**B.  COLLECTION OF INFORMATION EMPLOYING STATISTICAL METHODS**

Eighty-seven geographic areas or Primary Sample Units (PSU's) Nationwide continue to be the boundaries from which housing units are selected based on 2000 Census data. Technical details of the sample design and estimation procedures of the Consumer Price Index are provided in Chapter 17 of the *BLS Handbook of Methods,* as well as "Redesigning the Consumer Price Index Area Sample" by Johnson, Shoemaker and Rhee, from the *2002 ASA Proceedings*.  This phase of implementing the sample design highlights the activity of replacing base sample, units selected using 1990 Census data, with units selected based on 2000 Census data.  A paper entitled *Cost Benefit Analysis: CPI 2007 Revision* outlines initial high-level research on statistical procedures used currently in calculating the CPI.  See Attachment V.

## 1.      Universe and Sample Size

The universe for the CPI Housing Survey consists of all urban rental-housing units.  The number of year-round rental housing units in the potential respondent universe is approximately 40 million units.* These units are distributed:

|          |            |
|----------|------------|
| Renters  | 38,443,000 |
| Vacant   |  4,087,000 |

\* Source:  Table l1. Estimates of the Total Housing Inventory for the United States:  2010 and 2011, Housing Vacancies and Homeownership (CPS/HVS), U. S. Census Bureau.  http://www.census.gov/hhes/www/housing/hvs/annual11/ann11ind.html.

The Rent index measures changes in rents paid by tenants and received by landlords adjusted for changes in quality.  The Owners' Equivalent Rent index (OER) measures the change in the implicit rent for owner-occupied housing.  The implicit rent is the amount the homeowner would pay to rent, or earn from renting his/her home in a competitive market.  It is for the construction of these indexes that a sample is selected and information gathered.  The sample design requires a sample size of approximately 10,000 segments with five units per segment, or, 50,000 housing units in 87 PSU's.

## 2.      Collection Procedures

The collection instruments for prescreening and CADC are found in Attachments II and III, respectively.

## 2.a.      Description of Sampling Methodology

A multi-stage sampling process is used in the CPI.  For Housing the main steps are:
(1) the sampling of geographic areas (segments);
(2) configuration and weighting of selected segments;
(3) the purchase of coded addresses for selected segments;
(4) the elimination of addresses with a very high probability of being owners and addresses that can be identified as commercial and post office boxes;

(5) the sampling of specific addresses in the segments;
(6) the mail prescreening of selected addresses by renter tenure; and
(7) the telephone/personal visit screening and initiation of eligible addresses from which rent prices will be followed over time.

## 2.b.  Description of Estimation Methodology

The CPI-U and CPI-W are defined as fixed quantity price indexes, and are the ratio of the cost of purchasing a set of items of constant quality and constant quantity in two different time periods.  The published CPI for the Rent and Owners' Equivalent Rent (OER) strata use a Laspeyres estimator.

The Laspeyres index,  $I_{t,0}^{L}$  , where "t" is the comparison period for which a new index is to be calculated and "0" the reference period, can be denoted by:

$$I_{t,0}^{L} = \frac{\sum_{i} P_{i,t} Q_{i,0}}{\sum_{i} P_{i,0} Q_{i,0}} * 100.0$$

where:

$P_{i,t}$   is the price for the ith item in comparison period t,

$P_{i,0}$   is the price for the ith item in reference period 0,

$Q_{i,0}$   is the quantity of the ith item consumed in the reference period 0.

The indexes for the Rent and OER strata are specifically calculated as follows:

Let   $S_6$   be the set of rental units interviewed in the Housing survey in time t in a market basket with valid comparable rents in both time t and in time t-6.  Vacant units that were previously renter occupied are also included in   $S_6$   and have current (t) and previous (t-6) month's rents assigned using a vacancy imputation process.  Non-interviewed units that were previously renter occupied are also included in   $S_6$   and have current (t) and previous (t-6) month's rents assigned using a non-interview imputation process.  Let the rent for rental unit i in time t be   $r_{i,t}$   and let   $a_{i,t}$   be a factor that adjusts for the estimated small loss in quality due to the aging it experienced between t-1 and t.  The 6-month estimate of rent change is calculated by:

$$R_{t,t-6}^{L} = \frac{\sum_{i \in S_6} r_{i,t} * W_{i6}}{\sum_{i \in S_6} r_{i,t-6} \, \dot{\iota} \, e^{(-6a_{i,t})} \, \dot{\iota} \, W_{i6}}$$

Where:

$W_{i6}$   is the renter unit's inverse probability of selection adjusted for non-response.

Using $R_{t,t-6}^L$ and the index for the previous month, $I_{t-1}$, the BLS computes the current month's rent index, $I_t$, as follows:

$$I_t = I_{t-1} * (R_{t,t-6}^L)^{1/6}$$

The final Rent and OER indexes for month t for each market basket are last month's index times the sixth root of the six-month relative.

The rents for renters are obtained directly. The basic weights for Rent and OER were computed with the initiation of the sample design.

## 2.c. Degree of Accuracy Required

The statute mandating the CPI does not specify a required precision or accuracy for the index. However, the BLS does provide measures of the standard error for the All U. S. CPI (CPI-U) and for the Northeast, Midwest, South and West Regions CPI (CPI-U). The most recent standard error data can be viewed at http://www.bls.gov/cpi/cpivar2011.pdf. The BLS also requires that the precision of the CPI be maximized given the total cost constraint imposed by the authorized spending level. The allocation of the Rent sample was optimized given a fixed cost constraint with the stipulation that the variance of the Rent Index and the Owners' Equivalent Rent index be approximately equal.

## 2.d. Special Sampling Procedures

Due to the difficulty in contacting some respondents, data on the rental units are collected through most of the index month.

## 2.e. Use of Periodic Data Collection Cycles

The rental units in the CPI survey are divided into 6 subsamples, called panels. Each month one-sixth of the renter units will be contacted. This reduces the burden on each respondent.

## 3. Methods to Maximize Response Rates

The Bureau of Labor Statistics has constantly engaged in research to improve the quality of the data collected and used in the CPI Housing indexes. The CPI collects data in a sample of 87 metropolitan areas called Primary Sampling Units (PSUs). The majority of the current sample, 32,000 rental units, were selected based on 1990 Census data. It is of paramount importance to the BLS to replace these units with units selected on the basis of 2000 Census data. Augmentation segments were selected based on 2000 Census data. To ensure consistent weighting of the old segments (based on the 1990 Census data) and the new segments (based on the 2000 Census data), the old segments were mapped into the 2000 Census sampling frame and reweighted. Sample augmentation began in 2009 to

increase the number of rental units by 16,000.  The expansion focused on seriously depleted neighborhoods.

The survey design for the new sample of rented units has two important features:  First, commercially available address lists are being used in place of a manual listing process, resulting in significant cost savings.  Second, a mail pre-screening survey is being employed to identify and screen out owner-occupied housing units in advance of in-person data collection.  The augmentation was implemented in four 6-month cycles (waves).  The first wave of units was first used in the CPI starting in July 2010, the second wave in January 2011, the third wave in July 2011 and the fourth wave in January 2012.  See Attachment VI for further information on the new renter sample.

The prescreening and mail survey processes are described as follows:  Initially, a vendor supplies addresses for each newly-created segment with codes that indicate the probability that the address is an owner.  Since owners are out of scope for the Housing Survey, addresses that are most certainly owners are removed.  Addresses that can be identified as commercial and post office boxes are also removed.  The remaining addresses are sampled for a prescreening of prospective renters.  Another vendor distributes and collects the mailed prescreening forms.  Additionally, telephone numbers may be collected through the prescreening process.

The BLS utilizes several techniques to insure that adequate sample sizes and response rates are maintained for estimating the CPI.  Initial sample sizes are larger than the desired sample sizes to cover non-responses, i.e., out-of-business, refusal, unable to locate, and housing units that convert to owner, among other reasons.

Response rates are tracked and EAs who collect the data are trained to obtain complete address and telephone information for all possible eligible respondents--tenants, managers or authorized respondents--in order to complete the survey.  Any potential respondent may be contacted by telephone or in person at any time during the index collection month time period.  In 2011, the non-response rate was 13.4%.  Of the 86.6% that did respond, 78% reported a rent and 8.6% were reported as vacant.

In the CPI Housing survey, two types of imputations are employed.  For non-responding units, a current price is imputed based on the movements of similar responding renters within the PSU.  Units that are reported as vacant have rents imputed for them as well. Rents for newly vacant units, that is have become vacant within the previous six months, are imputed using responding rental units that have been occupied by the current tenant for six months or less.  Rents for longer term vacant units are imputed using responding rental units that have been occupied by the current tenant for longer than six months.  For all imputations, a group-mean imputation is used.

## 4.    Testing Procedures or Plans

With submittal of this Information Collection Budget package, the next phase of the sample redesign begins.  The replacement of the 32,000 units that were selected based on the 1990 Census data will be implemented in eight six-month waves over four years.  The

first replacement wave of units will first be used in the CPI in November 2012, the second wave in May 2013, and so on through May 2016. We are requesting additional burden hours for sample replacement. This request assures the smooth and orderly continuation of data collection for new segments in each of the 87 existing geographic areas.

By the end of the replacement phase of this process, rotation of the sample will commence. BLS statisticians intend to design a new sample frame. Because the rental expenditure data that is used in selecting the CPI Housing sample has been dropped from the Decennial Census starting in 2010, future samples will likely use data from the American Community Survey, either instead of or in addition to Decennial Census data. The sample selection process will continue with the same procedures as with sample replacement, as described above. One sixth of the sample will be initiated and replaced each year over the next six years. This will occur in waves.

## 5.     Statistical Contacts

W. John Layng, Assistant Commissioner for Consumer Prices and Price Indexes (telephone 202-691-6955) and Steven P. Paben, Chief, Division of Price Statistical Methods in the Office of Prices and Living Conditions of the BLS (telephone: 202-691-6147) have reviewed and approved the statistical methodology for the survey design. Other than the mail prescreened data, the Office of Field Operations of the BLS will collect all data. The data will be processed by the Division of Consumer Price Computer Systems of the Directorate of Survey Processing of the Office of Technology and Survey Processing of BLS. Michael W. Horrigan, Ph.D., Associate Commissioner, Office of Prices and Living Conditions of BLS has overall responsibility for the CPI.

OMB Supporting Statement Attachments:

    I.        Code of Laws—Title 29

    II.        Consolidated Prescreening Forms (Provided to Strategic Research Group)

    III.        Screen Shots—Collection Instrument for Housing

    IV.        Draft Housing Survey Brochure

    V.        Cost Benefit Analysis: CPI 2007 Revision

    VI.         Updating the Renter Sample

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