

Real Personal Income and Regional Price Parities for States and Metropolitan Areas, 2008–2012

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IN APRIL 2014, the Bureau of Economic Analysis (BEA) released real, or inflation-adjusted, estimates of personal income for states and metropolitan statistical areas (MSAs), the first release of the data as official statistics.¹ The inflation-adjustments are based in part on regional price parities (RPPs) that provide a measure of differences in price levels across each state and metropolitan area relative to the national price level for each year in 2008–2012.² When RPPs are applied in conjunction with BEA’s national personal consumption expenditures (PCE) price index, which measures price changes over time, comparisons of the purchasing power of personal income can be made across regions and time periods.

This article discusses the most recent RPPs and real personal income estimates for states and metropolitan areas. This article first notes the results for 2008–2012 and then provides an explanation of how the RPPs are used to estimate real personal income and a description of the data and the methodology used to estimate the RPPs.

Real per capita personal income

Real per capita personal income is available for both states and metropolitan areas. All results, including the RPPs, are available on the BEA Web site (see “Data Availability”).

States

State per capita personal income results are presented in table 1. The change in real per capita personal income in 2012 ranged from a decline of 2.3 percent in South Dakota to an increase of 12.7 percent in North Dakota. These rates reflect the year-over-year changes in a state’s real personal income and population. After

North Dakota, the states with the largest growth rates were Indiana (3.3 percent), Mississippi (3.1 percent), Montana (2.9 percent), and California (2.5 percent). Along with South Dakota, per capita personal income also declined in the District of Columbia (–1.7 percent), and Alaska (–0.4 percent). The states with the smallest growth rates were Maine (0.3 percent), Alabama (0.4 percent), Hawaii (0.4 percent), and Kansas (0.4 percent).

Price adjustment using the RPPs and the PCE price index narrowed the range of per capita personal income. In 2012, the unadjusted range was \$41,116, the difference between \$74,773 in the District of Columbia and \$33,657 in Mississippi. For real per capita personal income, the range narrowed to \$25,179, the difference between \$59,759 in the District of Columbia and \$34,580 in Utah.

In 2012, the states with the highest RPPs were the District of Columbia (118.2), Hawaii (117.2), New York (115.4), New Jersey (114.1), and California (112.9). Mississippi (86.4), Arkansas (87.6), Alabama (88.1), Missouri (88.1), and South Dakota (88.2) had the lowest RPPs among the states. States with high (low) RPPs typically have relatively high (low) price

Data Availability

Real personal income data, regional price parities, and implicit regional price deflators are available through the BEA Web site. Data are available for 2008 to 2012 for states, state metropolitan and nonmetropolitan portions, and metropolitan areas at www.bea.gov.

To access the data, select the “Interactive Data” tab at the top of the home page. At the next screen, select “GDP & Personal Income” under Regional Data.

Click on “Begin using the data,” and at the next screen, select “Real personal income and Regional Price Parities.”

For further information about these data, e-mail the Regional Prices Branch at rpp@bea.gov.

1. The Office of Management and Budget defines MSAs as one or more counties with a high degree of social and economic integration, with a core urban population of 50,000 or more. In this article, we refer to MSAs simply as metropolitan areas.

2. RPPs are calculated for the 50 states and the District of Columbia, state metropolitan and nonmetropolitan portions, and metropolitan areas. Estimates for metropolitan areas include an estimate for the nonmetropolitan portion of the United States to provide complete coverage of all U.S. counties.

levels for rents. The states with RPPs closest to the national average price level were Florida (98.8), Oregon (98.8), Illinois (100.6), and Vermont (100.9). RPPs are expressed as a percentage of the overall national price level, which is equal to 100 in each year.

Metropolitan areas

Across metropolitan areas, change in real per capita personal income in 2012 ranged from a decline of 5.4 percent in Kennewick-Richland, WA, to an increase of 7.9 percent in Pine Bluff, AR (table A). The metropolitan areas with next largest growth rates were Greenville, NC (7.8 percent), Jackson, TN (7.6 percent), Albany, GA (7.4 percent), and Danville, IL (7.3 percent). After Kennewick-Richland, WA, the metropolitan areas with the largest declining growth rates were Watertown-Fort Drum, NY (-4.2 percent), Manhattan, KS (-4.0 percent), Jacksonville, NC (-2.9 percent), and State College, PA (-2.6 percent).

RPP estimates for the metropolitan areas had a larger range than those for the states: 43.5 (table B) versus 31.8 for the states (table 1). The RPP for the nonmetropolitan portion of the United States was 87.9. The RPP across all metropolitan areas and the nonmetropolitan portion of the United States is equal to 100 in each year.

The metropolitan areas with the highest RPPs were Urban Honolulu, HI (122.9), followed by New York-Newark-Jersey City, NY-NJ-PA (122.2), San Jose-Sunnyvale-Santa Clara, CA (122.0), Bridgeport-Stamford-Norwalk, CT (121.5), Santa Cruz-Watsonville, CA (121.4).

Danville, IL (79.4), Jefferson City, MO (80.8), Jackson, TN (81.5), Jonesboro, AR (81.7), and Rome, GA (82.2) had the lowest RPPs among the metropolitan areas. Their RPPs were 6 percent to 10 percent below the RPP of 87.9 for the nonmetropolitan portion of the United States.

Using RPPs to estimate real personal income

An important application of the RPPs is the adjustment of consumption-related data to control for price level differences across regions. In this article, the RPPs are used to adjust current-dollar personal income on a per capita basis.³ Personal income is the income re-

3. This article uses state personal income estimates released by BEA's Regional Income Division on September 30, 2013, and local area personal income estimates released on November 21, 2013.

ceived by all persons from all sources. It is the sum of net earnings by place of residence, property income, and personal current transfer receipts.⁴

The adjustment begins by calculating personal income at RPPs (for an example, see table C). This is equal to current-dollar personal income divided by the RPP for a given year and region.⁵ Real personal income

4. For more information, see www.bea.gov/regional.

5. The sum across all regions of the adjusted results should equal the sum of current-dollar estimates, however, small differences arise. To correct this, the adjusted data are divided by a balancing factor equal to the ratio of the adjusted personal income sum to the unadjusted personal income sum. These factors are specific to the regions, reference period, and data series being adjusted.

Table A. Largest Percent Changes in Real Per Capita Personal Income Across Metropolitan Areas, 2012¹

Area	Real per capita personal income		Percent change
	2011	2012	2012
Areas with largest percent increases			
Pine Bluff, AR.....	33,794	36,455	7.9
Greenville, NC.....	35,601	38,381	7.8
Jackson, TN.....	39,737	42,744	7.6
Albany, GA.....	35,245	37,850	7.4
Danville, IL.....	37,776	40,538	7.3
Areas with largest percent declines			
State College, PA.....	38,991	37,962	-2.6
Jacksonville, NC.....	46,766	45,422	-2.9
Manhattan, KS.....	45,659	43,852	-4.0
Watertown-Fort Drum, NY.....	45,844	43,907	-4.2
Kennewick-Richland, WA.....	38,318	36,255	-5.4
United States nonmetropolitan.....	36,911	38,125	3.3
All metropolitan areas and the U.S. nonmetropolitan.....	40,663	41,282	1.5

1. Real personal income data for all metropolitan areas can be found at www.bea.gov/regional.

Table B. Highest and Lowest Regional Price Parities (RPPs) Across Metropolitan Areas, 2012¹

Area	RPP for all items
Highest RPPs	
Urban Honolulu, HI.....	122.9
New York-Newark-Jersey City, NY-NJ-PA.....	122.2
San Jose-Sunnyvale-Santa Clara, CA.....	122.0
Bridgeport-Stamford-Norwalk, CT.....	121.5
Santa Cruz-Watsonville, CA.....	121.4
Lowest RPPs	
Rome, GA.....	82.2
Jonesboro, AR.....	81.7
Jackson, TN.....	81.5
Jefferson City, MO.....	80.8
Danville, IL.....	79.4
United States nonmetropolitan.....	87.9
All metropolitan areas and the U.S. nonmetropolitan.....	100.0

1. Regional Price Parities for all metropolitan areas can be found at www.bea.gov/regional.

Table C. Real Per Capita Personal Income for Connecticut, 2012

Personal income (billions of dollars)	Regional price parities (RPPs)	Balancing factor	Personal income at RPPs (billions of dollars)	PCE price index (base year=2008)	Real personal income (billions of dollars)	Population (persons)	Real per capita personal income (thousands of dollars)
214.3	1.094	0.99892	196.1	1.05943	185.1	3,590,347	51.6

is personal income at RPPs divided by the national personal consumption expenditures (PCE) price index.⁶ Dividing by the population yields real per capita personal income. Real personal income estimates are calculated in chained dollars, with 2008 as the reference year.⁷ The example shows how RPPs can be used in conjunction with the PCE price index to calculate real estimates of regional personal income. They can also be used to derive the implicit regional price growth underlying this calculation (see “Technical Note on Growth Rates”).

Data and Methodology

The following sections focus on the data and methods used to estimate RPPs. Data and methodology for the other inputs to the estimation of real personal income, namely current-dollar personal income and the PCE price index, are available in other BEA publications.⁸

The RPPs are constructed in two stages. The first stage uses price and expenditure inputs collected for the Bureau of Labor Statistics (BLS) Consumer Price Index (CPI) program and the BLS Consumer Expenditure Survey (CE). CPI price data are available for 38 urban areas, while CPI expenditure weights, derived from CE survey data,⁹ are available for the 38 urban areas plus four additional rural regions. In this stage, price levels are estimated for CPI areas.¹⁰

In the second stage, the price levels and expenditure weights are allocated from CPI areas to all counties in the United States.¹¹ They are then recombined for regions, such as states and metropolitan areas, for which final RPPs, including all items RPPs, are estimated.¹² This stage incorporates data for housing from the Census Bureau’s American Community Survey (ACS). The

6. The order of adjustment does not matter; that is, one could first divide by the national price index and then divide the resulting constant dollars by the RPPs.

7. The reference year is 2008, because it is the first year in our series. Subsequent RPP releases will use the same reference year as other BEA chained dollar statistics.

8. For personal income methods, see *State Personal Income and Employment* (October 2013) and *Local Area Personal Income and Employment* (May 2014) at www.bea.gov. For PCE methods, see “Chapter 5: Personal Consumption Expenditures,” in *Concepts and Methods of the U.S. National Income and Product Accounts* at www.bea.gov.

9. For more information on the derivation of CPI expenditure weights, known as cost weights, see the “Consumer Price Index,” in the *BLS Handbook of Methods*, chapter 17 at www.bls.gov.

10. The 38 CPI sampling areas are designed to represent the U.S. urban and metropolitan population. Of the 38 areas, 31 represent large metropolitan areas, 3 represent small metropolitan regions, and 4 represent urban nonmetropolitan regions. For more information on these BLS-defined areas, see www.bls.gov/cpi. A list of the counties sampled in each area can be found in Aten (2005).

11. For a description of input data and methods used to estimate RPP expenditure weights, see Figueroa, Aten, Martin (2014).

12. The term “all items” refers to all the detailed consumption goods and services used in the estimates.

Technical Note on Growth Rates

The RPP indexes are calculated using the Geary system and express a region’s average price relative to the U.S. average, which is equal to 100.0,

$$RPP_{i,t} = (P_i/P_{US})_t$$

where i is the region and t is the time period.

The real personal income statistics presented in this article use the national PCE price index to measure U.S. price change over time and the RPPs to capture the change in price level differences across states. The implicit price growth for each state can be calculated as

$$\text{Implicit price growth or regional inflation} = (P_{i,t}/P_{i,t-1}) = (RPP_{i,t}/RPP_{i,t-1}) \text{ multiplied by } (P_{US,t}/P_{US,t-1}) \text{ as measured by the national PCE price index.}$$

For example, if the RPP for area A is 120 and for area B, it is 90, then on average, prices are 20 percent higher than the U.S. average for area A and 10 percent lower than the U.S. average for area B. If the personal income for area A is \$12,000 and if it is \$9,000 for area B, then the RPP-adjusted income for area A is \$10,000 (\$12,000/1.20) and for area B, it is \$10,000 (\$9,000/0.90). In other words, the purchasing power of the income of each area is equivalent when the income is adjusted by the price levels of the area.

ACS provides snapshots of the entire U.S. population, with a focus on demographic and housing conditions. It is available annually for large geographic areas, such as states, and on a rolling multiyear basis for smaller geographic areas, such as counties.

The following sections describe the use of the price and expenditure data from the CPI and the housing data from the ACS, how their geographies are reconciled, and how the overall indexes are computed.

First stage

CPI price data cover a wide array of consumer goods and services, ranging from high-expenditure goods, such as new automobiles, to low-expenditure services, such as haircuts. Over a million price quotes are collected each year and are classified into more than 200 item strata, each consisting of detailed entry level items (ELIs). The item strata can be combined into nine expenditure groups: apparel, education, food, housing, medical, recreation, rents, transportation and other goods and services.¹³

13. See the “Consumer Price Index,” in the *BLS Handbook of Methods*, chapter 17 at www.bls.gov.

Because the CPI was not designed to measure geographic price level differences, items with identical characteristics are not always priced in all sampling areas. Therefore, for the ELIs in the 75 highest item strata (accounting for roughly 85 percent of expenditure weights), we estimate hedonic regressions which take into account the variation in the characteristics of the sampled items.¹⁴

For the “carbonated drinks” ELI, for example, we use a hedonic price model to adjust for the brand and manufacturer, the variety of the beverage (cola, club soda, tonic water, energy drink, or other), the individual container and unit size (number of ounces, and if it is a 6-pack or 12-pack, or other), and the type of outlet where it was purchased (such as a large retailer, a gas station, or convenience store, or other business). An example of an item-specific hedonic regression may be found in Aten (2006).

After the ELI price levels are estimated, they are aggregated to yield item strata price levels using a weighted country product dummy (CPD-W) approach, with weights corresponding to the importance of the ELIs within the item strata.¹⁵ Both the ELI and the item strata price levels undergo an outlier checking process.¹⁶

Lastly, the item strata price and expenditure levels in each of the 38 areas are aggregated to 16 expenditure classes using the Geary multilateral index (see Balk 2012).¹⁷ One of the advantages of the Geary index is that it is additive at various levels of aggregation. Previ-

ous research on the RPPs (Aten and Marshall 2010) has shown that other methods such as the EKS-Törnqvist and Fisher indexes, the CPD-W approach, and a GAIA index, tend not to deviate greatly from the Geary.¹⁸

The Geary multilateral price index P_{Geary}^c is given by the following equations:

$$P_{Geary}^c = \frac{\sum_{n=1}^N p_n^c q_n^c}{\sum_{n=1}^N \pi_n q_n^c}$$

$$\pi_n = \sum_{c=1}^M \frac{p_n^c}{P_{Geary}^c} \frac{q_n^c}{\sum_{d=1}^M q_n^d}$$

where p is the relative price of the item stratum or the expenditure class

π is the national average price of the item stratum or expenditure class

q is the notional quantity equal to $(pq)/p$

c and d are regions which take a value of 1 through M

n is the item stratum or expenditure class which takes a value of 1 through N

Second stage

The second stage begins with the allocation of price levels and expenditure weights from CPI areas to counties. Price levels for each county are assumed to be those of the CPI sampling area in which the county is located. For example, counties in Pennsylvania are assigned price levels from either the Philadelphia or Pittsburgh areas or from the Northeast small metropolitan area. Rural counties are not included in any of the 38 urban areas for which stage one price levels are estimated. These counties are assigned price levels of the urban area that (1) is located in the same region and (2) has the lowest population threshold.¹⁹

Expenditure weights in the second stage incorporate CPI data for rural regions and therefore cover both urban and rural counties. To allocate a weight to each

14. The item strata price levels for the remaining ELIs are estimated using a shortcut approach described in Aten (2006).

15. The CPD-W is the weighted geometric mean when there are no missing observations. For a complete description, see Rao (2005).

16. The process is modeled after the Quaranta method used by the Organisation for Economic Co-operations and Development, Eurostat, and the International Comparison Program of the World Bank, www.worldbank.org.

17. The 16 expenditure classes are derived from the 9 groups subdivided into goods and services: apparel has only goods, rents has only services, and the other seven groups have both goods and services.

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18. The Geary formula is solved simultaneously for the area RPPs and the expenditure class price levels (notation and formulas follow Deaton and Heston 2010).

19. Price levels in rural counties in the South, Midwest and West regions are assumed to be the same as those in the BLS urban, nonmetropolitan area for the region. BLS has no urban, nonmetropolitan area for the Northeast so rural counties are assumed to have the same price levels as those in the BLS-defined small, metropolitan areas of the Northeast.

county, weights for each CPI area are distributed to its component counties in proportion to household income.²⁰

The county-level results then undergo two adjustments. First, weights for the rents expenditure class are replaced with estimates derived from the 5-year ACS file, broken down into several types of housing units: from one bedroom apartments to detached houses with three or more bedrooms. These estimates model the relationship of monthly tenants' rents to owner-equivalent rents in the BLS CPI housing file and apply it to the monthly tenants' rents data in the ACS file. The resulting imputed owner-equivalent rents are then multiplied by the number of owner-occupied units in each county and summed across the housing units.²¹

20. The allocation uses county-level ACS Money Income for the 2008–2012 period. Census Bureau money income is defined as income received on a regular basis (exclusive of certain money receipts such as capital gains) before payments for personal income taxes, social security, union dues, Medicare deductions, etc. Therefore, money income does not reflect the fact that some families receive part of their income in the form of non-cash benefits. For more information, see www.census.gov. In past papers, population was used to distribute the weights; for a comparison, see Figueroa, Aten, and Martin (2014).

21. For more information on how the RPP program estimates expenditures on owner-occupied rents, see Aten, Figueroa, and Martin (2012a).

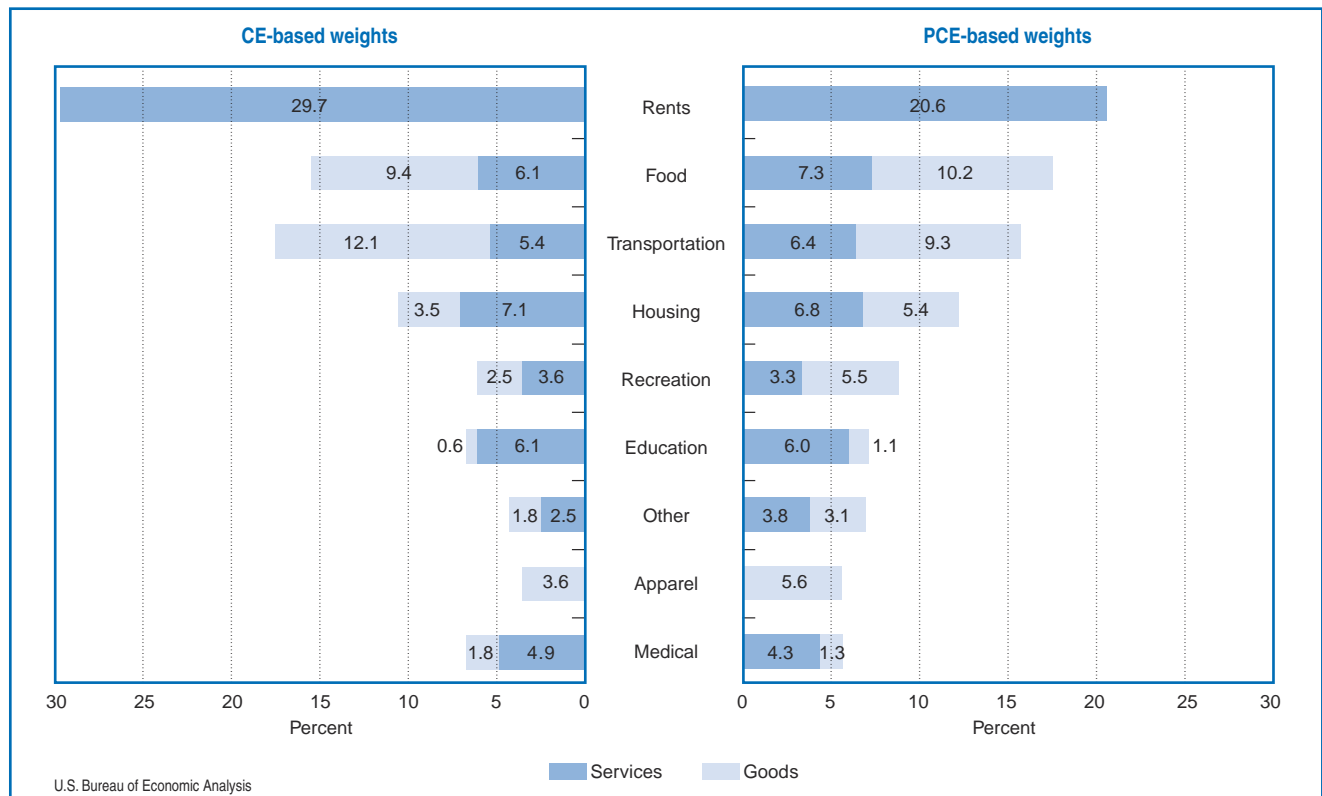
The total expenditure weight on rents by county is calculated as the sum of the estimated owner-occupied rent expenditures plus the directly observed tenant rent expenditures.

Second, shares for the 16 expenditure classes are adjusted to reflect the valuation in BEA's personal consumption expenditures (PCE), yielding weights consistent with BEA's national accounts.²² This adjustment shifts the distribution of weights across expenditure classes, notably reducing the share of rents expenditures from total consumption in the United States from 29.7 percent to 20.6 percent (chart 1).

After the county price levels and expenditure weights have been obtained for each class and for each year, as outlined above, the weighted geometric mean of the price levels for states, state metropolitan and nonmetropolitan portions, and metropolitan areas is obtained. This weighted geometric mean is a 5-year average for goods and services other than rents. Rent price levels are estimated directly from the ACS: annually for states, and across 3 years for metropolitan

22. The adjustment is based on BLS research on providing PCE-valued weights for CPI item strata (Blair 2012).

Chart 1. Share of Household Expenditure Weights Based on BLS Consumer Expenditures (CE) and BEA Personal Consumption Expenditures (PCE) by Expenditure Class, 2012



areas.^{23,24} The estimates are quality adjusted using a hedonic model that controls for basic unit characteristics such as the type of structure, the number of bedrooms and total rooms, when the structure was built, whether

it resides in an urban or rural location, and if utilities are included in the monthly rent. Additional research on rent estimates using the ACS and CPI Housing surveys is available in Martin, Aten, and Figueroa (2011).

Similarly, expenditure weights are annual for states and across 3 years for metropolitan areas.²⁵ The final step is to aggregate the price levels and expenditures for the 15 classes of goods and services, plus rents, into one all item RPP for all geographies and all years using the Geary multilateral index.

23. In Aten and D'Souza (2008), the imputation for county-level owner-occupied rent levels used owner's monthly housing cost data from the 5-year ACS housing file, together with the annual CPI Housing Survey from BLS. In more current work (Aten, Figueroa, and Martin 2011, 2012b), only observed rent price levels from the ACS were used, making no imputations for the owner-occupied rent levels. The monthly housing costs in the ACS include mortgage payments, but do not specify the term or interest rate of the loan. The coverage and distribution of the reported payments was highly variable, and using that information has been postponed until more data or further research is completed.

24. ACS data for 2012 did not incorporate a revision made by BEA to its MSA definitions (see David G. Lenze, "Comprehensive Revision of Local Area Personal Income," *SURVEY OF CURRENT BUSINESS* 93 (December 2013): 17). Among other changes, the revision designated 23 new MSAs. ACS rents for these MSAs were estimated from ACS data for state metropolitan and nonmetropolitan portions.

25. When RPPs for metropolitan areas are initially released, they use ACS rents data from 3-year files which end in the target year. These RPPs are revised the following year when 3-year files centered on the target year become available. For example, 2012 data in this release use 2010–2012 3-year files. Next year's release of 2013 data will include revised 2012 RPPs using 2011–2013 3-year files.

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Tables 1 and 2 follow.

