Measuring Regional Cost of Living

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Abstract
The American Chamber of Commerce Research Association (ACCRA) produces the only source of publicly available regional cost of living data which, this paper suggests, may provide misleading information. An evaluation of the quality of the ACCRA indexesconcludes that they contain substantial errors and biases, predominantly from the estimated prices, although error also is introduced by the choice of index formula. To evaluate the ACCRA index, this paper uses category indexes produced by BLS researchers, Kokoski, Cardiff and Moulton (KCM 1994) to produce new regional cost-of-living indexes which substantially reduce the errors and biases found in the ACCRA indexes.

Measuring Regional Cost of Living [1]

I. Introduction

Regional cost of living is an issue of great interest to many people yet at the current time there is only one source of publicly available data. The American Chamber of Commerce Research Association (ACCRA) produces a quarterly city/metropolitan area cost-of-living (COL) index. However, city participation in the ACCRA program is voluntary, and varies over time. Individual city indexes, say for example, Boston, cannot be compared from quarter to quarter because the ACCRA formula compares individual prices to the sample aggregate. We believe the ACCRA indexes contain substantial errors and biases and may provide misleading information about the comparison of regional costs of living. Still, because it is the sole remaining source of timely, publicly available data, the ACCRA index is often used in city comparisons by researchers and in the popular press, such as "The Best Place to Live Today" by Money Magazine.[2] In this paper we investigate the quality of ACCRA index estimates of regional cost of living and produce a new cost-of-living index which substantially reduces the errors and biases found in the ACCRA index.

Due to budget reductions, in 1982 the Bureau of Labor Statistics (BLS) discontinued a program which provided a time series of cost of living for twenty four metropolitan areas, four nonmetropolitan regions and Anchorage, Alaska. Recently, however BLS economists have experimented with the vast detailed price data collected for the consumer price index (CPI) to calculate regional cost-of-living indexes (see Kokoski et al 1994, Moulton 1995, Kokoski et al 1996 among others). Since the items priced in the CPI are selected on the basis of a probability sample, prices are not directly comparable across regions. Kokoski, Cardiff

[1]The authors thank Mary Daly and other participants at the Federal Reserve System Committee on Regional Analysis, Mary Kokoski, Brent Moulton, Wolf Weber, Kim Zieschang and Mark Wynne for valuable insights. Jeff Osborne and John Benedetto provided valuable research assistance. This paper does not represent the official views of the Federal Reserve Bank of Dallas or the Federal Reserve System.

[2]*Money*, July 1996

and Moulton (KCM 1994) use hedonic regressions to utilize BLS's large, high quality CPI database. KCM estimate COL indexes for the 32 largest Metropolitan Statistical Areas (MSAs) and 12 regions for the period July 1988 to June 1989 for 11 major expenditure categories, such as food, transportation and shelter. KCM do not produce a composite index for each city, however, due to computational limitations.

In this paper we aggregate the KCM price indexes for each city and produce a new composite cost-of-living index for 26 MSAs, using a second-best aggregation technique. We use the new composite indexes to measure two sources of error and biases which the ACCRA index may have. First, we create a benchmarked ACCRA index, which uses our aggregation of KCM price indexes in a Laspeyres formula similar to that used by ACCRA. The deviation between the ACCRA index and our new benchmarked ACCRA index estimates the sampling error, sampling bias and aggregation bias caused by the quality of ACCRA's estimated prices of goods and services and the definition of the market basket. Next, we create a new composite index which uses our aggregated KCM price indexes in a superlative formula. The difference between our new composite index and the benchmarked ACCRA index estimates ACCRA's formula bias introduced by the choice of a particular index number formula to represent the unknown true index (see Selvanathan and Rao 1994).[3]

We find significant differences between the ACCRA index, the benchmarked ACCRA and the new composite index. The predominant source of the difference between these indexes appears to come from the estimated prices rather than the formula, although there is a difference introduced by the formula as well. This study suggests that users should be cautious using the ACCRA indexes as an accurate representation of relative costs of living

[3]Our new index does not explicitly treat heterogeneous products between areas. Kokoski, Moulton, and Zieschang (KMZ, 1996) do treat heterogeneous products between areas. They also establish the most general form of transitive Tõnquivist bilateral indexes which compares area prices and expenditure shares to some reference price and share vector. They offer two ways of determining that reference based on minimum adjustment criteria. We do not use the KMZ formula because the raw data is not readily available to us. Furthermore one of this paper's aims is to find the major source of errors and biases of the ACCRA index and, we believe, our new index serves the purpose.

across metropolitan areas, and suggests an improved new composite regional cost-of-living index.

II. Related Concepts of Indexes

1. The theory of the cost of living index

Cost of living is a unique concept for each individual and is determined by the individual's preferences for different types of goods and services and the prices at which that individual can purchase them. The theory of the regional cost-of-living index starts from the expenditure function of a representative individual in the region,

$$e(p^r, u) = \min_{q_i^r} \sum_{i=1}^{N} p_i^r q_i^r \; : \; U(q^r) \geq u, \tag{1}$$

where p_i^r(q_i^r) denotes the price (quantity) of the ith good or service consumed at region r, $p^r = (p_1^r, p_2^r, \ldots, p_N^r)$, and $q^r = (q_1^r, q_2^r, \ldots, q_N^r)$. The expenditure function gives the minimum cost to the representative individual of attaining some specified level of utility, u, when faced with a set of prices, p^r, for the goods and services that enter that individual's utility function.

The true cost-of-living index is then defined on the basis of the expenditure function. Specifically, it is the change in the cost of attaining some base level of utility, u^*, between a base area, b, and a comparison area c:

$$\frac{e(p^c, u^*)}{e(p^b, u^*)}, \tag{2}$$

where p^c and p^b denote the prices faced by the individual in the comparison and base regions respectively. In other words, the true cost-of-living index is the comparison of the cost of purchasing the goods and services which provide the same utility in both a comparison area and a base area. Bilateral regional cost-of-living indexes are approximations of this true cost-of-living index. One bilateral index is better than another bilateral index if it is a closer approximation of the true cost-of-living index. In essence, Diewert's (1976) concept of 'superlative index'[4] can be considered as attempts to evaluate indexes based on the degree of approximation of indexes to the true cost-of-living index.

2. Bilateral Indexes

A well-known approximation of the true cost-of-living index is the Laspeyres index. A Laspeyres index calculates the difference in the cost of living between two areas by comparing the cost of purchasing in each area a bundle of goods and services purchased in the base area:

$$P^L = \frac{\sum_{i=1}^{N} p_i^c q_i^b}{\sum_{i=1}^{N} p_i^b q_i^b}, \tag{3}$$

where q_i^b denotes the quantity of the ith good or service consumed at the base area. For example, a Laspeyres type cost-of-living index which has Dallas as the reference city would aggregate the quantity of goods consumed in the Dallas market basket multiplied by the price of purchasing those items in New York divided by the quantity of goods consumed in the Dallas market basket multiplied by the price of purchasing all items in Dallas.

Another well known cost-of-living index is the Paasche index. A Paasche index calculates the price change between two areas by comparing the cost of purchasing the bundle of goods purchased in the compared area with the cost of purchasing the bundle in the base area:

$$P^P = \frac{\sum_{i=1}^{N} p_i^c q_i^c}{\sum_{i=1}^{N} p_i^b q_i^c} \tag{4}$$

[4]An aggregator functional form is said to be 'flexible' if it can provide a second order approximation to an arbitrary twice differentiable linearly homogenous function. An index number functional form is said to be 'superlative' if it is exact (i.e., consistent with) for a 'flexible' aggregator functional form (Diewert 1976).

where q_i^c denotes the quantity of the ith good or service consumed in the compared region. For example, a Paasche type cost-of-living index which has Dallas as the base city would aggregate the quantity of goods consumed in the New York market basket multiplied by the price of purchasing those items in New York divided by the quantity of goods consumed in New York market basket multiplied by the price of purchasing all items in Dallas.

A Laspeyres index and a Paasche index assume a fixed market basket for each city and do not capture the ability of consumers to substitute between products based on the relative prices in each city. For example, people in New York may consume more bagels than people in Dallas because bagel prices tend to be lower in New York. Use of a fixed Dallas market basket would not count that consumers will adapt their market basket to increase utility based on the prices in New York. This type of bias is called substitution bias.

The substitution bias in a Laspeyres index and a Paasche index move in opposite directions, i.e., one index tends to overstate the real cost-of-living in each city while the other tends to understate the real cost-of-living. The consequence is the Laspeyres-Paasche gap. Empirically it is known that the Laspeyres and the Paasche indexes typically differ less than 0.5 percent in a time series context for adjacent periods, but they sometimes differ more than a tolerable level in a cross-section context.[5] Irving Fisher (1922) proposes taking the geometric mean of the Laspayres and Paasche indexes in the Fisher ideal index:

$$P^F = \sqrt{P^L * P^P}. \qquad (5)$$

Konus (1924) shows that the Fisher ideal index is the exact cost-of-living index for the homogeneous quadratic utility function. Because the homogeneous quadratic is a flexible functional form, the Fisher ideal index is a superlative index according to Diewert's (1976) definition.

[5]Diewert (1978) shows that the Laspeyres index and the Paasche indexes approximate the superlative indexes to the first order when calculated with the same price and quantity data.

Törnqvist advocates a weighted geometric mean of the price ratios of the following form:

$$P^T = \prod_{i=1}^{N} (\frac{p_i^c}{p_i^b})^{s_i}, \quad (6)$$

where $s_i = (\frac{1}{2})\frac{p_i^b q_i^b}{p^b q^b} + (\frac{1}{2})\frac{p_i^c q_i^c}{p^c q^c}$ is the average expenditure share on good of service i for $i = 1, \ldots, N$. Diewert (1976) shows that the Törnqvist index is a superlative index for the translog utility function.

Since all known superlative index formulae approximate each other to the second order as shown by Diewert (1978), we can consider both the Fisher index and the Törnqvist index as close approximations of the true cost-of-living index even without knowing the functional form of the utility function. Empirically it has been known that superlative indexes typically approximate each other to less than 0.2 percent in the time series context and 2 percent in the cross-section context (see Fisher 1922, Ruggles 1967 and Diewert 1987).

3.Multilateral Indexes

When we have more than two regions, there are two major factors, among others, which must be considered when constructing an index.[6] The first is transitivity (circularity) of the index. If there are three regions, A, B and C, transitivity implies that index $P_{B/A}$ multiplied by index $P_{C/B}$ should equal index $P_{C/A}$, where $P_{j/i}$ denotes the relative price of region j compared with region i. Without transitivity we cannot get a consistent picture of the ensemble of regions, and sometimes even the order of the regions cannot be determined. The second factor which is important to consider when there are more than two regions is the characteristicity of the weights. This requirement means that the weights used for any index computations should be characteristic of the two given regions. For example, using national weights in a Dallas-New York comparison would be uncharacteristic of both regions and

[6]Drechsler (1973) discusses characteristic of weights, unbiasedness, transitivity, internal consistency and factor relations as factors to consider when we evaluate multivariate index.

would fail to incorporate important information into the index formula. A regional cost of living index should measure the cost of purchasing a constant level of utility across regions. Using a fixed market basket, for example a national market basket, fails to allow consumers to substitute between products to achieve the highest level of utility based on the opportunities in each region. A regional cost-of-living index should maintain as much characteristicity as possible to obtain the closest estimate of the true cost of living.

The characteristicity and transitivity requirements are incompatible with one another. One set of indexes cannot satisfy both requirements. As mentioned by Drechsler (1973), "Characteristicity of the weights requires that each bilateral comparison ignore the outside world. However, the outside world is always something else from bilateral comparison to bilateral comparison; and if one uses different weights, i.e. different yardsticks in each bilateral comparison, one cannot expect the requirement of circularity to be met."

But, there are several ways to achieve transitivity without completely sacrificing characteristicity. Two well known methods are the central country(region) solution and Eltetö-Köves and Szulc (EKS) method. With the central country solution, one single region is used to carry out the multilateral comparisons. Transitivity can be achieved by keeping all other individual indexes fully characteristic, and compiling other indexes as products or quotients of the appropriate central indexes. For example, if the index $P_{A/B}$, $P_{A/C}$ and $P_{A/D}$ are defined as $\frac{A}{B}$, $\frac{A}{C}$ and $\frac{A}{D}$ respectively, then $P_{B/C} = \frac{B}{C} = (P_{A/C}/P_{A/B})$ and the set of indexes satisfies the circular test. Drechsler (1973) calls this method the central country solution.

The EKS method achieves transitivity while minimizing the deviation of the EKS indexes from the Fisher type indexes. The general form of EKS indexes is

$$P_{i/j}^{EKS} = \left(\frac{\prod_K P_{i/K}^F}{\prod_K P_{j/K}^F}\right)^{\frac{1}{n}}, \quad (7)$$

where $P^F_{i/K}$ is the Fisher index with K as a base region and j as a comparision region, and $K = a, \dots, i, j, \dots, n$. The EKS indexes satisfy the transitivity condition. We can define the price of area j relative the price of all n regions, P_j^{EKS}, as the geometric mean of the bilateral output comparisons between j and each of regions,

$$ln\, P_j^{EKS} = \frac{1}{n}\sum_K ln\, P^F_{j/K}, \tag{8}$$

which is the denominator (or numerator) of the above formula. The EKS indexes are, in spirit, the same as a central country solution in that the national average is the base region carrying multilateral comparison. In both cases the characteristicity sacrifice is distributed among the various bilateral comparisons; however the sacrifice is smaller in the EKS indexes.[7]

Caves, Christensen and Diewert (1982, CCD) advocate the use of the translog Tõrnqvist index instead of using the Fisher formula of equation (7). CCD's revision of the EKS method is called the generalized EKS method.

[7]This is called 'minimum property' of the EKS indexes. See Drechsler (1973) for details.

III. The ACCRA Cost-of-Living Index.

The goal of the ACCRA program is to measure the cost of maintaining a mid-management standard of living. The data for the ACCRA index is gathered by volunteers who often are associated with a local chamber of commerce. The ACCRA index is produced for a wide number of cities but, since participation is voluntary, the index is not always available for every city. Some cities participate every other quarter or more sporadically, and cities join and leave the survey fairly frequently.[8]

The ACCRA index is designed to serve as a bilateral and multilateral index. It is bilateral in that the value for each city is the cost of living in the city relative to the national average. The index can also be used as a multilateral index - multilateral in the sense that each of the cities can be compared to each of the other cities by taking the ratio of the two cities cost-of-living indexes. For example, if the value for Dallas is 101.6 and the value for Chicago is 124.1, than one can take these bilateral indexes (which are relative to the national average) and divide the value for Dallas by the value for Chicago to get a multilateral index for Dallas relative to Chicago of 81.9.

The products chosen to be part of the ACCRA index are those that are generally available in all regions of the country. The items are intended to represent a 'national' market basket and may not be representative of the expenditure pattern of any region. The prices collected by the volunteers are posted prices and do not include sales taxes. Price data are recorded for 59 items. For most items, five is the minimum acceptable sample size. The ACCRA Cost-of-Living Index manual recommends that for larger metropolitan areas a larger sample size be used. For example, for areas with over one million people, the ACCRA manual states that 10 establishments would be a reasonable sample size. Examples of price items include a 2 liter bottle of Coca-Cola, a 175-count box of Kleenex tissue, a six-pack of

[8]Prior to June 1991 any area was allowed to participate, but since then, participation has been restricted to areas that have a population of at least 50,000 that is settled at a density of more than 1,000 persons per square mile or have a county population of at least 40,000 and is capable of pricing according to the ACCRA specifications.

Miller Lite or Budweiser, and monthly rent for an unfurnished two bedroom, 950 square foot apartment that excludes all utilities except water and sewage. Housing (which is 20.6 percent of the index) is priced by the cost of an 1800 square foot new home that meets certain specifications that define the likely home of a mid-management level person. Specifications include location, lot size, and amenities. Interest costs are also recorded although property tax, and insurance costs are not.

Price relatives for each of the 59 items are calculated by dividing the average price in the area by the average price across all cities. Prices in large areas such as New York and Los Angeles are given the same weight as small areas such as Lufkin, Texas. Thus the index measures prices relative to the average city price not to the price the average consumer pays (since there are many more consumers in New York than in Lufkin). The relative prices for each area for each of the 59 items are then aggregated using the national consumption weights for professionals to form six broad categories and a composite. Since the sample size and the average price across all cities varies over time, the ACCRA index cannot be used as a time series, even for a city that participates in every survey.

Weights on the prices are the same for every urban area. The weights are calculated using data on the proportional distribution of expenditures by US households. The reference person has a professional or managerial occupation, in a household in the upper quintile of income. The source of the weight data is the Bureau of Labor Statistics Consumer Expenditure Survey.

The formula to compute the ACCRA index at region r is

$$ACCRA^r = \sum_{i=1}^{N} p_i^{r*} \omega_i^*, \qquad (9)$$

where p_i^{r*} is the price of item i at region r relative to the sample's average price of item i (which is ACCRA's proxy for the national consumption share of item i) and ω_i^* is the national weight for item i.[9] The formula can be written as

$$ACCRA^r = \sum_{i=1}^{N} p_i^{r*}\omega_i^* = \sum_{i=1}^{N} \left(\frac{p_i^r}{p_i^*}\right)\frac{p_i^* q_i^*}{\sum_{i=1}^{N} p_i^* q_i^*} = \frac{\sum_{i=1}^{N} p_i^r q_i^*}{\sum_{i=1}^{N} p_i^* q_i^*} \qquad (10)$$

where p_i^* is the price of item i in the 'nation'. It follows that the bilateral ACCRA index is a Laspeyres type index of equation (3) with the nation as the base region.

When used for multilateral comparisons, say New York and Dallas , the ACCRA index is given as

$$ACCRA^{NY/DL} = \frac{ACCRA^{NY}}{ACCRA^{DL}} = \frac{\sum_{i=1}^{N} p_i^{NY*}\omega_i^*}{\sum_{i=1}^{N} p_i^{DL*}\omega_i^*}. \qquad (11)$$

We may interpret the ACCRA index as the central region solution with the nation as the base region. The central region solution provides the ACCRA index with the property of transitivity, but sacrifices more characteristicity than with the EKS method.

[9]The * used in p_i^{r*} and ω_i^* are both intended to represent "national average" but in practice are not identical because the average price across all cities is only a proxy for the national consumption share and actually changes based on the sample.

IV. KCM Cost-Of-Living Index

BLS researchers, Kokoski, Cardiff and Moulton (KCM, 1994)) estimated cost-of-living indexes for 11 categories of expenditures (representing, on average, about 85 percent of total consumption) for the period July 1988 - June 1989. But KCM do not go further to construct a composite index which comprises all expenditure categories.

The KCM indexes use BLS's large, high quality data set which is the source for the national CPI and various urban and regional CPIs. The goal of the CPI is to measure the average change in prices paid by urban consumers. Prices are collected from about 21,000 retail and service establishments in eighty-five urban areas across the United States. The recorded prices are prices paid (less discounts) and thus include sales taxes. Data on rents are collected from about 40,000 landlords or tenants, and 20,000 owner-occupants are asked about their housing units. Shelter costs are measured using the concept of owners' equivalent rent, which measures the cost of renting housing services equivalent to those services provided by owner-occupied housing. BLS' concept of shelter is careful to distinguish the investment aspect of owning a home from the consumption aspect. All price information is collected by BLS field agents, with great care to minimize the errors caused by incorrect and incomplete information.

Prices are gathered based on a probability sample - all items are not sampled in all cities. The choice of a specific item to represent a given category of good or service depends on the probability of that item being selected by the consumer in that particular outlet and city. For example, as described in the KCM article: "while a twelve-ounce jar of Folger's coffee may be selected to represent instant coffee in a grocery in Milwaukee, the same category is represented by a ten-ounce jar of house brand coffee in a convenience store in Baltimore. Any comparison of the price of coffee in Milwaukee relative to that in Baltimore would have to control for differences in the characteristics and quality of the specific coffee product. ... It is, however, possible to use the CPI database to construct inter-area price indices by using statistical techniques to explicitly accommodate the heterogeneity of the price sample." The KCM study used regression analysis to account for the differences in item characteristics and outlets across cities, recording about 2153 prices per urban area.

The KCM index is computed in 3 stages. First, to separate out the price differences due to regional differences, the authors regressed the natural logarithm of each item's price on three sets of variables representing geographic areas, item characteristics and type of outlet. Regressions were done at the finest level of prices (Elementary Level Item, ELI) using weighted least squares, and prices were measured relative to the Philadelphia SMSA. The authors weighted each ELI's price index by the 1988 Consumer Expenditure Survey weight for each area and summed up the data to the next highest level of detail (the stratum level),

$$P^r_{STR} = \sum_i \left(\frac{p^r_{i,ELI}}{p^p_{i,ELI}}\right) \omega^r_i, \tag{12}$$

where $p^p_{i,ELI}$ is the price of item i at Philadelphia SMSA, and ω^r_i is the consumption share of item i at region r. The coefficients on the geographic area dummies taken from the regression equation are the estimates of $(p^r_{i,ELI}/p^p_{i,ELI})$'s.

Second, the stratum level bilateral price indexes (all relative to the Philadelphia SMSA) were used to create sets of bilateral price indices at the next highest level of aggregation (Expenditure Class, EC) using the Törnqvist-translog price index. The Törqvist-translog index is a superlative index like the Fisher equation discussed earlier and holds the same properties of accommodating substitution in consumer spending while holding living standards or welfare constant. For each EC, a 44 by 44 (there are 44 regions for which price indices are calculated) matrix of bilateral price indexes are created using the following formula:

$$ln\, P^T_{rl} = \frac{1}{2} \sum_j (s^r_j + s^l_j)\, ln\left(\frac{p^r_j}{p^l_j}\right) \quad r,\, l = 1, \ldots, M \tag{13}$$

where the summation is over the strata in the appropriate EC, S_j^r is stratum j's share of the EC expenditures in area r and $ln(p_j^r/p_j^l)$ is the difference between the item stratum-level relative prices for area r and area l for item stratum j.

Third, KCM created a multilateral index using the following formula to calculate a weighted geometric mean of the Törnqvist bilateral price indices for area r relative to each other area l:

$$ln\,\delta_r = \sum_{l=1}^{M} (p_l \cdot q_l / \Sigma p \cdot q)\, ln\, P_{rl}^T \qquad r = 1, \ldots, M \tag{14}$$

where $p_l \cdot q_l$ are expenditures in area l, and the denominator, $\Sigma p \cdot q$, is the sum of expenditures in all areas; thus the weights are area l's share of expenditures for all areas in the sample. The index δ_r represent the price level in area r relative to all other areas. For comparison of area a to area b, the multilateral price index is given by δ_a/δ_b.

The KCM index is a revision of the generalized EKS index proposed by CCD (1982). Just like the ACCRA index, the multilateral price index is given as a ratio between two regional indexes and the transitivity condition is satisfied. But unlike CCD (1982), KCM uses a 'weighted' geometric mean to create a multilateral index.

V. Sampling Errors, Sampling Bias, and Aggregation Biases in the ACCRA index

The KCM index is similar to the ACCRA index in that it uses a national average as a hypothetical base region to secure transitivity. However, the KCM price indexes are superior to the ACCRA indexes for comparing regional cost of living because the KCM indexes are created with great effort to reduce several sources of bias that are inherent in price indexes.

First, the price data used in the KCM index is of a higher quality than in the ACCRA index.[10] The CPI database has more reported items and a larger sample size than the ACCRA database. Furthermore, unlike the ACCRA index which uses data collected by volunteers, the CPI database is collected and processed by professional field representatives and technicians who use great care to detect quality changes and reduce errors. The higher quality price data in the KCM index produces less 'sampling error' than in the ACCRA index.[11] Sampling bias is introduced in the ACCRA index because the items chosen for the 'national' market basket are based on items that are generally available in all regions. Thus, the base market basket may in fact be comparing prices of items that are not very representative of those consumed in any city. On the surface the ACCRA method may be appealing because the user thinks she is comparing apples to apples. For example, if a Big Mac costs 30 percent more in New York, then it is likely that most things cost 30% more in New York. The problem is, of course, that New York can have so many alternatives to a Big Mac that less people want to eat one and so the price differential is not very important to either New Yorkers or the average individual who is likely to move to New York. Another source of bias is introduced in the ACCRA index by the use of an unweighted average to calculate the price of certain categories relative to the sample average. If the prices are higher in large cities, since prices

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[10]Even though the CPI data are of high overall quality, there are also some weakness. The most important of these are (a) there are difficulties in controlling for all of the relevant characteristics for item categories that are especially heterogeneous, and (b) small samples for some cities, especially as measured by the total number of sample outlets for a product category, could skew the indexes for a particular city. These factors affect some product categories more than others. For example, the food and shelter indexes are more reliable than the apparel and house furnishings.

[11]Errors include quality bias and outlet substitute bias. See Wynne and Sigalla (1994) for detailed discussion.

in big metropolitan areas have the same weight as small areas, the sample average price would tend to understate prices. As a consequence, the ACCRA index for bilateral comparison to the national average would tend to overstate the real cost of living of the big metropolitan areas.[12] The KCM index solves this aggregation bias problem by using the weighted geometric mean of the Tőrnquist bilateral index.[13]

The magnitude of the sampling error, sampling bias and aggregation bias is estimated by creating a benchmark ACCRA index which uses the KCM price indexes in a Laspeyres formula similar to that used by ACCRA. This can be done because the price indexes estimated by KCM and the relative prices used by ACCRA are conceptually identical, that is, they both use the nation as the base region. The comparison of the ACCRA index and the benchmarked ACCRA index gives us information on the 'error and biases' caused by the ACCRA data collection and aggregation process.

The benchmarked ACCRA index is constructed using the indexes for goods and services generated in the KCM study, weighted with consumption data from the Consumer Expenditure Survey. The KCM price indexes are calculated from monthly data over the period July 1988 to June 1989. A market basket for each metropolitan area is estimated using data from the 1988-89 Consumer Expenditure Survey. The consumption of each item is divided by the total consumption for each city to estimate individual weights for each commodity item. These weights are assumed to cover all categories of consumption expenditures so that the sum of the weights equals one.

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[12]It is worth noting that the direction of bias not be so systematic for multiple comparison as for bilateral comparison since the aggregation bias in calculating the national average prices is eliminated for multiple comparison. KMZ show that general price level (for multiple comparison) measured by transitive systems of bilateral Tőrnqvist indexes is completely arbitrary if the data are exactly transitive to begin with.
[13]It should be noted that the ACCRA data may have less problem with quality changes than the BLS series because the ACCRA index is not a time series. That is, if an item changes quality over time (a box becomes smaller or a product more efficient), that is not a problem since the ACCRA attempts to sample the same item across the country and is not concerned with changes from period to period. However, if new products or product changes are not available at the same time across the country, the ACCRA index could still be affected by mismeasured quality changes.

There is not always an exact match between the KCM price indexes, which are estimated with data from both the Continuing Point of Purchase Survey and the Consumer Expenditure Survey, and the consumption data, which are solely from the Consumer Expenditure Survey. Therefore, we made certain assumptions to deal with missing price indexes and weights. First of all, there is a slight difference between the city definitions used in the two surveys. New York City is one category in the consumption data but is divided into two categories in the KCM study (New York city and New York-Conn. Suburbs). We averaged the item price indexes for these two regions before aggregating them into a city price index. In some cases, we were able to match the price indexes by averaging individual city price indexes into larger MSA prices. ACCRA price indexes were combined using a weighted average based on the share of personal income for the following cities: Cleveland, Akron and Lorain; Dallas and Fort Worth; San Francisco and San Jose; Seattle and Tacoma. Other assumptions were necessary to blend the price and consumption item categories. Table 1 details the relative price indexes chosen from the KCM study and the corresponding weight chosen from the consumer expenditure survey.

To calculate weights for items not covered in the Consumer Expenditure Survey, missing categories were matched with similar categories wherever possible. In some cases, such as cash contributions, and pensions and social security (which are essentially free to purchase and the same across regions), the relative price of 1 for all areas is considered most appropriate, assuming that the price of this expenditure is fixed for all regions. For other categories, the level of the price of the variable is assumed to be similar to that of the average regional price index. This requires calculating the weighted average of all of the other relative prices in each region and using this average regional price index as a proxy for the price of that variable. As mentioned earlier, missing price indexes, on average, represent only about 15% of consumer expenditure across the metropolitan areas in the CPI.

In Table 2 we calculate several different measures that compare the ACCRA index to the benchmark ACCRA index. The measures attempt to capture the combined effects of sampling error, sampling bias and aggregation bias. Because the ACCRA index is designed to serve both as a bilateral and a multilateral index, we take care to measure the differences between it and the benchmark series for both uses. The first measure, DIFF, compares the two series on a bilateral basis, i.e how do the series differ if you are comparing each city to the national average. As shown in the table, the ACCRA index for Boston is 47 percentage points higher relative to the national average than the benchmark series. On average across the metropolitan areas in the table, the ACCRA index is 9.75 percentage points higher. Since Boston appears to be an outlier we also calculate the average difference without Boston.

The DIFF measures shows that, in general, the differences are larger for the larger metropolitan areas. This result supports our argument that aggregation bias, incurred when the national average price is constructed as an unweighted average of the regional prices, would understate the national average and consequently overstate the cost of living of the bigger and higher cost areas. The rankings of the cities are generally close although important differences exist. For example, the Cincinnati MSA is ranked 13 in the benchmarked index but 21 in the ACCRA index. The Portland MSA is ranked 23 in the new index and 16 in the ACCRA. We believe that there exists serious sampling error or sampling bias[14] in the data collection process of these regions by the ACCRA.

The combined effects sampling error and sampling bias, and aggregation bias were also estimated using measures that are relevant to the use of the ACCRA index as a multilateral index. While DIFF measures the difference between the two series when compared to the national average, the two other measures look at the difference between the two series when each city is used as a base and compared to all other cities. For example, the root mean squared error (RMSE) measure for Boston gives the square root of the squared difference between the two series when the cost of living in Boston is measured relative to each of the other cities while assuming the benchmarked index as true index of cost of living.

[14]The sampling bias is introduced through the use of only a subset of commodities, randomly selected, in the computation of the relevant index number. See Selvanathan and Rao (1994).

The results of the calculation are quite different for some cities than the for the bilateral case. For example, when comparing Seattle-Tacoma to the national average, there is very little difference (-1.75 percentage points) between the ACCRA index and the Benchmark ACCRA index. But in comparing the cost of living in Seattle-Tacoma to Boston, San Francisco, and the rest of the included metropolitan areas, the RMSE is large (14.89 percentage points). On average, the multilateral comparison differences, as measured by the RMSE, show larger differences than the bilateral comparisons. Because the RMSE gives larger weight to outlier, we also look at the mean absolute difference (MAD), which on average is smaller than DIFF. Nonetheless, while some cities such as Minneapolis-St. Paul are very similar for the bilateral comparison (using DIFF), all cities average at least a 5.8 percentage point difference in the multilateral comparisons using the MAD measure.[15]

In summary, the three measures presented in Table 2 suggest that the sampling error and bias and aggregation bias contained in the ACCRA is potentially large. As shown by the DIFF measure, the average error and bias in 9.75 percentage points when using a bilateral comparison to the national average. When using the index for multilateral comparisons, the mean absolute difference is at least 5.8 percentage points, depending on the city that is being compared, and, on average, is 8.47 percentage points.

[15]Root mean square error is defined as $RMSE(b) = \sqrt{E(b-\beta)^2} = \sqrt{variance(b) + bias(b)^2}$, and mean absolute difference is defined as $MAD(b) = E|b-\beta|$, where b is an estimator and β is the true value.

VI. New Cost of Living Index and Substitution Bias in the ACCRA Index

As mentioned earlier, the ACCRA index for bilateral comparison with the national average is a Laspeyres index which uses a national basket for weighting prices. ACCRA's choice of a Laspeyres formula to estimate cost of living introduces subtitution bias. The empirical facts that the Laspeyres index and the Paasche index typically differ by less than 0.5 percent for adjacent periods in the time series context means that the substitution bias of the Laspeyres index can be a tolerable level for adjacent periods in the time series context. But in a cross section context the substitution bias can be significant considering that the difference between the Laspeyres index and the Paasche index varies case by case.

We isolate the substitution bias of the ACCRA index by comparing the benchmarked ACCRA index which eliminates ACCRA's sampling error, sampling bias and aggregation bias with a new cost of living index. The KCM results provide reliable sub-category price indexes with negligible errors and bias. We use these KCM results to construct a new cost of living index with a Fisher type superlative formula. Then the difference between the benchmarked index and a superlative index can be practically interpreted as substitution bias.

To construct the Fisher type index we need to modify the Paasche index so that the KCM results can be used:

$$(P^P)^{-1} = \frac{\sum_{i=1}^{N} p_i^* q_i^r}{\sum_{i=1}^{N} p_i^r q_i^r} = \sum_{i=1}^{N} \left(\frac{p_i^*}{p_i^r}\right) \frac{p_i^r q_i^r}{\sum_{i=1}^{N} p_i^r q_i^r} = \sum_{i=1}^{N} (\delta_{ri})^{-1} \omega_i^r. \tag{15}$$

Then, the Fisher index at region r which represents the price level in area r relative to the nation is calculated as:

$$New\,Index_r = P_r^F = \sqrt{P^L * P^P} = \sqrt{\frac{\sum_{i=1}^{N} (\delta_{ri}) \omega_i^*}{\sum_{i=1}^{N} (\delta_{ri})^{-1} \omega_i^r}}. \tag{16}$$

Just like the ACCRA index, for a comparison of area a and b, the new multilateral index is given by $(new\, index_a/new\, index_b)$. Since the new multilateral index has the form of the ratio of the regional indexes, it satisfies the transitivity condition.[16]

Table 3 reports the difference between the benchmarked ACCRA index and the new index using KCM results. The difference in the indexes for bilateral comparison with the nation are mostly positive and average 0.6 percent. For multilateral comparisons, RMSE and MAE are also quite even except Houston-Galveston-Brazoria MSA (1.96 and 1.91 respectively) and the averages are relatively small (0.68 and 0.55). RMSE and MAE are not related with the size of the indexes which they are based on for comparison. These measures show that substitution biases in the ACCRA indexes for both bilateral comparisons and multilateral comparisons must be tolerable in practice.

Table 4 reports the difference between the ACCRA index and our new index. The measures of differences are quite similar to those between the ACCRA index and the benchmarked ACCRA index reported in Table 2. The ACCRA index overstates the cost of living in high cost-of-living areas. The rankings of two MSAs, Cincinnati MSA and Portland MSA, are dramatically different, which means that using the ACCRA index to compare the cost of living in these MSAs with other regions will be misleading. The average error people

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[16]Readers may be curious why KCM do not construct a composite index by aggregating their sub-category price indexes. Readers also may want to know why we do not use the generalized EKS method to construct the new cost-of-living index.

The generalized EKS method in the KCM study aggregates the EC level 44 by 44 bilateral index matrix and constructs price indexes of 11 categories of goods and services. In order to use the generalized EKS method to construct a composite index, we need to have an 11 by 11 bilateral index matrix. But the indexes for the comparison of two regions are given as multilateral indexes, which sacrifice a certain amount of characteristicity to secure the transitivity condition. This problem seems to have made KCM reluctant to construct a composite index. KMZ (1996) derive a general form of Törnqvist multilateral index which preserves the aggregation rule in the unadjusted data at each level of aggregation. However the 1991 data that KMZ use is partially coded and edited characteristic information, constraining KMZ and leading them to experiment with only a set of food price data.

With these problems and our limited access to the raw CPI database in mind, we concluded that the Fisher type index, which can be constructed with KCM's bilateral index, can be the second best solution even though we cannot keep the consistency in every level of aggregation. We keep more characteristicity while maintaining transitivity by using bilateral indexes rather than multilateral indexes (and generalized EKS indexes). Investigation on the theoretical properties of this index and simulation experiments are in our future research agenda.

in an MSA can have when they compare the cost of living is 8.25 percent overall, and 7.73 percent without Boston-Lawrence-Salem MSA. Given that the estimates of measurement bias of the CPI are around 1 percent, an 8 percent difference is striking.[17]

Figure 1 visually compares the rankings of the ACCRA index and new index. The horizontal distance between a point and the 45 degree line is the difference in rankings between the two indexes. The dispersion of points in the Figure 1 is substantial. It again leads us to cast doubt on the reliability of the ACCRA index even for ranking of the cost of living among cities.

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[17]See Wynne and Sigalla (1996) for details.

VII. Conclusions.

There is a great need for information about regional costs of living. Employers and employees who are considering moving to other cities in the US need information about what types of wage adjustments will be needed to maintain a constant standard of living. Economists seek to study how and if real wages have converged across US regions. While the BLS produces some regional CPI data -these data only measure how prices change over time and not the relative prices in regions at any point in time.

Currently the only timely source of cost of living differentials across US metropolitan areas are the ACCRA indexes. The ACCRA data are very useful in the sense that they are produced quarterly, contain a large number of US cities and a lot of detail about the price data gathered. One main weakness of the series is that, as stated by ACCRA, since cities drop in and out of the survey it cannot be used as a time series even for the cities remaining in the sample.

In this paper we examine other potential weaknesses of the ACCRA series - sampling error, sampling bias, aggregation bias and substitution bias. In order to evaluate the ACCRA index we use results of a BLS study that utilized the large CPI data set to produce cost-of-living indexes for 11 major expenditure categories for the 32 largest U.S. MSAs for the period from mid-1988 to mid-1989. Using a Fisher index methodology, we first aggregate the KCM expenditure categories indexes for each metro and then compare these metro cost-of-living indexes to the ACCRA data for the 23 metropolitan areas that were available from both sources.

We find substantial weaknesses exist in the ACCRA data. We find that the ACCRA indexes deviate substantially from our new cost-of-living indexes calculated by the aggregation of the KCM indexes. Of the criteria that we investigated, sampling bias and aggregation bias are shown to be the largest potential sources of deviation from our new index. Our results suggest some caution in using the ACCRA indexes as an accurate reflection of the cost-of-living differentials across US metropolitan areas.

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Table 1

New Regional Cost of Living Prices and Weights

Bold indexes represent categories that do not have a price index from the Kokoski paper.

Relative Price Index	Consumer Expenditure Weight
Renters	Shelter, rented dwellings
Owners	Shelter, owned dwellings
Other Lodging (Use Renters Price)	Other lodging
Food-at-home	Food-at-home
Food-away-from-home	Food-away-from-home
Alcohol and Tobacco Products	Alcoholic Beverages + Tobacco Products
All Utilities	Utilities, fuels and Pub services
Household Furnishings and Operations	Household furnishings and Equip + T.V., Radios and Sound Equip (Entertainment) + Household Operations+ Housekeeping Supplies
EC36	Apparel, Men, 16 and over
EC37	Apparel, Boys
EC38	Apparel, Women
EC39	Apparel, Girls
EC40	Apparel, Footwear
EC41	Apparel, Children under 2
Other Apparel Products (weighted avg. price of EC36 - EC41)	Other Apparel products
Private transportation	Transportation
Medical Services	Medical Services
Health Insurance (Medical Services Price)	Health Insurance
Drugs and Medical Supplies (Overall Price Index)	Drugs and Medical Supplies
Entertainment	Fees and admissions + Pets, toys etc. + other supplies, equip. and serv. + reading
Education (Overall Price Index)	Education
Miscellaneous (Overall Price Index)	Miscellaneous
Cash Contributions (Value of 100 for all areas)	Cash Contributions
Personal Insurance (Overall price index)	Personal Insurance
Pensions and Social Security (Value of 100 for all areas)	Pensions and social security

Table 2

ACCRA Index and Benchmarked ACCRA Index

July 1988- June 1989

Region	ACCRA		Benchmarked ACCRA		DIFF*	RMSE**	MAE***
	RANK	VALUE	RANK	VALUE			
Boston-Lawrence-Salem, MA-NH	*1*	164.1	*2*	117.10	47.00	20.51	20.21
San Francisco-San Jose, CA	*2*	134.9	*1*	117.25	17.65	8.52	7.20
Washington, DC-MD-VA	*3*	128.5	*4*	110.85	17.65	9.31	8.02
Phila-Wilmington-Trenton, PA-DE-NJ	*4*	127.6	*9*	105.30	22.30	12.30	11.52
San Diego, CA	*5*	126.0	*8*	106.59	19.41	10.66	9.60
Los Angeles-Long Beach	*6*	124.2	*3*	113.49	10.71	8.11	5.78
Chicago-Gary-Lake County, IL-IN-WI	*7*	124.1	*6*	108.86	15.24	8.87	7.34
Anchorage, AK	*8*	120.5	*5*	110.61	9.89	8.39	5.88
Miami-fort Laderdale, FL	*9*	111.1	*14*	99.83	11.27	9.17	7.04
Atlanta, GA	*10*	107.7	*10*	103.79	3.91	11.08	7.06
Baltimore, MD	*11*	106.9	*11*	103.56	3.34	11.46	7.38
Seattle-Tacoma	*12*	105.8	*7*	107.55	-1.75	14.89	11.30
Pittsburgh-Beaver Valley, PA	*13*	104.3	*18*	97.33	6.97	10.02	6.68
Buffalo-Niagra Falls, NY	*14*	104.3	*19*	96.74	7.56	9.86	6.69
Milwaukee, WI	*15*	103.8	*16*	98.69	5.11	10.79	6.95
Portland-Vancouver, OR-WA	*16*	103.0	*23*	93.47	9.53	9.78	7.19
Houston-Galveston-Brazoria, TX	*17*	102.4	*15*	99.66	2.74	12.25	7.99
Minneapolis-St. Paul, MN-WI	*18*	102.2	*12*	101.67	0.53	13.77	9.66
Cleveland-Akron-Lorain,OH	*19*	101.6	*20*	95.71	5.89	10.62	6.94
Dallas-Fort Worth	*20*	101.6	*17*	97.97	3.63	11.78	7.51
Cincinnati-Hamilton, OH-KY-IN	*21*	100.8	*13*	100.66	0.14	14.25	10.14
St. Louis-East St. Louis, MO-IL	*22*	99.0	*21*	95.09	3.91	11.86	7.56
Kansas City, MO-Kansas City, KS	*23*	96.4	*22*	94.74	1.66	13.69	9.23
Average					9.75	11.39	8.47
Average w/o Boston					8.06	10.97	7.94

* Difference at MSA i is $A_i - BA_i$

** Root Mean Square Error (RMSE) at MSA i is $\{\frac{1}{22}\sum_{j \in \forall msa} (\frac{A_j}{A_i} - \frac{BA_j}{BA_i})^2\}^{\frac{1}{2}}$.

*** Mean Absolute Error (MAE) at MSA i is $\frac{1}{22}\sum_{j \in \forall msa} |\frac{A_j}{A_i} - \frac{BA_j}{BA_i}|$

Table 3

Benchmarked ACCRA Index and New Index

July 1988- June 1989

Region	Benchmarked ACCRA RANK	Benchmarked ACCRA VALUE	New Index RANK	New Index VALUE	DIFF	RMSE	MAE
San Francisco-San Jose, CA	*1*	117.25	*2*	116.23	1.02	0.54	0.45
Boston-Lawrence-Salem, MA-NH	*2*	117.10	*1*	116.92	0.18	0.56	0.41
Los Angeles-Long Beach	*3*	113.49	*3*	113.05	0.44	0.48	0.35
Washington, DC-MD-VA	*4*	110.85	*4*	110.69	0.16	0.60	0.43
Anchorage, AK	*5*	110.61	*5*	110.16	0.45	0.49	0.35
Chicago-Gary-Lake County, IL-IN-WI	*6*	108.86	*6*	108.24	0.62	0.48	0.36
Seattle-Tacoma	*7*	107.55	*7*	107.25	0.30	0.55	0.40
San Diego, CA	*8*	106.59	*8*	106.65	-0.06	0.76	0.61
Phila-Wilmington-Trenton, PA-DE-NJ	*9*	105.30	*9*	105.21	0.09	0.67	0.49
Atlanta, GA	*10*	103.79	*11*	103.09	0.70	0.52	0.41
Baltimore, MD	*11*	103.56	*10*	103.5	0.06	0.70	0.52
Minneapolis-St. Paul, MN-WI	*12*	101.67	*12*	101.1	0.57	0.51	0.39
Cincinnati-Hamilton, OH-KY-IN	*13*	100.66	*13*	99.69	0.97	0.69	0.60
Miami-fort Laderdale, FL	*14*	99.83	*14*	99.45	0.38	0.55	0.40
Houston-Galveston-Brazoria, TX	*15*	99.66	*17*	97.4	2.26	1.96	1.91
Milwaukee, WI	*16*	98.69	*15*	98.59	0.10	0.70	0.52
Dallas-Fort Worth	*17*	97.97	*16*	97.47	0.50	0.53	0.40
Pittsburgh-Beaver Valley, PA	*18*	97.33	*18*	96.64	0.69	0.57	0.45
Buffalo-Niagra Falls, NY	*19*	96.74	*19*	95.84	0.90	0.70	0.60
Cleveland-Akron-Lorain,OH	*20*	95.71	*20*	95.72	-0.01	0.81	0.63
St. Louis-East St. Louis, MO-IL	*21*	95.09	*21*	94.42	0.67	0.58	0.46
Kansas City, MO-Kansas City, KS	*22*	94.74	*22*	93.55	1.19	0.99	0.92
Portland-Vancouver, OR-WA	*23*	93.47	*23*	92.74	0.73	0.63	0.51
Average					0.56	0.68	0.55
Average w/o Boston					0.54	0.68	0.55

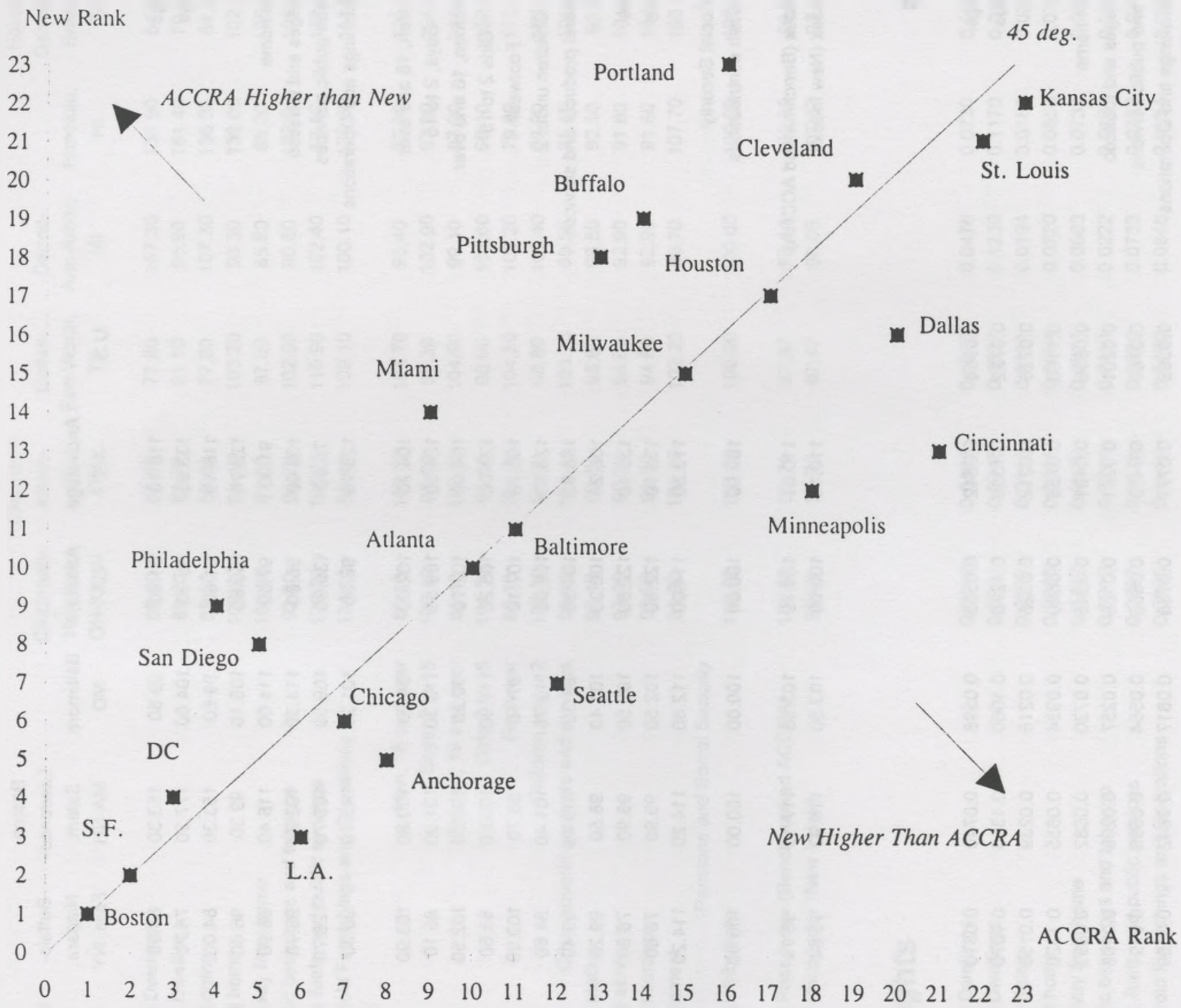
Table 4

ACCRA Index and New Index

July 1988- June 1989

Region	ACCRA RANK	ACCRA VALUE	New Index RANK	New Index VALUE	DIFF	RMSE	MAE
Boston-Lawrence-Salem, MA-NH	*1*	164.1	*1*	116.92	47.18	20.14	19.85
San Francisco-San Jose, CA	*2*	134.9	*2*	116.23	18.67	8.55	7.24
Washington, DC-MD-VA	*3*	128.5	*4*	110.69	17.81	8.98	7.61
Phila-Wilmington-Trenton, PA-DE-NJ	*4*	127.6	*9*	105.21	22.39	11.85	11.06
San Diego, CA	*5*	126.0	*8*	106.65	19.35	10.16	9.03
Los Angeles-Long Beach	*6*	124.2	*3*	113.05	11.15	7.96	5.61
Chicago-Gary-Lake County, IL-IN-WI	*7*	124.1	*6*	108.24	15.86	8.73	7.22
Anchorage, AK	*8*	120.5	*5*	110.16	10.34	8.24	5.71
Miami-fort Laderdale, FL	*9*	111.1	*14*	99.45	11.65	8.97	6.82
Atlanta, GA	*10*	107.7	*10*	103.09	4.61	10.86	6.88
Baltimore, MD	*11*	106.9	*11*	103.5	3.40	11.60	7.60
Seattle-Tacoma	*12*	105.8	*7*	107.25	-1.45	14.98	11.56
Pittsburgh-Beaver Valley, PA	*13*	104.3	*18*	96.64	7.66	9.80	6.54
Buffalo-Niagra Falls, NY	*14*	104.3	*19*	95.84	8.46	9.60	6.55
Milwaukee, WI	*15*	103.8	*15*	98.59	5.21	10.84	6.85
Portland-Vancouver, OR-WA	*16*	103.0	*23*	92.74	10.26	9.61	7.11
Houston-Galveston-Brazoria, TX	*17*	102.4	*17*	97.4	5.00	11.07	6.98
Minneapolis-St. Paul, MN-WI	*18*	102.2	*12*	101.1	1.10	13.63	9.64
Cleveland-Akron-Lorain,OH	*19*	101.6	*20*	95.72	5.88	10.68	6.86
Dallas-Fort Worth	*20*	101.6	*16*	97.47	4.13	11.64	7.42
Cincinnati-Hamilton, OH-KY-IN	*21*	100.8	*13*	99.69	1.11	13.80	9.75
St. Louis-East St. Louis, MO-IL	*22*	99.0	*21*	94.42	4.58	11.60	7.32
Kansas City, MO-Kansas City, KS	*23*	96.4	*22*	93.55	2.85	13.03	8.60
Average					10.31	11.14	8.25
Average w/o Boston					8.64	10.74	7.73

Figure 1. Ranks of ACCRA Index and the New Index



Appendix, page 1

Price Indexes

	U.S.	Anchorage, AK	Atlanta, GA	Baltimore, MD	Boston-Lawrence-Salem, MA-NH	Buffalo-Niagara, Falls, NY	Chicago Gary-Lake County IL-IN-WI
Rented Dwellings		116.10	91.80	99.60	153.30	84.00	116.10
Owned Dwellings		133.90	95.30	104.80	177.20	76.70	113.60
Other lodging		116.10	91.80	99.60	153.30	84.00	116.10
Food at home		125.70	106.80	105.10	99.30	96.60	102.20
Food away from home		91.30	97.60	114.00	116.40	98.90	97.80
Alcoholic beverages and tobacco		108.00	96.80	114.30	102.20	96.70	101.90
Utilities, fuels, and public services		75.80	139.90	109.50	105.70	128.70	128.30
Household Furnishings and Operations		128.70	96.80	101.20	145.10	90.30	129.00
Apparel							
Men, 16 and over		104.70	102.00	94.20	100.80	103.90	100.90
Boys, 2 to 15		124.30	109.50	113.30	101.90	85.10	111.50
Women, 16 and over		104.00	102.70	90.20	100.50	102.50	96.40
Girls 2 to 15		123.00	108.20	111.90	100.60	83.80	110.20
Footwear		105.70	107.10	97.10	98.70	100.90	95.80
Children under 2		123.80	109.00	112.70	101.40	84.60	111.00
Other apparel products and services		108.93	104.35	96.39	100.49	99.40	99.47
Transportation		102.20	100.30	101.40	98.50	99.20	105.20
Medical services		136.10	122.80	102.50	99.90	78.60	90.40
Health insurance		136.10	122.80	102.50	99.90	78.60	90.40
Entertainment		113.30	114.00	112.80	114.20	114.20	111.40
Pensions and Social Security							
Cash contributions		100.00	100.00	100.00	100.00	100.00	100.00
Overall Price Index (Benchmarked ACCRA)		110.61	103.79	103.56	117.10	96.74	108.86
Overall Price Index (New Index)		110.16	103.09	103.50	116.92	95.84	108.24

Weights

	U.S.	Anchorage, AK	Atlanta, GA	Baltimore, MD	Boston-Lawrence-Salem, MA-NH	Buffalo-Niagara, Falls, NY	Chicago Gary-Lake County IL-IN-WI
Rented Dwellings	0.0968	0.0642	0.0535	0.0598	0.0740	0.0510	0.0515
Owned Dwellings	0.0722	0.1350	0.1270	0.1060	0.1350	0.1070	0.1160
Other lodging	0.0226	0.0212	0.0325	0.0216	0.0239	0.0156	0.0204
Food at home	0.1160	0.0756	0.0680	0.0934	0.0655	0.1320	0.0795
Food away from home	0.0636	0.0481	0.0545	0.0720	0.0682	0.0633	0.0671
Alcoholic beverages and tobacco	0.0201	0.0201	0.0129	0.0257	0.0206	0.0208	0.0224
Utilities, fuels, and public services	0.0767	0.0473	0.0668	0.0564	0.0596	0.0791	0.0598
Household Furnishings and Operations	0.0989	0.0777	0.0763	0.0817	0.0842	0.0669	0.0866
Apparel							
Men, 16 and over	0.0136	0.0098	0.0132	0.0162	0.0121	0.0112	0.0123
Boys, 2 to 15	0.0032	0.0019	0.0042	0.0048	0.0019	0.0016	0.0028
Women, 16 and over	0.0226	0.0149	0.0203	0.0229	0.0154	0.0211	0.0290
Girls 2 to 15	0.0040	0.0043	0.0033	0.0036	0.0023	0.0041	0.0035
Footwear	0.0029	0.0063	0.0064	0.0089	0.0052	0.0089	0.0082
Children under 2	0.0083	0.0031	0.0027	0.0021	0.0028	0.0028	0.0026
Other apparel products and services	0.0112	0.0095	0.0093	0.0086	0.0131	0.0056	0.0119
Transportation	0.2200	0.1910	0.1750	0.1840	0.1910	0.2150	0.1810
Medical services	0.0216	0.0228	0.0277	0.0222	0.0099	0.0193	0.0174
Health insurance	0.0229	0.0100	0.0162	0.0184	0.0164	0.0229	0.0138
Entertainment	0.0474	0.0590	0.0452	0.0324	0.0488	0.0332	0.0355
Pensions and Social Security							
Cash contributions	0.1210	0.1300	0.1220	0.0990	0.0945	0.0713	0.1090
Overall Price Index	0.0695	0.0473	0.0635	0.0599	0.0553	0.0470	0.0703

Price Indexes

	Cincinnati-Hamilton, OH-KY-IN	Cleveland-Akron-Lorain, OH	Dallas-Fort Worth, TX	Detroit-Ann Arbor, MI	Honolulu, HI	Houston-Galveston-Brazoria TX	Kansas City, MO Kansas KS
Rented Dwellings	88.50	87.60	77.80	107.30	136.90	64.20	82.40
Owned Dwellings	81.60	82.70	81.90	95.90	161.40	70.20	77.10
Other lodging	88.50	87.60	77.80	107.30	136.90	64.20	82.40
Food at home	106.20	96.40	103.20	98.30	139.00	102.40	101.30
Food away from home	100.80	91.60	97.80	85.80	85.20	105.10	83.60
Alcoholic beverages and tobacco	92.30	96.70	102.90	90.60	122.90	108.10	100.00
Utilities, fuels, and public services	120.20	100.70	110.90	102.40	57.50	138.00	72.90
Household Furnishings and Operations	134.10	93.40	109.10	100.10	139.60	111.60	98.10
Apparel							
Men, 16 and over	89.10	101.50	104.70	98.40	83.30	121.70	120.40
Boys, 2 to 15	102.80	97.00	99.30	102.90	67.30	154.00	114.40
Women, 16 and over	85.40	102.30	104.90	99.10	87.20	111.40	108.90
Girls 2 to 15	101.50	95.60	98.00	101.60	66.10	152.80	113.10
Footwear	88.10	104.20	104.30	100.20	79.80	115.10	109.20
Children under 2	102.30	96.50	98.80	102.40	66.90	153.50	113.90
Other apparel products and services	90.41	101.44	103.73	99.56	81.46	121.42	111.91
Transportation	98.10	99.60	98.60	98.50	92.10	96.40	96.30
Medical services	93.90	92.30	94.60	92.90	91.60	104.80	103.10
Health insurance	93.90	92.30	94.60	92.90	91.60	104.80	103.10
Entertainment	81.90	103.40	102.20	89.70	107.70	103.10	123.90
Pensions and Social Security							
Cash contributions	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Overall Price Index (Benchmarked ACCRA)	100.66	95.71	97.97	98.44	109.85	99.66	94.74
Overall Price Index (New Index)	99.69	95.72	97.47	98.05	107.83	97.40	93.55

Weights

	Cincinnati-Hamilton, OH-KY-IN	Cleveland-Akron-Lorain, OH	Dallas-Fort Worth, TX	Detroit-Ann Arbor, MI	Honolulu, HI	Houston-Galveston-Brazoria TX	Kansas City, MO Kansas KS
Rented Dwellings	0.0444	0.0446	0.0665	0.0478	0.0730	0.0581	0.0435
Owned Dwellings	0.0997	0.0745	0.0837	0.1230	0.1170	0.0939	0.1160
Other lodging	0.0137	0.0116	0.0151	0.0194	0.0182	0.0283	0.0168
Food at home	0.0958	0.0811	0.0684	0.0720	0.0855	0.0767	0.0877
Food away from home	0.0732	0.0672	0.0611	0.0603	0.0733	0.0630	0.0619
Alcoholic beverages and tobacco	0.0212	0.0214	0.0191	0.0222	0.0194	0.0204	0.0184
Utilities, fuels, and public services	0.0667	0.0676	0.0629	0.0733	0.0382	0.0705	0.0726
Household Furnishings and Operations	0.0965	0.1010	0.0880	0.0846	0.0854	0.0800	0.0799
Apparel							
Men, 16 and over	0.0115	0.0139	0.0141	0.0215	0.0105	0.0110	0.0079
Boys, 2 to 15	0.0019	0.0044	0.0023	0.0020	0.0022	0.0032	0.0027
Women, 16 and over	0.0162	0.0295	0.0185	0.0136	0.0162	0.0236	0.0221
Girls 2 to 15	0.0049	0.0035	0.0035	0.0049	0.0019	0.0037	0.0028
Footwear	0.0093	0.0106	0.0071	0.0082	0.0054	0.0062	0.0054
Children under 2	0.0034	0.0030	0.0020	0.0032	0.0030	0.0016	0.0021
Other apparel products and services	0.0107	0.0096	0.0163	0.0107	0.0137	0.0121	0.0107
Transportation	0.2100	0.2060	0.1940	0.2170	0.1790	0.1770	0.1860
Medical services	0.0152	0.0200	0.0305	0.0198	0.0178	0.0190	0.0260
Health insurance	0.0188	0.0156	0.0161	0.0145	0.0168	0.0182	0.0278
Entertainment	0.0432	0.0418	0.0392	0.0333	0.0318	0.0435	0.0439
Pensions and Social Security							
Cash contributions	0.0830	0.1020	0.1320	0.0903	0.1210	0.1270	0.1140
Overall Price Index	0.0607	0.0714	0.0596	0.0585	0.0702	0.0632	0.0518

Price Indexes

	Los Angeles CA	Miam-Fort Lauderdale FL	Milwaukee, WI	Minneapolis St.Paul MN-WI	New York NY	Phila-Wilmington-Trenton PA-DE-NJ	Pittsburgh-Beaver Valley, PA	Portland-Vancouver OR-WA
Rented Dwellings	162.00	108.60	102.50	110.30	151.55	115.60	84.00	99.20
Owned Dwellings	155.85	99.40	98.00	97.40	197.05	109.90	76.70	91.20
Other lodging	162.00	108.60	102.50	110.30	151.55	115.60	84.00	99.20
Food at home	100.55	95.20	95.90	93.40	105.35	102.10	93.30	94.10
Food away from home	98.65	100.80	98.80	90.50	129.05	108.30	83.60	91.70
Alcoholic beverages and tobacco	91.10	104.00	99.00	125.90	106.40	102.00	99.00	97.00
Utilities, fuels, and public services	91.20	84.20	97.90	114.80	146.10	109.60	127.50	109.20
Household Furnishings and Operati	109.90	99.30	103.60	103.00	98.20	102.40	106.20	94.40
Apparel								
Men, 16 and over	105.10	101.20	98.00	102.40	113.60	102.60	103.30	95.40
Boys, 2 to 15	104.20	93.10	96.40	112.50	109.85	106.90	103.20	94.20
Women, 16 and over	103.30	112.70	102.70	105.50	115.70	100.90	101.00	99.00
Girls 2 to 15	102.90	91.80	95.00	111.10	108.50	105.60	101.90	92.90
Footwear	104.10	113.70	99.70	103.50	111.35	101.60	104.40	96.80
Children under 2	103.70	92.60	95.90	111.90	109.30	106.40	102.70	93.70
ther apparel products and services	103.90	104.08	99.83	105.20	113.51	102.67	102.24	96.77
Transportation	102.65	102.80	96.60	101.90	100.30	101.40	96.80	90.70
Medical services	119.45	109.40	100.40	93.40	118.50	117.40	107.20	62.30
Health insurance	119.45	109.40	100.40	93.40	118.50	117.40	107.20	62.30
Entertainment	124.00	83.80	91.50	91.90	116.45	100.40	102.20	75.80
Pensions and Social Security								
Cash contributions	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Overall Price Index (Benchmarked	113.49	99.83	98.69	101.67	120.32	105.30	97.33	93.47
Overall Price Index (New Index)	113.05	99.45	98.59	101.10	119.82	105.21	96.64	92.74

Weights

	Los Angeles CA	Miam-Fort Lauderdale FL	Milwaukee, WI	Minneapolis St.Paul MN-WI	New York NY	Phila-Wilmington-Trenton PA-DE-NJ	Pittsburgh-Beaver Valley, PA	Portland-Vancouver OR-WA
Rented Dwellings	0.0435	0.0663	0.0620	0.0484	0.0766	0.0622	0.0528	0.0694
Owned Dwellings	0.1160	0.1090	0.1350	0.1430	0.1110	0.0964	0.0861	0.1090
Other lodging	0.0168	0.0226	0.0132	0.0183	0.0226	0.0332	0.0167	0.0138
Food at home	0.0877	0.0701	0.1030	0.0703	0.0796	0.0818	0.0936	0.0990
Food away from home	0.0619	0.0753	0.0527	0.0659	0.0741	0.0698	0.0651	0.0521
Alcoholic beverages and tobacco	0.0184	0.0196	0.0228	0.0210	0.0179	0.0206	0.0217	0.0225
Utilities, fuels, and public services	0.0726	0.0646	0.0650	0.0547	0.0687	0.0642	0.0786	0.0602
Household Furnishings and Operati	0.0799	0.0830	0.0830	0.0854	0.0819	0.0915	0.0855	0.0839
Apparel								
Men, 16 and over	0.0079	0.0113	0.0132	0.0128	0.0144	0.0139	0.0108	0.0096
Boys, 2 to 15	0.0027	0.0037	0.0041	0.0015	0.0027	0.0046	0.0018	0.0031
Women, 16 and over	0.0221	0.0096	0.0239	0.0280	0.0262	0.0207	0.0257	0.0202
Girls 2 to 15	0.0028	0.0024	0.0044	0.0025	0.0038	0.0052	0.0041	0.0039
Footwear	0.0054	0.0044	0.0079	0.0070	0.0088	0.0075	0.0087	0.0060
Children under 2	0.0021	0.0019	0.0020	0.0020	0.0025	0.0029	0.0026	0.0030
Other apparel products and services	0.0107	0.0106	0.0071	0.0099	0.0120	0.0106	0.0095	0.0103
Transportation	0.1860	0.2100	0.1730	0.1770	0.1550	0.1700	0.1940	0.1760
Medical services	0.0260	0.0221	0.0206	0.0128	0.0291	0.0156	0.0175	0.0229
Health insurance	0.0278	0.0188	0.0192	0.0182	0.0128	0.0146	0.0190	0.0185
Entertainment	0.0439	0.0572	0.0403	0.0408	0.0435	0.0374	0.0364	0.0412
Pensions and Social Security								
Cash contributions	0.1140	0.0855	0.0956	0.1170	0.0950	0.1120	0.0954	0.1070
Overall Price Index	0.0518	0.0524	0.0511	0.0630	0.0617	0.0656	0.0740	0.0676

Price Indexes

	San Diego, CA	San Francisco-Oakland San Jose CA	Seattle-Tacoma WA	St. Louis-East St. Louis MO-IL	Wash. DC-MD-VA
Rented Dwellings	133.30	164.60	107.20	85.50	121.30
Owned Dwellings	156.60	168.70	107.20	80.10	128.00
Other lodging	133.30	164.60	107.20	85.50	121.30
Food at home	97.30	102.40	104.30	105.70	104.10
Food away from home	98.30	106.00	103.40	82.90	107.50
Alcoholic beverages and tobacco	96.40	99.80	145.30	91.20	98.90
Utilities, fuels, and public services	81.00	84.60	105.10	105.50	136.20
Household Furnishings and Operati	109.90	96.90	113.00	102.30	103.70
Apparel					
Men, 16 and over	90.40	103.70	122.00	97.40	115.80
Boys, 2 to 15	91.40	116.10	123.60	117.10	120.80
Women, 16 and over	81.80	99.90	128.90	101.20	112.50
Girls 2 to 15	90.10	114.80	122.30	115.80	119.50
Footwear	83.00	106.50	131.80	103.90	117.60
Children under 2	90.90	115.60	123.10	116.60	120.30
ther apparel products and services	85.52	103.92	126.86	104.18	115.29
Transportation	99.40	104.20	99.50	91.70	104.10
Medical services	115.70	146.80	122.20	84.80	106.70
Health insurance	115.70	146.80	122.20	84.80	106.70
Entertainment	105.40	167.20	116.60	101.90	114.50
Pensions and Social Security					
Cash contributions	100.00	100.00	100.00	100.00	100.00
Overall Price Index (Benchmarked	106.59	117.25	107.55	95.09	110.85
Overall Price Index (New Index)	106.65	116.23	107.25	94.42	110.69

Weights

	San Diego, CA	San Francisco-Oakland San Jose CA	Seattle-Tacoma WA	St. Louis-East St. Louis MO-IL	Wash. DC-MD-VA
Rented Dwellings	0.0837	0.0839	0.0551	0.0332	0.0573
Owned Dwellings	0.1100	0.1320	0.1090	0.1160	0.1390
Other lodging	0.0160	0.0222	0.0224	0.0147	0.0177
Food at home	0.0716	0.0732	0.0861	0.0812	0.0629
Food away from home	0.0517	0.0618	0.0572	0.0636	0.0649
Alcoholic beverages and tobacco	0.0187	0.0192	0.0204	0.0227	0.0188
Utilities, fuels, and public services	0.0430	0.0441	0.0533	0.0855	0.0516
Household Furnishings and Operati	0.1280	0.0834	0.0940	0.0895	0.0912
Apparel					
Men, 16 and over	0.0091	0.0199	0.0092	0.0092	0.0127
Boys, 2 to 15	0.0027	0.0016	0.0024	0.0026	0.0021
Women, 16 and over	0.0195	0.0235	0.0208	0.0193	0.0216
Girls 2 to 15	0.0025	0.0025	0.0019	0.0030	0.0025
Footwear	0.0046	0.0086	0.0058	0.0063	0.0088
Children under 2	0.0022	0.0025	0.0026	0.0043	0.0022
Other apparel products and services	0.0124	0.0107	0.0085	0.0085	0.0123
Transportation	0.1860	0.1810	0.1830	0.1850	0.1810
Medical services	0.0195	0.0130	0.0134	0.0179	0.0197
Health insurance	0.0116	0.0129	0.0199	0.0203	0.0131
Entertainment	0.0588	0.0434	0.0517	0.0414	0.0400
Pensions and Social Security					
Cash contributions	0.0945	0.1090	0.1220	0.1100	0.1230
Overall Price Index	0.0549	0.0518	0.0605	0.0663	0.0569

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