Measurement Error in the CE: Monitoring the Quality of the Estimates

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Roger Tourangeau, Lucilla Tan, Brian Meekins and Brandon Kopp, July 15, 2014

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Introduction

• Based on our review of the state of knowledge about the error in the Consumer Expenditure Survey (CE), we concluded that less was known than was desirable

• In addition, we should be able to track how well the CE is doing over time

• As a practical matter, most of the measures proposed track overall error in the CE, not just measurement error
MMMI approach

• Many methods have been used to assess error in the CE, each with their strengths and weaknesses

• We recommend an multi-method-multi-indicators (MMMI) approach that consists of three main categories:
  — Internal indicators (based solely on CE data or paradata)
  — External indicators (compare estimates from the CE to an external data source)
  — Comparison of CE production estimates with “gold standard” interviews
MMMI approach—II

• Precisely because no one approach is perfect, we think coming at this from several angles will provide a much more comprehensive picture of the CE quality

• It is time to move away from reliance on the PCE estimates as the main basis for evaluating the CE
Criteria for External Indicators

• Comparability: Is the external estimate comparable to the CE

• Consistency: Do the estimates show a similar magnitude difference from CE estimates over repeated survey administrations?

• Ease of producing the estimate: How difficult are the benchmark estimates to produce? Can they be produced in a timely manner without undue burden on the CE Survey staff?

• Timeliness and periodicity of the benchmark estimate: What is the elapsed time between data collection and publication of the benchmark estimate? How frequently are the data collected?

• Comprehensiveness: Taken together do the various benchmarks provide an overall picture of error in CE estimates (across multiple sections, waves, and time periods)?
External Indicators

• Comparison to external data sources

• Two main external sources
  — Personal Consumption Expenditures from NIPA (National Income and Product Accounts)
  — Compare CE estimates with other surveys (e.g., MEPS, PSID, RECS)

• Weakness—Although PCE covers many categories and a lot of work has gone into establishing “concordance” of PCE/CE categories, errors in PCE are not well established; not clear external benchmarks are really more accurate than the CE
### Some Candidate Indicators

<table>
<thead>
<tr>
<th>CE Category</th>
<th>MEPS</th>
<th>PSID</th>
<th>NHEA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physician Services</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Dental Services</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Eyecare services</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonphysician services (excluding dental and eyecare)</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Hospital-inpatient</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Prescription drugs</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Vision aids</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Some Candidate Indicators--2

<table>
<thead>
<tr>
<th>CE Category</th>
<th>ACS</th>
<th>AHS</th>
<th>RECS</th>
<th>PSID</th>
<th>PCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Total Other Fuels</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel Oil</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Propane/LPG</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kerosene</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Fuels (Wood, Coal, etc.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water/Sewer</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Garbage</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Primary Mortgage</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Rent</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Homeowner's Insurance</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Property Tax</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>
### External Indicators

Expenditure Shares for our 3 illustrative examples

<table>
<thead>
<tr>
<th>CE Category</th>
<th>Expenditure Share (2011)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>2.9%</td>
</tr>
<tr>
<td>Rent</td>
<td>6.1%</td>
</tr>
<tr>
<td>Prescription Drugs</td>
<td>1.0%</td>
</tr>
<tr>
<td>Average Annual Spending</td>
<td>$49,705</td>
</tr>
</tbody>
</table>
Combining External Indicators

• To increase the robustness of the external comparisons, we recommend taking weighted averages of the external estimates for the commodity

• The weights would reflect the reliability of the ratio of the CE estimate to the external indicator over time and would downweight estimates that show large fluctuations over time

• For a given commodity category, a ratio $r_{j,t}$ is constructed for each selected implementation from source $j$ ($t$), dividing the CE estimate for the commodity with the external source estimate.

• An average of the ratios is taken, where $\bar{r}_j = (\sum^T r_{j,t})/T$, where $T$ is the total number of time points from external source $j$. Next a variance is computed, $s^2_j = \sum^T (r_{j,t} - \bar{r}_j)^2$ for each external source $j$. The estimates from all external sources are then combined using a weighted average at each time, $t$.

• Where the weighted average is given by, $WR_t = \frac{\sum^J (\bar{r}_{j,t} * 1/s^2_j)}{\sum^J 1/s^2_j}$, where $J$ is the total number of external sources.
An Example

- The external sources for electricity are PCE, ACS, AHS, RECS, and PSID.
Another Example

- The external sources for rent are PCE, ACS, and AHS.
Internal Indicators

• Internal indicators should be robust, easy to interpret, and based on similar metric to the external indicators.

• Candidate indicators include both commodity- or section-specific indicators and interview-level indicators.
  — Section specific indicators:
    ✦ record use
    ✦ section interview time
  — General indicators
    ✦ Willingness to provide income data
    ✦ The number of attempts required to complete and interview

— The indicators are then evaluated by examining their relationship with the reported expenditure of the commodity category. Those showing no relationship or a weak relationship with expenditure are discarded.
Latent Class Models for Combining Internal Indicators

• Four variables seem to have strong relation to reporting across a number of commodity categories:
  — Use of the infobook (+);
  — Whether the interview is done by telephone (-);
  — Whether R used records (+);
  — Commodity-specific time (+)

• Classify respondents into one of two latent classes based on these variables

• Construct ratios of mean expenditures reported by all reporters over “good reporters”
An Example

The external sources for electricity are PCE, ACS, AHS, RECS, and PSID.
Another Example

- The external sources for rent are PCE, ACS, and AHS.
One More

Prescription Drugs - Survey Ratios

- External
- Wtd External
- Internal
- CE/NHEA
Gold Standard Interview

• Key to assessing validity of internal and external indicators—Are the ratios in the internal and external indicators for a given commodity category similar (e.g., <1) to those from the gold standard interview (that is, GS estimate/production estimate)?

• Also, key to establishing level and direction of errors

• Borrows many features of the proposed new CE interview

• Five key features:
  — Initial bounding interview
  — Short reference period
  — Reliance on aided recall (records, diaries); prospective collection of records
  — Reduced burden
  — Contingent incentives
Some Topics for Research

• We see at least four factors as critical for successful gold standard interview

  — Incentives for records collection or diary keeping

  — Other inducements for encouraging record keeping

  — Length of reference period (burden versus stability of estimates)

  — Selection of commodity categories
Conclusions

• No one approach is perfect

• We recommend building on past efforts

• Develop a time series with multiple indicators
  — Internal indicators
  — External indicators
  — These are both inexpensive
  — Still, given the flaws, they should be supplemented with periodic (but regular) gold standard interview studies
  — Have overlapping expenditure categories to assess convergence across methods