6. Percent of cases with partial data by response mode

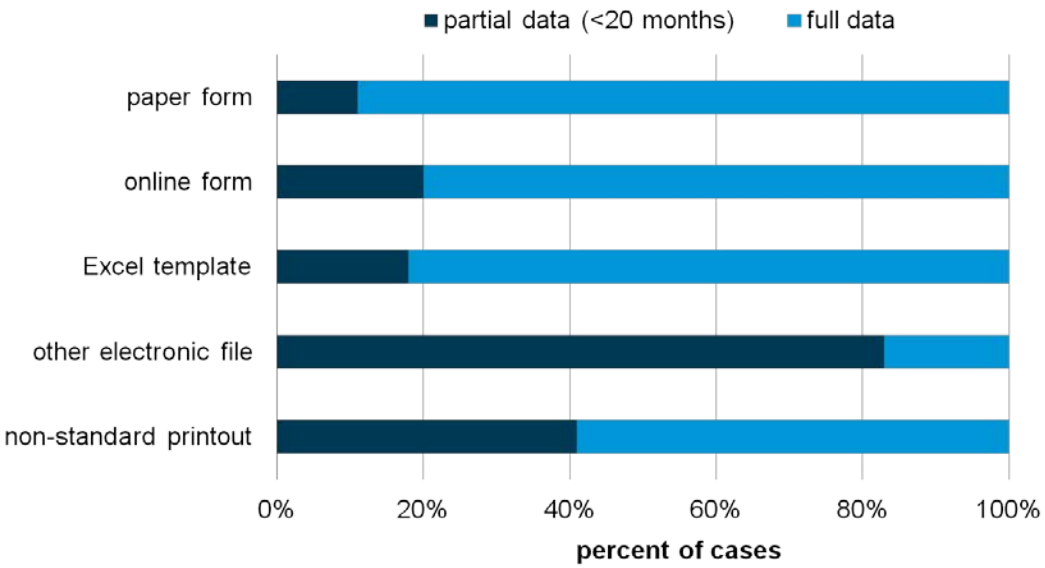


Table 2 shows the percent of cases with edit failures by response mode and size category. For companies with 20 cases or fewer, the online form had the lowest edit failure rates of all modes, and the companies with only one or two cases performed the best. The largest edit failure rate occurred when the largest companies (greater than 100 cases) submitted via the online form, inflating the percentage of cases submitted via the online form that failed edits. Cases submitted via the Excel template had a fairly consistent edit failure rate across size categories. The paper form did as well, with the exception of the largest companies, who had a far lower edit failure rate when submitting in this mode. The non-standard modes had variable non-patterned edit failure rates across size categories.

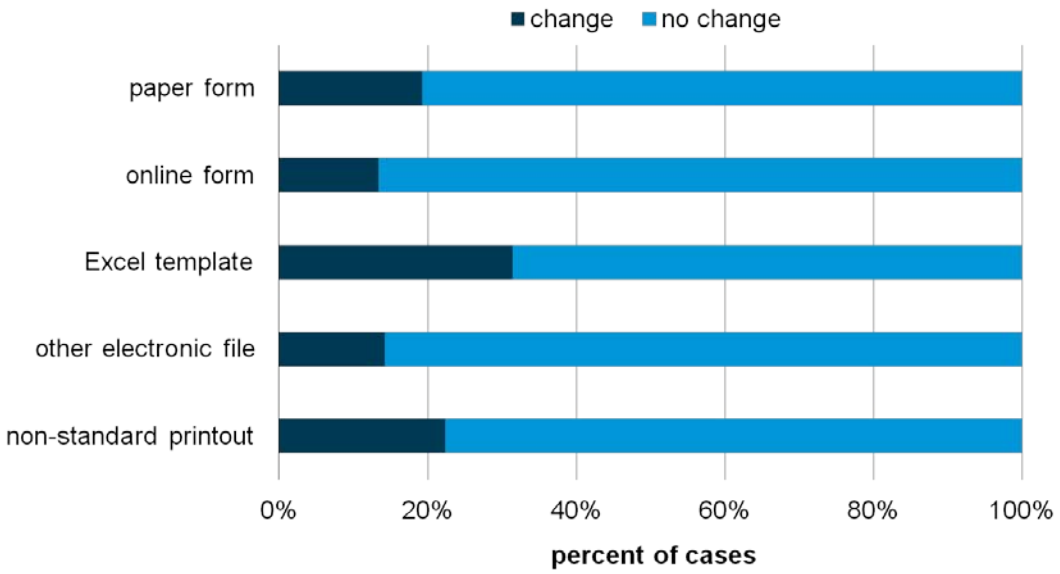
Table 2. Percent of cases with edit failures by response mode and size of data request

	paper form	online form	Excel template	other elec. file	non-standard printout
less than 3	59	35	S	S	S
3 to 6	56	46	54	S	S
7 to 20	69	46	54	S	49
21 to 100	56	48	46	S	70
greater than 100	37	73	54	33	34

S = suppressed because less than 75 cases in category or less than 5 companies

For a more pointed assessment of the quality of the data, the number of changes to case data was compared by mode. The changes in this discussion reference changes made during the editing phase, not those resulting from annualization or item imputation. The cases submitted via the Excel template were the most error-prone, requiring more data changes than any other response mode. Corrections were made to 31% of cases submitted via the Excel template. The cases submitted via the online form were the least error-prone, with only 14% needing changes. Paper forms were fairly clean as well, needing changes to about 19% of cases. Figure 7 shows the percentage of cases with data changes by mode.

Figure 7. Percent of cases with data changes by response mode



While the online and paper forms had large edit failure rates, they had low data change rates, indicating a high rate of false positive edit failures for those two modes. The large quantity of false positives could have been triggered by a number of causes, e.g. a company that leaves extraneous comments for each case, resulting in an increase in processing time with no changes to the data.

An evaluation of changes by the same size categories as before shows that Excel template submissions were the most error-prone of the standard modes in all size categories. Online forms were the cleanest in almost all of the size categories, likely in part due to the built-in instrument edits. Paper forms were somewhere in between, generally dirtier than the online forms but cleaner than the Excel templates. Other electronic files submitted by the largest companies were fairly clean, but required extra effort in mapping constructs and formatting.

Across the modes, companies submitting 6 or fewer cases required the least data changes, with the smallest submissions having the cleanest cases. Respondents with fewer records to report may be overall less likely to make mistakes when entering data and more likely to check their work.

Table 3. Percent of cases with data changes by response mode and size of data request

	paper form	online form	Excel template	other elec. file	non-standard printout
less than 3	17	7	S	S	S
3 to 6	17	11	23	S	S
7 to 20	28	10	39	S	41
21 to 100	18	19	34	S	36
greater than 100	15	14	30	7	15

S = suppressed because less than 75 cases in category or less than 5 companies

5. Conclusion

These results suggest that compared to the paper forms, the online forms did not sacrifice quality and showed slight improvement, but the Excel templates performed less effectively. Cases submitted via the online form were fairly complete and the least error-prone of all response modes. In contrast, cases submitted via the Excel template had higher unit non-response and were the most error-prone, as evidenced by changes to 31% of cases during post-data collection editing. The paper form, traditionally used for ESS data collection, fell between the other standard modes but had the lowest item non-response and a similarly high level of correctness as the online forms. Data collected in the non-standard modes were generally of lower quality, with a particularly high rate of item non-response.

Overall, the 2009 RECS ESS had a higher response rate than previous survey cycles, which suggests internet data collection and the choice of response modes were attractive to companies. However, differences in field procedures and non-response follow-up could have also contributed to the improved response rate. The new data collection method implemented was largely successful, although there are some clear opportunities for improvement. Due to the high data quality of their submissions, the paper forms and online forms are obvious response modes to offer companies in the future. While the Excel template submissions did have lower levels of completeness and correctness, it is likely this mode will have to be offered for future ESS data collections to manage burden. Although the RECS ESS is a mandatory survey, EIA is aware of the burden placed on the handful of companies with the largest number of cases requested.

Two potential changes may be implemented in order to improve the quality of the Excel template submissions. First, companies uploading an Excel template could answer a few key questions, e.g. “Do the costs submitted include taxes?” If respondents are able to accurately answer these questions, it would help to identify data quality issues that affected all cases within the spreadsheet. Second, the Excel templates could be reviewed (either manually or electronically) as soon as possible after submission to

examine whether all requested cases were submitted. If any cases are missing, the company could then be automatically prompted or re-contacted, reducing unit non-response.

The observed interactions between company size, mode, and data quality indicate that steering or recommending companies to respond via a specific mode may lead to overall improved data quality. For example, a personalized statement on the instruction page could inform a respondent that "The online forms are recommended for companies of your size."

The examination of the ESS post-data collection editing process as a part of this research indicates two possible areas for improvement: revising the editing process to identify fewer "false positives", and exploring the possibility of tailoring the edits to each response mode. About half of all cases failed at least one post-data collection edit and required manual review, but most of the cases reviewed required no data changes. A review of each edit and the number of changes it affected may allow for streamlining of the edit specifications to focus on only those edits that are closely correlated with actual data errors.

The "completeness" and "correctness" of administrative record data collections are similar to "coverage error" and "measurement error", common concerns in survey research. As evidenced in this research, Federal agencies that endeavor to use administrative records to supplement, complement, or replace survey data should keep in mind that they are not error-free and conduct quality assessments of the data when possible. A comprehensive understanding of the record system and the role of the keeper of the records is needed to ensure administrative record data is used appropriately. Planners of administrative record data collections that, like the ESS, place most of the burden on the keeper of the records to provide the data should be aware of the possibility of issues with completeness and correctness, and consider them when designing their data collection approach and selecting a response mode.

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