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

Roger Tourangeau, Westat
Lucilla Tan, Brian Meekins
and Brandon Kopp, Bureau of Labor Statistics

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BLS

Westat

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

CE Category	MEPS	PSID	NHEA
Physician Services	X		X
Dental Services	X		X
Eyecare services	X		
Nonphysician services (excluding dental and eyecare)	X		X
Hospital-inpatient	X	X	X
Prescription drugs	X	X	X
Vision aids	X		

Some Candidate Indicators--2

CE Category	ACS	AHS	RECS	PSID	PCE
Electricity	X	X	X	X	X
Natural Gas	X	X	X		X
Total Other Fuels	X	X	X		
Fuel Oil		X	X		
Propane/LPG			X		
Kerosene			X		
Other Fuels (Wood, Coal, etc.)		X			
Water/Sewer	X	X		X	X
Garbage		X			X
Primary Mortgage	X	X		X	
Rent	X	X		X	
Homeowner's Insurance	X	X		X	X
Property Tax	X	X		X	

External Indicators

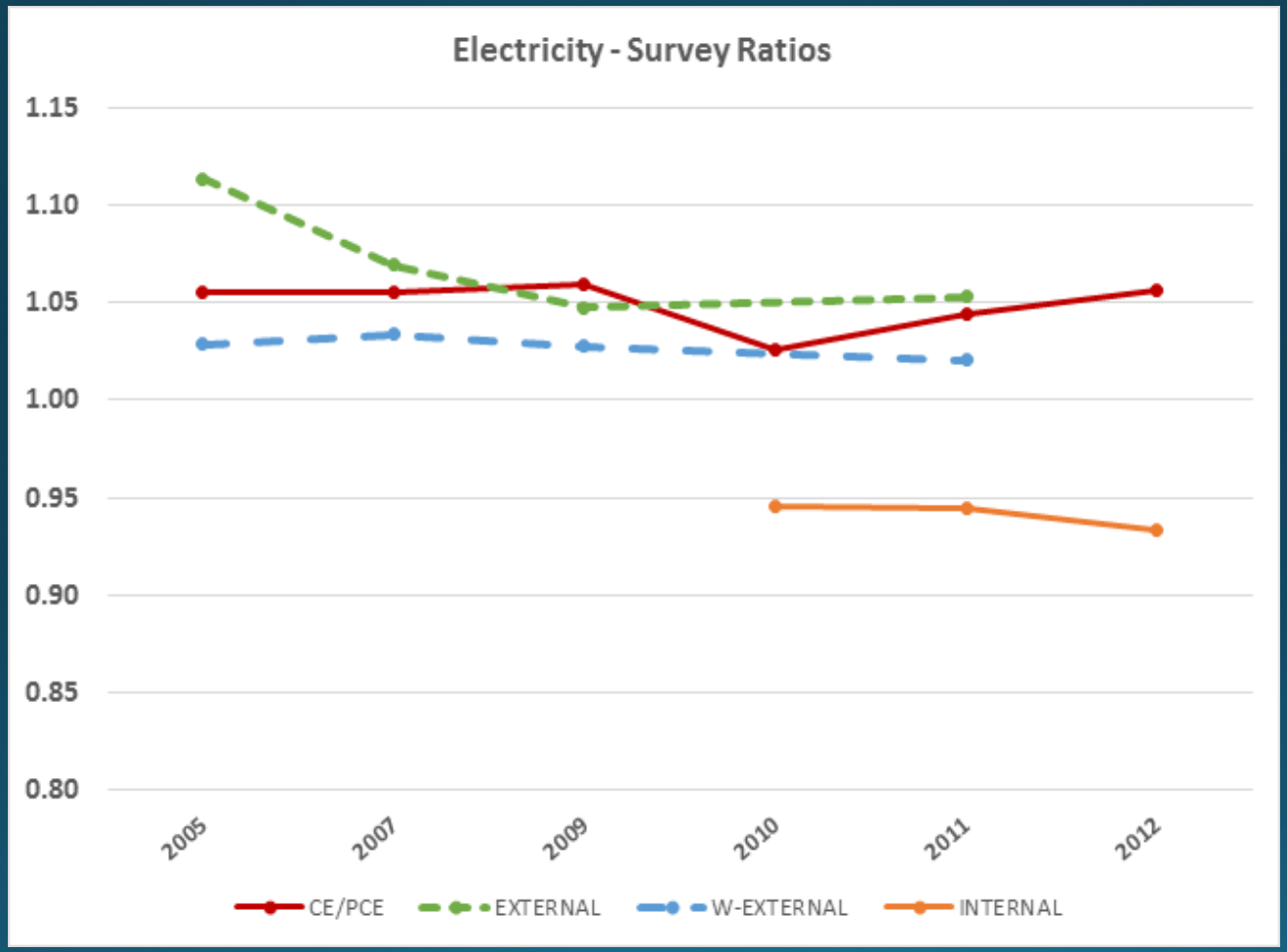
Expenditure Share for our 3 illustrative examples

CE Category	Expenditure Share (2011)
Electricity	2.9%
Rent	6.1%
Prescription Drugs	1.0%
Average Annual Spending	$49,705

Combining External Indicators

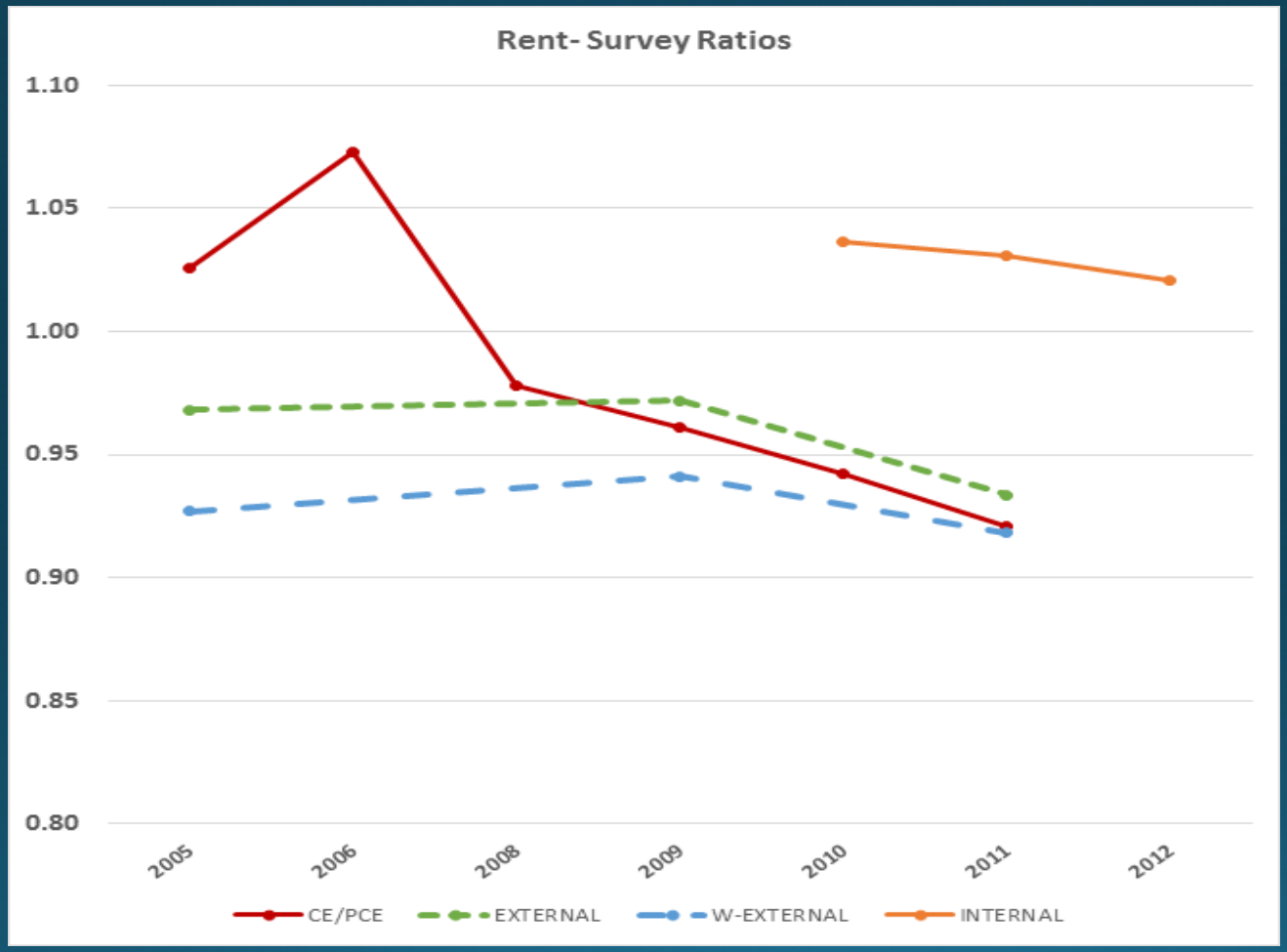
- To increase the robustness of the external comparisons, we recommend taking weighted averages of the external estimates for the commodity
- The weights would reflect the reliability of the ratio of the CE estimate to the external indicator over time and would downweight estimates that show large fluctuations 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, $s_j^2 = \sum^T (r_{j,t} - \bar{r}_j)^2$ 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, $WR_t = \frac{\sum_{j=1}^{J} (r_{j,t} * 1/s_j^2)}{\sum_{j=1}^{J} 1/s_j^2}$, where J is the total number of external sources

An Example



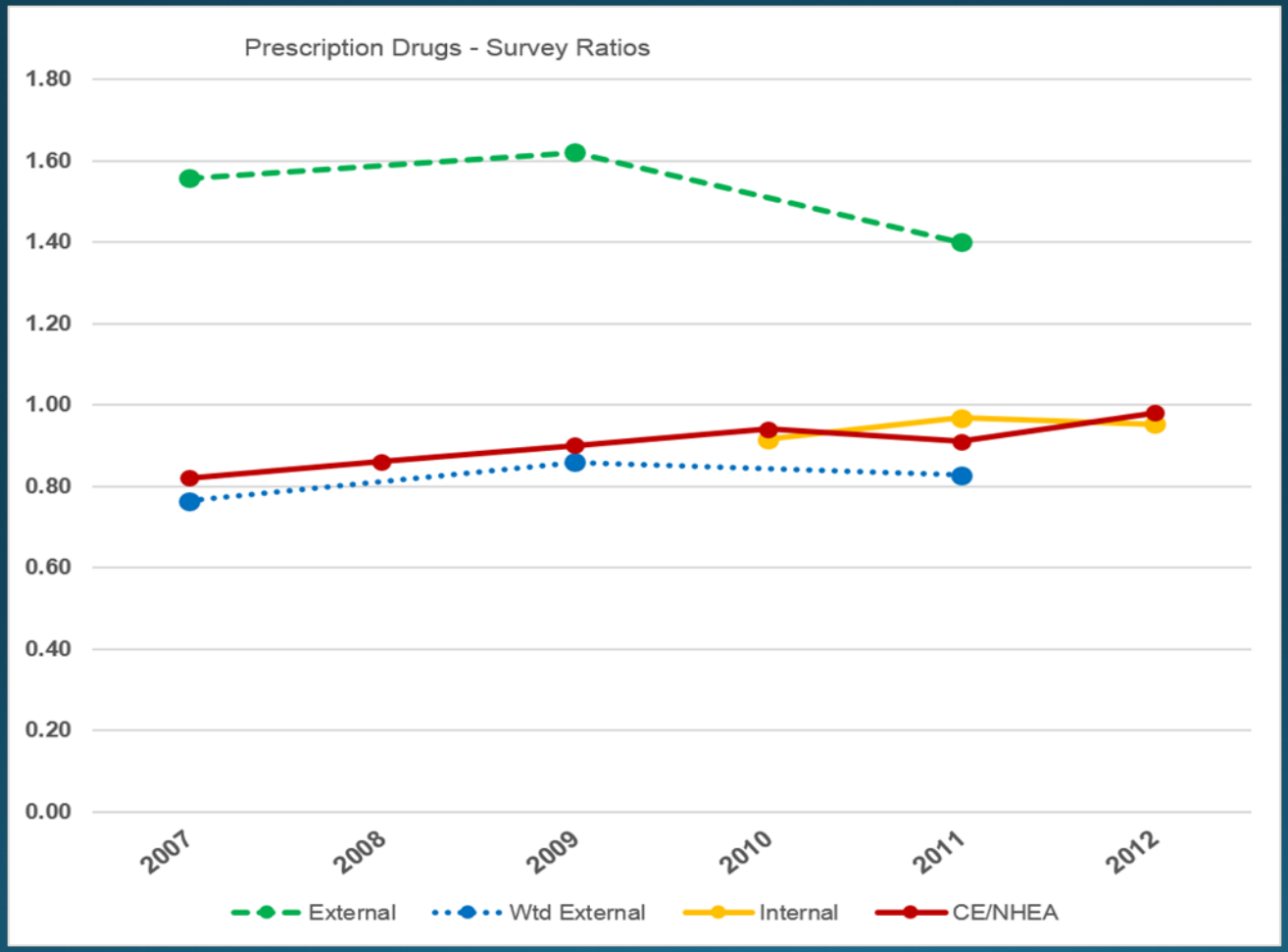
- The external sources for electricity are PCE, ACS, AHS, RECS, and PSID.

Another Example



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

One More


Prescription Drugs - Survey Ratios
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
2007
2008
2009
2010
2011
2012
External
Wtd External
Internal
CE/NHEA

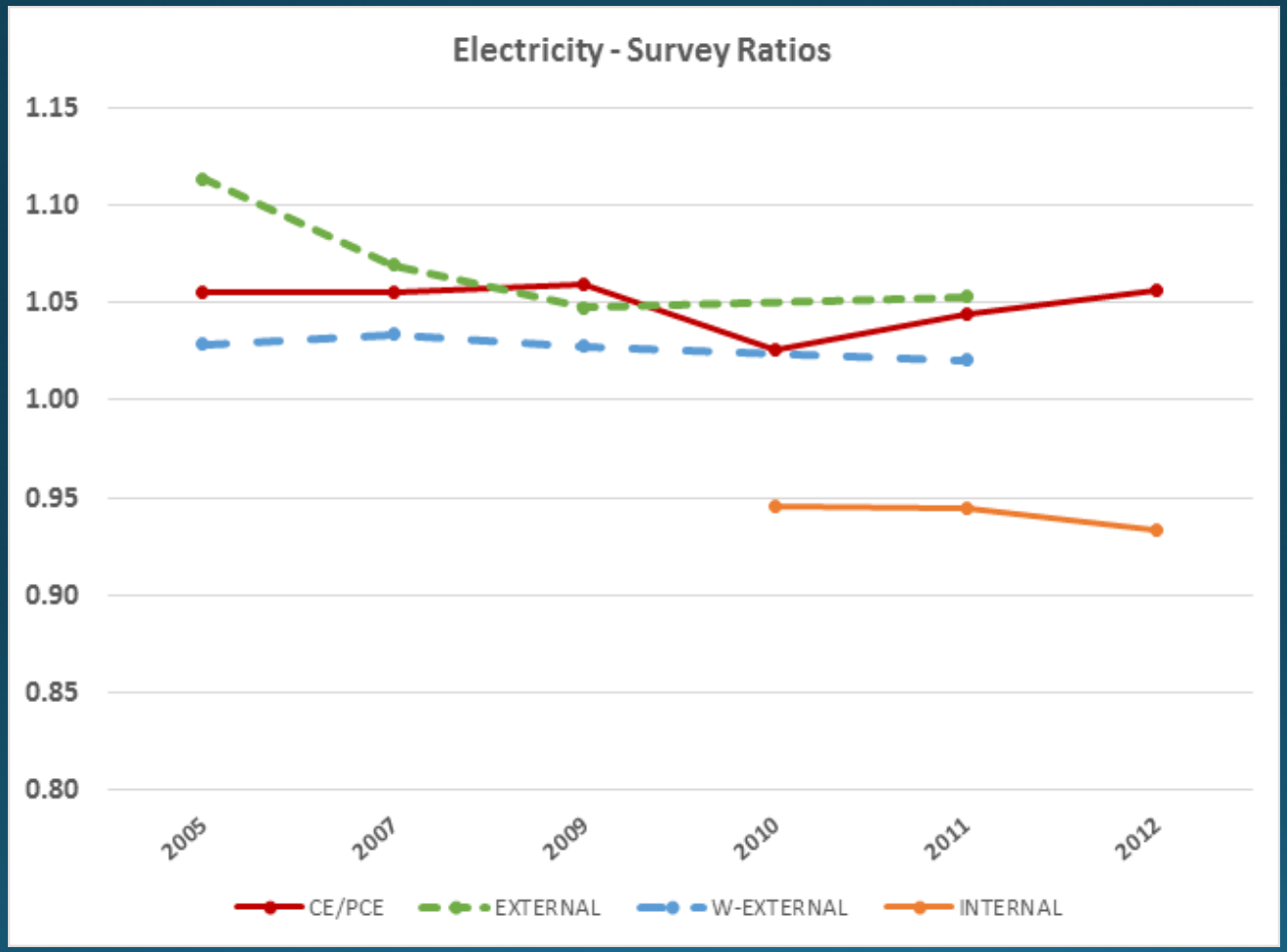
Internal Indicators

- 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



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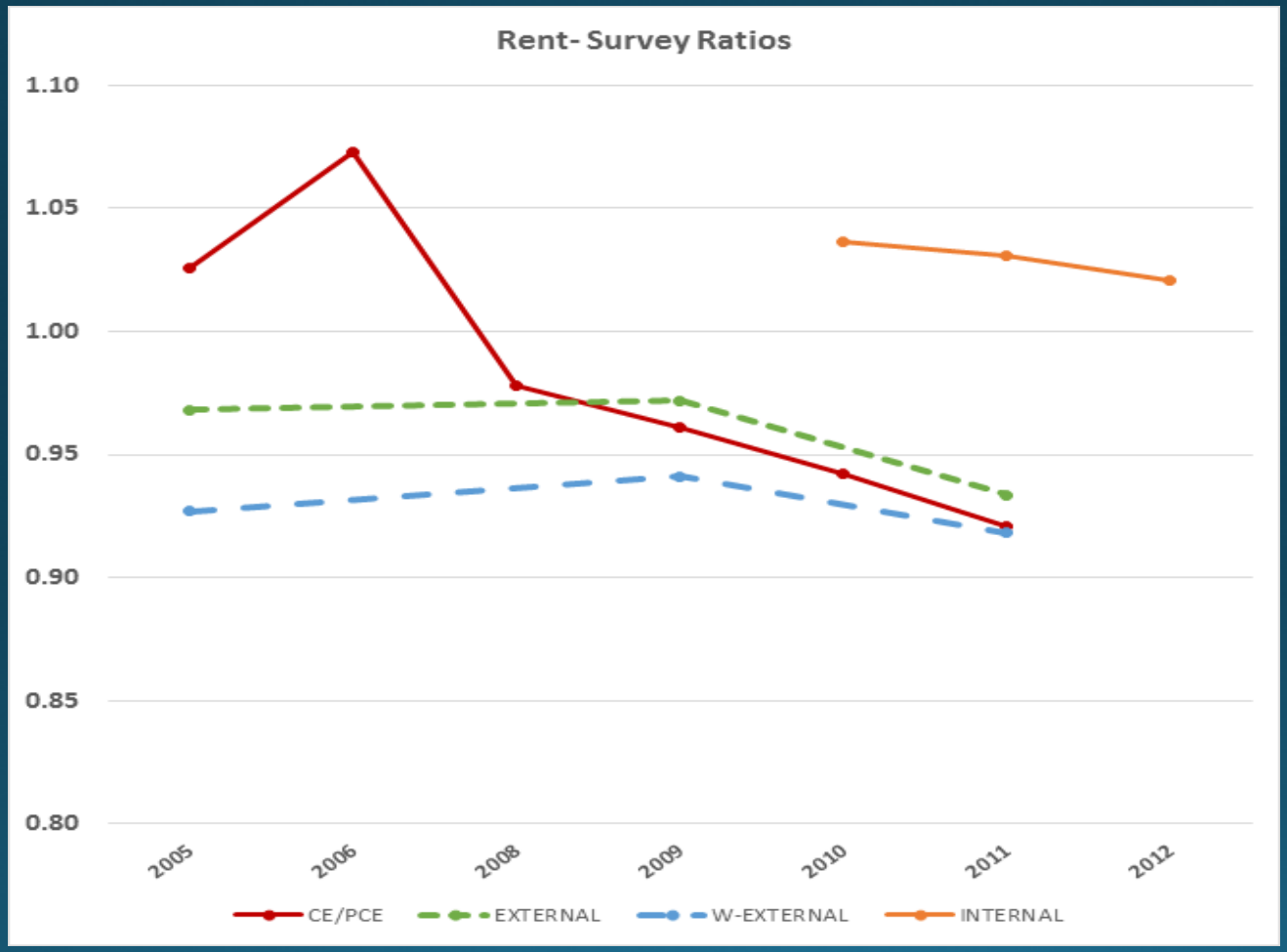
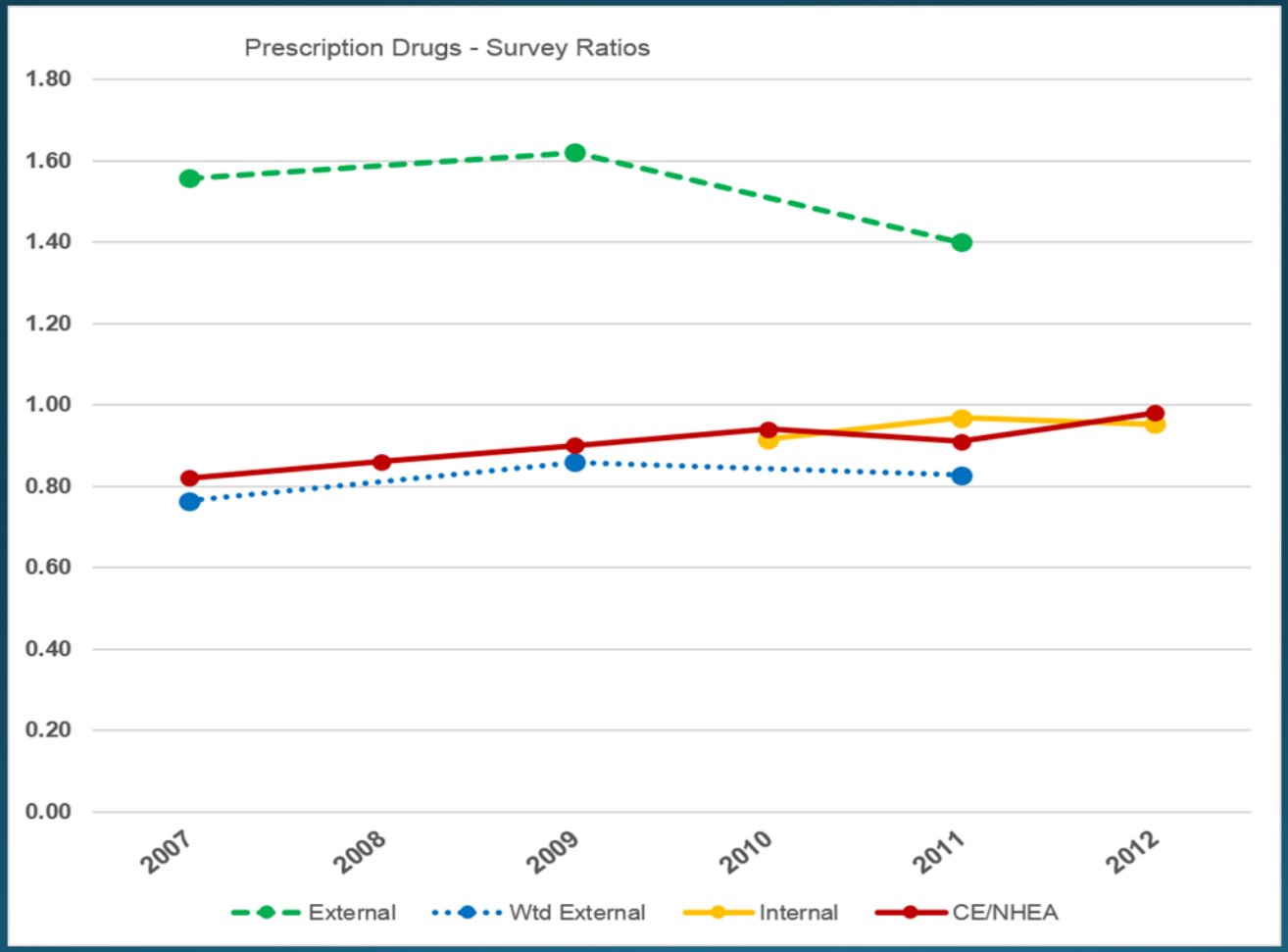


- The external sources for rent are PCE, ACS, and AHS.

One More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0.80
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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

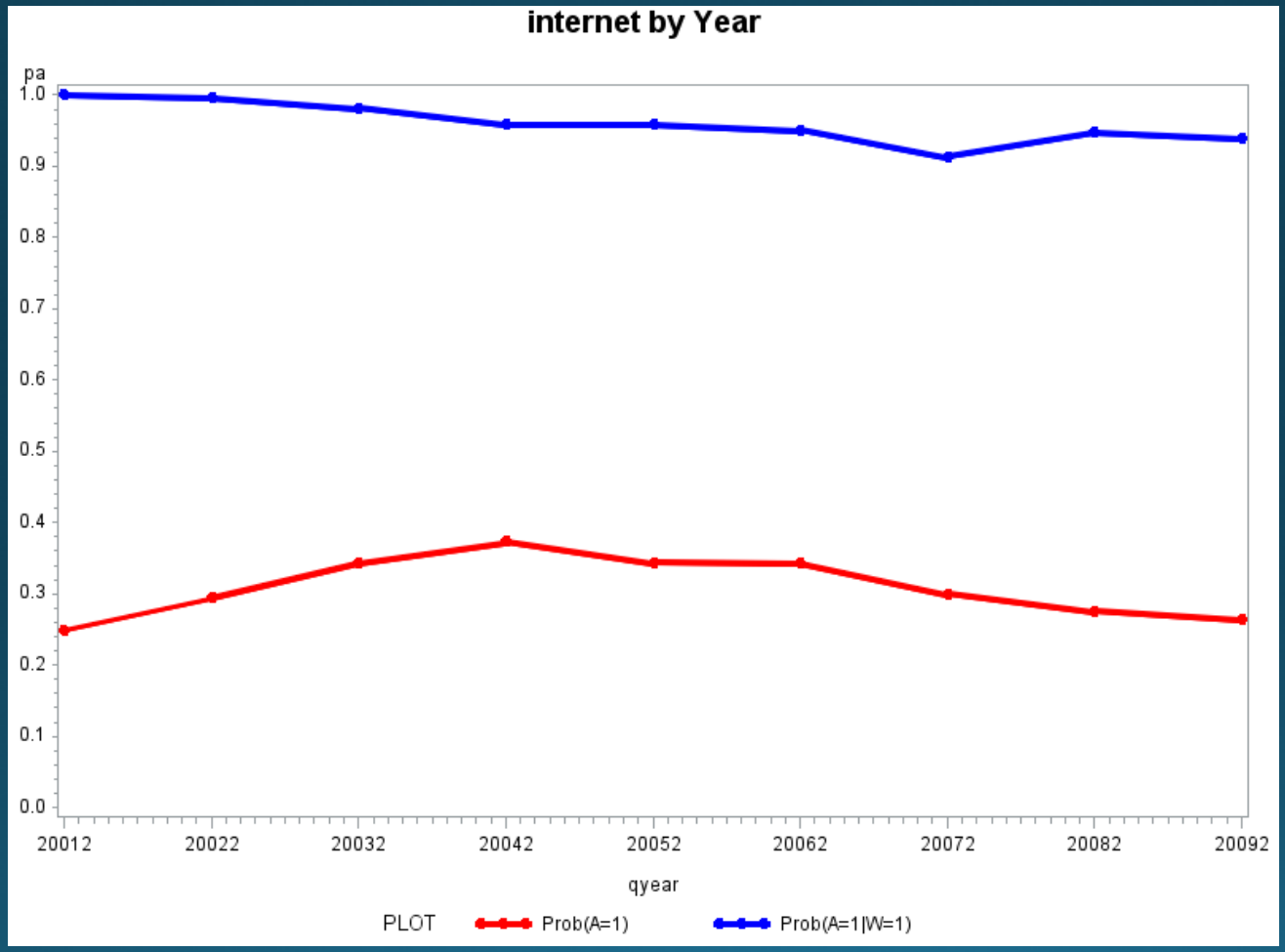
Some Topics for Research

- 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

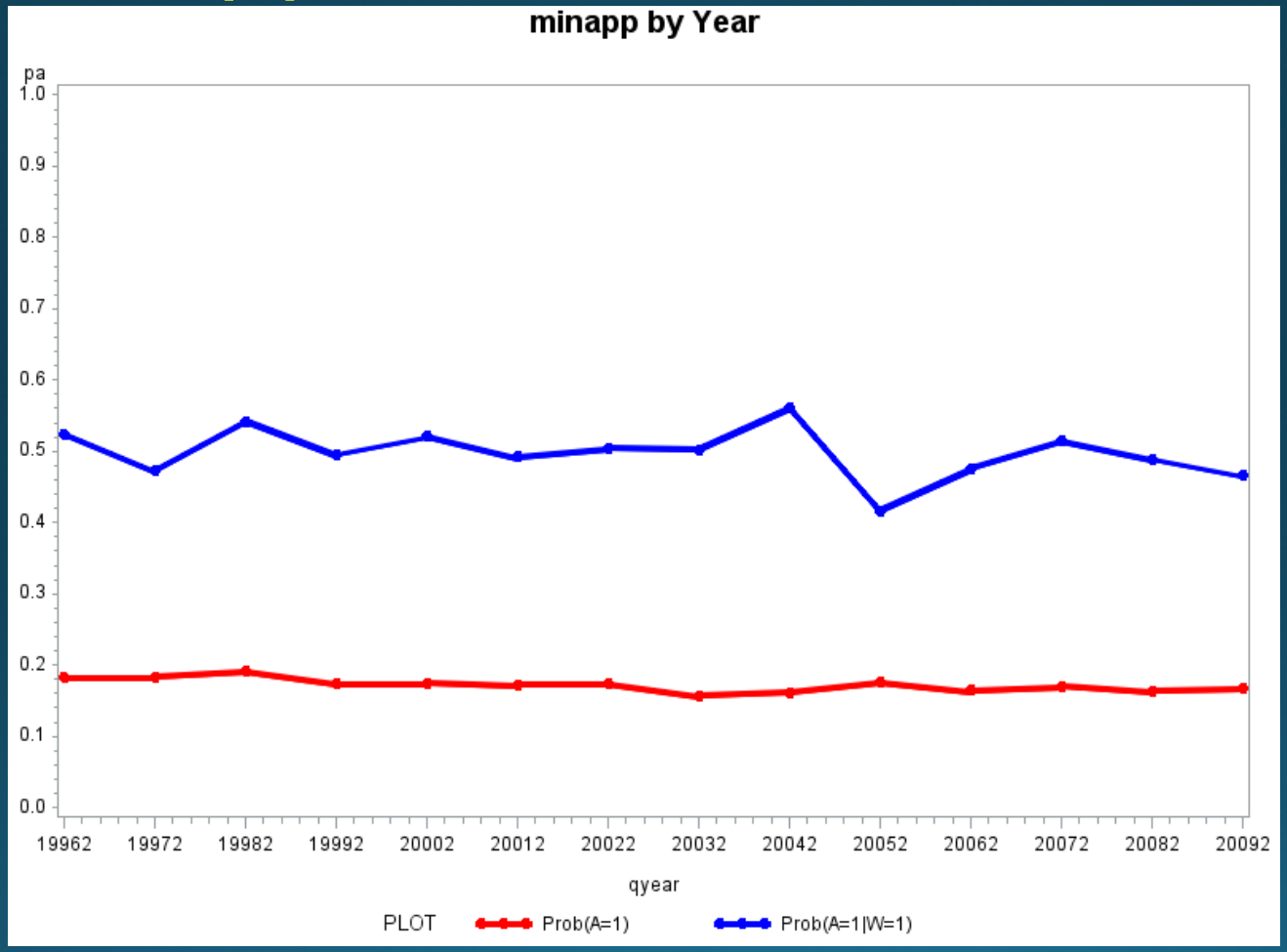
Markov Latent Class Analysis

- Uses repeated measurements from panel survey data to estimate classification error
- Does not require external validation data; estimates of error directly from panel data
- LCA used to study measurement or response error (VandePol and deLeeuw 1986; Tucker 1992; Van de Pol and Langeheine 1997; Bassi et al. 2000; Biemer and Bushery 2000; Tucker, et al. 2002, 2003, 2004, 2005, 2006, and 2008); Meekins et al. (2011)
- Accuracy rates by subgroup - percent of true purchasers that reported purchasing that commodity
- Could easily produce a ratio of reported expenditure/reported expenditure*1/accuracy

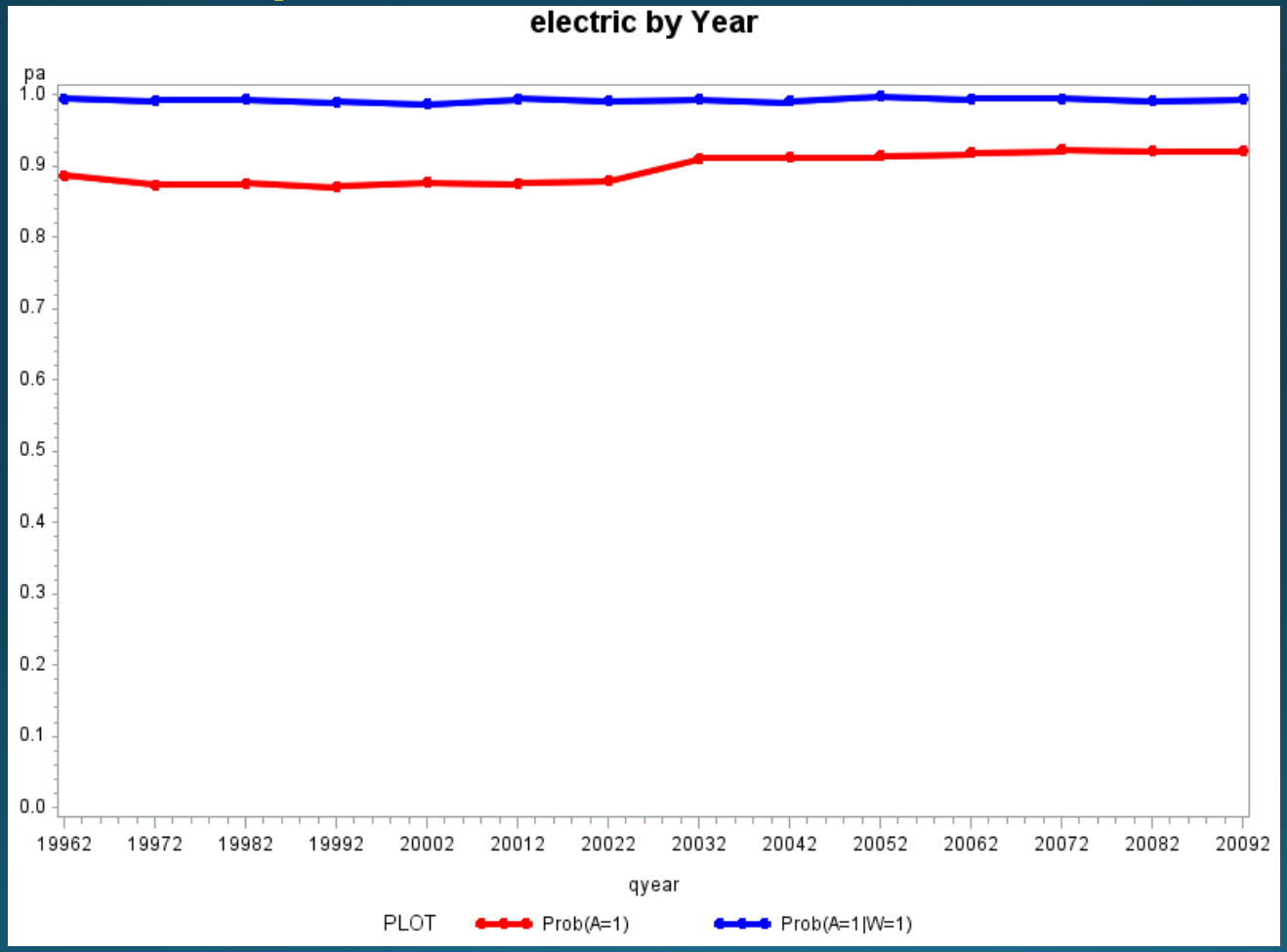
Internet


internet by Year
pa
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
20012
20022
20032
20042
20052
20062
20072
20082
20092
qyear
PLOT
Prob(A=1)
Prob(A=1|W=1)

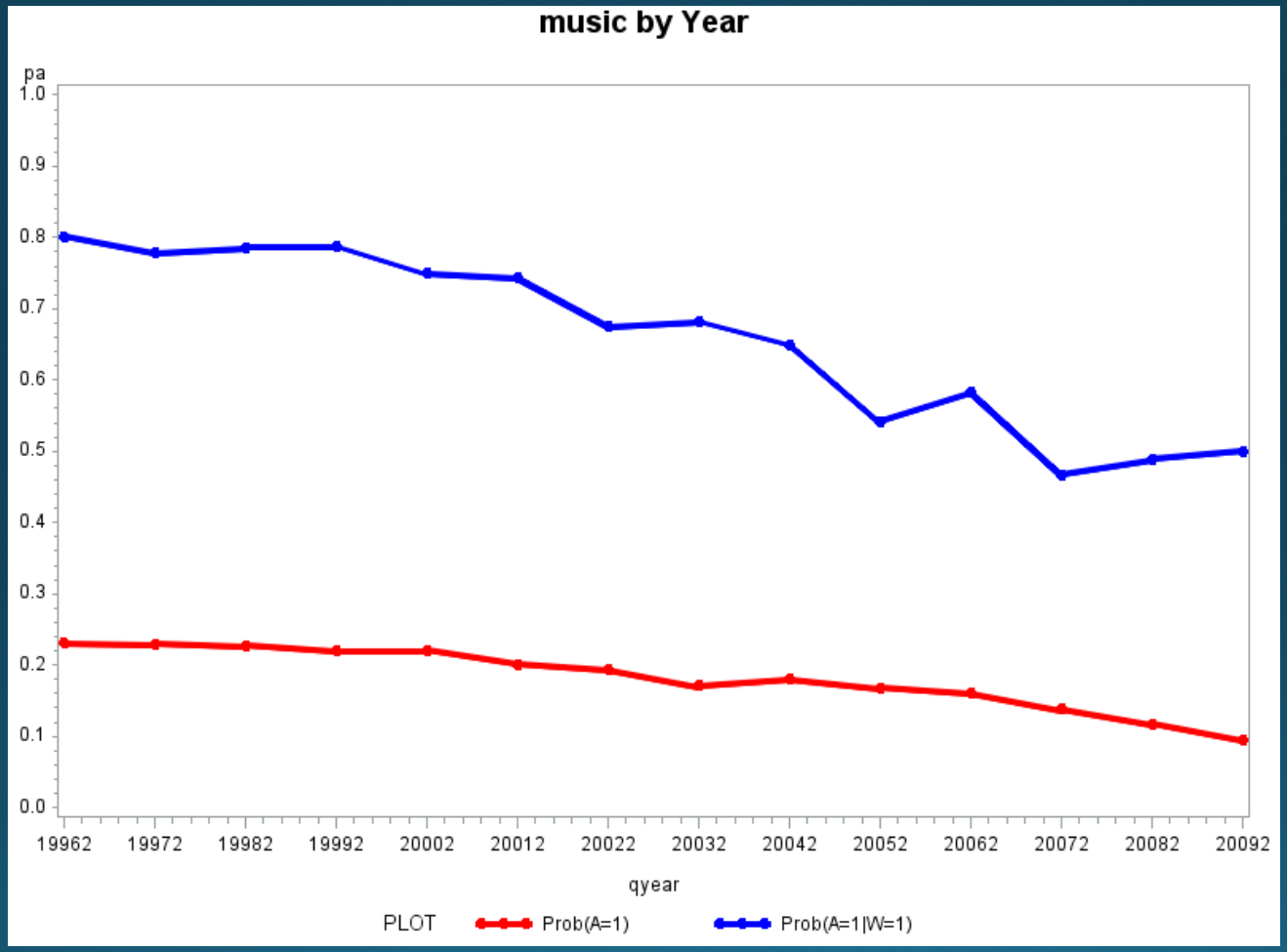
Minor Appliances



Electricity



Music


music by Year
pa
1.0
0.9
0.8
0.7
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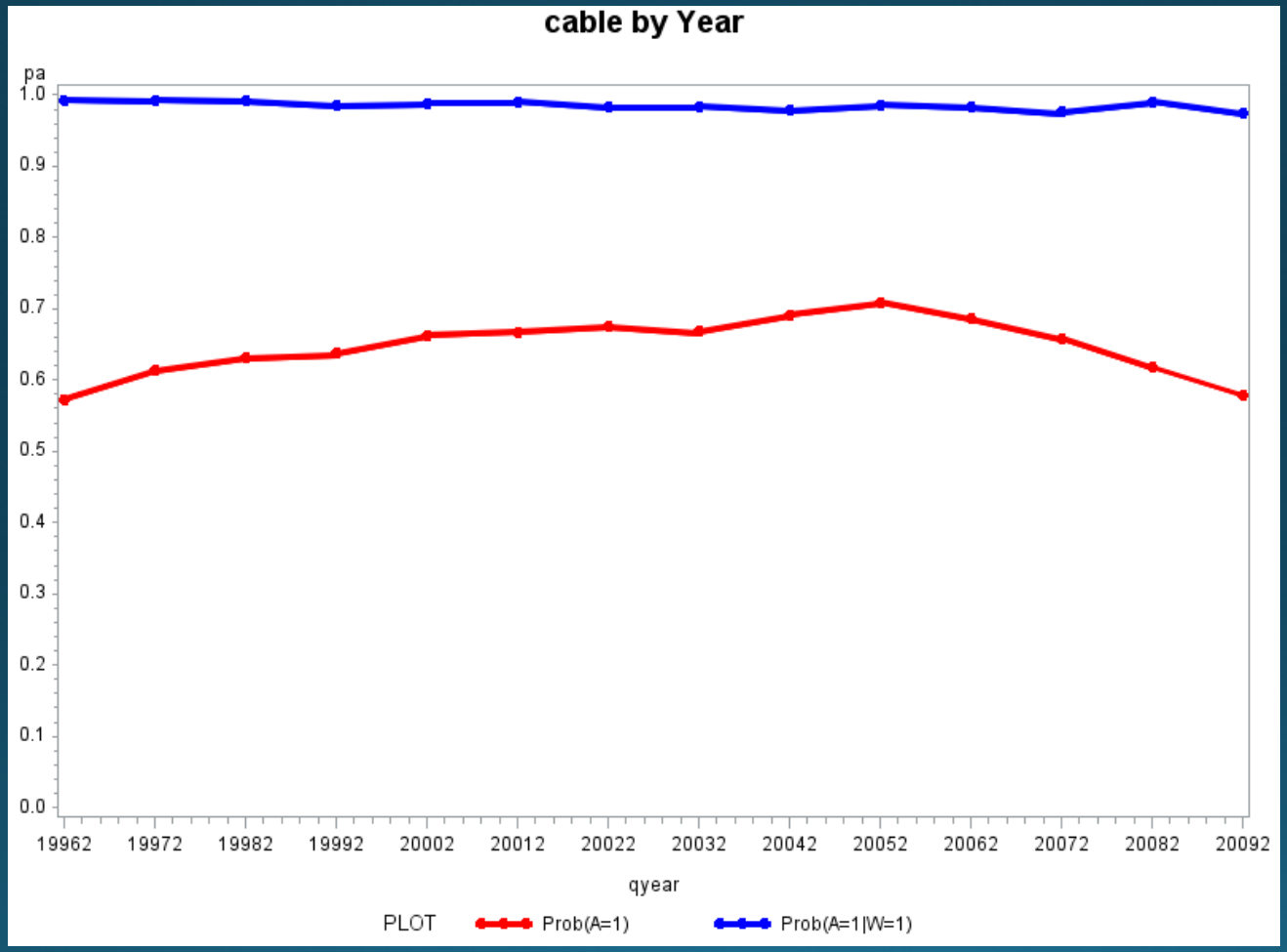
qyear
PLOT
Prob(A=1)
Prob(A=1|W=1)

Cable TV


cable by Year
pa
1.0
0.9
0.8
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19962
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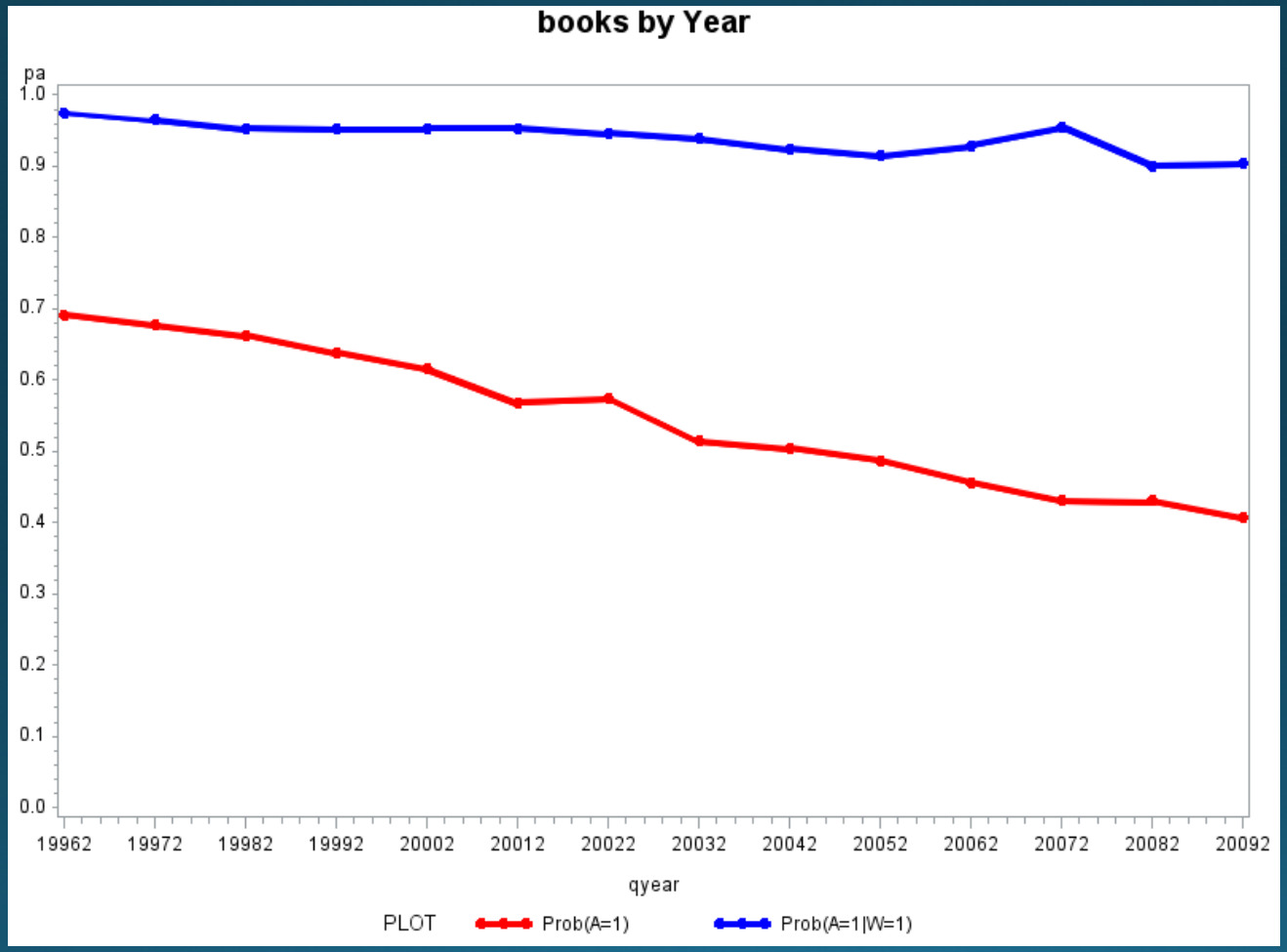
qyear
PLOT
Prob(A=1)
Prob(A=1|W=1)

Books


books by Year
pa
1.0
0.9
0.8
0.7
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0.5
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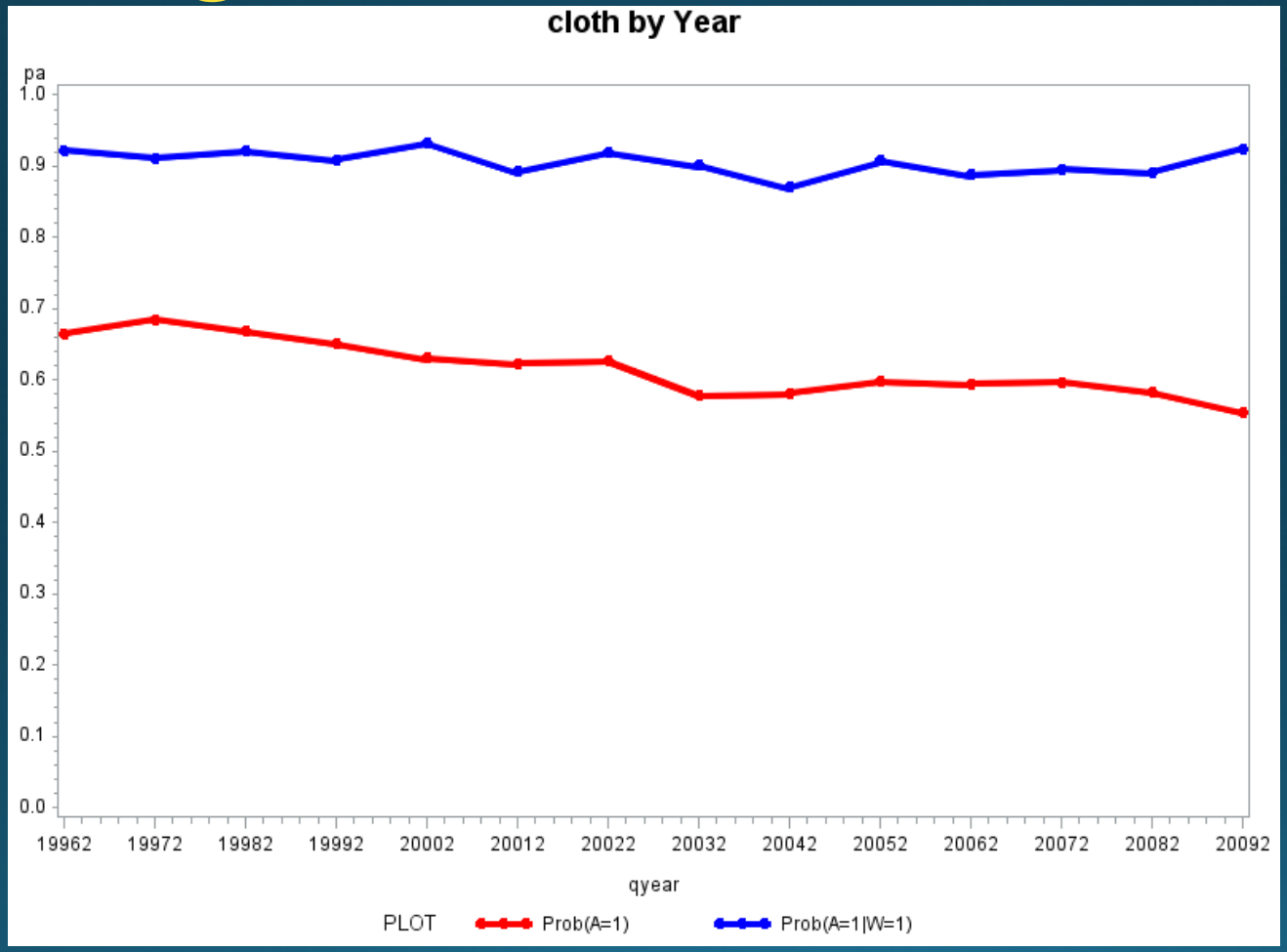
qyear
PLOT
Prob(A=1)
Prob(A=1|W=1)

Clothing


cloth by Year
pa
1.0
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20092
qyear
PLOT
Prob(A=1)
Prob(A=1|W=1)

Conclusions

- No one approach is perfect
- We recommend building on past efforts
- Develop a time series with multiple indicators
  - Internal indicators
  - External indicators
  - Possibly MLCA models
  - These are all 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

Contact

Brian Meekins
Bureau of Labor Statistics
meekins.brian@bls.gov