

Improving Preliminary Estimates of the U.S. Chained CPI-U: Current and Future Work

**Meeting of Group of Experts on
Consumer Price Indexes
UNECE/ILO**

May 30 – Jun 1, 2012

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Conditions**

Outline

- Background to the CPI
- The importance and uses of CPI based measures of inflation
- Background to the chained CPI-U
- Improving estimates of the preliminary CPI-U
 - ▶ Adjustment factor
 - ▶ CES
 - ▶ Times series analysis

Goal of the CPI

- The goal of the CPI is to approximate a cost of living index.
- Cost of living is a theoretical concept. The CPI seeks to measure the change in the cost of living by measuring the change in prices that consumers pay for a market basket of goods and services.

Scope / Coverage

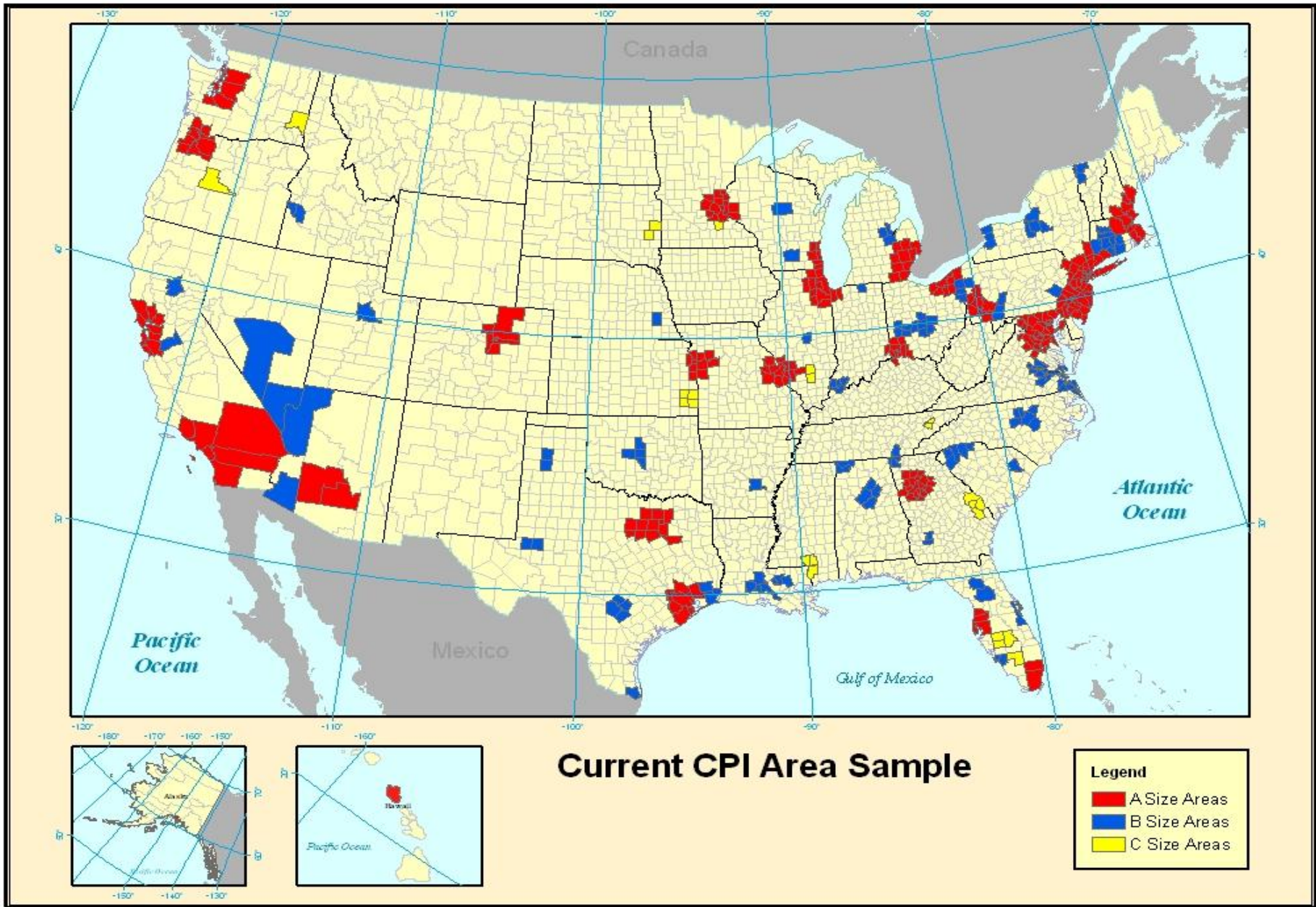
- The CPI reflects prices paid by consumers in urban areas of the U.S. for a market basket of goods and services.
- Any item purchased for consumption, goods or services, is eligible for pricing.

Classification system

- In the CPI, the consumer market basket is a categorization of goods and services with corresponding weights. In the U.S. there are 211 categories of items (goods and services) that are aggregated into eight major groups:
 - Food And Beverages
 - Housing
 - Apparel
 - Transportation
 - Medical Care
 - Recreation
 - Education and Communication
 - Other Goods and Services

Geography

- Based on Census and OMB definitions, 87 geographic areas are selected to represent the urban population – Primary Sampling Units (PSUs)
- These 87 areas represent 38 distinct geographical units (31 large cities plus a combination of the remaining 56 smaller areas into 7 geographical units).



Weighting

- The CPI-U uses the results of 76,000 interviews with consumer units in the Consumer Expenditure Survey (CE) to determine the weights used in the construction of price indexes.
- The weights reflect how households divide their purchases among 211 categories of goods and services in each of 87 geographical areas or 8018 elementary item area indexes.
- The current weights used in the CPI are based on consumer expenditures in 2009-2010. ⁸

CPI Indexes and population coverage

▶ CPI-U / Chained CPI-U

- Consumer Price Indexes for all urban consumers
- 88% of the population live in CPI-U households

▶ CPI-W Wage and Clerical Workers

- Restricted to consumer units for which 50% of total earnings of the head of household or spouse are from hourly wage or clerical occupations.
- 29% of the population are in CPI-W consumer units

▶ Experimental CPI-E Elderly

- Restricted to consumer units for which either the head of household or spouse are 62 years of age or older.
- 16% of the population are in CPI-E consumer units

Social Security

- Social Security benefits are revised annually based on changes in the CPI-W
 - ▶ In 2010, about 53 million Americans received about \$700 billion in Social Security payments
- Why does the Social Security Administration use the CPI-W to adjust Social Security payments?
 - ▶ At the time when Social Security payments were first indexed using the CPI in 1975, the CPI was based on the W population concept. The CPI-U was introduced in 1978.

| CPI Relative Importances, December 2011 | CPI-U | CPI-W | CPI-E |
|----------------------------------------------------|--------------|--------------|--------------|
| All items | 100.0 | 100.0 | 100.0 |
| Food and beverages | 15.0 | 15.7 | 12.8 |
| Food at home | 8.5 | 9.3 | 7.9 |
| Food away from home | 5.6 | 5.5 | 4.2 |
| Alcoholic beverages | 0.9 | 0.9 | 0.7 |
| Housing | 40.2 | 39.2 | 44.5 |
| Shelter | 30.9 | 30.0 | 34.3 |
| Rent of primary residence | 6.4 | 8.8 | 3.8 |
| Owners' equivalent rent | 23.5 | 20.5 | 29.3 |
| Apparel | 3.5 | 3.6 | 2.4 |
| Transportation | 16.5 | 18.7 | 14.5 |
| Motor Fuel | 5.4 | 6.9 | 4.1 |
| Medical Care | 6.9 | 5.6 | 11.3 |
| Medical Care Commodities | 1.7 | 1.3 | 3.0 |
| Medical Care Services | 5.2 | 4.3 | 8.3 |
| Recreation | 5.9 | 5.5 | 5.3 |
| Education and Communication | 6.7 | 6.7 | 3.8 |
| College Tuition and Fees | 1.7 | 1.4 | 0.4 |
| Other Goods and Services | 5.3 | 5.1 | 5.4 |
| Tobacco & smoking products | 0.8 | 1.2 | 0.6 |

| CPI Relative Importances Dec 2011 | CPI-U | CPI-W | CPI-E |
|----------------------------------------------|--------------|--------------|--------------|
| Shelter | 30.9 | 30.0 | 34.3 |
| Medical Care | 6.9 | 5.6 | 11.3 |

Alternative Approaches to Adjusting Social Security Payments

- The Chained Consumer Price Index (C-CPI-U)
 - ▶ First produced in 2002, data back to December 1999
 - ▶ The C-CPI-U is designed to be a closer approximation to a cost-of-living index in that it reflects changes in consumer spending patterns across CPI item categories

The Chained Consumer Price Index (C-CPI-U)

- The index uses a superlative Tornqvist formula and utilizes expenditure data in adjacent time periods to capture consumer substitution across item categories as a result of changing relative prices.
- The C-CPI-U has been considered recently as an alternative measure to adjust Social security payments

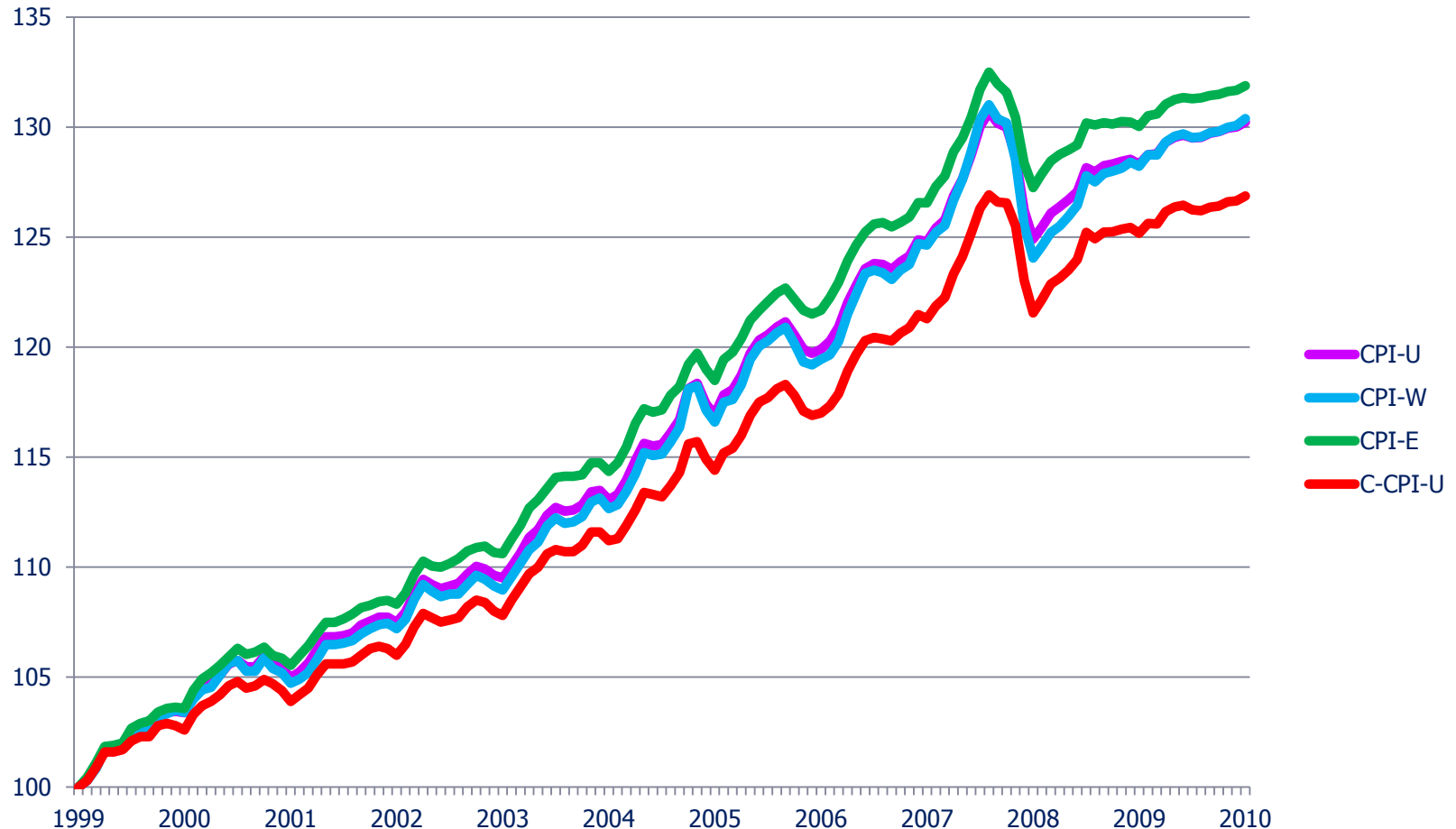
C-CPI-U Estimation Formulas

$$I_{,A} I_{t-1,t} = \prod_{i,a \in I,A} \left(\frac{{}_{i,a} P_t}{{}_{i,a} P_{t-1}} \right)^{\frac{({}_{i,a} \mathbf{r}_{t-1} + {}_{i,a} \mathbf{r}_t)}{2}}$$

The Chained Consumer Price Index (C-CPI-U)

- The National Commission on Fiscal Responsibility and Reform: The Moment of Truth, December 2010
 - ▶ Recommendation 5.7: ADOPT IMPROVED MEASURE OF CPI. Use the chained CPI, a more accurate measure of inflation, to calculate the Cost of Living Adjustment for Social Security beneficiaries.

Percentage change Dec 1999 to Dec 2011 for **CPI-E (35.6%)**, **CPI-W (34.6%)**, **CPI-U (34.1%)**, and **C-CPI-U (29.7%)**



The Chained Consumer Price Index (C-CPI-U)

- Monthly expenditure shares for year Y are not available until the beginning of year Y+2.
- “Initial” values of the C-CPI-U are issued monthly using the most recent expenditure data. In year y+1, interim C-CPI-U indexes are released and in year y+2, final values are released.
- For example, in February 2012,
 - ▶ Jan 2012 index initial value of C-CPI-U released
 - ▶ Interim values for 12 months of 2011 released
 - ▶ Final values for 12 months of 2010 released

C-CPI-U Estimation Formulas

A Geometric Mean Formula with an adjustment factor is used to estimate the initial value of the C-CPI-U index in month t

PRELIMINARY:

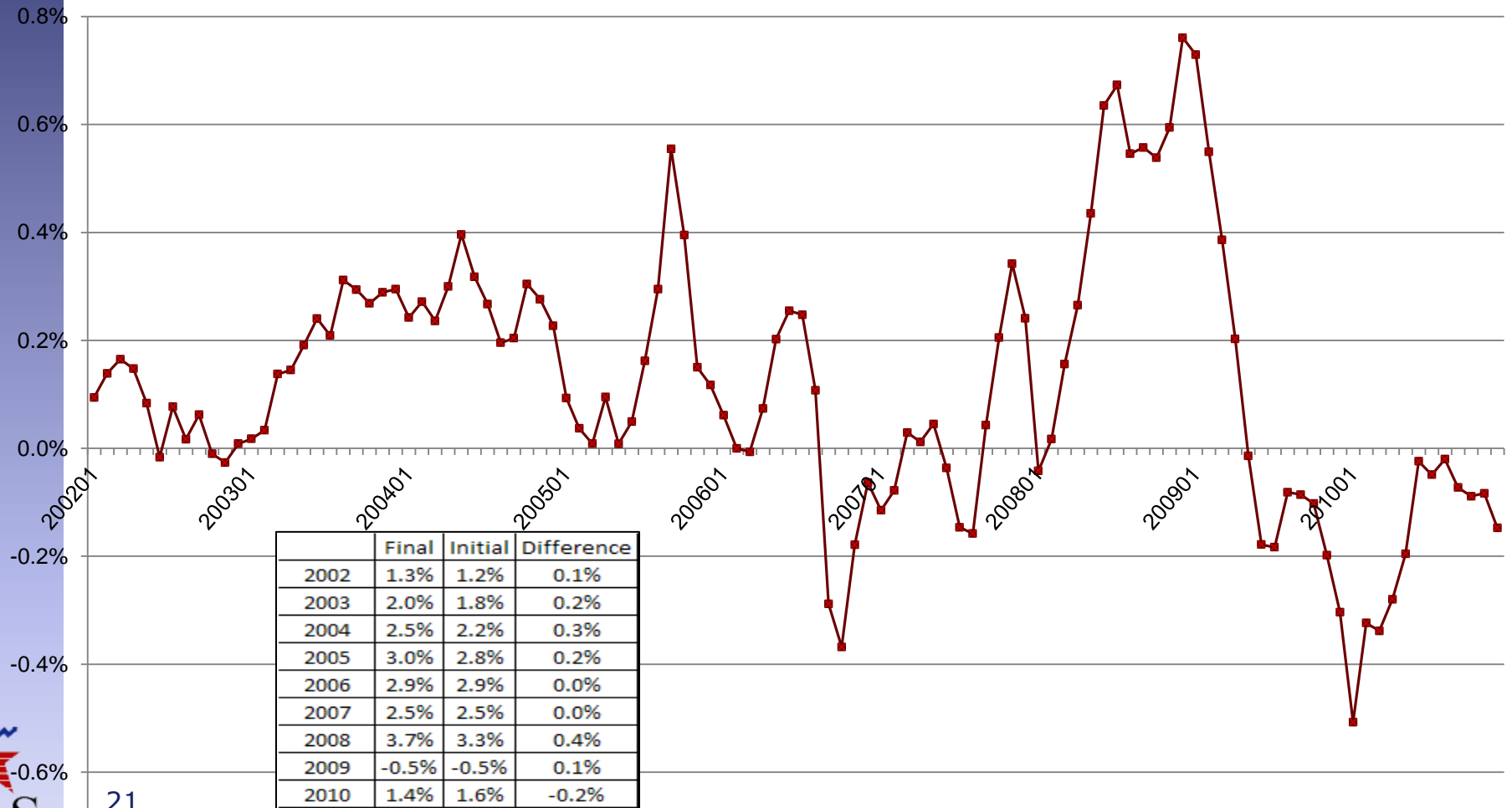
$$I_{,A} \hat{I}_{t-1,t} = \prod_{i,a \in I,A} \left(\frac{{}_{i,a} P_t}{{}_{i,a} P_{t-1}} \right)^{{}_{i,a} r_b} \times f_y$$

The Chained Consumer Price Index (C-CPI-U)

- This formula is consistent with a Cobb-Douglas consumer expenditure function, with expenditure shares that remain constant when prices change.
- The BLS has included an adjustment factor to the formula, allowing for the possibility that the expenditure shares may change as prices change.
- Research to date has not provided conclusive evidence pointing to a value for the adjustment factor other than unity.
- To date, BLS has set the factor with a value of unity.

FINAL minus PRELIMINARY C-CPI-U estimate of 12-month price change

2002.01 to 2010.12; All-items, U.S. City Average, C-CPI-U



The Chained Consumer Price Index (C-CPI-U)

- Revisions to initial C-CPI-U indexes have often been significant. In most years, the initial indexes have underestimated the final C-CPI-U.
- Current research is focused on refining and improving this formula to reduce the difference between the initial estimate and the final index
- This presentation presents work by John S. Greenlees
 - ▶ BLS Statistical Working Paper, "Improving the Preliminary Values of the Chained CPI-U."
 - ▶ www.bls.gov/osmr/abstract/st/st100060.htm

Improving the PRELIMINARY estimate of the C-CPI-U:

- Use Constant Elasticity of Substitution (C.E.S.) as the price index alternative formula

Develop models to estimate optimal elasticity of substitution parameter η

$$= \left[\sum_{i,a \in I,A} r_{i,a} \left(\frac{\mathbf{P}_{i,a,t}}{\mathbf{P}_{i,a,b}} \right)^{1-\eta} \right]^{\frac{1}{1-\eta}}$$

Constant Elasticity of Substitution (CES) formula

- In the CES formulation, as prices change, the η parameter measures the proportionate change in the relative quantity demanded in response to a percentage change in price, or elasticity.
- The formula reduces to the Geometric Mean index form when the substitution parameter equals unity, which is the current method for calculating the initial estimates of the C-CPI-U.
- And to the Laspeyres form when the price elasticity is equal to be zero, which is the assumption underlying the current headline CPI-U.

Methodology for estimating η

- Greenlees tries to estimate a substitution parameter $0 < \eta < 1$
- Assuming that consumer preferences do exhibit a constant elasticity of substitution over the range of price changes and between all goods (a very strong assumption)
- Estimates η using a weighted regression of changes in shares on changes in prices

Methodology for estimating η

- This weighted regression is of the form:

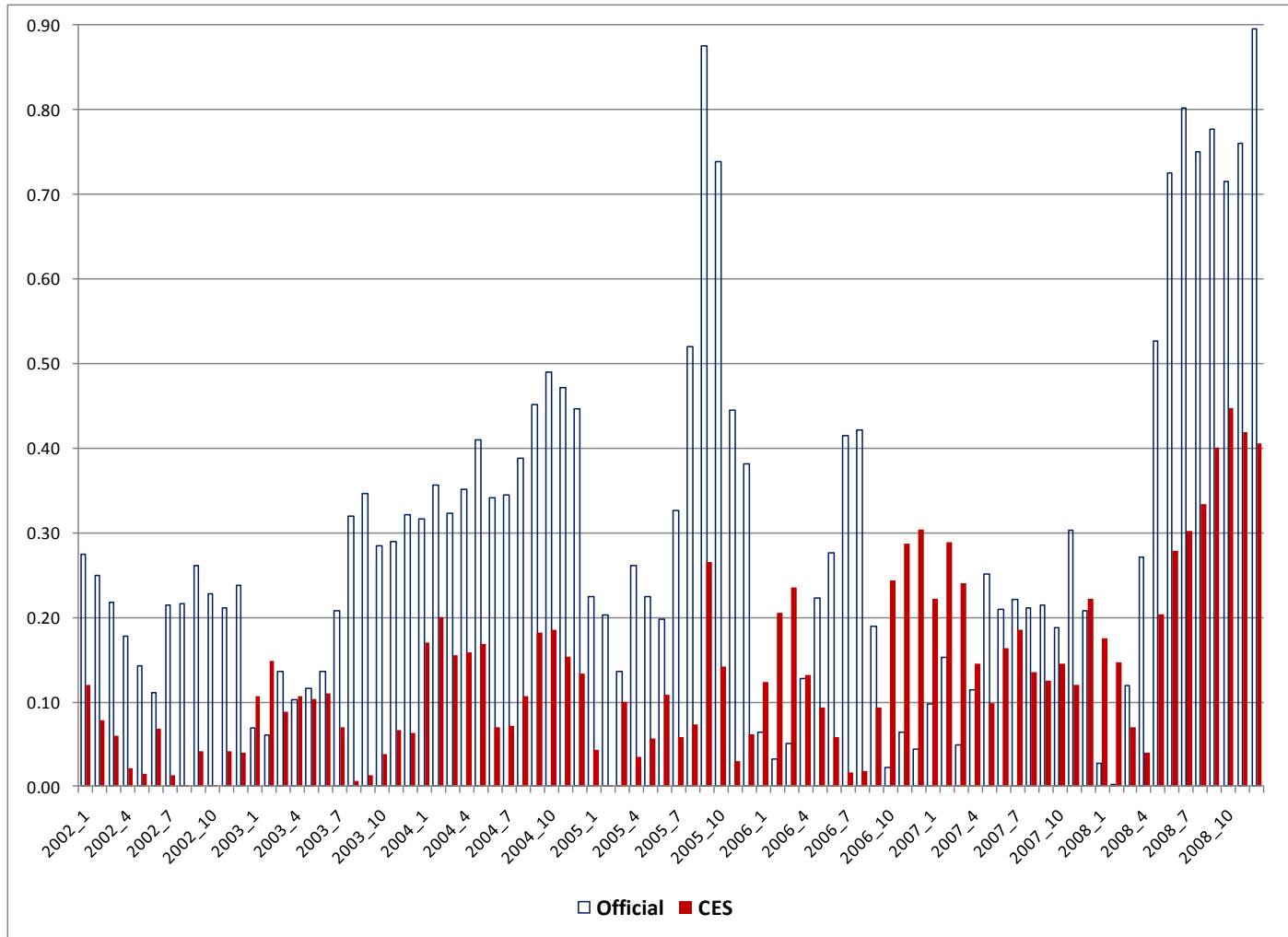
$$d \ln s = \alpha + \beta d \ln p + \varepsilon$$

- Feenstra and Reinsdorf show that the estimated value of β will equal $\eta - 1$

Estimated Substitution Parameters

| Start Year | End Year | Parameter Estimate |
|------------|----------|--------------------|
| 1999 | 2000 | .637 |
| 1999 | 2001 | .584 |
| 1999 | 2002 | .598 |
| 1999 | 2003 | .595 |
| 1999 | 2004 | .606 |
| 1999 | 2005 | .597 |
| 1999 | 2006 | .602 |
| 1999 | 2007 | .639 |
| 1999 | 2008 | .589 |

Initial Forecast Absolute Errors



Greenlees Chained CPI JSM



Comparison of Prediction Errors, Current Official Method and CES

- Compared to final C-CPI-U indexes, the CES initial estimates generally have lower absolute errors than the official geometric mean based estimates.
- Between 2006 and 2008 there were a number of months in which the official initial index had lower errors than then CES based index.

Comparison of Prediction Errors, Current Official Method and CES

- This period in the U.S. is associated with dramatic swings in gasoline prices (which accounted for a large share of the change in the overall CPI-U).
- The implied assumption of unitary elasticity in the official geometric mean based estimate of the initial C-CPI-U may be closer to representing consumer behavior over this period than the relatively more inelastic parameter estimates Greenlees found for the CES.

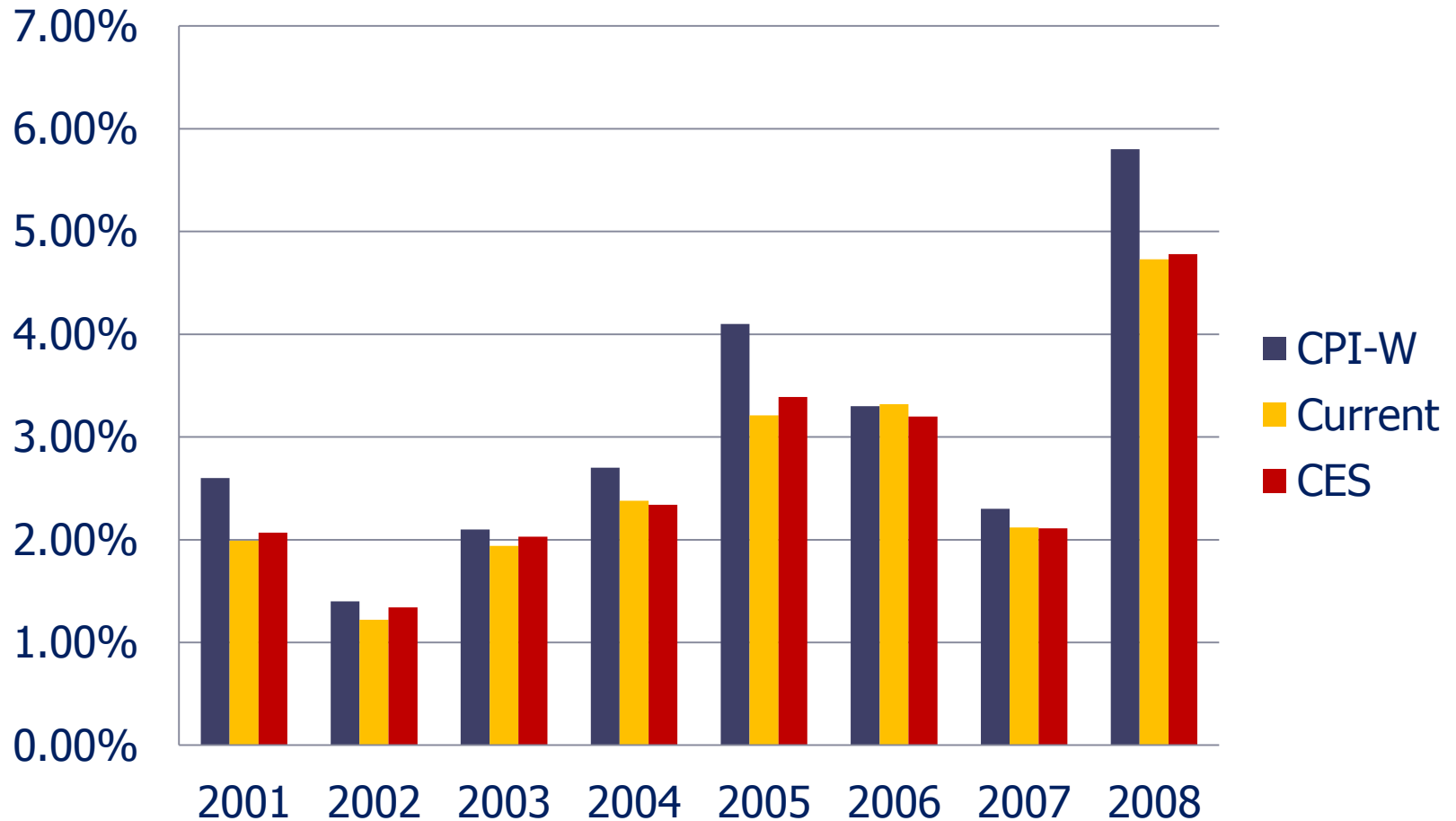
Adjusting Social Security Payments using CES based Preliminary estimates of C-CPI-U

- The cost of living adjustment for U.S. Social Security Payments administered in January of year $(y+1)$ is based the percent change in the third quarter average value of the CPI-W between year $y-1$ and year y .
- Substituting the chained CPI-U for the CPI-W would require calculating the percent change in the Initial C-CPI-U from the 3rd quarter of year $(y-1)$ to the third quarter year (y)

Adjusting Social Security Payments using CES based Preliminary estimates of C-CPI-U

- Since both the current geometric mean method and the CES estimate for estimating the initial C-CPI-U incorporate substitution, one question is how much lower are the estimated rates of inflation than the official ones based on the CPI-W that assume no substitution?
- The following chart shows that the C-CPI-U based rates are significantly lower than the CPI-W ones.
 - ▶ The CES estimates are systematically higher than the geometric mean estimates.

Cost of Living Adjustments for U.S. Social Security based on the CPI-W and on Initial C-CPI-U using Current and CES Methodologies



From Research to Official Use

- BLS has chosen to continue using the current geometric mean formulation for estimating the initial values of the Chained CPI-U.
- Research continues investigating models for improved estimation of the initial values.
- The decision of which CPI index to use to calculate Social Security cost of living adjustments is not up to BLS.