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KEY WORDS: sample redesign, sample areas

1. Introduction

Three of the Bureau of Labor Statistics compensation survey programs, the Employment Cost Index (ECI), the Employee Benefits Survey (EBS), and locality wage surveys, were integrated, creating one comprehensive National Compensation Survey (NCS) program. The ECI publishes national indexes which track quarterly and annual changes in employers' labor costs and also cost level information, previously annually but now quarterly, on the cost per hour worked of each component of compensation. Annual incidence and detailed provisions of selected employee benefit plans are published by the survey that was formerly known as the EBS. The locality wage surveys program publishes locality and national occupational wage data.

Currently, the locality wage estimates are produced for metropolitan areas and non-metropolitan areas as defined by the Office of Management and Budget (OMB) in 1994. In 2003 OMB released a new set of area definitions. The new area definitions define a set of Core Based Statistical Areas (CBSA) and designate the remaining geographical units as outside CBSA counties. The CBSA areas are divided into Metropolitan Statistical Areas and Micropolitan Statistical Areas. The NCS sample needs to be redesigned to incorporate the new metropolitan area definitions.

Section 2 of this paper provides a brief summary of the current NCS sample design and then an explanation of the new sample of areas, based on the new area definitions, that has been selected for the NCS. In Section 3, we will discuss various options that were proposed for implementing the new area sample, along with pros and cons of each. In section 4 we then present the actual transition plan that will be used for the NCS. Finally, Section 5 will list future work that is needed before the transition is complete.

2. NCS Sample Design and New Area Sample

The integrated NCS sample of about 37,000 establishments covers State and local governments and private industry, except for agricultural units and private households. The private industry sample consists of five rotating replacement sample panels. Each of the five sample panels will be in sample for five years before being replaced by a new panel selected annually from the most current frame. A new state and local government sample for the NCS is selected and replaced less frequently. A government replacement sample is not selected annually because government units are generally more stable and do not change as rapidly as private industry establishments. The current plan is to select and replace the government

sample when new area definitions are introduced, that is, every 10 years.

The NCS sample is selected using a three-stage stratified design with probability proportionate to employment sampling at each stage. The first stage of sample selection is a probability sample of areas; the second stage is a probability sample of establishments within sampled areas; and the third stage is a probability sample of occupations within sampled areas and establishments.

Currently the NCS sample consists of 152 areas based on OMB's 1994 area definitions. Of the 152 areas, 34 areas were selected with certainty. Three out of the 34 certainty areas would not have been certainty based on total employment, but were added to meet the needs of the President's Pay Agent, a primary customer, because of their large federal employment. (The President's Pay Agent consists of the Secretary of Labor and the Directors of the Office of Management and Budget and the Office of Personnel Management. The Pay Agent makes recommendations for locality pay rates for federal workers.) These 152 areas comprise (1) MSAs, areas with a central city of 50,000 or more people and a total area population of at least 100,000, (2) CMSAs, large integrated areas of 1 million or more people consisting of two or more Primary Metropolitan Areas, and (3) non-metropolitan areas, areas that are not part of an MSA or CMSA.

The new OMB area definitions define CBSAs and outside CBSA counties. A CBSA is a geographic entity associated with at least one core of 10,000 or more population, plus adjacent territory that has a high degree of social and economic integration with the core as measured by commuting ties. The CBSA areas are divided into Metropolitan Statistical Areas and Micropolitan Statistical Areas. Metropolitan Statistical Areas, are areas based on urbanized areas of 50,000 or more population, and Micropolitan Statistical Areas, are based on urban clusters of at least 10,000 population but less than 50,000 population. The new area definitions also include the Combined Statistical Areas (CSA). CSAs are comprised of two or more CBSAs.

The NCS has selected a new sample of areas using the 2003 CBSA and outside CBSA definitions which will replace the current set of primary sampling units (PSUs) defined by MSAs and non-metropolitan counties. For the CBSAs, a PSU is defined to be either a CSA, a Metropolitan Statistical area, or a Micropolitan Statistical area. For the counties that are not included in a CBSA, a PSU is defined to be a county or group of counties with generally at least 10,000 employment. A total of 152 PSUs were selected for the new area sample. Of the 152 areas, 57 of them were selected with certainty. One of the 57 certainty areas, Huntsville, would not have been certainty

based on total employment, but was added to meet the needs of the President's Pay Agent. In addition, for 27 of the certainty areas, the NCS is using the Combined Statistical Area (CSA) definition instead of the MSA definition. The CSA definitions are used in these areas to also meet the needs of the Pay Agent.

After the certainty area were selected, the remaining 95 areas were allocated, proportional to total employment, across 27 cells defined by census division and type of area (metropolitan, micropolitan, or county cluster). For selection, the areas were stratified by census division and area type and then sorted by the PSUs average annual wage. The non-certainty micropolitan areas and county clusters were selected proportional to size within the defined strata. The metropolitan areas were selected using an overlap maximization technique based on the Causey, Cox, and Ernst (1985) method.

The final new area sample includes 27 Combined Statistical Areas, 90 Metropolitan Statistical Areas, 22 Micropolitan Statistical Areas, and 13 County Clusters.

3. Transition Plan Options

Once the new sample of areas was selected, a plan was needed to transition from the old area sample to the new sample. Many factors were considered when developing a transition plan including resources, impact on estimates and variance estimates.

A number of potential transition plans were developed. These plans were evaluated in two ways. First, plans were compared against a list of sample design priorities and statistical issues. Transition plans were ranked based on how well they met sample design criteria and how they affected various statistical issues. Second, the plans were analyzed to determine the amount of data collection and processing resources that would be needed to complete the transition. Any plans that significantly exceeded the amount of available resources were considered not viable.

A list of ten sample design priorities was developed and used to rank possible transition plans. These ten priorities were:

1. Continue regular publications for ECI, ECEC, benefits, and national wage estimates
2. Rapid implementation of areas new to NCS
3. Rapid implementation of a new government sample
4. No large impacts on variances due to large sample weights
5. All collected data used in national estimates together with sample group weighting factors that optimize variances. (Sample group weighting factors are discussed in Section 3.)
6. Produce some locality estimates using full sample sizes and new area definitions only in less than 5 years
7. Minimal or no additional complexity to final weight calculations
8. Entire universe represented in each replacement sample group
9. No differential bias due to time in sample effects (Ideally, to avoid such bias while satisfying priority 5, in each industry and in each area 1/5 of the sample should be in each of the five most recent replacement groups.)
10. Complete replacement of old area sample in 5 years or less.

When evaluating potential transition plans, one of the basic needs was to be able to continue the regular estimation and publication schedule for the primary outputs of the NCS, namely the ECI, the ECEC, the benefit products, and the wage estimates for large metropolitan areas and the nation. All potential transition plans needed to meet this condition, priority 1.

In addition to maintaining the publishability of current large locality areas, an emphasis was placed on the ability to publish estimates for areas new to NCS as quickly as possible while continuing the publication of estimates in areas dropping out of the NCS for as long as possible, which is priority 2. As will be seen, we were not completely able to meet this priority

Another key element of the final transition plan would be the ability to select and implement rapidly a new sample of state and local government establishments. The current NCS government sample is aging and needs to be replaced as soon as possible given the sample design and other desired sample enhancements, that is priority 3.

Developing a transition plan that balanced the need to continue current products, expedite estimates in new areas, and rapidly implement a new government sample proved very challenging. Many different options were considered before being rejected. Next, we'll discuss different features of rejected plans, how they attempted to address the sample design priorities listed above, and why they were not acceptable.

First we considered plans that continue a standard 5-year rotational sample replacement design for both private industry and government. This plan would maintain the current sample design and therefore allow for regular publication of the current NCS products. However, it did not fulfill many of the other requirements. A standard 5-year rotation of private and government units does not allow for a rapid implementation of areas new to the NCS sample. Only after 5 years would a full sample be available in every new area.

Another key disadvantage is that it would take an additional 5 years to replace the current government sample, meaning that some government units would have been in sample for more than 15 years by the time they drop out. Our past experience also shows that it takes more time and data collection resources to initiate government units. Thus adding annual government initiation work on top of the annual private industry data collection would exceed the available data collection resources. In addition, spreading out initiation of a new government sample would affect planned publication of benefit estimates. Government and total civilian benefit estimates would not be published during the early years of the transition.

Computing such estimates using only a small portion of the new government sample would have a severe negative impact on variances since we have not collected all the necessary benefits data in the current government sample. Rejecting plans with this feature meant that a non-traditional rotation would be necessary for the transition.

Two of the proposed non-traditional plans involved collection years for which initiations would only take place in incoming areas and for one of these plans a collection year for which sample would only be dropped from outgoing areas. This would cause weighting problems, that is, priority 7 would not be satisfied. This is because the probability that an area is an incoming sample area is the joint probability that it was not in the old sample and is in the new sample. Because we have used an overlap maximization procedure to select the new sample areas (Ernst, Izsak, and Paben 2004), these joint probabilities are not easy to calculate. More importantly, they can be very small, which can result in large weights and consequently large variances. The weighting problem for outgoing areas is analogous. Note that for some areas, because of the use of an overlap procedure, the probability that an area is incoming or the probability that it is outgoing may even be 0. In either case, biased estimates will result unless a complicated weighting process is used, which increases the weights for these areas for some sample groups to compensate for the sample groups in which these areas have no chance of having any sample.

One proposed non-traditional rotation pattern involved replacing the complete government sample in the first year. To alleviate the problem with workload and resources, less than the standard 20% of the private industry would be initiated in the first year. The remaining private industry sample would be spread out over years 2-5. Although this approach eased the resource issues in year 1, it exacerbated the problem in years 2-5. NCS was near its maximum data collection workload with just 20% of the private industry sample. Adding any additional data collection on top of this would exceed available resources. This plan also fails priorities 8 and 9 because the initiations for the government are only in the first year and the initiations for private industry are not distributed uniformly over the five years. However many of the other non-standard plans do worse with respect to these two priorities.

Spreading government replacement over 5 years or compacting private industry replacement in a time frame of less than 5 years didn't work. Next we looked at plans which initiated and rotated new samples differently, by area, instead of across all areas. Some options rotated sample in particular census divisions each year. This type of plan would result in a rapid implementation in at least some of the areas allowing estimates in these areas to publish sooner than 5 years using new area definitions only, that is satisfying priority 6. However, this type of rotation would fail priorities 8 and 9, possibly in a severe way; it would impact national estimates like the ECEC. Some localities have a higher average annual compensation than other areas. Introducing a new sample group to the NCS that only contains units from a section of the areas could create a spike in certain estimates at the national level. If the localities also have different rates of change in compensation then analogous spikes could occur in ECI.

Other disadvantages of rotation by area or groups of areas instead of across all areas would be that establishments from some areas would remain in the sample longer than the originally planned 5 years. In some variations of this type of transition plan, old sample units would remain in sample 2-3 years longer than originally planned. When data is first collected from an establishment, a set of occupations are sampled from all occupations that exist in that establishment at that time. This set of occupations stays fixed until the establishment rotates out of the sample. The longer a unit stays in sample, the more likely it is that the mix of occupations originally selected no longer represents the current picture of that establishment or its industry. In addition, the longer a unit stays in sample, the higher the attrition rate as establishments can go out of business or occupations can be abolished or down-sized.

Rotation by area(s) would also result in a number of complexities in the weighting process used for the NCS. The current sample design, with each replacement sample group representing the entire geographic scope of the survey, results in a weighting factor applied to each sample group as a whole so that the final weights are correct when multiple sample groups are combined together for estimation. Altering the annual replacement sample groups such that only a subset of areas are represented in a given year would make this weighting factor process much more difficult.

Transition plans that phase in sample faster in some areas (such as incoming areas new to the NCS) or that phase out old sample faster in some areas (such as areas dropping out of the NCS sample) are susceptible to failing priority 5 because they result in estimation problems. However, these problems can be handled in one of three ways.

(1) Use only a portion of the new data in national estimates
(2) Use weighting factors that are not optimal for all areas
(3) Use optimal weighting factors that vary at the area or county level

Instead of using all new data, national estimates would only use a portion of the sample from new areas. The proportion used in a sample group would be the same as the ratio of the proportion of new sample in the rest of the areas for that sample group to the proportion of new sample in the new areas. For example, if year one initiated 50% of the sample in new areas and 10% of the sample in other areas, only 20% of the data from the new areas would be used in national estimates. This eliminates possible weighting complications but would have an impact on variances since only a portion of the new data is used. Clearly, this is also not desirable from an operational standpoint. One never likes to throw away collected data.

In option #2, the entire sample collected in new areas would be used in estimates but the sample group weighting factor would be the same as used for other areas. Continuing the example from above, the factor used for all areas would be .1, based on the 10% sample rotation used in areas that are not new to the sample. Although all the data is used, the method would result in an inefficient use of sample in estimation for the new areas. This would result in larger variances than would occur if higher sampling factors were used for the new areas.

The last option would use all data from new areas in estimation but use weighting factors for each sample panel that optimizes the variances. To do this, different sample group weighting factors would be needed for each area and in some cases, factors would need to vary by county within an area to adjust for differences between old and new area definitions. Otherwise, the sum of the factors for a county that moves from one area to another in the new design might not sum to 1 and result in biased estimates. As mentioned above, this type of arrangement would make the weight adjustment process in NCS much more complex and very difficult, operationally, to implement. Even though these estimation problems can be handled as described above, these plans were rejected due to the operational complexity involved in implementing the required estimation modifications and due to data collection workload considerations.

Data collection in transition plans that rotate by area would also be very difficult. NCS data collection staff are stationed throughout the U.S. Designating only certain areas for initiation each year would require a significant shifting of data collection resources within or between regional offices to handle the changing number of initiation areas each year. This shifting of resources was not considered to be reasonable.

Ultimately, all plans that completed the transition from the old area sample to the new area sample and replaced the government sample in five years or less were rejected. The workload associated with this time frame exceeded available data collection resources.

One common feature in almost every proposed transition plan was a "mixing" of old and new area definitions for a particular area. Of the 78 areas in common between the old and new area sample, only one-third (25 areas) had no change in the definition. If the transition does not entirely replace the old sample all at one time, then locality estimates will be calculated based partly on data collected from establishments in the old area definition and partly from establishments in the new area definition. While this does not cause any statistical problems in estimation, one must be careful that the data users are aware of the differences.

Finally, we looked at the proposed transition plans to assess the complexity of the rotation schedules and how that would affect annual replacement samples after the initial transition to the new area sample. It was desirable to return to the 5-year annual replacement rotation scheme after the transition was complete, but we had to be concerned with how to rotate out the sample groups created

during the transition. If new replacement groups were introduced in a manner much different than the standard rotation plan, that is, with the new sample introduced at different rates in some areas than others, it would be difficult to convert these groups to rotate out using the standard rotation plan.

4. Final Transition Plan

After considering many variations of the plans described above, a final transition plan was chosen. The new NCS area sample will be introduced over 6 years. In the first year, an entire new state and local government sample will be initiated and completely replace the old government samples. There will not be a new private industry sample the first year; the private industry sample will be frozen for one year and the last 5 annual private industry samples will continue to update data collection. After the first year, the government sample will be frozen. In year 2, a new private industry sample will be introduced across all areas, similar to the current NCS sample design. The private industry sample will continue to be replaced in years 3-5. At the end of 6 years, all samples from the old set of areas will have been replaced by samples using the new area definitions only.

This plan has many advantages. First, it fulfills the need to replace the current government sample as quickly as possible and allows for calculation of government estimates for all products after the first year, satisfying priority 3. Second, after the year #1, the plan maintains the current 5-year rotational sample design currently used in the NCS. Therefore, no additional complexity is added to the weighting, estimation, or variance estimation processes and priorities 4, 5, and 7 are satisfied. Finally, this plan corresponds with the projected data collection resource budget in each of the 6 years. The sample size and amount of work needed to initiate a new government sample is roughly the same as needed for each of the 5 annual private industry replacement samples.

As expected, it was not possible to develop a transition plan that fulfilled every desired goal. Delaying the implementation of the private industry replacement samples by one year to replace the government sample means that the older private industry samples will remain in sample one year longer than originally intended and priority 2 is not satisfied. However, we do not expect that one additional year in sample will have much of an impact on the response rates.

Another disadvantage of this plan is the length of time it will take to fully transition from the old sample based on old area definitions to the new area sample based on the new area definitions. The NCS active establishment sample will not be completely based on the new area sample until after all six years of annual replacement samples are complete, at this time in mid-2012, thereby failing to satisfy priority 10, although it appears that no plan could have satisfied this priority given the available data collection resources. During this time period, estimates for 53 of the areas common to both the old and new area samples will continue to be a mix of area

definitions. For areas new to the NCS sample, it will take 6 years before estimates can be calculated based on the full sample size and it will be difficult to inform respondents and customers when to expect a robust publication and priority 7 is not completely satisfied.

Finally, as is generally the case for non-traditional rotation plan, this plan does not satisfy priorities 8, and 9. For the final plan, priority 9 is not satisfied mainly due to different time in sample distributions between the government sample and the private sample. Similarly priority 8 is not satisfied since the government sample and the private industry sample appear in different replacement sample groups, although this causes relatively few problems.

5. Future Work and Conclusion

Although the general transition plan has been determined, there is still much work to be done. Publications may be redesigned to address the mixing of area definitions and the introduction of a new government sample in some areas prior to initiation of any private industry units. Data collection procedures need to be determined for handling new establishment sample units that overlap pre-existing sample units, especially for certainty establishments selected with the new private industry samples. (The key issue here is when an establishment is selected for a replacement group and is still in sample for a previous replacement group, do we select a new set of occupations for the establishment and, if so, are both sets of occupations used in the estimates or only the newly selected set.) Finally, there is a need for additional advertising of the transition plan and its effect on all of the NCS products so respondents and customers are kept informed and are able to interpret the data correctly.

6. References

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