THE IMPACT OF DROPPING THE BUSINESS AREA SAMPLE AS A MEANS OF COVERING BIRTH EMPLOYERS AND NONEMPLOYERS IN THE CURRENT BUSINESS SURVEYS

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1. Overview

Over time, the Bureau of the Census has changed the way its samples represent the business universe. From 1951 to 1968, it published monthly retail and services statistics based on an area sample supplemented by a relatively small list of the largest firms. In 1968, a major shift put primary reliance on a list sample. As a result, from 1968 through July 1993, the business surveys primarily used a list sample, taking advantage of expanded computer processing capabilities and administrative records for frame construction and survey control, while retaining a small area sample to complete coverage. In August 1993, the area sample was dropped in favor of other methods. For those interested in a historical perspective, Daly, et al. (1972) describes the change in 1968 from primary reliance on an area sample to primary reliance on a list sample, but with a small supplementary area sample. Daly's paper also gives comparisons of statistical, cost, and control considerations relating to the change at that time.

This paper reviews the impact of dropping the business area sample as a means of covering both new employer businesses (birth employers) and nonemployer businesses for the business surveys. Since August 1993, a factor adjustment obtained through a benchmarking operation has accounted for these two components in the monthly retail surveys. Monthly surveys for services are no longer done. Because of budget cuts, the Census Bureau discontinued the monthly list and area sample surveys for selected services industries in 1981.

The same area sample used for the monthly surveys also contributed to the annual surveys. The Annual Retail Trade Survey (ARTS) and the Service Annual Survey (SAS) used the birth employers and nonemployers identified in the monthly area sample survey for November, December and January. The area sample picked up data for retail in all twelve months, but for services only in these three months. These area sample cases were mailed and tabulated for the annual surveys. The 1992 annual surveys were the last to use the area sample component. The 1993 and later annual surveys will use an alternate methodology.

This new method is based on supplemental samples for birth employers along with administrative records tabulations to account for nonemployers.

In recent years the area sample has been a small contributor to monthly and annual total retail sales estimates, averaging about five percent of the estimate. For services annual estimates, the area sample contribution overall has been nearer to ten percent on average, primarily because of significant nonemployer receipts. Area sample contributions vary widely by specific kind-of-business activity within the retail and services areas.

Replacing the area sample has yielded improvements in the quality of business survey estimates and significant cost savings. Specifically, the key benefits from this effort are given below.

• Better coverage of birth employers and nonemployers in the annual business surveys.

• Closer relationships between the monthly and annual surveys and their census benchmarks.

• Savings of about $800,000 annually from no longer collecting area sample field data.

• Acceptable monthly survey estimates with significantly reduced processing costs.

Here is the way the rest of the paper is organized. Section 2 briefly describes our business surveys with specific focus given to the roles of the list sample and area sample. In Section 3, we look at the reasons for replacing the area sample survey. Sections 4 and 5 present the basis for the new methodology and its impact. Section 6 gives a summary and conclusions.

2. The Current Business Surveys

The current business surveys consist of nine surveys in the retail, wholesale, and services areas, four monthly and five annual, for which various economic data are collected and published. In this context, we use the words "current business surveys" in contrast to censuses, i.e. "current" need not mean "present".

Three of the four current business monthly surveys that were directly effected by the area sample are given below, along with their major function.

• The Monthly Retail Trade Survey (MRTS) collects monthly retail sales data.

• The Monthly Advance Retail Trade Survey (MARTS) gives early estimates of monthly retail sales trends.

• The Monthly Retail Inventory Survey (MRIS) covers retail inventories. Estimates from MRIS are included in the same publication as sales from the MRTS. Both the MRIS and the MARTS use subsamples of the larger MRTS sample.

The monthly surveys provide monthly estimates of levels and of changes in levels from a month ago and a year ago for the entire U.S. for various levels of Standard Industrial Classification (SIC) codes. The MRTS also provides estimates of retail sales by various SIC levels and subnational geographic areas, for example, regions, divisions, selected states, selected large Metropolitan Statistical Areas (MSAs) and cities.

Only two of the five current business annual surveys were directly effected by the area sample. These are given below, along with their major functions.

• The Annual Retail Trade Survey (ARTS) uses essentially the same sample as its monthly counterpart, the MRTS. In addition to sales, it collects end-of-year inventories, inventory valuation methods, value of purchases, sales taxes, and accounts receivable data.

• The Service Annual Survey (SAS) collects annual services receipts data and various expense items for selected services.

The annual surveys give annual estimates of levels and year-to-year changes in levels for various SICs at the U.S. geographic level only. In the next two sections we will focus on some basic information about the list and area sample.

2.1. The List Sample

Every five years when we redraw our list samples, we construct a list sample frame for the current business surveys from the Census Bureau's Standard Statistical Establishment List (SSEL). The SSEL is a universe list of employer business firms and establishments built and periodically updated with the administrative records of the Federal Government (chiefly those of the Internal Revenue Service (IRS) and the Social Security Administration (SSA)), along with the results of current surveys and censuses.

To account for birth employers that come into being after the initial sampling frame is created and the initial sample selected, we conduct additional sampling. Also, to keep the sample current, we delete selected sampling units that become inactive from the active mailing lists for the surveys. The appropriate updating of the initially selected sample is accomplished first by a large "birth backlog" sampling operation and a companion operation to delete inactive units before the new samples are introduced. This is followed by quarterly birth employer samplings and inactive deletions which continue for as long as the samples are in use. See Konschnik, et al. (1985) for more details on various aspects of list frame and sample construction and maintenance, and the list sample processing relative to the area sample.

2.2. The Area Sample

The area sample consisted of a sample of approximately 420 land segments canvassed each month within 59 Primary Sampling Units (PSUs). It was used to cover business establishments not covered by the list sample. About 70 census field representatives (interviewers) canvassed a different sample of segments each month, searching for retail businesses and picking up SIC, sales, inventory and business identification data. In three months out of the year they also identified and collected data for services establishments for annual survey use. Nonemployer businesses never became part of the list sample frame, while birth employers had to be represented by the area sample until they were subjected to list sampling in the quarterly birth processing. The strong attraction of the area sample was that, theoretically, it gave complete, up-to-date, supplementary coverage to the list sample. To ensure that coverage was not duplicated, complex automated and clerical procedures were set up to determine which establishments found in canvassing were to be represented by the list and area samples. The papers Isaki, et al. (1981) and Konschnik, et al. (1991) provide more detailed descriptions of the business area sample, its history, design and survey processes.

3. Reasons for Replacing the Area Sample Survey

We replaced the area sample essentially because: (1) it had high relative cost; (2) it had quality problems; (3) we had good alternatives for the annual surveys; (4) we could reduce the variance of the estimates without the area sample; and (5) we had an acceptable alternative for the monthly surveys. These are discussed in some detail in what follows.

• **High relative cost** -- A compelling reason for replacing the area sample was its high cost relative to its perceived benefits. The area sample survey cost about one million dollars to operate each year, with field work in canvassing each month making up the largest portion of the cost.

• **Quality issues** -- Issues of data quality also played a role in the decision to drop the area sample in favor of other methods. For example, the area sample estimates had high variance due to the small sample size (retail and services establishments within the monthly area sample segments represented approximately 1/1000 of the universe of such establishments). Moreover, because we canvassed a different sample of area sample segments each month, there was often a wide variation in the estimates from one month to the next for various SIC and geographic levels.

In addition to the wide variability of area sample estimates, the area sample did not adequately represent certain types of businesses, chiefly many types of services nonemployer establishments. These were difficult for census field representatives to spot because they were typically located in private residences with no external signs of business activity. Thus, services nonemployers, which make up a significant percentage of services receipts in some SICs, were largely understated by the area sample survey.

Because of this deficiency in the area sample estimates for services, we have been using a factor adjustment for services nonemployers for the SAS for about the past fifteen years. This factor approach consisted essentially of using the percentage estimates for nonemployers in the census to determine the SAS nonemployer estimates in years following the census.

• **Attractive alternatives for the annual surveys** -- A major factor in our decision to replace the area sample survey was our determination that we could cover, just as well or better, birth employers in the annual surveys using supplemental birth samples. Because the annual surveys are published about 15 months after the close of the reference year, we can take advantage of this lag and use the quarterly birth sampling during this period to represent all, or nearly all, birth employers which started operations in the reference period. To cover nonemployers, we are in the process of making arrangements with IRS to receive receipts from business tax returns on an annual basis, rather than only during economic census processing periods. This means that we will be able

to tabulate nonemployers for the annual surveys based on a universe tabulation of tax-return records. Thus both employer births and nonemployers can be well represented in the annual surveys without an area sample.

• **Reduced variances for monthly estimates** -- To reduce the representation of birth employers in the high variance area sample and instead account for more of them in the lower variance list sample, we changed the criterion for birth sampling. This change consists of sampling a new Employer Identification Number (EIN) (which an employer birth must obtain from IRS and use as its taxpayer identification number) as soon as we learn that it has nonzero payroll reported to the IRS. This change took effect for the first time in the MRTS for the November 1992 data month. Before this change, we waited until we received an SIC classification from the SSA. SSA assigns codes to new EIN's based on their reported kind of business on the IRS Form SS4, Application for an Employer Identification Number. Thus, the earlier sampling meant that these new EINs were selected as unclassified as to SIC in the first phase of our double sampling procedure.

We mail the EINs selected in the first phase to obtain the appropriate SIC, measure of sales size for sampling--and other information--all of which allows us to subject the EINs to the second phase of sampling, three months after the first phase selection. Getting birth employers into the list sample earlier reduced the area sample sales estimates for retail birth employers to about two percent, down from the historical average of about three percent.

• **A good alternative for the monthly surveys** -- The biggest problem in dropping the area sample was the need to represent birth employers and nonemployers for the monthly retail surveys. Theoretically, the area sample provides complete, up-to-date, supplementary coverage to the list sample. Another area sample advantage is that the SIC coding of an establishment is thought to be of high quality, since a census field representative can observe the business activity as well as collect detailed information on the spot.

These positive attributes had to be balanced with the problems of the area sample. In addition to the problems of quality mentioned earlier, coverage of key business activity could be inadequate. As one example, the estimate of motor vehicle dealers (new car sales) establishments have frequently been

understated by the area sample. Also, the process of unduplicating the cases picked up in the area sample survey from the list sample was sometimes imprecise due to insufficient information.

We made our decision to drop the area sample when we were convinced that an alternative method could adequately satisfy the needs of the monthly retail surveys. This method provided for the use of factors determined through benchmarking to account for birth employers and nonemployers in the monthly estimates. The paper by Konschnik, et al. (1991) discusses major parts of this issue.

Sections 4 and 5 which follow will detail the new methodology that replaced the area sample and give the basis for its use.

4. Basis for the New Annual Survey Methodology

The alternatives to the area sample had to satisfy both the annual and monthly survey requirements. The following sections provide evidence that this is indeed the case. The annual surveys are discussed first, followed by the monthly surveys.

4.1. Comparisons of SSEL and Area Sample Tabulations for 1991 ARTS Birth Employers

To determine the reliability of the area sample relative to alternative means for covering birth employers in the annual surveys, we produced several tabulations. The first was a tabulation of birth employers not represented by the list sample for the 1991 ARTS. We identified retail birth employers with nonzero 1991 payroll on the SSEL, most of which had business receipts (sales) obtained from IRS tax-return records for 1991.

We compared the universe tabulation of these birth employers extracted from the SSEL with the area sample's birth employer estimates for the 1991 ARTS. The ARTS publication SIC levels formed the stub for the table.

It showed that the dollar volume estimate of retail sales for birth employers at the total retail level and based on the SSEL extracted establishments was about $49 billion. This compares to about $35 billion for the area sample. In terms of estimated number of establishments, the extracted universe showed about 191,000 birth employer establishments not included in the list sample as compared to about 150,000 establishments from the area sample. Nearly $5 billion of the extracted establishments' sales estimates came from those that were unclassified. In this case, we assigned unclassified records to retail using rates which were typical in previous classifications of the

unclassified. We then raked (i.e. apportioned) the retail total down to retail SICs based on each SIC level's proportion of the total.

The largest discrepancy between universe and area sample tabulations occured in SIC 551 (Motor vehicle dealers-franchise). Here the total extracted sales estimate exceeds the area sample estimate by a little more than $6 billion. Generally, for the vast majority of SICs, the extracted sales are somewhat larger than the area sample estimates. One other item of note is the unweighted area sample establishment counts. This showed the relative sparseness of the area sample in some SICs. For example, SIC 551 had poor representation with only one area sample birth employer, whereas SIC 541 (Grocery Stores) had good coverage with 46 area sample cases.

For the 1991 SAS, we obtained similar results--the tabulation of birth employers from the SSEL exceeded the area sample estimates by nearly $15 billion.

4.2. 1987 Census to 1987 Annuals Comparison for Retail and Services Nonemployers

Comparing ARTS to census nonemployers provided evidence that the administrative records tabulation of retail and services nonemployers, if done in a manner similar to the census nonemployer tabulations, would provide good estimates of nonemployers for the annual surveys since the annual survey estimates are always less than the census estimates at the total level and for most SICs.

4.3. Comparisons of SSEL and Area Sample Tabulations for 1992 ARTS Birth Employers

We did the same comparisons between the area sample and a universe tabulation of birth employers extracted from the SSEL for the 1992 reference year. The universe tabulation of birth employers yielded about $34.5 billion as compared with about $28 billion for the area sample. SIC 551 (Motor vehicle dealers-franchise) shows an area sample deficiency of about $3.9 billion relative to the universe tabulation. By contrast, the SIC 541 (Grocery stores) estimates from the ARTS area sample exceeds the universe tabulation by nearly $1 billion.

4.4. Comparison of Supplemental Births Sample Tabulations and Area Sample Tabulations for 1992 ARTS Birth Employers

For the 1992 reference year, we also produced a tabulation of a list sample estimate of employer births. We used birth employers obtained from a

supplemental sample of employer births for 1992 (selected throughout 1993) and compared them with the 1992 ARTS area sample estimates. The supplemental sample estimate shows a total of $29.4 billion as compared with the $28 billion total for the area sample. We plan to use the supplemental birth sample to mail and obtain sales and other annual survey data, namely, purchases, accounts receivables, inventories, and to otherwise represent the employer births not represented in the list sample. We did, however, address the approximately $5.1 billion difference (representing 0.26% of the 1992 ARTS total retail sales estimate of $1,959 billion) between the employer birth universe estimate and the supplemental sample estimate of this universe. We found that, in addition to sampling error, there were two main sources for this difference which can largely both be overcome by improvements in our quarterly birth sampling procedures.

5. Basis for the New Monthly Survey Methodology

5.1. An Investigation of Using Benchmarking to Adjust for Birth Employers and Nonemployers for the Monthly Retail Surveys

Since about 1978, the monthly retail trade survey sales data have been benchmarked to the ARTS estimates which are themselves benchmarked to the retail censuses. This is accomplished, for example, by ensuring that the estimates for the 1987 ARTS are adjusted to equal the 1987 retail census estimates at all SIC and aggregate levels. Likewise, the levels of the monthly estimates are adjusted so that their sum over all the months of the year are equal to the annual estimates. This adjustment to the monthly estimates is done in such a way as to minimize revisions to the estimates of month-to-month change.

That is, the function F below is minimized subject to several constraints.

$$F = \sum \left(\frac{Y_{t+1}}{Y_t} - \frac{X_{t+1}}{X_t} \right)^2$$

Here,
X_t = the monthly sales estimate (unrevised), and
Y_t = the revised monthly sales estimate for month t, where t ranges over all months of the time series.

One constraint is that $\sum y_i$ = ARTS annual estimate, where i ranges over all months of the year.

Because of benchmarking, we depend on the monthly surveys chiefly to produce good estimates of month-to-month change; the level estimates come from

benchmarking. Consequently, we looked at the impact of the area sample on estimates of month-to-month change. We used two data series for each retail publication stub: (1) list sample plus area sample, and (2) list sample only, for the period December 1987 through February 1993. We took the following steps using these series.

• We benchmarked both series, list sample plus area sample and list sample only (without the area sample), to the ARTS estimates for 1988, 1989, 1990, 1991.

• We produced measures of differences between the benchmarked series with the area sample and the benchmarked series without the area sample. Since the benchmarking minimizes month-to-month change, the differences in trend before and after benchmarking are nearly the same.

From these comparative benchmarkings, we observed the following.

• For most SICs, the month-to-month change is little affected by the area sample. However, SIC 541 (Grocery stores) with about 19% of total retail sales, SIC 5813 (Drinking places) with about .7% of total retail sales, and SIC 592 (Liquor stores) with about 1.3% of total retail sales are significantly affected by the area sample. Total Less Auto is affected because SIC 541 makes up 23.7% of that total.

• The area sample has little affect on the current month (current year) to current month (previous year) trend.

5.2. The Application and Effects of Using Benchmarking to Account for Births Employers and Nonemployers for the Monthly Retail Survey

Based on this benchmarking study, the Census Bureau decided to replace the area sample with a benchmarking technique for the monthly retail surveys. This meant that henceforth the monthly estimates of month-to month change would be derived from list sample contributions only. Thus, birth employer and nonemployer levels would be included in the estimates through a benchmarking factor and would play no role in determining the month-to-month change. In this regard, they would be similar to the list sample nonresponse cases which had an imputation rate of about 20% in terms of the dollar volume of total retail sales. Using a factor approach for the area sample amounts to increasing the imputation rate to about 23%. We realized that dropping the area sample made

it incumbent on us to try to improve the response rate for our list sample survey.

For each SIC, every month we apply a benchmarking factor to each estimate to adjust for the difference between the sample level (unrevised level) and the latest benchmark level (revised level which is comparable to the latest ARTS estimate). We call this factor a "carry forward factor". As of July 1993, we had last benchmarked to the 1991 ARTS, so the carry forward factor consisted of the December 1991 estimate (revised) divided by the December 1991 estimate (unrevised).

In addition to using the usual carry forward factor, we multiplied each composite estimate beginning with the August preliminary and July final estimates (obtained from the August data month tabulations) by the July preliminary estimate (with area sample) divided by the July preliminary estimate (without area sample). This had the effect of ensuring that the preliminary-to-final shift in the July published estimates would be the same as the preliminary-to-final shift in the list sample only estimates for July. Thus, a significant discontinuity in the time series was avoided. In effect, we had a new carry forward factor which contributed the birth employer and nonemployer component from the July preliminary estimate for each month for the remainder of 1993. Thus, without an area sample, for all future benchmarking operations, the input series (X_t) will be the composite estimates for the list sample only.

At the annual benchmarking time (March 1994) we created a time series of monthly data without area sample contributions and re-benchmarked the series using the 1992 ARTS as an additional constraint. Since the 1992 ARTS and all prior annual surveys included an area sample representation of birth employers and nonemployers, the revised series included this component level also. The carry forward factor projects this component onto the published series for 1993 and 1994.

For a broader discussion of revision and benchmarking of business times series, see Monsour and Trager (1979).

6. Summary and Conclusions

We based our decision to drop the area sample on detailed studies of the area sample compared with promising alternatives. These studies gave us good statistical alternatives that were far less costly than the area sample. Implementing the benchmarking factors to cover birth employers and nonemployers in the monthly surveys has gone well. Converting the annual surveys to the new techniques is in progress. When this work is completed, we expect to have higher quality annual survey estimates. These new techniques must, however, still face the test of time and varying economic circumstances.

We are currently working on nonemployer estimates for the 1992 censuses. Final numbers for 1992 census nonemployers should be available later this fall. Beginning with the 1994 year, we will have IRS tax return data available annually and plan to tabulate nonemployers every year.

The business area sample always demanded much in the way of resources--to select and maintain the segments, to canvass the segments and collect data, to process the survey and determine whether a case found in the area sample should be included in the tabulations or not, and to produce separate and combined estimates and variance estimates. The business area sample lasted about 43 years. Few mourn its demise. A longer version of this paper, giving complete tables and details, is available on request from the author.

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