OVERVIEW OF THE CES REDESIGN

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I. Introduction

A. Employment Statistics in the United States

On the first Friday of each month, the U.S. Bureau of Labor Statistics releases data on the United States' employment situation for the previous month. On release day, the Commissioner of Labor Statistics appears before the Joint Economic Committee of Congress and provides a detailed analysis of the current month's data and trends; at the same time, the data are made available to the news media and the financial and business communities. This closely watched set of statistics is the earliest indicator available on the previous month's economic activity and is used as a major gauge of the health of the U.S. economy. The data in the release cover employment, hours, and earnings by detailed industry which are derived from the Bureau's 400,000 unit monthly establishment survey - the Current Employment Statistics (CES) survey - along with labor force and unemployment data which are derived from the Bureau's 60,000 unit household survey—the Current Population Survey (CPS).

The establishment survey data have many important economic uses. Due to the CES survey's size and timeliness in conjunction with the importance of the basic payroll statistics which it collects, the CES monthly estimates are not only used as principal economic indicators but they also are included in the development of many of the Nation's other major economic indicators including: Personal Income estimates of the National Income and Product Accounts, the Index of Leading Economic Indicators, the Index of Coincident Indicators, the Industrial Production Index, Real Earnings measures, and Productivity measures. The CES data are not only widely used on a monthly bases due to its timeliness and substantial industry detail, but the CES also provides many continuous monthly industry timeseries which span over 50 years.

B. Current Employment Statistics Survey

The CES survey, with 400,000 units, is the largest monthly sample survey in the United States. It is conducted by the Bureau as a Federal-State cooperative program under which the Bureau specifies the survey's sample design and operational procedures while the States conduct data collection and edit reconciliation activities. The Bureau produces and publishes extensive monthly industry detail at the 2, 3, and 4-digit industry levels for the Nation as a whole while each State produces monthly State and area (270 Metropolitan Statistical Areas) estimates.

Once a year, complete universe employment counts for the previous year become available from the Unemployment Insurance tax records; these counts are used to annually benchmark (realign) the CES sample estimates to these universe counts. The annual benchmark process yields more accurate current monthly estimates along with providing an annual estimate of overall survey error. The average difference in the CES final sample estimate versus the complete universe count over the past 5 years is under 0.3%. While the CES monthly estimates have been relatively accurate in tracking the universe counts, there have always been concerns over the statistical foundation of the CES program.

II. Background

The CES program was established in the 1920s and thus predated the development of probability sampling theory. During the 1950s, 1960s, and 1970s as most sample surveys were converted to probability-based designs, the CES experienced little change to its fundamental operations and procedures.

Due to the need to support monthly industry detail at both the National and State level, the CES sample coverage has been approximately 40% of all employment in the U.S. since the 1950s. Essentially, the CES has been operated as an exceptionally large quota sample where an optimum allocation was used to establish a required sample size for each sampling cell (State by detailed industry by size class). Ongoing solicitation for replacement units was carried out each month to offset normal sample attrition. As in most establishment surveys, the coverage of birth units (i.e., new business establishment) was limited and, for the CES survey, an elementary modeling procedure was put in place to attempt to account for the presumed missing employment from these units.

Over the years, there have been both formal outside reviews (Gordon Commission 1960 and Levitan Commission 1980) and also internal reviews of the CES program and while in most reviews it was felt that probability sampling would be useful, they stopped

short of formally recommending the implementation of a probability design for CES. There were a number of cost-benefit factors which supported such a position.

- First, it was felt that the large sample coverage, at 40%, probably produced a fairly accurate picture of the basic population and the changes occurring within it.
- Secondly, the CES used a procedure to annually benchmark to the full population counts of employment from the Unemployment Insurance Tax system and this would realign any error in the sample estimates which occurred over the year.
- Thirdly, while the modeling procedure for births (known as bias adjustment) was a very simplistic approach to a difficult measurement issue, it appeared to be working reasonably well because the annual revision to the population counts only produced small adjustments—usually well within a $\pm$ .5% range.
- Finally, the observed annual benchmark revisions were believed to be primarily associated with the problem of sampling and measuring new business births and these were inherent frame limitations which would not be resolved by a probability design.

In addition, to the cost-benefit measurement factors there were also a number of practical/operational issues.

- The CES survey was a Federal/State cooperative program where all sampling and collection activities were done under contract by the States and changes in the process, particularly major changes, were quite costly. A change in the sampling and estimation procedures would require a full rewrite of 50 State processing systems.
- Correspondingly, monthly collection was done by mail with mail solicitation yielding only about a 30% cooperation rate for the voluntary CES survey. A change to a probability design would require not only major systems changes but also a much more staff-intensive effort to achieve an acceptable response rate—this would also require major increases in program funding.
- Finally, until 1983 the Bureau did not have responsibility for program funding or State contracts, the Bureau's role was limited to providing recommended methods and procedures for the ongoing program.

Thus, prior to the 1980s there was little empirical evidence to support major program changes or funding increases. In 1984, BLS was given responsibility for the program funds for the Federal/State cooperative programs and began funding research and improvement projects. Several of the research projects subsequently played a pivotal role in preparing for a major redesign of the CES survey.

III. CES Research and the ASA Panel Recommendations

During the 1980s, several major survey infrastructure improvements were made to the CES program which provided the foundations for addressing the issue of implementing a probability design in the CES program. After BLS received responsibility for program funding in 1984, a major effort was launched to develop and export a single CES processing system to all States. The conversion of all States to this new system was completed in 1993. The use of a single exportable State processing system provided a cost-effective way to change major processing system modules (e.g., the sampling module) in a timely manner.

The Bureau also made major changes to the CES program's data collection procedures. The CES program had been conducted as a mail survey for over half a century, however, it was felt that the decentralized State mail solicitation would never be able to achieve acceptable response rates for a monthly probability design. Beginning in 1983 and spanning a 7-year period, BLS conducted extensive research into alternative data collection approaches including: CATI, TDE, Voice Recognition, FAX, and EDI collection. In 1991, BLS received funding to implement these new collection methods and by 1996, over 75% of the survey's 400,000 monthly respondents were reporting under these new automated methods. In addition to automating much of the ongoing monthly collection, BLS also created two regional CES CATI collection centers. These centers are now being set up to conduct CATI solicitation for the new probability design.

Another major automation area for the Bureau in the early 1990s was the creation of a linked longitudinal universe file of establishment microdata. Systems were developed for matching the quarterly UI universe files and creating a longitudinal establishment database. A 12-month universe file for the 1993 benchmark year (i.e., April 1992 through March 1993) was extracted from the database for subsequent CES research on the primary causes of the 1993 benchmark revision.

In the initial phase of research, the population was divided into birth units, death units, and continuing units with a tabulation of over-the-year change from each component. The CES survey had experienced an upward revision of 263,000, however, the universe data

showed an offsetting effect for the net birth/death employment—suggesting that most of the CES survey's 263,000 underestimate was in the continuing population. This result contradicted earlier beliefs that most of the underestimation error in the CES was due to the birth unit measurement problems. To study the measurement accuracy of the existing CES sample versus a probability sample, the existing CES sample was matched and flagged on the universe file and then an additional 30 independent, identically distributed (to the CES) random samples were drawn from the population of continuing units—the results showed that the current CES sample exhibited a strong underestimation bias. Further research suggested that the cause was an age-of-firm bias. Under the CES survey's quota sample approach, firm's agreeing to participate could stay in the sample indefinitely and while there was some replenishment for sample attrition, the net effect was that the average age of units in the sample was 9 years older than that of the population. Additionally, research using the population file on growth rates by age-of-firm showed that younger firms exhibited accelerated growth rates compared to older firms. In summary, this new research suggested that the CES measurement issues were not strictly birth measurement issues but were also significantly affected by the existing non-probability design. In particular, the research results provided empirical evidence that even with an extensive population coverage of 40% of all employment, a non-random sample can be subject to a quite significant measurement bias.

At the same time that this research was being concluded, another major Bureau-sponsored technical review of the CES program was completed. In 1993, the Bureau had commissioned the ASA to form an expert panel to review the CES program and provide a "Research Agenda" to guide future CES program improvements. Of the 26 recommendations in the 1994 ASA report, the "first priority" recommendation was the implementation of a probability design for the CES survey.

In June 1995, following the conclusion of the Bureau's internal research effort and the final ASA report, BLS announced plans for a full redesign of the CES survey.

IV. CES Redesign Research Phase

The Bureau's CES Redesign proposal called for a 2-year research phase to be followed by a 1-year production test of systems and procedures and then a phased-in implementation of the new design.

A redesign research committee was formed consisting of BLS national and regional office staff, State staff, and outside consultants. Eleven States participated on the committee along with consultants from Westat, NORC, and Michigan Survey Research Center. The committee met quarterly over the 2-year period and evaluated the results from a series of research studies. A brief summary of each research area is described below, the full technical papers and results are discussed in this and one other ASA session:

- *User Needs:* The initial committee meetings focused on user needs and survey products at the national, State, and area level. The results from these meetings provided guidelines for developing the basic design. A separate effort studying the feasibility of collecting "all employee" earnings is still underway.
- *Birth Research:* This research focused on the feasibility of constructing a timely birth frame by obtaining immediate access, at the State level, to employer applications for new UI account numbers. Frames were constructed, sampled and interviews were conducted. The results showed mixed success in terms of the timeliness, consistency, and accuracy of the individual State frames. In addition to studying the feasibility of direct sampling and measurement of the birth population, research was also conducted on profiling the birth and death changes over time in the population and the feasibility of modeling the net effect. This work has produced favorable results.

While capturing the initial employment of new units when they first file for UI coverage is important, the earlier research suggested that it was equally important to move these units into the design as soon as possible so their employment movements could be reflected in the current monthly estimates—this research had show that younger units grow far faster than older units. Plans are being made to implement quarterly sample maintenance procedures to address this issue.

- *Sample Design Research:* Research focused on developing and refining State designs for the eleven States on the research committee. Initial test simulations used 12-month linked microdata universe files and as refinements were made, tests were expanded to use 60-month files to study design effects over time. Design options were studied in terms of their effect on State level estimates, detailed industry estimates, and MSA estimates; additional consideration was given to the ability to make small area estimates.
- *Estimator Research:* This research focused on editing/outlier detection, reweighting for atypical units, imputation options, alternative forms of the

estimator, and the appropriate cell level for applying population controls. In addition to developing an employment estimator, separate estimator research was conducted for the hours and earnings data elements where unlike the employment data, universe counts do not exist.

- *Solicitation Research:* In the redesign, CES solicitation will be conducted using CATI procedures. Research was conducted at the two BLS regional collection centers and at the Michigan Research Center facility. The research looked at cost-effective methods of sample refinement, the initial contact materials, the correct point of entry into the firm, alternative version of the questionnaire, profiling employer reluctance issues, and refusal conversion techniques. A final solicitation protocol is being developed and tested in the BLS collection centers.

In June of 1997, the Bureau announced the completion of the research phase and the beginning of the Production Test/Implementation phase. The results of the research phase are being documented in a set of papers being presented at the 1997 Annual Meeting of the ASA.

V. CES Redesign Production Test and Implementation Phase

The research phase of the Redesign applied sampling theory principles to fixed universe files and through a series of simulations, identified design and estimator properties which satisfied the survey's publications goals; the production test phase will now test the proposed design in a live survey environment.

A sample for the Wholesale Trade industry has been selected under the new design and is now being solicited for ongoing monthly collection. The CES Production Test is being conducted as an independent parallel sample to the current CES sample. During the 2-year production test, monthly estimates from the new parallel Wholesale Trade sample will be constructed and evaluated for conformance to both the design expectations and the quarterly universe counts.

The initial goals of the Production Test are to field test and refine the new survey operations and procedures; to validate systems and data flows; to provide unit cost and workload measures; and to identify streamlining options to reduce cost, workload, and potential error sources. Solicitation and ongoing response rates will be closely monitored along with the accuracy of the microdata being collected. Measures of sampling error will be calculated for levels and over-the-month change and compared to design expectations.

As quarterly universe counts become available (on a 9-month lag basis), the monthly sample estimates will be compared to the corresponding universe counts. Differences will be studied in terms of disaggregated error components for births, deaths, and continuing units. The imputation procedures will also be evaluated against the monthly population employment data reported under the mandatory UI tax system. The evaluation phase will also include an assessment of the non-economic effects on monthly change estimates due to survey activities such as quarterly sample maintenance and imputation updates. As a sufficient number of monthly estimates become available for the major publication cells, the seasonal pattern from the new design will be evaluated against the corresponding universe series and the current CES sample.

If the results from the evaluation phase are acceptable, the new Wholesale Trade sample will be put into ongoing production in June 1999 and the old sample for the industry will be discontinued. Subsequently, each major industry division will be phased-in after a similar period of parallel estimation and evaluation.

REFERENCES

Butani, S., G. Stamas, and J.M. Brick (1997), "Sample Redesign for the Current Employment Statistics Survey", *Proceedings of the Section on Survey Research Methods*, American Statistical Association, in print.

Clayton, Richard L. (1997), "Implementing Fully Electronic Data Collection in the Redesign of the Current Employment Statistics Survey", *Proceedings of the Section on Survey Research Methods*, American Statistical Association, in print.

Getz, P.M., J. Kropf, and S. Strifas (1997), "Measuring the Contribution of Business Births and Deaths to Overall Employment Movements", *Proceedings of the Section on Survey Research Methods*, American Statistical Association, in print.

Groves, R.M., D.I. Cantor., K. McGonagle, and J. Van Hoewyk (1997), "Research Investigations in Gaining Participation from Sample Firms in the Current Employment Statistics Program", *Proceedings of the Section on Survey Research Methods*, American Statistical Association, in print.

Harter, R.M., and K.M. Wolter (1997), "Estimators for the Bureau of Labor Statistics' Current Employment Statistics Program", *Proceedings of the Section on*

Survey Research Methods, American Statistical Association, in print.

Stamas, G., K. Levin, D.I. Cantor, and K.L. Goldenberg (1997), "Sampling for Employment at New Establishments in a Monthly Business Survey", *Proceedings of the Section on Survey Research Methods*, American Statistical Association, in print.

Werking, George S. (1994), "Establishment Surveys: Designing the Survey Operations of the Future", *Proceedings of the Section on Survey Research Methods*, American Statistical Association, Invited Panel on the Future of Establishment Surveys, pp. 163-169.

Werking, G.S., and R.L. Clayton, "Enhancing Data Quality Through the Use of Mixed Mode Collection", *Survey Methodology*, June 1991, 17, No. 1, pp. 3-14.

Werking, G.S., A.R. Tupek, and R.L. Clayton (1988), "CATI and Touchtone Self-Response Applications for Establishment Surveys", *Journal of Official Statistics*, 4, No. 4, 1988, pp. 349-362.

West, S.A., D.-T. Kratzke, and P. Grden (1997), "Estimators for Average Hourly Earnings and Average Weekly Hours for the Current Employment Statistics Survey", *Proceedings of the Section on Research Survey Methods*, American Statistical Association, in print.