Building a Better Benchmark:

Disaggregating the Consumer Price Index

by

Yuting Zhang

An honors thesis submitted in partial fulfillment

of the requirements for the degree of

Bachelor of Science

Undergraduate College

Leonard N. Stern School of Business

New York University

May 2012

Professor Marti G. Subrahmanyam	Professor Paul Wachtel
Faculty Adviser	Thesis Advisor

Contents

Abstract

This paper presents an examination of the differences in purchasing patterns between various demographics, and how this affects the overall rate of inflation they experience. Three broad demographic groups were examined: high-income households, low-income households, and households that pay for college tuition. Price indices are constructed for these demographics via weighing and aggregating, a rough approximation of the Bureau of Labor Statistic's methodology of constructing the Consumer Price Index. These indices are then compared with a reconstructed version of the Consumer Price Index that serves as a benchmark for this paper. We find that, because of different purchasing patterns, the examined demographics do not experience the same rates of inflation, neither with each other nor with the benchmark index, as they do not use their income in the same way.

Acknowledgements

First and foremost, I would like to thank my faculty advisor, Professor Paul Wachtel. Without his motivation and dedication, the idea from which this paper stemmed would never have been fully developed. I would also like to thank the Stern Honors Program coordinator, Professor Marti Subrahmanyam as well as Jessie Rosenzweig for organizing and supporting this effort which has afforded me the opportunity to complete this project.

Background

As defined by the Bureau of Labor Statistics (BLS), the Consumer Price Index (CPI) measures the average change in price over time for a basket of goods and services that people purchase for everyday living.[1] Although the CPI attempts to evaluate the change in the price of a basket of goods that obtains a certain standard of living, it is not a true cost of living index (COLI); rather, the goal of the CPI is to *approximate* a COLI. A true COLI would include nonprice factors such as crime rates, the weather, and health of the population; the CPI includes only price factors.

History

The advent of the CPI was during World War I, when rapid inflation necessitated the creation of the index to aid in adjusting wages to account for cost of living. To obtain the appropriate weighting on expenditures for various goods and services, studies of consumer spending were conducted in 92 industrial centers. In 1919, the BLS began publishing separate indexes for 32 different cities and regular publication of an aggregate national index began in 1921.

The CPI has undergone many revisions over its history in an attempt to become more accurate. The first major revision occurred in 1940: prices were collected in 34 of the largest cities, weights were used based off of a 1934-36 study on consumer spending, and a weighted average of cities was used for the US national average. The second major revision occurred in 1953: weights from a 1950 expenditure survey were used, the CPI for Urban Wage Earners and Clerical Workers (CPI-W) was started, a sample of small and medium-sized cities were added, new items and sources of price data were added, and the methods of pricing and calculation were improved.

---

[1] "Chapter 17. The Consumer Price Index." *Bureau of Labor Statistics*. Web (2007). <http://www.bls.gov/opub/hom/pdf/homch17.pdf>.

The third major revision occurred in 1964, three years after the Price Statistics Review Committee – or Stigler Committee – released their report: single-person households were added, pricing was extended to the suburbs from just the metropolitan area, and the sample of cities, goods and services, and retail stores and service establishments were updated. The fourth major revision occurred in 1978: the CPI-U began to be published, the number of PSUs was expanded to 85, monthly pricing of certain large metropolitan areas was established, and methods of sampling and pricing became more sophisticated. The fifth major revision occurred in 1987: the samples of items, outlets, and areas were updated, the CPI housing survey was redesigned, and the statistical methods and data processing and collection methods were improved and streamlined.

The sixth, and last, major revision occurred in 1998, two years after the Advisory Commission to Study the Consumer Price Index – the Boskin Commission – released its report: geographic and housing samples were updated, the item classification system was extensively revised, a new housing index estimation system was implemented, computers began to be used in the process of data collection, and TPOPS was implemented to assist in collecting outlet and item samples. Since 1998 revision, many other changes have been made, including, but not limited to, a new housing survey based on the 1990 census, changes in the calculation for the most basic indices to mitigate lower-level substitution bias, implementation of a 4-year outlet rotation, biennial weight updates, and the Chained Consumer Price Index for All Urban Consumers (C-CPI-U).

Overview of BLS Methodology in Constructing the CPI

Today, the BLS divides the United States into 38 different urban centers and collects price data on 211 different goods or services for each of these centers, giving a total of 8,018 item-area

combinations. There are two broad stages in calculating the CPI: the calculation of *basic* indices and the calculation of *aggregate* indices. Basic indices show the price change in each one of the 8,018 different item-area combinations, while aggregate indices are produced by aggregating via weighing and averaging various sets of the basic indices. Examples of aggregate indices include the national index for the price level of baked goods or the all-items index for one of the 38 urban centers, such as Boston.

To calculate any price index, it is generally necessary to obtain two pieces of information: (1) the prices of items and (2) the appropriate weight to give that item when aggregating. To obtain the former, the BLS divides the country into primary sampling units, or PSUs; these are defined as "the smallest geographic areas in which pricing is done for the CPI."[1] Currently, there are 87 PSUs. The BLS uses field representatives to collect prices for almost all items – this excludes rent or owner's equivalent rent for primary residence – in the CPI. Additionally, telephone point of purchase surveys (TPOPS) are also conducted by the US Census Bureau to further collect price data for the CPI. Prices for certain groups of items, such as shelter, cannot be observed through either of these two methods. For shelter, the BLS uses a housing survey to calculate rent or owner's equivalent rent of primary residence.

The weights for an aggregate index are derived from the Consumer Expenditure Survey (CES). The CES is conducted by the BLS to collect information on the spending habits and demographics – such as age and income – of various households and families, or consumer units (CUs). It consists of two components, an interview survey and a diary survey. The interview survey is conducted every quarter for five consecutive quarters, and is designed to capture expenditures that the respondent(s) can recall for a period of three or more months; these usually include relatively large expenditures, such as automobile purchases or spending on property. The

diary survey, on the other hand, is designed to capture the purchase of smaller, everyday items; in this component, each CU records all of its expenditures every day for two consecutive one week periods. Both components exclude certain categories of spending. The interview survey, for example, excludes spending on food items while the diary survey excludes spending on overnight travel and auto vehicle repair work. These two data sources are integrated in calculating the CPI.[2]

What the CPI is Used For

The CPI is used in many ways, and because of this it affects virtually all Americans. Firstly, it can be used as an economic indicator. The CPI is the most common measure of inflation, and the government – President, Congress, and Federal Reserve – all use the CPI to formulate and monitor the effectiveness of fiscal and monetary policy. Similarly, many business leaders also use the CPI as a guide to making economic decisions.

Secondly, the CPI can be used as an index to which incomes or payments are pegged. In this way, the index directly affects the income of almost 80 million workers. Moreover, Social Security benefits and government pension payments are all indexed to the CPI, as is the food stamp program and school lunch program. Private firms may also use the CPI as an index for rent, alimony, and child support payments.

Thirdly, the government uses the CPI to make tax code decisions, such as adjusting tax brackets and deduction rules.

---

[2] "Frequently Asked Questions (FAQs)." *Bureau of Labor Statistics*. Web (2012). <http://www.bls.gov/cex/csxfaqs.htm>.

Fourthly, many other parts of the government and private sector use either all or parts of the CPI to adjust for price changes and produce inflation-adjusted numbers for their own purposes. Examples of this include wage numbers produced by the BLS and retail sales measures.

Problems with Calculating a Price Index

Though the BLS uses complex methods that combine economic theory, sampling, and other statistical techniques to produce the CPI in such a way that minimizes errors, some problems with the methodology – indeed, these problems plague the construction of any price index, not just the CPI – have been identified. These can be broadly categorized into pricing and item selection issues, weighting issues, and issues that affect both pricing/item selection and weighting.

Pricing and item selection issues include, but are not limited to: outlet substitution bias, quality change bias, and new product bias. Outlet substitution bias occurs when consumer shifts to lower price outlets are not accounted for; this can result in overstating inflation. Quality change bias occurs when improvements in the quality of products are not taken into account; this can result in overstating item prices and, thus, inflation. New product bias occurs when new products are either not included in the market basket, or are included after a long lag time.

Weighting issues include, but are not limited to, substitution bias and how frequently reweighing the market basket occurs. Substitution bias describes the tendency of consumers to purchase inexpensive substitutes for expensive items when prices change; thus, the weight of the inexpensive substitute should rise and the weight on the expensive item should fall. Failure to take this into account can result in overestimation of inflation. Weighing frequency is another issue: currently, the BLS adjusts its weighting every two years. While it is true that purchasing

habits generally do not change significantly over that time period, the lag time in adjusting may still lead to inaccuracies in calculating inflation.

One of the major problems that affects both pricing/item selection and weighting issues is that of overaggregation. The CPI represents the composite consumer, not any specific individual household or subset of households; thus, the CPI may not be an accurate proxy for cost of living for all subgroups. I will be focusing on this issue for the remainder of this paper.

Hypothesis

Because the CPI is the composite price index for a consumer, I pose that the process for calculating the national CPI results in a number that misrepresents inflation for certain demographics because of inaccurate weighting. Specifically, I am interested in looking at high income households, low income households, and households whose expenditures include spending on college education for the 1998-2011 period.

Existing Research

Research on Income Inflation Gap

Existing research on the inflation differentials experienced between high- and low-income households show mixed results. Hardouvelis, Kosma, and Simintzi[3] find in 2007 that poor Greek households do not experience significantly higher inflation than rich households, though their rates are slightly higher; poor households do, however, face higher inflation *uncertainty*.

[3] Hardouvelis, Gikas, Kosma, Olga and Simintzi, Elena. "The differential rate of inflation between the poor and the rich following the introduction of the euro." *Eurobank Research: Economy & Markets* 3. Web (2007). <http://www.eurobank.gr/Uploads/Reports/Econ%20Markets%203(2).pdf>.

Leicester, O'Dea, and Oldfield find in 2009 that the poor in Britain suffer from a higher inflation rate than the rich because of low-income households' tendencies to spend the majority of their income on necessary goods that have faced high inflation, in particular food and energy. The rich, on the other hand, benefited from events such as cuts in mortgage rates.[4]

Cheema and Malik studied inflation rates in Pakistan and find that the poor only experienced greater inflation than the rich when food prices rose at higher rates than those of non-food items.[5] Baldini, on the other hand, examined Italian households during the 1986-2004 period and found that rich households experienced higher rates of inflation than that of poor households, though the difference was not great.[6]

Research on Education Inflation

College education has experienced some of the greatest inflation over the period examined: from 1998-2011, the overall CPI, as calculated by the BLS, has risen 38%. Education – a subcategory of education and communication – on the other hand, has risen 103.5%. College tuition and fees, moreover, has risen by even more: 118.7%. Because the CPI represents the composite consumer, though, the weight placed on education and communication is fairly small – only about 6.8%, with education accounting for just about half of that.[7]

In 1984, Suttle found that inflation-adjusted higher education costs were not significantly above historical levels[8]; the cost of education has, of course, risen considerably since that time period.

---

[4]Leicester, Andrew, O'Dea, Cormac and Oldfield, Zoe. "Average inflation falls, but remains high for some." *Institute for Fiscal Studies*. Web (2009). <http://www.ifs.org.uk/publications/4454>.

[5] Cheema, Aftab Ahmad and Malik, Muhammad Hussain. "Income-Specific Inflation Rates in Pakistan." *The Pakistan Development Review* 25. Web (1986). <http://www.jstor.org/stable/10.2307/41258745>.

[6]Baldini, Massimo. "Inflation inequality in Italy." *University of Modena*. Web (2005). <http://www.capp.unimore.it/pubbl/cappapers/Capp_p08.pdf>.

[7] "Table 1." *Bureau of Labor Statistics*. Web (2010). < http://www.bls.gov/cpi/cpiri2010.pdf>.

[8] Suttle, J. Loyd. "The Rising Cost of Private Higher Education." *Research in Higher Education*. Web (1984). <http://www.jstor.org/stable/40195536>.

Limited further research exists as to how the rising cost of a college education has affected those households that are financing the education and, in turn, the levels of inflation they experience as a result of redistributed spending weights as compared to the composite consumer. This paper serves to partially fill in that gap.

Data

Sources

Unless otherwise stated, all data was obtained from the BLS to construct the price indices found in this paper. Data for prices was found online through the BLS' CPI historical database tables. Item weights and demographic data were mainly derived from the 2010 CES. All pricing data – both on the individual and aggregate levels – was indexed such that 1998 = 100. Any weights that come from the BLS, including weights that were used to account for sampling errors, are from the most recent official weights released for the CPI-U; in this case, it is the 2009-2010 weights. Weights were assumed to be held constant for the time period examined.

Procedure

Selecting a Sample Group

As mentioned earlier, the CES consists of two parts: an interview survey and a diary survey. The interview survey is conducted once a quarter for each consumer unit (CU) for five consecutive quarters. The purpose of this survey is to capture large purchases, such as spending on rent or purchase of new vehicles; however, this survey excludes certain key items such as food expenditures. The diary survey is designed to capture smaller, every day purchases, and is

completed by each CU for two consecutive weeks. Although the BLS integrates these two sources of data in calculating the CPI, for the purposes of this study, only data from the diary survey was used.

In all, 6,895 CUs were sampled for the 2010 CES Diary Survey. The following group was selected to potentially capture spending on post-secondary education[9]:

1. All CUs who have spent money on either college education or college supplies

The following groups were selected to represent high-income CUs[9]:

1. CUs making over $300,000 in after-tax income
2. The top 300 CUs in terms of after-tax income
3. The top 10% of CUs in terms of after-tax income, excluding negative income and non-reporting households

The following groups were selected to represent low-income CUs[9]:

1. CUs reporting negative after-tax income
2. The bottom 300 CUs in terms of after-tax income
3. The bottom 10% of CUs in terms of after-tax income, excluding negative income and non-reporting households

Weighting

There are four expenditure files for the 2010 CES Diary Survey, one for each quarter. 504 UCCs for expenditures were obtained from these four files. Next, those expenditures that are not included in the BLS-constructed CPI were eliminated for consistency in constructing this price

[9] For sample sizes, please see Appendix

index. In all, 22 UCCs were eliminated; the eliminations include items deemed “nonconsumption” by the BLS, such as investment expenditures, alimony payments, and life insurance. For a complete list of excluded items, please see the Appendix. The remaining UCCs were then paired with their corresponding category on the BLS-constructed CPI. For a complete list of pairings, please see the Appendix.

Information from the CES expenditure files were used to obtain the weighting for each item as follows:

Where:

P = overall price of an item

P_{CU} = amount spent on each item in consumer unit CU

w_{CU} = weight of the consumer unit CU

In words, every CU has a weight (w_{CU}) in accordance with the approximate number of US households they represent; the base is around 30,000 households and this number is later adjusted. The amount spent on each item in a household (P_{CU}) was multiplied by this weight to obtain a representative amount of what the CU and all its representative households would spend on that item (P).

To obtain the total expenditure, the following method was used:

Where:

TE = total expenditure on all items for all consumer units

TE_i = total expenditure on item i for all consumer units

The number 2.53% represents the percentage that the BLS allows for unsampled items according to the weights released for the 2009-2010 period

In words, the amount spent on each item was summed to find the total expenditure on that item (TE_i), and then all item total expenditures were summed to find the final expenditure on all items. However, because the BLS allows for 2.53% of the CPI to be unsampled items, that has to be accounted for in the final equation as well.

The final weighting for each item was obtained as follows:

$$\frac{}{}$$

Where:

w_i = final weight for item i

TE_i = total expenditure on item i for all CUs

TE = total expenditure on all items for all CUs

In words, the final weight for an item, w_i , was obtained by dividing the total expenditure on a particular item by the final total expenditure.

Pricing

The BLS-constructed all-item CPI uses the years 1982-1984 as base years, where the item prices are 100; however, many of the individual items in the CPI use December 1997 as a base month. For this reason, 1998 was chosen as a base year for the price indices in this analysis.

To calculate the price of each item with 1998 as 100, the following equation was used on the price of each item for the years 1999-2011:

$$\frac{}{}$$

Where:

$PA_{i,y}$ is the 1998-base adjusted price of item *i* in year *y*

$P_{i,y}$ = the BLS-given price of item *i* in year *y*

The price of an unsampled subcategory item *s* (ie: unsampled furniture) was assumed to be the same price as that of its broader category item *S* (ie: furniture and bedding). For a full list of unsampled item categories and their weights, please refer to the latest list of weights released by the BLS[10].

The CPI is comprised of multiple categories and subcategories. For example, the broadest category, all items, is made up of the subcategories food and beverages; housing; apparel; transportation; medical care; recreation; education and communication; and other goods and services. Medical care, in turn, is made up of the subcategories medical care commodities and medical care services, and so on.

[10] "Relative importance of components in the Consumer Price Indexes." *Bureau of Labor Statistics*. Web (2010). <http://www.bls.gov/cpi/cpiri2010.pdf>.

Because consumer group spending may differ even at the subcategory level, the following method was used to obtain the price for each broader category from the subcategory prices that were calculated above:

1. The weight for each category was figured out as follows :

   Where:

   w_i = weight for a sucategory *i*

   W_i = weight for a subcategory *i*'s broader item cateogry

   In words, the weight for a broader item category was calculated by summing up the weights of all its subcategory items.

2. The subweight for each subcategory was figured out as follows:

   Where:

   sw_i = subweight for category *i*

   w_i = weight for subcategory *i*

   W_i = weight for a subcategory *i*'s broader item cateogry

   In words, the subweight for each category was calculated by dividing each subcategory weight by its broader category weight.

3. The summation of each subweight (sw_i) in a category multiplied by its corresponding price(p_i) was used to figure out the price of the broader category (P_i):

   Where:

   sw_i = subweight for item i

   p_i = price for item i

   P_i = price for item i's broader category

   In words, the summation of each subweight in a category was multiplied by its corresponding price was used to figure out the price of the broader category.

This process was repeated starting with the most specific categories and moving up from there, eventually resulting in the final price index number.

Confidence Interval

Confidence intervals were only produced on the all-item basis at the 95% level. The procedure was done as follows:

1. The standard error for a given year, SE[11], was multiplied by 1.96, giving SE*.
2. Year-over-year percentage change for the all-items index was calculated as follows:

   Where:

   $\%\Delta CPI_{y-1,y}$ = the percentage change experienced by the all-item price index from year *y*-

[11]Standard errors were used for the 12-month period. Data is available back until 2003; for 1998-2002, the average of the years 2003-2011 was used. See Appendix for a list detailing the standard errors for the all-items index by year.

1 to year *y*

CPI_y = the all-item price index in year *y*

3. The 95% confidence interval for year-over-year percentage change, then, is as follows:

4. The lower limit for the CPI confidence interval was calculated as follows:

   Where:

   $CPI_{L,y}$ = the lower limit for the 95% confidence interval for the CPI in year *y*

   In words, to calculate the lower limit for the CPI in year *y*, the CPI from year *y-1* was multiplied by the difference between the percentage change in the CPI between the two years and *SE**.

5. The upper limit for the CPI confidence interval was calculated as follows:

   Where:

   $CPI_{H,,y}$ = the upper limit for the 95% confidence interval for the CPI in year *y*

   In words, to calculate the upper limit for the CPI in year *y*, the CPI from year *y-1* was multiplied by the sum of the percentage change in the CPI between the two years and the respective *SE**.

All data and tables are in the Appendix.

Results

Reconstructing the CPI

Because this paper's method of weighing and aggregating the individual price indices is not the same as that of the BLS, it was necessary to reconstruct the BLS CPI (CPI_{BLS}) for the period ranging 1998-2011 using their weights, called CPI_{RC}. Additionally, the data from the 6,895 CUs that participated in the CES diary survey was aggregated and a price index, CPI_{AGG}, was constructed from this.

The results from this are shown in Table 1a:

Table 1a.

Year	CPI_{BLS}	CPI_{RC}	CPI_{AGG}
1998-1999	2.21%	1.63%	1.93%
1999-2000	3.36%	4.28%	4.13%
2000-2001	2.85%	2.82%	2.63%
2001-2002	1.58%	1.76%	1.30%
2002-2003	2.28%	3.28%	3.18%
2003-2004	2.66%	3.55%	3.45%
2004-2005	3.39%	4.54%	4.59%
2005-2006	3.23%	4.13%	4.12%
2006-2007	2.85%	3.49%	3.44%
2007-2008	3.84%	5.29%	5.61%
2008-2009	-0.36%	-1.73%	-2.16%
2009-2010	1.64%	2.93%	2.83%
2010-2011	3.16%	4.80%	4.94%

Year	CPI_{RC}-CPI_{BLS}	CPI_{AGG}-CPI_{BLS}	CPI_{RC}-CPI_{AGG}
1998-1999	-0.58%	-0.28%	-0.29%
1999-2000	0.92%	0.77%	0.15%
2000-2001	-0.03%	-0.22%	0.19%
2001-2002	0.18%	-0.28%	0.46%
2002-2003	1.00%	0.90%	0.09%
2003-2004	0.89%	0.78%	0.11%
2004-2005	1.15%	1.20%	-0.05%
2005-2006	0.90%	0.89%	0.01%
2006-2007	0.65%	0.59%	0.05%
2007-2008	1.45%	1.77%	-0.32%
2008-2009	-1.38%	-1.80%	0.42%
2009-2010	1.29%	1.19%	0.11%
2010-2011	1.64%	1.78%	-0.14%

The table on the left shows the percentage change between the years indicated, while the table on the right shows the difference in percentage change for the years indicated between the various

indices. As can be seen, CPI_{BLS} generally showed lower inflation than the two indices that were constructed using my weighing method.

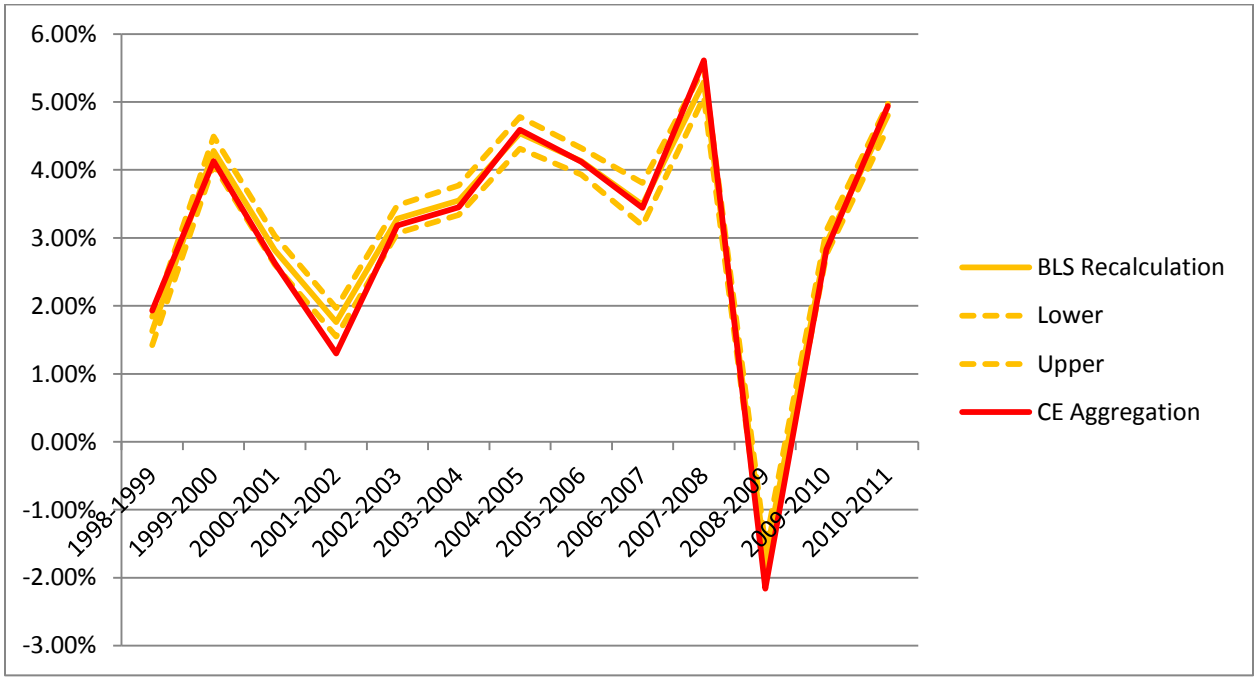
Table 1b shows the aggregate inflation for the three indices:

Year	CPI_{BLS}	CPI_{RC}	CPI_{AGG}
1998	100.00	100.00	100.00
1999	102.21	101.63	101.93
2000	105.64	105.98	106.14
2001	108.65	108.97	108.92
2002	110.37	110.89	110.34
2003	112.88	114.52	113.85
2004	115.89	118.59	117.78
2005	119.82	123.98	123.19
2006	123.68	129.09	128.26
2007	127.20	133.60	132.67
2008	132.09	140.67	140.11
2009	131.62	138.23	137.09
2010	133.78	142.28	140.96
2011	138.00	149.11	147.92

Table 1b.

Ultimately, the CPI_{RC} showed the highest inflation over the 1998-2011 period at 49.11%, 11.11% higher than the CPI_{BLS}; the CPI_{AGG} showed the second highest overall inflation at 47.92%. Although the difference between CPI_{BLS} and the other two seems to be fairly large in aggregate, the largest year-over-year percentage change difference between CPI_{BLS} and CPI_{RC} is only 1.64% in the 2010-2011 time period, as seen in Table 1a; because these two methods use the same prices for the most basic goods as well as the same weights for all goods, the difference in the indices is most likely because of the method of calculation used.

Because CPI_{AGG} and the following indices examined in this paper all use data from the CES Diary Survey, CPI_{AGG} will be used as a benchmark for the rest of the indices. Graph A shows the 95% confidence intervals for both CPI_{AGG} and CPI_{RC}:



Graph A

As can be seen, the year over year change for CPI_{AGG} and CPI_{RC} do not differ significantly for most of the time period. Additionally, the aggregate change for CPI_{AGG} falls well within the 95% confidence interval for the aggregate change for CPI_{RC} (see error tables in Appendix).

The difference between the CPI_{RW} and CPI_{AGG} must be because of the weights, as the prices for the most basic goods are the same. The weights given to the eight subcategories of the overall CPI for these two methods are as follows:

Category	CPI_{BLS}	CPI_{AGG}	CPI_{BLS}-CPI_{AGG}
Food and beverages	15.26%	18.07%	-2.81%
Housing	41.02%	37.57%	3.45%
Apparel	3.36%	4.95%	-1.58%
Transportation	16.88%	15.65%	1.23%
Medical care	7.06%	6.23%	0.83%
Recreation	6.04%	7.31%	-1.26%
Education and	6.80%	6.47%	0.33%
Other goods and services	3.39%	3.77%	-0.39%

Table 1c.

Although most of the categories' weights are close, the largest differences are in fairly long-term purchases such as housing or transportation, or short-term, everyday purchases such as food and beverages or apparel. This is because the CES Diary Survey is designed to capture everyday purchases, so it would be biased more towards the items in this category, slightly skewing the index.

High Income and Low Income Households

Table 2a details the year-over-year percentage change in price index for high-income CUs:

Year	CU_{HI1}	CU_{HI2}	CU_{HI3}	CPI_{AGG}
1998-1999	1.26%	1.60%	1.66%	1.93%
1999-2000	3.35%	3.46%	3.59%	4.13%
2000-2001	2.53%	2.55%	2.54%	2.63%
2001-2002	1.60%	1.53%	1.47%	1.30%
2002-2003	2.43%	2.59%	2.72%	3.18%
2003-2004	2.59%	2.88%	2.97%	3.45%
2004-2005	3.60%	3.84%	4.01%	4.59%
2005-2006	3.54%	3.67%	3.74%	4.12%
2006-2007	3.04%	3.11%	3.16%	3.44%
2007-2008	4.53%	4.66%	4.85%	5.61%
2008-2009	-0.90%	-1.10%	-1.37%	-2.16%
2009-2010	1.73%	1.97%	2.21%	2.83%
2010-2011	3.51%	3.83%	4.11%	4.94%
Average	2.52%	2.66%	2.74%	3.08%

Table 2a.

Where:

CU_{HI1} = CUs with reported after-tax incomes >$300,000 (n = 116)

CU_{HI2} = Top 300 CUs in terms of reported after-tax income

CU_{HI3} = Top 10% of CUs in terms of reported after-tax income, excluding negative- and zero-income CUs (n = 605)

As can be seen in the table above, the richer a CU was, the average annual inflation it experienced, although all three groups were fairly close. The "richest" group, CU_{HI1}, experienced inflation at a rate that was, on average, around 0.56% less than the benchmark CPI_{AGG}.

Graph B details the 95% confidence intervals for year over year inflation experienced by CPI_{HI1}, the highest income household group, and CPI_{AGG}, the benchmark:

Graph B

As shown above, CPI_{HI1} experiences significantly lower year over year inflation in most periods, and aggregate inflation of 38.31%, well below the confidence interval for aggregate inflation experienced by CPI_{AGG} (see error tables and Exhibit C in Appendix).

This difference can be explained by examining the weights placed on each CPI subcategory, as well as the average price of each subcategory. Table 2b details this data:

CU_{AGG}		
Category	**Weight**	**Price**
Food and beverages	18.07%	118.70
Housing	37.57%	120.93
Apparel	4.95%	93.20
Transportation	15.65%	143.91
Medical care	6.23%	130.35
Recreation	7.31%	110.34
Education and communication	6.47%	110.94
Other goods and services	3.77%	125.35

CU_{HI1}		
Category	**Weight**	**Price**
Food and beverages	16.35%	118.73
Housing	45.04%	116.59
Apparel	5.21%	93.68
Transportation	10.92%	139.07
Medical care	5.59%	131.71
Recreation	8.95%	107.64
Education and communication	4.85%	112.90
Other goods and services	3.09%	113.69

Table 2b.

As can be seen, the richest households end up with lower prices in many of the major categories and higher spending weights for these categories. Table 2c details the difference between the average prices and weights for these two demographics:

Category	**$W(CU_{HI1})$-$W(CU_{AGG})$**	**$P(CU_{HI1})$-$P(CU_{AGG}$**
Food and beverages	-1.71%	0.03
Housing	7.47%	-4.34
Apparel	0.26%	0.48
Transportation	-4.72%	-4.83
Medical care	-0.64%	1.35
Recreation	1.64%	-2.70
Education and communication	-1.62%	1.95
Other goods and services	-0.68%	-11.66

Table 2c.

Where:

W = the weight placed on a given category

P = the average price given to the specified category

As can be seen, the largest discrepancy in weights between the two categories is in housing: CU_{HI1} spends 7.47% more of their income on housing, but, on average, the price they pay has been 4.34 points less.

Turning to look at low-income households, Table 3a details inflation experienced by selected low-income CUs:

Year	CU_{LI1}	CU_{LI2}	CU_{LI3}	CPI_{AGG}
1998-1999	1.68%	2.19%	1.96%	1.93%
1999-2000	5.34%	4.78%	4.37%	4.13%
2000-2001	2.29%	2.83%	2.76%	2.63%
2001-2002	0.65%	1.53%	1.23%	1.30%
2002-2003	3.69%	4.12%	3.49%	3.18%
2003-2004	4.28%	4.42%	3.78%	3.45%
2004-2005	6.04%	5.52%	5.00%	4.59%
2005-2006	5.05%	4.73%	4.32%	4.12%
2006-2007	4.15%	3.95%	3.59%	3.44%
2007-2008	8.29%	6.57%	5.97%	5.61%
2008-2009	-5.00%	-2.68%	-2.30%	-2.16%
2009-2010	4.15%	3.51%	3.23%	2.83%
2010-2011	7.35%	5.78%	5.33%	4.94%
Average	3.69%	3.63%	3.29%	3.08%

Table 3a.

Where:

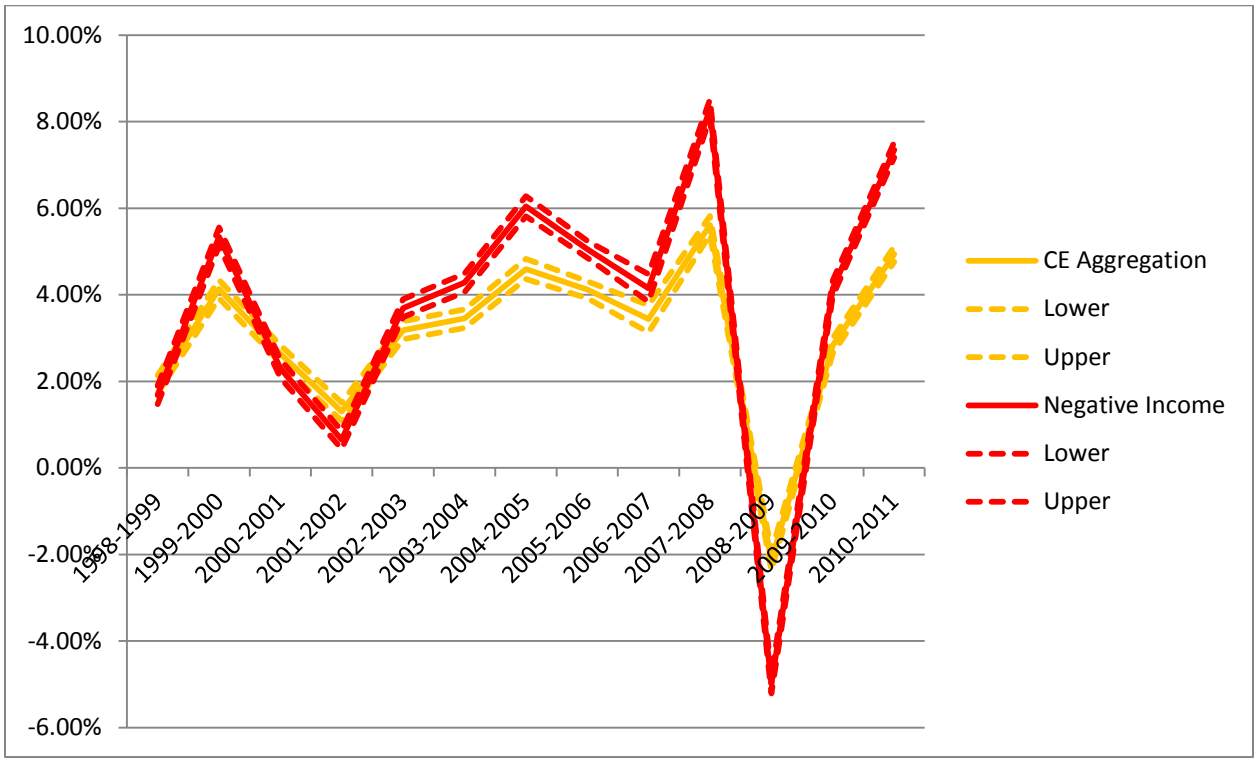
CU_{LI1} = CUs reporting negative after-tax income (n = 95)

CU_{LI2} = Bottom 300 CUs in terms of after-tax income, excluding negative and zero income CUs

CU_{LI3} = Bottom 10% of CUs in terms of after-tax income, excluding negative and zero income CUs (n = 605)

As can be seen in Table 3a, the negative-income households (CU experienced the highest annual rate of inflation, 0.4 percentage points higher than CU_{LI3} and 0.61 percentage points higher than the benchmark CPI_{AGG}.

Graph C details the 95% confidence intervals for year over year inflation experienced by CU_{LI1}, the lowest income group, and CPI_{AGG}, the benchmark:



Graph C

As shown above, CPI_{LI1} generally experienced not only higher, but more extreme inflation than the benchmark in most years. Ultimately, this led to the CU_{LI1} group experiencing aggregate inflation of 59.14% in the 1998-2011 period, as compared with the benchmark group experiencing inflation of 47.92%, a 11.22% difference (see Exhibit C and error tables in Appendix).

To explain the difference, the weights and prices assigned to each CPI subcategory can be examined in Table 3b:

CPI_{AGG}		
Category	**Weight**	**Price**
Food and beverages	18.07%	118.70
Housing	37.57%	120.93
Apparel	4.95%	93.20
Transportation	15.65%	143.91
Medical care	6.23%	130.35
Recreation	7.31%	110.34
Education and communication	6.47%	110.94
Other goods and services	3.77%	125.35

CU_{LI1}		
Category	**Weight**	**Price**
Food and beverages	14.46%	118.94
Housing	32.26%	130.52
Apparel	11.75%	97.20
Transportation	16.53%	151.82
Medical care	9.22%	131.58
Recreation	6.95%	110.49
Education and communication	5.17%	107.57
Other goods and services	3.66%	122.40

Table 3b.

As can be seen, the negative-income households tend to have higher weights placed on higher-priced categories, and vice versa. Lower-income households also tend to spend more of their income on necessary goods such as gas fuel (included in Transportation), which explains the greater volatility in inflation.

The differences between the average price and weights for the benchmark and negative-income households are detailed as follows:

Category	$W(CU_{LI1})$-$W(CPI_{AGG})$	$P(CU_{LI1})$-$P(CPI_{AGG})$
Food and beverages	-3.60%	0.24
Housing	-5.31%	9.59
Apparel	6.81%	3.99
Transportation	0.88%	7.91
Medical care	2.99%	1.23
Recreation	-0.36%	0.15
Education and communication	-1.29%	-3.37
Other goods and services	-0.12%	-2.94

Table 3c.

As can be seen above, the negative-income CUs experience higher prices, on average, in almost every category except for education and communication and other goods and services.

Table 4a compares the highest income and negative-income households' rate of inflation experienced year-over-year, as well as the difference between the two:

Year	CU_{LI1}	CU_{HI1}	$CU_{LI1} - CU_{HI1}$
1998-1999	1.68%	1.26%	0.42%
1999-2000	5.34%	3.35%	2.00%
2000-2001	2.29%	2.53%	-0.24%
2001-2002	0.65%	1.60%	-0.94%
2002-2003	3.69%	2.43%	1.26%
2003-2004	4.28%	2.59%	1.68%
2004-2005	6.04%	3.60%	2.44%
2005-2006	5.05%	3.54%	1.50%
2006-2007	4.15%	3.04%	1.12%
2007-2008	8.29%	4.53%	3.76%
2008-2009	-5.00%	-0.90%	-4.10%
2009-2010	4.15%	1.73%	2.42%
2010-2011	7.35%	3.51%	3.84%
Average	3.69%	2.52%	1.17%

Table 4a.

As can be seen, negative-income households experienced higher inflation for almost every year excluding the 2000-01, 2001-02, and 2008-09 periods.

Table 4b examines the differences in weights and average prices given to the broadest CPI subcategories:

Category	$W(CU_{LI1})$-$W(CU_{HI1})$	$P(CU_{LI1})$-$P(CU_{HI1})$
Food and beverages	-1.89%	0.21
Housing	-12.78%	13.92
Apparel	6.54%	3.51
Transportation	5.60%	12.75
Medical care	3.63%	-0.12
Recreation	-2.00%	2.85
Education and communication	0.33%	-5.32
Other goods and services	0.57%	8.71

Table 4b.

As can be seen, negative-income households experience higher prices on average for virtually every CPI subcategory, with the exceptions of education and communication and medical care.

Spending on Higher Education

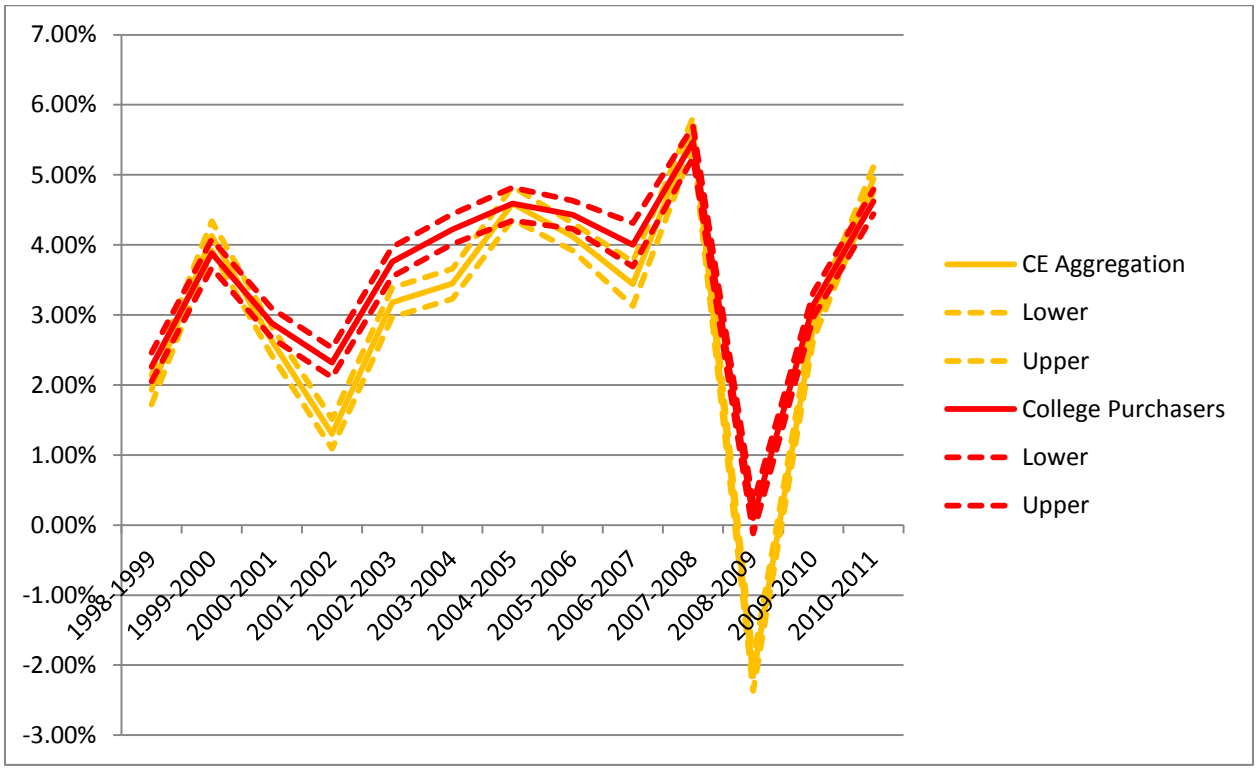
Table 5a examines the year-over-year inflation experienced by the benchmark group, CPI_{AGG}, as well as CU_C, the group that recorded spending money either on college tuition or college education supplies, here defined as UCC codes 660110 and 670110 (see Appendix):

Year	CPI_{AGG}	CU_C	CU_C - CPI_{AGG}
1998-1999	1.93%	2.26%	0.33%
1999-2000	4.13%	3.88%	-0.26%
2000-2001	2.63%	2.88%	0.25%
2001-2002	1.30%	2.32%	1.02%
2002-2003	3.18%	3.76%	0.58%
2003-2004	3.45%	4.22%	0.78%
2004-2005	4.59%	4.59%	0.00%
2005-2006	4.12%	4.43%	0.31%
2006-2007	3.44%	4.00%	0.56%
2007-2008	5.61%	5.47%	-0.14%
2008-2009	-2.16%	0.10%	2.25%
2009-2010	2.83%	3.14%	0.32%
2010-2011	4.94%	4.62%	-0.32%

Table 5a.

As seen above, the group represented by CU_C experienced higher year-over-year inflation in all periods except for three.

Graph D shows the year-over-year inflation experienced by CU_C and CPI_{AGG}.



Graph D.

As can be seen above, CU_C tended to experience higher inflation than the aggregate benchmark, which resulted in the benchmark experiencing 47.92% total inflation over the 1998-2011 period, while CU_C experienced 56.46% increase in the price of their market basket (see Appendix, Exhibit C and error tables), a 8.54% difference.

Table 5b examines the weights and prices assigned to each CPI subcategory by the benchmark group and CU_C:

CU_{AGG}		
Category	**Weight**	**Price**
Food and beverages	18.07%	118.70
Housing	37.57%	120.93
Apparel	4.95%	93.20
Transportation	15.65%	143.91
Medical care	6.23%	130.35
Recreation	7.31%	110.34
Education and communication	6.47%	110.94
Other goods and services	3.77%	125.35

CU_C		
Category	**Weight**	**Price**
Food and beverages	13.00%	118.77
Housing	27.81%	120.54
Apparel	8.79%	94.47
Transportation	11.49%	146.54
Medical care	3.76%	130.75
Recreation	6.60%	109.16
Education and communication	25.57%	141.33
Other goods and services	2.99%	118.01

Table 5b.

The average prices of the goods remain relatively similarly, with the marked exception of education and communication. Table 5c details the differences in weights and average price for both groups:

Category	**$W(CU_C)$-$W(CPI_{AGG})$**	**$P(CU_C)$-$P(CPI_{AGG})$**
Food and beverages	-5.06%	0.08
Housing	-9.76%	-0.39
Apparel	3.84%	1.27
Transportation	-4.16%	2.63
Medical care	-2.47%	0.40
Recreation	-0.71%	-1.18
Education and communication	19.10%	30.38
Other goods and services	-0.78%	-7.34

Table 5c.

As the table shows, CU_C places less weight on almost every category except for education and communication, on which it places 19.1% more; additionally, the price of this category is also 30.38 more on average.

To further break down the education and communication category, Table 5d details the average price and weights given to its subcategories for both CPI_{AGG} and CU_C:

CPI_{AGG}		
Category	**Price**	**Weight**
Education	147.51	32%
Communication	94.12	68%
Education and communication	110.94	100%

CU_C		
Category	**Price**	**Weight**
Education	150.78	85%
Communication	88.54	15%
Education and communication	141.33	100%

Table 5d.

As shown above, the benchmark – that is, the composite consumer – places a relative weight of 32% on the relatively more expensive education and 68% on the relatively cheaper communication in this category, while CU_C places an 85% weight on education and 15% weight on communication.

Conclusion

What we can take away from this analysis in regard to the original hypothesis is that the BLS CPI does not, and cannot, represent the purchasing habits of every demographic as each demographic has different - possibly extremely different - purchasing habits. As an inflation measure for the average consumer, the CPI may be relatively accurate and act as a good measure to sustain a consistent purchasing power; however, for certain groups, something else may serve as a better measure going forward.

Caveats

As shown earlier in this analysis, the method of building an index shown in this paper does not completely mirror that of the BLS. Attempts were made to mitigate this by: (1) reconstructing the CPI using BLS-given weights and (2) constructing a benchmark CPI using the aggregate data

gained from CES Diary Survey expenditure files. The later, demographic-specific price indices were compared only to the benchmark CPI, not the BLS CPI.

Moreover, since the most basic item's prices used in this paper's method were taken from the BLS, they are subject to the same possible errors that the BLS itself faces: sampling and nonsampling errors. Sampling error arises from not being able to capture every expenditure; nonsampling error arises from receiving inaccurate information.[1] The BLS attempts to mitigate this by accounting for unsampled items in the CPI.

Additionally, because only the Diary Survey from the CES was used to compute the weights; this means that the weights are probably skewed towards more short-term purchases, as the Diary Survey is not designed to capture long-term expenditures on items such as durable goods or rent. This analysis attempts to minimize this error by using the Survey data to construct a benchmark index.

The Diary Survey data is also subject to nonsampling and sampling error. Here, sampling error arises from the fact that even though the households surveyed are chosen so that they are supposed to be representative of the country's population as a whole, not every household in the country is surveyed to record their purchases; additionally, not every purchase is guaranteed to be captured. Nonsampling error in this case comes from households recording inaccurate information, whether it is in reporting information about their household demographic or about a purchase.

Assumptions used in this analysis may also be subject to error. For example, weights were held constant during the entire period because of lack of access to microdata. Unsampled item weights were also priced at their broader category's item weight; this may not be accurate.

Appendix

Exhibits

Exhibit A: Excluded UCC Items

UCC Code	Item	Reason
1000	Stocks, bonds, mutual funds	Investment
1100	Precious metals	Investment
1200	Miscellaneous investments	Investment
1400	Employment counseling & fees	Nonconsumption
2000	Savings account deposit	Investment
2100	Insurance other than health, hospital, vehicle and property	Nonconsumption
2200	Retirement plans	Investment
4000	Contributions	Gift
4100	Cash gifts	Gift
4190	Gifts not specified	Gift
5000	Alimony and child support	Alimony
9900	Property assessment	Investment
220000	Capital improvements	Investment
220210	Property taxes	Investment
220400	Purchase of property or real estate	Investment
230000	Repair of property	Investment
230110	Maintenance of property	Investment
270311	-	Not on list (nonsampling error)
670903	-	Not on list (nonsampling error)
690117	-	Not on list (nonsampling error)
999000	Home ownership expense	Investment
999900	Taxes not specified	Nonconsumption

Exhibit B: UCC Codes[12] and their Corresponding Categories

UCC Codes	CPI Category	UCC Codes	CPI Category
10110, 10210	Flour and prepared flour mixes	240110, 240120, 240210, 240220, 240320, 320140, 320420, 320430, 320511, 320522, 320610, 320902, 320905	Tools, hardware and supplies
10210	Breakfast cereal	320150, 320410, 320630, 330610	Outdoor equipment and supplies
10310, 10320	Rice, pasta, cornmeal	330110, 330210, 330310	Household cleaning products
20110, 20210	Bread	280230, 330510	Household paper products
20310	Fresh biscuits, rolls, muffins	340210, 340310, 340520, 340530	Miscellaneous household products
20410, 20510	Cakes, cupcakes, and cookies	340410	Domestic services
20610, 20620, 20710, 20810, 20820	Other bakery products	340510	Gardening and lawncare services
30110	Uncooked ground beef	230140, 270900, 340610, 340620, 340630, 340901, 340903	Moving, storage, freight expense
30210, 30310, 30410	Uncooked beef roasts	360110,360120, 360210	Repair of household items
30510, 30610, 30710	Uncooked beef steaks	360311, 360312, 360320, 360330, 360350, 360901	Men's suits, sports coats, and outerwear
30810	Uncooked other beef and veal	360340, 360410	Men's furnishings
40110, 40510	Bacon, breakfast sausage, and related products	360513	Men's shirts and sweaters
40310, 40610	Ham	370110, 370120, 370130, 370211, 370212, 370213, 370220, 370311, 370314, 370901	Men's pants and shorts
40210	Pork chops	380110	Boys' apparel
40410	Other pork including roasts and picnics	380210	Women's outerwear
50110, 50210, 50310, 50410, 50900	Other meats	380311, 380312, 380313, 380320, 380333, 380510	Women's dresses
60110, 60210	Chicken	380340, 380410, 380420, 380430, 380901, 380902	Women's suits and separates
60310	Other poultry including turkey	390110, 390120, 390210, 390223, 390230, 390310, 390321, 390322, 390901	Women's underwear, nightwear, sportswear and accessories
70230	Fresh fish and seafood	400110	Girls' apparel
70110, 70240	Processed fish and seafood	400210, 400220	Men's footwear
80110	Eggs	400310	Boys' and girls' footwear
90110	Milk	410110, 410120, 410130, 410140, 410901	Women's footwear
100210	Cheese and related products	430110	Infants' and toddlers' apparel
100410	Ice cream and related products	430120	Watches

[12] The original category associated with each UCC code can be found through BLS Diary Survey Data Documentation, orderable online through www.bls.gov

UCC Codes	CPI Category	UCC Codes	CPI Category
90210, 100510	Other dairy and related products	450110, 450310, 460110, 460901, 460902, 520511, 520521, 520904	Jewelry
110110	Apples	470111	New and used motor vehicles
110210	Bananas	470112	Gasoline (all types)
110310, 110510	Citrus fruits	480110	Other motor fuels
110410	Other fresh fruits	470211, 470220, 480212, 480213, 480214	Tires
120110	Potatoes	490000, 490110, 490311, 490312, 490313, 490314, 490315	Vehicle accessories other than tires
120210	Lettuce	490211, 490212, 490220, 490231, 490232, 490411, 490412, 490413	Motor vehicle maintenance and servicing
120310	Tomatoes	500110	Motor vehicle repair
120410	Other fresh vegetables	520110, 520310	Motor vehicle insurance
130310, 140210, 140220, 140230	Canned fruits and vegetables	520410, 520531, 520541, 520550, 520901	State motor vehicle registration and license fees
130121, 140110	Frozen fruits and vegetables	530110	Parking and other fees
130320, 140310, 140320, 140330, 140340	Other processed fruits and vegetables including dried	530210, 530311, 530412, 530510	Airline fare
170110, 170210	Carbonated drinks	530903	Other intercity transportation
130110, 130122, 140410	Frozen noncarbonated juices and drinks	530903, 54000, 550110, 550210, 550410, 550310, 550320, 550330, 570901, 570902	Intracity transportation
130211, 130212, 140420, 170510, 170531, 170532, 170533	Nonfrozen noncarbonated juices and drinks	560110, 560210, 560310, 560330, 560400, 570000, 570230, 570220, 340906, 580000, 580901	Medical care commodities
170310, 170410	Coffee	270310	Medical care services
170520	Other beverage materials including tea	620912, 620913	Cable and satellite television and radio service
150211, 150212	Sugar and artificial sweeteners	420110, 420120, 320, 512	Video discs and other media, including rental of video and audio
150110	Candy and chewing gum	310140	Sewing machines, fabric and supplies
150310	Other sweets	310210, 310335, 310900, 340909	Televisions
100110, 160110	Butter and margarine	310220, 310230, 310241, 310242	Other video equipment
160212	Salad dressing	310311, 310313, 310314, 310320, 310331, 310332	Audio equipment
160211, 160320	Other fats and oils including peanut butter	310340, 310352	Audio discs, tapes and other media
180110	Soups	610310, 610320	Pets and pet products
180210, 180220	Frozen and freeze dried prepared foods	620410, 620420	Pet services including veterinary
180310, 180320	Snacks	600110, 600120, 600130, 600310, 620915	Sports vehicles including bicycles
180410, 180420, 180510, 180520	Spices, seasonings, condiments, sauces	600210, 600410, 600420, 600430, 600900, 600903	Sports equipment

UCC Codes	CPI Category	UCC Codes	CPI Category
180620	Baby food	610210, 610220, 610230	Photographic equipment and supplies
160310, 180611, 180612, 180710, 180720	Other miscellaneous foods	620320, 620330	Photographers and film processing
190112, 190212, 190312, 190322, 190912, 190922	Full service meals and snacks	610110, 610120, 610140, 610901, 610902, 610903	Toys
190111, 190211, 190311, 190321, 190911, 190921	Limited service meals and snacks	610130	Music instruments and accessories
190114, 190214, 190314, 190324, 190914	Food at employee sites and schools	620111, 620112, 620113, 620121, 620710	Club dues and fees for participant sports and group exercises
190113, 190213, 190313, 190323, 190913, 190924	Food from vending machines and mobile vendors	620211, 620221, 620510, 620930	Admissions
200111, 200112	Beer, ale, and other malt beverages at home	620310, 620810	Fees for lessons or instructions
200210, 200410	Distilled spirits at home	590110, 590210, 590900	Newspapers and magazines
200310	Wine at home	590220, 590230	Recreational books
200511, 200512, 200513, 200514, 200521, 200522, 200523, 200531, 200532, 200533, 200534	Alcoholic beverages away from home	660000, 660110, 660210, 660310, 660900, 670902	Educational books and supplies
210110	Rent of primary residence	670110	College tuition and fees
210310	Housing at school, excluding board	670210	Elementary and high school tuition and fees
210210	Other lodging away from home including hotels and motels	670310	Child care and nursery school
9000, 230900	Owners' equivalent rent of primary residence	670901	Technical and business school tuition and fees
220110, 220120, 350110	Tenants' and household insurance	340110	Postage
250110	Fuel oil	340120	Delivery services
250210, 250220, 250900	Propane, kerosene, and firewood	270000	Telephone services
260110	Electricity	690110	Computer software and accessories
260210	Utility (piped) gas service	690114, 690116	Internet services and electronic information providers
260210	Water and sewer maintenance	320232, 340913, 520560, 690115, 690230	Telephone hardware, calculators, and other consumer information items
270210	Garbage and trash collection	630110	Cigarettes
270410	Floor coverings	630210, 630220	Tobacco products other than cigarettes
23012, 230130, 240900, 280210, 320110, 320120, 320620	Window coverings	640110, 640120, 640130, 640210, 640220, 640420	Hair, dental, shaving, and miscellaneous personal care products
280110, 280120, 280130, 280220, 280900	Other linens	640310, 640410	Cosmetics, perfume, bath, nail preparations and implements
290110, 290120	Bedroom furniture	650110, 650210	Haircuts and other personal care services

UCC Codes	CPI Category	UCC Codes	CPI Category
290210, 290310, 290320, 290410	Living room, kitchen, and dining room furniture	680110	Legal services
290420, 290430, 290440, 320901, 320904, 340904	Other furniture	680140, 680901	Funeral expenses
300110, 300210, 300220, 300310, 300320, 300330, 300410, 340907	Major appliances	440120, 440210	Laundry and dry cleaning services
300900, 320521	Other appliances	440110, 440130, 440140, 440150	Apparel services other than laundry and dry cleaning
320220, 320233	Clocks, lamps, and decorator items	680210, 680220, 680902	Financial services
320903	Indoor plants and flowers	320130, 330410, 430130, 620925, 620926, 680903	Miscellaneous personal goods
320310, 320320, 320330, 320340	Dishes and flatware		
320350, 320360, 320370, 320380	Nonelectric cookware and tableware		

Exhibit C: Selected Price Indices (1998-2011):

Year	BLS (1998=100)	CPI_{RC}	CPI_{AGG}	$CPI(CU_{HI1)}$	$CPI(CU_{LI1)}$	$CPI(CU_{C})$
1998	100.00	100.00	100.00	100.00	100.00	100.00
1999	102.21	101.63	101.93	101.26	101.68	102.26
2000	105.64	105.98	106.14	104.64	107.11	106.22
2001	108.65	108.97	108.92	107.29	109.56	109.28
2002	110.37	110.89	110.34	109.00	110.28	111.81
2003	112.88	114.52	113.85	111.66	114.35	116.02
2004	115.89	118.59	117.78	114.55	119.24	120.92
2005	119.82	123.98	123.19	118.68	126.45	126.46
2006	123.68	129.09	128.26	122.89	132.83	132.07
2007	127.20	133.60	132.67	126.62	138.34	137.35
2008	132.09	140.67	140.11	132.36	149.82	144.86
2009	131.62	138.23	137.09	131.17	142.33	145.00
2010	133.78	142.28	140.96	133.44	148.24	149.56
2011	138.00	149.11	147.92	138.13	159.14	156.46

Exhibit D: Groups and Sample Sizes

Group	Sample Size
CPI_{AGG}	6895
CU_{HI1}	116
CU_{HI2}	300
CU_{HI3}	605
CU_{LI1}	95
CU_{LI2}	300
CU_{LI3}	605
CU_{C}	137

Exhibit E: Selected Groups and Category Weightings

	Food and beverages	Housing	Apparel	Transportation	Medical care	Recreation	Ed. and comm.	Other goods and services
CPI_{BLS}	15.26%	41.02%	3.36%	16.88%	7.06%	6.04%	6.80%	3.39%
CPI_{AGG}	18.07%	37.57%	4.95%	15.65%	6.23%	7.31%	6.47%	3.77%
CU_{HL1}	16.35%	45.04%	5.21%	10.92%	5.59%	8.95%	4.85%	3.09%
CU_{HL2}	16.76%	41.55%	5.43%	12.95%	5.38%	8.78%	6.19%	2.97%
CU_{HL3}	16.56%	40.88%	5.16%	14.90%	4.95%	8.42%	6.15%	3.00%
CU_{LL1}	14.46%	32.26%	11.75%	16.53%	9.22%	6.95%	5.17%	3.66%
CU_{LL2}	19.30%	33.39%	3.71%	12.55%	9.05%	7.63%	11.18%	3.18%
CU_{LL3}	19.62%	32.76%	3.75%	17.87%	7.31%	7.13%	8.01%	3.55%
CU_{C}	10.17%	27.87%	9.48%	9.24%	3.49%	5.31%	31.47%	2.97%

Exhibit F: Standard Deviations by Year

Year	σ
1998	0.107%
1999	0.107%
2000	0.107%
2001	0.107%
2002	0.107%
2003	0.110%
2004	0.120%
2005	0.100%
2006	0.160%
2007	0.110%
2008	0.110%
2009	0.090%
2010	0.090%
2011	0.070%

Exhibit F: Confidence Interval Results - CPI_{RC}

% Change (Year-over-Year)

Year	Actual	Lower	Upper
1998-1999	1.63%	1.42%	1.84%
1999-2000	4.28%	4.07%	4.49%
2000-2001	2.82%	2.61%	3.03%
2001-2002	1.76%	1.55%	1.97%
2002-2003	3.28%	3.07%	3.48%
2003-2004	3.55%	3.34%	3.77%
2004-2005	4.54%	4.31%	4.78%
2005-2006	4.13%	3.93%	4.32%
2006-2007	3.49%	3.18%	3.81%
2007-2008	5.29%	5.07%	5.50%
2008-2009	-1.73%	-1.95%	-1.52%
2009-2010	2.93%	2.76%	3.11%
2010-2011	4.80%	4.62%	4.97%
Aggregate	**49.11%**	**45.12%**	**53.19%**

Exhibit G: Confidence Interval Results - CPI_{AGG}

% Change (Year-over-Year)

Year	Actual	Lower	Upper
1998-1999	1.93%	1.72%	2.14%
1999-2000	4.13%	3.92%	4.34%
2000-2001	2.63%	2.42%	2.83%
2001-2002	1.30%	1.09%	1.51%
2002-2003	3.18%	2.97%	3.39%
2003-2004	3.45%	3.23%	3.66%
2004-2005	4.59%	4.36%	4.83%
2005-2006	4.12%	3.92%	4.31%
2006-2007	3.44%	3.13%	3.76%
2007-2008	5.61%	5.39%	5.82%
2008-2009	-2.16%	-2.37%	-1.94%
2009-2010	2.83%	2.65%	3.00%
2010-2011	4.94%	4.76%	5.12%
Aggregate	**47.92%**	**43.97%**	**51.98%**

Exhibit H: Confidence Interval Results – CU_{HI1}

% Change (Year-over-Year)

Year	Actual	Lower	Upper
1998-1999	1.26%	1.05%	1.46%
1999-2000	3.35%	3.14%	3.56%
2000-2001	2.53%	2.32%	2.74%
2001-2002	1.60%	1.39%	1.81%
2002-2003	2.43%	2.22%	2.64%
2003-2004	2.59%	2.38%	2.81%
2004-2005	3.60%	3.37%	3.84%
2005-2006	3.54%	3.35%	3.74%
2006-2007	3.04%	2.72%	3.35%
2007-2008	4.53%	4.32%	4.75%
2008-2009	-0.90%	-1.11%	-0.68%
2009-2010	1.73%	1.56%	1.91%
2010-2011	3.51%	3.33%	3.69%
Aggregate	**38.13%**	**34.42%**	**41.93%**

Exhibit I: Confidence Interval Results – CU_{HI2}

% Change (Year-over-Year)

Year	Actual	Lower	Upper
1998-1999	1.60%	1.39%	1.81%
1999-2000	3.46%	3.25%	3.67%
2000-2001	2.55%	2.34%	2.76%
2001-2002	1.53%	1.32%	1.73%
2002-2003	2.59%	2.38%	2.80%
2003-2004	2.88%	2.66%	3.09%
2004-2005	3.84%	3.61%	4.08%
2005-2006	3.67%	3.48%	3.87%
2006-2007	3.11%	2.80%	3.42%
2007-2008	4.66%	4.44%	4.87%
2008-2009	-1.10%	-1.31%	-0.88%
2009-2010	1.97%	1.80%	2.15%
2010-2011	3.83%	3.66%	4.01%
Aggregate	**40.51%**	**36.74%**	**44.38%**

Exhibit J: Confidence Interval Results – CU_{HI3}

% Change (Year-over-Year)			
Year	**Actual**	**Lower**	**Upper**
1998-1999	1.66%	1.45%	1.86%
1999-2000	3.59%	3.38%	3.80%
2000-2001	2.54%	2.33%	2.75%
2001-2002	1.47%	1.26%	1.68%
2002-2003	2.72%	2.51%	2.93%
2003-2004	2.97%	2.76%	3.19%
2004-2005	4.01%	3.78%	4.25%
2005-2006	3.74%	3.55%	3.94%
2006-2007	3.16%	2.85%	3.47%
2007-2008	4.85%	4.63%	5.07%
2008-2009	-1.37%	-1.59%	-1.16%
2009-2010	2.21%	2.04%	2.39%
2010-2011	4.11%	3.94%	4.29%
Aggregate	**41.97%**	**38.16%**	**45.88%**

Exhibit K: Confidence Interval Results – CU_{LI1}

% Change (Year-over-Year)

Year	Actual	Lower	Upper
1998-1999	1.68%	1.47%	1.89%
1999-2000	5.34%	5.13%	5.55%
2000-2001	2.29%	2.08%	2.50%
2001-2002	0.65%	0.44%	0.86%
2002-2003	3.69%	3.48%	3.90%
2003-2004	4.28%	4.06%	4.49%
2004-2005	6.04%	5.81%	6.28%
2005-2006	5.05%	4.85%	5.24%
2006-2007	4.15%	3.84%	4.47%
2007-2008	8.29%	8.08%	8.51%
2008-2009	-5.00%	-5.21%	-4.78%
2009-2010	4.15%	3.98%	4.33%
2010-2011	7.35%	7.17%	7.53%
Aggregate	**59.14%**	**54.90%**	**63.48%**

Exhibit L: Confidence Interval Results – CU_{LI2}

% Change (Year-over-Year)

Year	Actual	Lower	Upper
1998-1999	2.19%	1.98%	2.40%
1999-2000	4.78%	4.57%	4.99%
2000-2001	2.83%	2.62%	3.04%
2001-2002	1.53%	1.32%	1.74%
2002-2003	4.12%	3.91%	4.33%
2003-2004	4.42%	4.20%	4.63%
2004-2005	5.52%	5.29%	5.76%
2005-2006	4.73%	4.53%	4.92%
2006-2007	3.95%	3.64%	4.27%
2007-2008	6.57%	6.35%	6.78%
2008-2009	-2.68%	-2.90%	-2.46%
2009-2010	3.51%	3.33%	3.68%
2010-2011	5.78%	5.60%	5.95%
Aggregate	**58.53%**	**54.32%**	**62.86%**

Exhibit M: Confidence Interval Results – CU_{LI3}

% Change (Year-over-Year)

Year	Actual	Lower	Upper
1998-1999	1.96%	1.75%	2.17%
1999-2000	4.37%	4.17%	4.58%
2000-2001	2.76%	2.55%	2.97%
2001-2002	1.23%	1.02%	1.44%
2002-2003	3.49%	3.28%	3.70%
2003-2004	3.78%	3.56%	3.99%
2004-2005	5.00%	4.77%	5.24%
2005-2006	4.32%	4.12%	4.52%
2006-2007	3.59%	3.28%	3.91%
2007-2008	5.97%	5.75%	6.18%
2008-2009	-2.30%	-2.52%	-2.08%
2009-2010	3.23%	3.05%	3.41%
2010-2011	5.33%	5.15%	5.50%
Aggregate	**51.87%**	**47.82%**	**56.03%**

Exhibit N: Confidence Interval Results – CU_C

% Change (Year-over-Year)

Year	Actual	Lower	Upper
1998-1999	2.26%	2.05%	2.46%
1999-2000	3.88%	3.67%	4.08%
2000-2001	2.88%	2.67%	3.09%
2001-2002	2.32%	2.11%	2.53%
2002-2003	3.76%	3.55%	3.97%
2003-2004	4.22%	4.01%	4.44%
2004-2005	4.59%	4.35%	4.82%
2005-2006	4.43%	4.23%	4.63%
2006-2007	4.00%	3.69%	4.31%
2007-2008	5.47%	5.25%	5.69%
2008-2009	0.10%	-0.12%	0.31%
2009-2010	3.14%	2.97%	3.32%
2010-2011	4.62%	4.44%	4.79%
Aggregate	**56.46%**	**52.30%**	**60.73%**