

Developing Response Metrics for the Economic Census¹

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1. Introduction

The Economic Census uses the check-in rate to measure the performance of data collection operations. The check-in rate, or return rate, is defined as

$$\text{Check-in Rate} = \frac{\text{Receipts} + 2\text{nd Time Undeliverables}}{\text{Number of Forms at Initial Mailout}} \times 100.$$

The check-in rate has been used as the proxy indicator of response for the Economic Census; however, a returned form does not necessarily indicate useable data was received. The Economic Census program is in the process of developing unit and item response rates to produce response metrics consistent with those used by other economic survey programs, to produce more meaningful information about data quality, and to comply with Census Bureau and Office of Management and Budget standards (U.S. Census Bureau, 2010 and Office of Management and Budget, 2006).

Most ongoing economic programs at the Census Bureau compute two different types of response rates: a unit response rate and weighted item response rates. The unit response rate (URR) is defined as the ratio of the total unweighted number of “responding units” to the total number of reporting units eligible for data collection. The URR is an indicator of the performance of data collection for obtaining usable responses. Weighted item response rates include Quantity and Total Quantity Response Rates (QRR and TQRR). These rates measure the proportion of each estimate obtained directly or indirectly from the survey unit. The QRR measures the weighted proportion of an estimate obtained directly from the respondent for the survey/census; the TQRR expands the rate to include data from equivalent quality sources. The QRR and TQRR are indicators of the quality of an estimate (U.S. Census Bureau, 2010).

Developing response rates for a large scale program such as the Economic Census is a major project. Although the Economic Census is conducted as a single data collection process, other processes, such as sampling and estimation, are organized by trade area. As such, the Economic Census Response Rate Team was established to develop URRs and item response rates for the Economic Census. The Team is made up of mathematical statisticians, survey methodologists, information technology specialists, and subject matter specialists from the eight major business trade areas. Currently, the Team is working on high level requirements for response rate calculations.

This paper documents the Team’s decisions and recommendations thus far. It also includes aspects of the Economic Census design and methodology that have been important in the decision making process.

This paper is organized as follows. Section 2 provides relevant terminology. Section 3 provides an overview of the Economic Census. Sections 4 and 5 discuss the URR and item response rates, respectively. Section 6 discusses possible uses of response rates in nonresponse follow-up. Section 7 reiterates key points and offers thoughts on future research.

2. Terminology

This section includes terminology which is useful for understanding the Economic Census and the discussion in this paper.

¹ Any views expressed are those of the authors and not necessarily those of the U.S. Census Bureau.

An **establishment** is defined as a business or industrial unit at a single, physical location that produces or distributes goods or that performs services and for which separate records are kept – for example, a factory or a store. Each establishment is owned by a **company** – a business organization or firm.

A **survey unit** is an entity selected from the underlying statistical population of similarly-constructed units. Some examples include an establishment, an Employer Identification Number, and a firm.

A company may own just one establishment, referred to as a **single-establishment company (SU)**, or it may own many establishments spread across different geographic or political jurisdictions, or across industry types, referred to as a **multi-establishment company (MU)**.

The Census Bureau continuously compiles listings of new businesses (**births**) identified from the Internal Revenue Service, Social Security Administration records, and other sources. Simultaneously, the Census Bureau also identifies establishments that are no longer in business (**deaths**), and updates sampling frames accordingly.

Generally there are three types of forms used to collect data from companies: A **long form** – used to collect detailed information about an establishment; a **short form** – used to collect less detailed information about an establishment; and a **classification form** – a special type of questionnaire used to determine an establishment’s correct North American Industry Classification System (NAICS) classification. These forms, also referred to as class cards, are typically mailed before long and short forms.

A **reporting unit** is an entity from which data are collected. The reporting unit may or may not correspond to a survey unit; establishments may be rolled into one unit for reporting purposes, and then broken out for tabulation purposes. These consolidated units are called **alternative reporting units (ARUs)**. For example, for some mining industries a company completes one survey form; the Census Bureau separates the consolidated data into the individual establishment level data.

An ARU is considered the reporting unit and is referred to as the **parent**. The individual establishments that make up the parent are referred to as **children**.

An **inter-trade transfer (ITT)** refers to a reporting unit mailed in one sector but later reclassified in another. For example, a business that previously operated in retail sales and now operates in a service industry.

The units that are used for estimation are called **tabulation units**. For many business surveys the tabulation unit is the same as the reporting unit.

3. About the Economic Census

The Economic Census is conducted by the Census Bureau every five years covering reference years that end in 2 or 7. For example, preparations for the 2012 Economic Census are now in their final stages, with data for reference year 2012 being collected during 2013. In addition to the 50 states and the District of Columbia, data are collected for U.S. territories and island areas, which include American Samoa, Guam, Northern Mariana Islands, Puerto Rico, and Virgin Islands. Other programs are associated with the Economic Census: the Survey of Business Owners (SBO), which provides data on minority-owned and women-owned businesses; the Commodity Flow Survey (CFS); the Business Expenditures Survey (BES); and statistics for firms with no paid employees (aka “non-employers”) based on data obtained from administrative sources. For the purposes of this paper, however, discussion of the Economic Census for Island Areas, SBO, CFS, BES, and non-employer statistics will not be addressed.

The Economic Census is a survey of U.S. business establishments in the eight major business trade areas: manufacturing, construction, mining, retail, services, wholesale, finance-insurance-real estate (FIRE), and utilities-transportation. Data are generally collected at the establishment level. Approximately 4.7 million establishments received the 2007 Economic Census. Given its establishment-level basis, the Economic Census is used to update the Census Bureau’s Business Register (BR), from which sample frames are extracted for industry-level annual and sub-annual economic surveys. Sample revisions for these current economic survey programs occur every five years following each Economic Census.

The Economic Census provides the most detailed benchmark data available about the U.S. economy. Statistics are produced for 18 of the 20 economic sectors covered by the NAICS, with geographic detail down to the ZIP code level, where possible, along with state and national estimates.

Data from the Economic Census are used by policymakers, industry analysts, economic development commissions, academic researchers, and businesses themselves. One primary use supports the estimation of the Gross Domestic Product. Other major economic indicators based on Economic Census data are input-output and productivity measures. Data may also be used for a wide variety of purposes, such as gauging industry growth and competitiveness, identifying geographic and industrial areas ripe for economic growth, and assessing the economic effects of natural disasters.

The Economic Census is collected using self-administered paper or electronic forms, tailored by industry, resulting in more than 500 different questionnaire versions. Paper forms are distributed and returned by mail. Various options to report electronically have been available since the 1987 Economic Census, primarily for large MUs. Currently forms are provided electronically via downloadable software called Surveyor, which, although available to all establishments eligible for the Economic Census since 2002, is built primarily to aid large MU reporting. Nearly 45% of MU data was submitted via Surveyor for the 2007 Economic Census. The 2012 Economic Census will be the first to offer direct internet or Web-based reporting, which will be marketed primarily to SU, or very small, businesses.

Although response to the Economic Census is required by law, the Census Bureau employs an intensive contact strategy in order to maintain high response rates. Contact initially begins in the autumn of the reference year, when large MUs are first provided with Economic Census forms and notified about electronic reporting procedures. The purpose of this early contact is to facilitate businesses' planning for Economic Census response as the reference year ends.

Mailout to the rest of the units eligible for the Economic Census occurs mid-December of the reference year, with a due date of February 12 of the following year. There are as many as four follow-up mailings to nonrespondents, the first of which begins approximately one week after the due date. Intervals between subsequent mailouts vary, but are roughly 30 days. The final follow-up of delinquent, but critical, MUs occurred in September, 2008, for the 2007 Economic Census, while data collection closed in August, 2008, more generally. Current plans for the 2012 Economic Census call for the final mailing to occur in July, 2013.

The contact and nonresponse reduction strategies for the Economic Census feature a number of approaches. For example, businesses are permitted to request due date extensions. Additionally, the largest MUs in each industry are assigned "Account Managers," who are subject area specialists tasked with proactively making contact with respondents and building rapport to aid response from these critical cases (Hartz and Marke, 2009). In the past two censuses, the final follow-up letter to selected delinquent, but critical, cases consisted of a stern notice from the General Counsel of the Department of Commerce emphasizing the mandatory authority under which the Economic Census is collected.

The 2007 Economic Census program had a goal of increasing the overall check-in rate to 86% for 2007 from 84% in 2002. This was achieved, largely through four nonresponse follow-up mailings and targeted nonresponse follow-up. For the 14% of cases that did not return a survey form even after follow-up, or returned a form with missing or unusable data, administrative data substitution was used to adjust for nonresponse. When such data were unavailable or thought to be unreliable, program areas used combinations of balance complex, logical edit item, model-based, and hot deck imputation methods. These methods are described in detail in Ozcoskun and Hayes (2009).

For the first time, the 2012 Economic Census will feature a targeted telephone follow-up contact strategy, beginning with automated reminder calls to selected cases during the first follow-up attempt. Later, based on propensity models using historical response/nonresponse characteristics and paradata, select nonresponding cases will be directed to telephone follow-up. Assuring the effectiveness of data-driven nonresponse follow-up strategies in the future relies on improved measures of response rates associated with data quality such as those described in the remainder of this paper.

For more information on the Economic Census, refer to the 2007 Economic Census User's Guide located at http://www.census.gov/econ/census07/www/user_guide.html.

4. Unit Response Rate

One characteristic of business surveys is their highly skewed populations. Users are often interested in estimates of totals, and typically a relatively small number of businesses make up the majority of a total. To avoid the over-representation of small cases which are common to business surveys, the URR in a business survey setting is often computed without using design weights (Lineback and Thompson, 2010). The URR formula employed by economic surveys and censuses at the Census Bureau is

$$URR = \frac{R}{E + U} \times 100,$$

where

R is the count of reporting units selected for the sample that were eligible for data collection and classified as a response,

E is the count of reporting units selected for the sample that were eligible for data collection, and

U is the count of reporting units selected for the sample for which eligibility could not be determined.

In other words, the URR represents the proportion of reporting units eligible for data collection that provided a valid response. To define the URR for the Economic Census, we asked what constitutes a reporting unit, what makes a unit eligible for data collection, and what are valid response criteria?

In general, for the Economic Census the reporting unit is the establishment. When it is predetermined that one establishment will report for multiple establishments, as in the case of an ARU, the unit with the opportunity to respond is the only reporting unit counted in the URR. A reporting unit will be counted in the sector in which it is ultimately published.

Only reporting units eligible for data collection or of unknown eligibility are calculated as part of the URR. Generally, eligibility status will be consistent with the rules for other business survey programs conducted by the Census Bureau. For instance, reporting units, including births and deaths, active at any point during the reference period will be eligible, and any duplicate reporting unit or reporting unit added in error will be considered ineligible.

Economic Census specific issues include ITTs and classification forms. In the case of an ITT, the reporting unit will be eligible in the sector in which it is resolved. In general, an establishment mailed a classification form is ineligible, because it is only given the opportunity to report industry classification information. In some industries, however, it is possible that a sample of resolved cases is selected and mailed survey forms. Given that they have a chance to report, these reporting units will be eligible.

In order to be classified as a respondent, an eligible reporting unit must have provided valid responses to a predetermined set of data items.² Valid responses exclude imputed, unusable, or "equivalent quality data." Valid responses may include edited values. Although the Economic Census processes data by trade area, the URR response criteria will not differ across trades.

5. Item Response Rates

As noted in section 4, one characteristic of business surveys is their highly skewed populations, with a relatively small number of tabulation units making up the majority of a total. It follows that one must weigh the cost-error tradeoffs of obtaining reported data from the large number of establishments making up a small percentage of a total.

² It is the Census Bureau's practice not to disclose response criteria.

An alternative is the use of administrative data in place of respondent data for survey units whose estimates are expected to contribute little to a total, where administrative data are obtained from an administrative source with the same reference period as the survey. Another possibility is to take a sample of survey units, where weighted estimates represent the population of interest.

The 2007 Economic Census utilized both administrative data and sampling methods. While all MUs were included in the Economic Census and mailed a questionnaire, SUs may have been handled in any of the following ways: included in the Economic Census and mailed a questionnaire, included in the Economic Census but not mailed a questionnaire (administrative data was used instead), or not included in the Economic Census but represented by other sampled SUs. For some industries, non-sampled SUs may have had key items filled with administrative data to provide unweighted estimates. (For a summary by trade area, refer to Attachment A.) Additionally, of the mailed SU cases, most received a long form, but some (e.g., those in manufacturing and mining) received a short form.

The item response rates employed by economic survey programs at the Census Bureau, the TQRR and QRR, reflect the unique properties of business surveys.

The TQRR is defined as

$$TQRR = \frac{\sum_{i=1}^N (q_i + r_i) w_i t_i}{\sum_{i=1}^N w_i f_i t_i} \times 100,$$

where

w_i is the design weight of tabulation unit i ,

r_i is the indicator variable for reported data for tabulation unit i ,

q_i is the indicator variable of equivalent quality data for tabulation unit i ,

t_i is the data value for unit i ,

f_i is the nonresponse weighting adjustment factor for tabulation unit i , and

N is the total number of eligible tabulation units.

In other words, this is the proportion of the weighted total of a data item obtained from directly reported and equivalent quality data. Note that the denominator includes a weighting adjustment factor, which equals one if no such factor was used. Note also that $q_i + r_i \leq 1$. A TQRR is typically calculated for each of a survey's key data items.

The above formula makes the distinction between reported data and equivalent quality data, where, by and large, equivalent quality data refers to administrative data. When administrative data is used, the Census Bureau standards require that an evaluation be done to assess the quality of such data (U.S. Census Bureau, 2010).³

A derivative of the TQRR that is also used is the QRR, which is defined as

$$QRR = \frac{\sum_{i=1}^N w_i r_i t_i}{\sum_{i=1}^N w_i f_i t_i} \times 100.$$

The QRR represents the proportion of the weighted total of a data item from directly reported data.

To define the TQRR and QRR for the Economic Census, we asked what are the key items of interest, what constitutes a tabulation unit, what constitutes reported data, and what constitutes equivalent quality data?

The Team identified four key items for all trade areas: receipts, payroll, number of employees, and number of establishments. We can calculate item response rates for three of these items: receipts, payroll, and number of employees. Number of establishments is a derived value, making it impractical to calculate an item response rate.

³ The use of administrative data is authorized under U.S.C.s Title 13 and Title 26.

For the Economic Census, the tabulation unit is the establishment. At the end of the survey processing cycle and prior to estimation, reporting unit estimates are rolled out to the establishment level, and an establishment is tabulated in the industry in which it is ultimately published.

At the estimation stage, a given data item is considered reported if the corresponding reporting unit provided a valid response for the item of interest. For example, if a parent record provided a valid response for payroll, then the corresponding children will have a status flag indicating that payroll was reported.

Equivalent quality data can come from one of three sources: a survey or census with the same reference period; administrative records; or some other validated source, such as company annual reports, trade association statistics, or Securities and Exchange Commission filings. Administrative data is the primary source of equivalent quality data for the Economic Census. Administrative data on receipts, payroll, and number of employees are maintained on the BR and updated regularly from sources such as federal tax records.

6. Recommendations for Use

Historically, the check-in rate has been calculated by mode, geography, place, sector, tax status, legal form of organization, and trade area, and the rates have been used to target nonresponse follow-up. Unlike the check-in rate, the URR indicates a valid response was received from a reporting unit. Therefore, given that the URR is a better indicator of usable Economic Census response, one potential use of URRs is targeted nonresponse follow-up.

The Team plans to recommend calculating the URR in real-time at the combined trade area level and on key subgroups, including 2-digit NAICS sector and 3-digit NAICS sub-sector. The Team will also recommend the capability to create user defined reports for lower levels of detail such as geography and 6-digit NAICS industry.

Ideally, the URR and the TQRR would both be used to determine how to target nonresponse follow-up. Together, they provide information about the stability of an estimate. For example, if an estimate is expected to stay stable with increased response rates, there is perhaps little justification for continued follow-up. On the other hand, if an estimate is clearly unstable, but response rates meet required thresholds, there may be justification for additional follow-up. Current Economic Census processing procedures, however, prevent us from calculating a QRR and TQRR in real-time.

In the meantime, the Team will recommend calculating the TQRR at the end of survey processing for receipts, payroll, and number of employees by 2-digit NAICS sector. The Team will also recommend the capability to create user defined reports for lower levels of detail. The Team will not recommend calculating the TQRR at the combined trade area level, because data are processed by sector, and item definitions are not necessarily comparable across sectors.

The Team will also recommend calculating the QRR by 2-digit NAICS sector, with the option to calculate the QRR on lower levels of detail. The QRR in conjunction with the TQRR will provide information about the percentage of the data coming from administrative sources.

7. Conclusions

The Economic Census, conducted every five years, produces the most detailed benchmark data available about the U.S. economy. It is not like other survey programs with respect to design or magnitude of information collected. While it is a single data collection process, sampling and estimation are organized by trade area. The Economic Census also makes use of administrative data for producing item estimates.

The Economic Census currently produces a check-in rate, which measures the status of the data collection process. The Economic Census is developing URRs and item response rates (the TQRR and the QRR) to meet agency standards, to produce response metrics similar to those used by other economic survey programs at the Census Bureau, and to provide information about data quality.

The Economic Census Response Rate Team is working on a list of high level response rate requirements and recommendations, which are outlined in this paper.⁴ The following steps remain: the development of low-level requirements, the development of an implementation plan, and program testing.

With response rates in place, the Economic Census program could consider using response rates under a responsive design framework (Groves and Heeringa, 2006). Under such a design the idea is to monitor process data and survey data with the option of altering the survey design during data collection to achieve better quality estimates. In other words, at any point in the survey process, we would have the information to make one of the following decisions: continue but alter the data collection process, continue data collection without making changes, or end data collection efforts.

The current design is one in which we collect data until we exhaust time and resources. With increasing survey costs, it is imperative to start looking into ways to make more informed decisions about when to change or end data collection efforts, while still maintaining high quality data.

8. References

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⁴ These requirements are subject to change.

Highlights of 2007 Economic Census Methods Across Trade Areas

(Refer to http://www.census.gov/econ/census07/www/user_guide.html for more information.)

	Wholesale	Manufacturing and Mining	Retail, Services, and Utilities-Transportation	FIRE	Construction
MUs	Take all with certainty	Take all with certainty	Take all with certainty	Take all with certainty	Take all with certainty
SUs	Take all with certainty	<p>Within industry, take those with largest payroll with certainty</p> <p>Fill remaining cases with administrative data*</p>	<p>Take those with largest payroll with certainty</p> <p>Fill those with the smallest payroll with administrative data</p> <p>Sort remaining cases and take a systematic sample. Non-selected units' key items** filled with administrative data</p>	<p>In select industries, take all with certainty</p> <p>In all other industries:</p> <ul style="list-style-type: none"> ✚ Take those with largest payroll with certainty ✚ Fill those with smallest payroll with administrative data ✚ Sort remaining cases and take a systematic sample. Non-selected units' key items filled with administrative data 	<p>Stratum 1 (Complete 6-digit NAICS):</p> <ul style="list-style-type: none"> ✚ Take a probability-proportional-to-size sample <p>Stratum 2 (Incomplete 6-digit NAICS):</p> <ul style="list-style-type: none"> ✚ Take those with largest payroll with certainty ✚ Take a simple random sample of remaining cases

*Often referred to as "non-mails"

**Key items include receipts, payroll, and number of employees