1SUPPORTING STATEMENT
UNITED STATES INTERNATIONAL TRADE COMMISSION QUESTIONNAIRE
Used Electronic Products: An Examination of U.S. Exports

Part B—Collection of Information Employing Statistical Methods

## 1. Response universe, sample sources, and sampling strata

The potential respondent universe includes all companies that conduct business in the United States and have primary NAICS categories corresponding to industries that USITC staff and industry experts identified as containing the highest concentration of firms that handle and export used electronic products. The sampling unit is the firm, rather than the establishment.

The potential respondent universe represents the sum of firms, net of duplicative records, identified in these data sources:

- A database derived from industry associations and industry directories, including
  - Members of industry associations, members of certified electronic recycling programs, and subscribers to industry publications and newsletters
  - Companies in recycling and refurbishing directories maintained by third parties
  - Companies in local, state, and federal government directories (e.g., companies approved by the EPA to export cathode-ray tubes)
  - Companies reporting sales of used electronics in online markets

- Exporters of electronics goods with low unit values identified by the U.S. Census Bureau.

- Firms obtained from Bureau van Dijk's Orbis database belonging to seven industries most likely to handle and export used electronic products.[1] These industries include:
  - Waste management and remediation (NAICS 562)
  - Smelting of nonferrous materials (selected industries in NAICS 3314)
  - Electronics manufacturing (selected industries in NAICS 333 and 334)
  - Wholesaling and brokering of electronics and of recyclable materials (selected industries in NAICS 423)
  - Repair and refurbishing of electronics products (selected industries in NAICS 811)
  - Other services (selected industries in NAICS 541, 561, 624, and 813). Because of the breadth of these industries and the limited number of relevant firms in them, a keyword search was used to identify relevant firms, such as companies that dispose of IT assets or charitable organizations that send used computers abroad.

The firms identified in Orbis are thought to be less likely engaged in used electronics activities than firms identified through industry associations and Census, but will nevertheless enable the USITC to capture responses from a greater number of firms potentially exporting used electronic products.

[1] Orbis is a proprietary global database with information on public and private companies.

Firms are stratified along three dimensions: (1) data source, (2) industry, and (3) size.

1. The data source is either the industry association list, the Census list, or the Orbis-based list, as given above. Stratifying by source is used to reflect the higher incidence of used electronics exporters in the Census and industry association lists than in the Orbis list.

2. Industries include the six sectors given above, such as waste management and remediation, smelting of nonferrous metals, and electronics manufacturing.

3. Size is defined by employment. Although the main variable of interest is exports, there are no firm-level export data available prior to sampling. Employment is the most available measure of firm size in the Orbis data and is known to be highly correlated with exports.
    a. The smallest firms in each stratum are not sampled to reduce respondent burden and to improve the statistical properties of the remaining estimates.[2]
    b. Small firms are defined as firms with fewer than 100 employees
    c. Large firms are defined as firms with 100 or more employees.
    d. Two industries had very heterogeneous large firms, so a separate stratum for very large firms with more than 1,000 employees was introduced in the electronics manufacturing and "other services" sectors.

Table 1 presents the number of firms in each stratum and the sample size, selected following the methodology described below.

Table 1 does not include the population or sample size for firms on the Census list. The Census Bureau has determined that the release of confidential firm-level export data for use in this study is in the national interest. They will provide data on firms that export products with low unit values in HTS chapters 84 and 85. These HTS codes include the majority of electronics products relevant to this study. Because the data are not yet available to staff at the USITC, they have not been included in the total number of firms in the population or sample in table 1. If the Census list become available in time, the USITC will include 300 of these firms in the sample. The industry distribution of firms on this list is not known, but these firms are unlikely to come from the waste management or smelting industries, which generally do not export products in chapters 84 and 85.

[2] In all industries except manufacturing, the smallest firms are defined as those with fewer than 10 employees. In manufacturing, the cutoff varied by NAICS 6-digit industry, and ranged from 10 to 50 employees. The manufacturing cutoffs were higher because small firms account for a much smaller share of employment and revenue in manufacturing than in the other industries in our sample, according to Orbis data. One caveat: firm size is not known for all firms in the industry association list, so sampling some very small firms from this list will be unavoidable.

**TABLE 1** Used electronics: Number of firms in the population and in the sample, excluding firms from the Census list.

| | Number of firms in the population | | | | | | | Number of firms in the sample | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | From Orbis | | | Industry list | | | | From Orbis | | | Industry list | | | |
| Industry | Small | Large | Very large | Small | Large | Very large | Total | Small | Large | Very large | Small | Large | Very large | Total |
| Waste management | 4,060 | 233 | —[a] | 309 | 23 | —[a] | 4,625 | 406 | 233 | —[a] | 93 | 23 | —[a] | 755 |
| Smelting of nonferrous metals | 141 | 35 | —[a] | 21 | 7 | —[a] | 204 | 20 | 35 | —[a] | 20 | 7 | —[a] | 82 |
| Electronics manufacturing | 2,207 | 838 | 161 | 82 | 16 | 44 | 3,348 | 279 | 838 | 161 | 31 | 16 | 44 | 1,369 |
| Electronics wholesaling and brokering | 10,375 | 694 | —[a] | 323 | 73 | —[a] | 11,465 | 981 | 694 | —[a] | 130 | 73 | —[a] | 1,878 |
| Electronics repair and refurbishing | 2,212 | 96 | —[a] | 209 | 18 | —[a] | 2,535 | 192 | 96 | —[a] | 40 | 18 | —[a] | 346 |
| Other services | 436 | 384 | 81 | 379 | 38 | 83 | 1,401 | 59 | 384 | 81 | 125 | 38 | 83 | 770 |
| Total | 19,431 | 2,280 | 242 | 1,323 | 175 | 127 | 23,578 | 1,936 | 2,280 | 242 | 437 | 175 | 127 | 5,200 |

*Note:* All figures subject to revision.

[a]Not all sectors required a separate stratum for very large firms.

Since this is the first large-scale survey of used electronics exports,[3] and no definitive list of all relevant firms exists, some coverage error is unavoidable. In particular, the industries in which used electronics exporters reside cannot be known with certainty in advance. This error has been minimized by incorporating an industry association list that combines the most complete industry lists available. In addition, USITC staff looked up the primary NAICS classification in the Orbis database for several thousand companies on the industry association list. A tabulation of these industries was used to select the most appropriate 6-digit NAICS industries in the Orbis-based frames.

The sample size of 5,500 is the number of surveys that will be sent out and is based on what is needed for a statistically significant response, given historical response rates. Based on results of similar past surveys, we expect the response rate to range from 45–60 percent, which would result in 2,475–3,300 surveys received from the sampled companies. Responses in previous and ongoing USITC surveys have not differed significantly by firm size or data source, and no information exists to predict differences in response rates across these particular industries. Thus a uniform response rate has been assumed for all strata.

## 2. Collection of information employing statistical methods

### a. Statistical methodology for stratification and sample selection

A stratified sample based on a simple stratification process is being implemented for this project. The goal of the stratification scheme is to develop a set of strata such that the variance of responses (such as level of employment, type of activities, and likelihood of exporting used electronics) within each stratum is minimized to the extent possible. Stratification is also being used to include rare observations. Because no pro-forma reliable data exist on the size and scope of the used electronics sector, the stratification scheme was based on the best judgment of industry and USITC experts.

The approach to stratification in this survey is based on a two-part procedure designed to maximize efficiency of the resulting estimates, and hence reduce the total number of firms sampled. First, firms identified by the Orbis database are optimally allocated across size and industry strata based on the standard deviation of employment within each strata. Second, oversampling is used to allocate firms identified by the industry association list, to reflect the higher expected prevalence of used electronics exporters in this list. For each industry, a higher sampling fraction is chosen for firms from the industry association list than from the Orbis database. These procedures are discussed in more detail below. As this procedure involves two sets of constraints, the procedure is iterated until all constraints are satisfied and the number of firms sampled from each source (Orbis and the industry association list) sums to the desired total, in this case 5,200. Including the Census exporter list, if it becomes available in time, will add an additional 300 firms, for a total of 5,500.

1.

[3] The largest used electronics survey to date was performed in 2011 for the Institute of Scrap Recycling Industries. That survey included 182 U.S. organizations, all in the recycling industry. See Daoud, 2011, "Inside the U.S. electronics recycling industry," International Data Corporation, http://ewasteguide.info/files/IDC_2011_ISRIl.pdf.

1. Orbis-based strata: In these strata, the Neyman method is used to allocate the share of the total allocated to each strata, based on weighted standard deviations. Strata with larger variance in employment (i.e. the more heterogeneous strata) will therefore be oversampled. Because of high standard deviations, some strata are sampled at 100%. In two industries, the optimal allocation to the large firm strata substantially exceeded the number of available firms, so separate "very large" strata were introduced.

2. Industry-association list-based strata: Selection rates in these strata were based on disproportionate sampling procedures for rare populations. Table 2 presents the estimated share of firms that handle used electronics in each industry for both the Orbis and industry association list, and the resulting relative sampling rates as suggested by Christman (2009) and Kalton (2009).[4] As some of these frames have relatively few firms, we will handle nonresponse through post-stratification adjustment, and where possible, we have included at least 20 firms per frame in the sample.

3. Census list: Firms from the Census list will be chosen using the same methodology as those on the industry association list, as shown in table 2. If there are relatively few additional firms on the Census list, and these rates imply fewer than 300 firms, then the total survey sample size will be between 5,200 and 5,500. With a large number of additional firms in the Census list, these sampling rates may imply more than 300 firms. In this case, the minimum size cutoff of firms will be raised to limit the number of firms from this list in the population, keeping the sample size from this list at 300 and the total sample size at 5,500.

**Table 2** Disproportionate sampling of firms in the industry association list

| | Share of industry that handles used electronics | | | Relative sampling rate | |
|---|---|---|---|---|---|
| Sector | Industry list | Census list | Orbis | Industry list/Orbis | Census list/Orbis |
| Waste management | 90 | —[a] | 10 | 3.0 | —[a] |
| Smelting of nonferrous metals | 90 | —[a] | 10 | 3.0 | —[a] |
| Electronics manufacturing | 90 | 100 | 10 | 3.0 | 3.2 |
| Electronics wholesaling and brokering | 90 | 100 | 5 | 4.2 | 4.5 |
| Electronics repair and refurbishing | 90 | 100 | 20 | 2.1 | 2.2 |
| Other services[a] | 90 | 100 | 15 | 2.5 | 2.6 |

[a]Not likely included in the Census list, which includes only firms that export under HTS chap. 84 and 85.
[b]In other services, the Orbis share reflects only those firms selected through the keyword search.

[4] Shares are based on USITC judgment of the likelihood of handling used electronics; the likelihood of exporting used electronics in each industry could not be estimated in advance. See Christman, Mary, 2009, "Sampling of rare populations," *Handbook of Statistics* vol. 29A, 112; and Kalton, Graham, 2009, "Methods for oversampling rare subpopulations in social surveys," *Survey Methodology* vol. 35 no. 2, 127.

## b. Estimation Procedure

Survey estimates will be based on weighted data. The weighting procedure will incorporate a sample selection weight, a nonresponse adjustment factor, and if necessary, a poststratification weighting factor.

- *Sample selection weighting*: Because the sampling rates are based on two criteria, as discussed above, the selection weight factor will account for both the probability of selection within a particular industry and size, and the oversampling of firms from the association list.
- *Nonresponse adjustment*: The nonresponse adjustment factor is designed to attenuate bias due to differential response rates. See the section below on response rates for further discussion.
- *Poststratification weighting*: If necessary, a poststratification weighting factor will be used to attenuate bias due to sample frame noncoverage or omissions. Although the best effort has been made to obtain a representative sample of used electronics exporters, this survey represents the first economy-wide survey of used electronics handling and exports, so the distribution of firms across industries cannot be known with certainty in advance.

In order to produce population estimates and precision statistics about the estimate, the following equations will be used:

The formula used to estimate the population attribute of interest is found in equation 1. The precision statistics about the estimate are found in equations 2-3. Per standard notation, the total estimate from a stratified random sample $\tau_{st}$ is given by

$$\tau_{st} = \sum_{h=1}^{L} N_h \overline{y}_h, \qquad (1)$$

where $h$ denotes an individual stratum, $N_h$ equals the population of stratum $h$, and $\overline{y}_h$ equals the average of the attribute of interest of the sampled items in stratum $h$. For example, $\overline{y}_h$ could represent the average amount of revenue within each stratum.

The variance estimate for sampling without replacement is given by

$$var(\tau_{st}) = \sum_{h=1}^{L} N_h (N_h - n_h ¿) \frac{s^2}{n_h} ¿ \qquad (2)$$

where $s^2$ equals the standard deviation of the attribute of interest within stratum $h$, and $n_h$ is the sample size for stratum $h$.

Its standard error is given by

$$\text{Standard error} = \sqrt{var(\tau_{st})} \qquad (3)$$

### c. Degree of accuracy needed for the purpose described in the justification

It is expected that it will be feasible to produce statistically significant results for the majority of survey items at the aggregate level at a 90 percent confidence level, both for the binary questions and for questions requiring responses in U.S. dollars. For example table 3 provides the maximum margin of error for a binary question, given alternative response rates. (These values are probably conservative, given that response rates to recent USITC surveys have ranged between 45 and 60 percent.) Note that this table is based on a sample size of 5,200; precision would increase if firms from the Census list are also included in the sample.

**Table 3** Margin of error for a 90% confidence interval[a]

| | Response Rates | | | |
|---|---|---|---|---|
| | 20% | 30% | 40% | 50% |
| Sample size | 1,040 | 1,560 | 2,080 | 2,600 |
| Standard error | 1.55% | 1.27% | 1.10% | 0.98% |
| Margin of error | 2.55% | 2.08% | 1.80% | 1.61% |

[a]Assuming the maximum margin of error of 50% for a binary question.

Given the sample size per stratum, it is assumed that it will also be feasible to distinguish the responses across the largest industries within a 90 percent confidence interval. This degree of confidence is sufficient for the purposes described in the justification.

### d. Unusual problems requiring specialized sampling procedures

No unusual problems were encountered.

### e. Any use of periodic (less frequent than annual) data collection cycles to reduce burden.

This data collection is currently only intended to occur once, and therefore will not be repeated on a periodic basis.

## 3. Methods to maximize response rates and deal with non-response

### a. Maximizing response rates

Commission staff will employ several techniques to increase the response rates of questionnaire recipient firms. Recipients will receive separate notices that (1) notify them that their firm was selected for the survey, (2) direct them to complete the survey, and (3) remind them, if necessary, to complete the survey before the deadline. Once the submission deadline has passed, firms that still have not responded will receive an additional reminder. Each of these communications will include a phone number and email address of a person who can help firms with filling out the questionnaire or answer their questions regarding the survey and/or study. Commission staff may

also contact firms directly, via phone or email, to urge them to complete the survey and to answer any questions they may have regarding this information collection or study in general. Commission staff may also contact firms, via phone or email, to correct information or fill in incomplete responses, or solicit additional information about a response. The burden associated with follow up calls or emails is included in the total response burden amount.

In addition to pre-contact and follow-up, the questionnaire itself has been designed to be clear and succinct as possible to gather the specific material requested by USTR. (See discussion of testing below.) This clarity and brevity should reduce burden and improve response rates. The questionnaire will clearly point out that firms are obligated by law to respond. Finally, the ability to access, fill out, and submit the survey electronically may also increase response.

**b. Accuracy and reliability of information collected**

The sample methodology has been designed to be as accurate and reliable as possible, based on Commission experience in past surveys. The sampling frame has been chosen to include firms in industries that are most directly involved in generating, processing, or selling used electronics, and hence are also the most reliable reporters of used electronics exports.

The size of firms include in the survey has also been carefully considered to improve accuracy and reliability. For each NAICS 6-digit industry included in the sampling frame, the Orbis data were used to ensure that the population included the large majority (generally over 90 percent) of total industry revenue.[5] Thus, the survey should capture nearly all exports, while excluding firms of the smallest size, for which a reliable population cannot be determined from the Orbis database.[6] On the other end of the size distribution, strata of very large firms were included when necessary to improve homogeneity of firms within strata, and hence to improve the reliability of resulting estimates.

Response rates in USITC surveys have recently been near 60%. The USITC will examine survey responses to detect and correct for any non-response bias. The team will first examine conditional response rates for groups of firms based on characteristics available in the data frame that are hypothesized to impact outcomes of interest. These may include variables such as firm size, industry, NAICS code, or location. Any differences in response rates can be further investigated through logistic regression analysis, using firm characteristics as predictors, and whether or not a recipient responded to the survey as a binary outcome. If the results of the logistic regression indicate that one or more of the characteristics investigated above affects the propensity of a survey recipient to respond to the survey, then those characteristics will be examined to determine whether they are associated with differences in the outcome variables under study across the dataset of survey responses collected. If any sources of non-response bias are found, they can be controlled for by the development of weights, which can then be used in concert with weighting based on population stratification, in the extrapolation of results to the entire population.

[5] The portion of revenue contributed by firms with 0–4 employees was not included in the calculation.
[6] Previous studies have shown that Orbis data on the number and revenue of firms of this size are unreliable. For example, Orbis generally reports several times more firms of this size than are reported by the U.S. Census Bureau.

Since each frame (based on industry and firm size) from the industry association list has a corresponding frame from the Orbis database, the Commission expects that all sampled information will yield "reliable" data that can be generalized to the universe studied.

**4. Tests of procedures or methods to minimize burden or improve utility**

The Commission field-tested the questionnaire with companies from several industries (e.g., recycling, smelting, repair and manufacturing ). These testers provided feedback in areas such as availability of data, product coverage, definitions, and clarity of instructions. See the table in part A for the field-testers comments and the subsequent changes made to the questionnaire.

In addition to field testing, the questionnaire has been made available for public comment. Notice of the draft questionnaire was published in the Federal Register, and the draft questionnaire was publicized in industry publications and conventions. It has also been extensively reviewed within the Commission. Industry analysts and economists have reviewed the document to ensure it contains information needed to adequately answer questions posed in the study while imposing a minimum burden on the responding businesses. The burden on the smallest companies (generally, those with fewer than 10 employees) has been eliminated, as these firms have been excluded from the survey.

The sampling methodology and procedures in this survey are quite similar to those in the ongoing USITC survey of remanufacturing activities. Both studies, for example, have populations drawn from Orbis and an industry association list, both studies stratify by industry and size, and both studies use similar methods of survey distribution and data collection. Although the USITC has not specifically tested the methodology and procedures of the used electronics survey, the remanufacturing survey has provided an implicit test of its practicability and utility. In addition, preliminary results from the remanufacturing survey have helped the used electronics survey team refine several questions.

**5. Contact information**

Collection and analysis of the data will be the responsibility of the Office of Economics and the Office of Industries within the Commission. Project leader Laura Bloodgood can be contacted at 202-708-4726, deputy project leader Andrea Boron can be contacted at 202-205-3433, and lead economist for this study William Powers can be contacted at 202-708-5405. Commission staff also worked with Boris Rachev and his colleagues at Summit Consulting, a survey design and data analysis consulting firm. Mr. Rachev may be contacted at 202-407-8300 or at boris.rachev@summitllc.us.