

Price Adjustment Using Regional Price Parities

New RPPs for 2022 and Revisions Back to 2008

By Eric Figueroa, Dakota Peterson, and Daniel Thang | May 13, 2024

In December 2023, the U.S. Bureau of Economic Analysis (BEA) released new 2022 estimates of regional price parities (RPPs) for states, state portions, and metropolitan areas. RPPs for these geographies were revised from 2008 to 2021. The revised estimates incorporated improvements to the methodology for estimating housing services.

The release included two price-adjusted series that were estimated using the RPPs: real personal consumption expenditures (PCE) for states and real personal income for states, state portions, and metropolitan areas. For each, new estimates were released for 2022 and revised estimates were released for 2008 to 2021.

This article describes the RPPs and their use in the price adjustment of regional PCE and personal income. Per capita results for 2022 are presented, including RPP-adjusted and real estimates.¹ Recent methods improvements are discussed, and their impacts on the RPPs are measured.

Regional Price Parities

RPPs are spatial price indexes that measure price level differences across U.S. regions for one period. They are estimated annually and express each region's price level relative to the U.S. average, which serves as the reference and is equal to 100. Each set of annual RPPs is independently estimated and cannot be compared across years.

RPPs are derived by directly comparing detailed price and expenditure microdata across all regions and product categories.² The RPP for all items covers all consumption goods and services. RPPs are also estimated for four subcategories: goods, housing rents, utilities, and other services.

Another example of spatial price indexes is purchasing power parities (PPPs), which measure differences in price levels across countries for a given period and can be used to convert estimates of per capita gross domestic product into comparable levels in a common currency. BEA's RPPs compare regions within the United States, without the need for currency conversion.

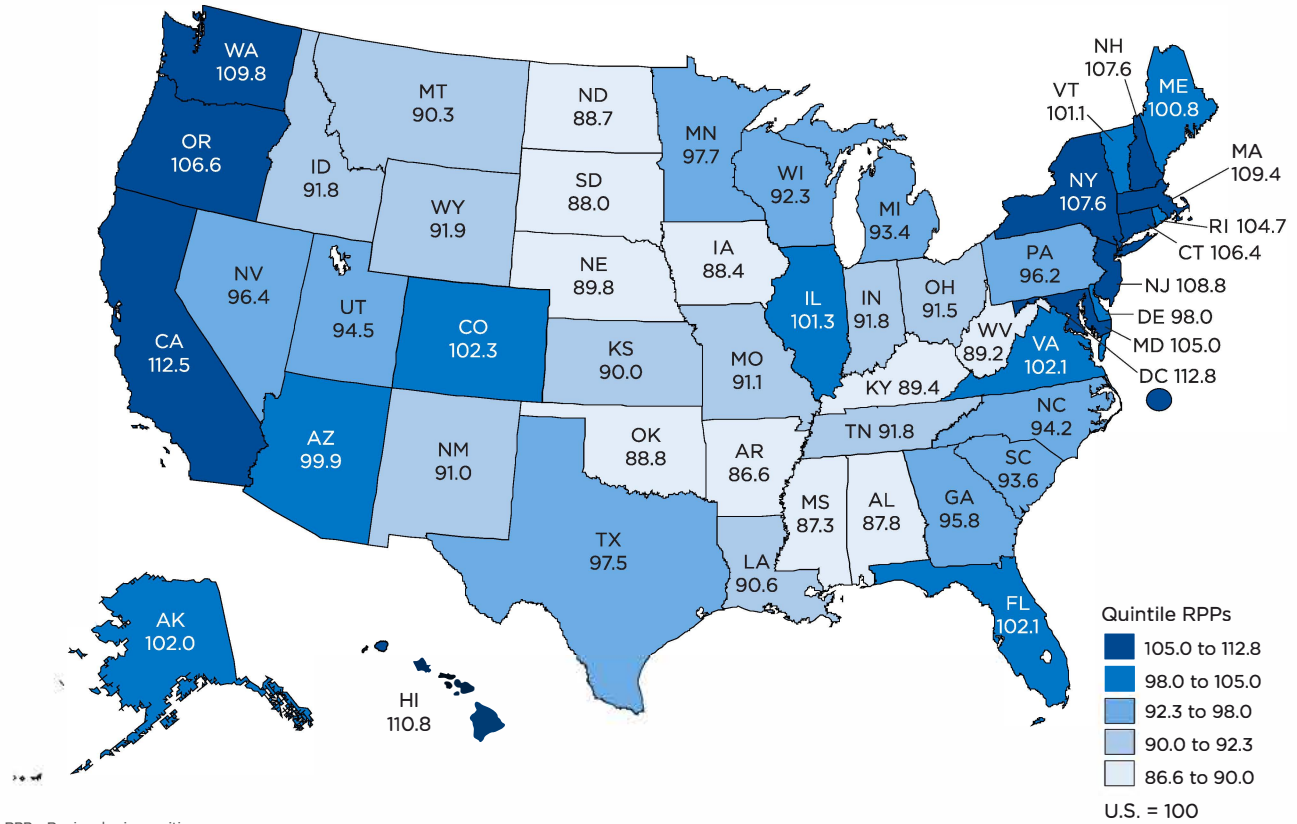
State RPP results for 2022

In 2022, state RPPs ranged from 112.5 in California to 86.6 in Arkansas (table 1). The District of Columbia's RPP was 112.8. These results show that California's price level was 12.5 percent higher than the U.S. average and 29.9 percent higher than in Arkansas.

States in the top RPP quintile were generally located in the Northeast and West and had relatively high housing rents and utilities RPPs (charts 1 and 2). California had the highest housing rents RPP across states at 160.2. The District of Columbia's housing rents RPP was 177.2. Hawaii had the highest utilities RPP across states at 201.2, more than double the national average.

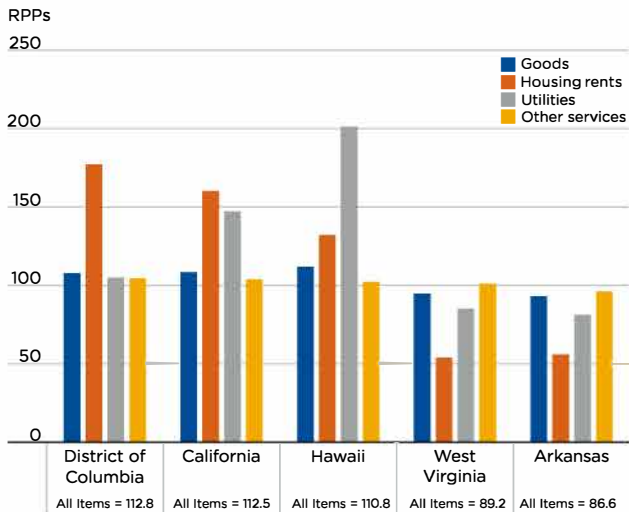
States in the bottom RPP quintile were all in the South and Midwest and had relatively low housing rents RPPs. West Virginia and Arkansas had the lowest housing rents RPPs at 53.9 and 55.8, respectively.

Chart 1. RPPs for States: All Items, 2022



RPPs Regional price parities
U.S. Bureau of Economic Analysis

Chart 2. Category RPPs for Selected States, 2022



RPPs Regional price parities
U.S. Bureau of Economic Analysis

Table 1. RPP and RPP-Adjusted Per Capita PCE and Personal Income by State, 2022

State	RPP	PCE (dollars)		Personal income (dollars)	
		Per capita	RPP-adjusted per capita	Per capita	RPP-adjusted per capita
United States	100.0	52,542	52,542	65,470	65,470
Alabama	87.8	42,391	48,295	50,916	58,007
Alaska	102.0	59,179	58,025	68,635	67,297
Arizona	99.9	50,123	50,175	58,442	58,502
Arkansas	86.6	42,245	48,783	52,618	60,762
California	112.5	60,272	53,589	77,036	68,494
Colorado	102.3	59,371	58,040	75,722	74,025
Connecticut	106.4	60,413	56,772	82,938	77,941
Delaware	98.0	54,532	55,669	63,243	64,562
District of Columbia	112.8	85,732	75,972	95,970	85,044
Florida	102.1	55,516	54,351	64,806	63,446
Georgia	95.8	47,406	49,468	56,589	59,051
Hawaii	110.8	54,655	49,310	61,779	55,737
Idaho	91.8	43,508	47,381	56,614	61,652
Illinois	101.3	54,341	53,666	67,655	66,816
Indiana	91.8	46,579	50,730	58,323	63,521
Iowa	88.4	45,455	51,407	60,222	68,108
Kansas	90.0	46,069	51,210	60,424	67,167
Kentucky	89.4	44,193	49,457	51,921	58,106
Louisiana	90.6	45,178	49,882	54,501	60,176
Maine	100.8	55,789	55,325	60,599	60,095
Maryland	105.0	52,651	50,164	70,228	66,911
Massachusetts	109.4	64,214	58,700	84,561	77,300
Michigan	93.4	49,482	52,963	57,038	61,050
Minnesota	97.7	52,849	54,081	68,840	70,444
Mississippi	87.3	39,678	45,435	46,370	53,099
Missouri	91.1	48,613	53,351	57,818	63,453
Montana	90.3	51,913	57,510	60,984	67,560
Nebraska	89.8	49,522	55,143	64,268	71,562
Nevada	96.4	50,922	52,833	62,085	64,415
New Hampshire	107.6	60,828	56,509	73,910	68,662
New Jersey	108.8	60,082	55,245	77,199	70,983
New Mexico	91.0	43,336	47,632	52,194	57,368
New York	107.6	58,571	54,434	75,407	70,082
North Carolina	94.2	47,834	50,777	58,109	61,684
North Dakota	88.7	52,631	59,365	70,360	79,363
Ohio	91.5	47,768	52,235	57,777	63,179
Oklahoma	88.8	42,046	47,364	56,298	63,420
Oregon	106.6	52,159	48,946	62,303	58,465
Pennsylvania	96.2	53,703	55,813	64,506	67,042
Rhode Island	104.7	52,820	50,449	63,557	60,703
South Carolina	93.6	46,220	49,406	53,618	57,314
South Dakota	88.0	48,997	55,684	68,176	77,481
Tennessee	91.8	46,280	50,416	58,292	63,501
Texas	97.5	49,082	50,335	62,586	64,182
Utah	94.5	48,189	51,009	59,457	62,936
Vermont	101.1	55,743	55,139	63,039	62,356
Virginia	102.1	52,057	50,967	68,985	67,542
Washington	109.8	56,567	51,496	75,332	68,578
West Virginia	89.2	44,460	49,818	49,993	56,018
Wisconsin	92.3	49,284	53,390	61,475	66,597
Wyoming	91.9	52,403	57,019	73,248	79,700
Maximum	112.8	85,732	75,972	95,970	85,044
Minimum	86.6	39,678	45,435	46,370	53,099
Range	26.3	46,055	30,537	49,600	31,945

PCE Personal consumption expenditures

RPP Regional price parities

Notes. Per capita personal income uses U.S. Census Bureau midyear population estimates available at the time of the release of the RPPs for 2022 on December 14, 2023.

Per capita values and ranges are computed from unrounded data.

Price Adjustments Using the RPPs

BEA's regional estimation of real PCE and real personal income uses two sets of price indexes. Current-dollar estimates are first adjusted by the RPPs. These results are then converted to real, constant-dollar estimates using the U.S. PCE price index.

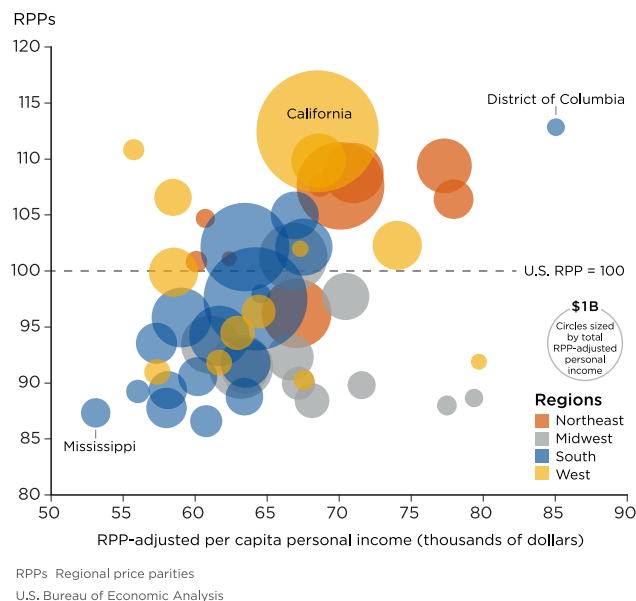
RPP-adjusted PCE and personal income

RPP-adjusted results are obtained by dividing each region's current dollar estimates by its RPP. This controls for geographic price level differences within the period and allows for more meaningful regional comparisons of expenditures and income.

For example, in 2022, per capita personal income for the District of Columbia was \$95,970, more than double that of Mississippi, which was \$46,370 (table 1). However, the District of Columbia's RPP of 112.8 was higher than that of any state, while Mississippi's was the second lowest, at 87.3. After adjusting with the RPPs, the difference in their per capita estimates narrows, and the District of Columbia's result (\$85,044) was only about 60 percent higher than Mississippi's (\$53,099).

State RPP results show a positive relationship between the price levels and income: in general, as RPP-adjusted per capita income increases so do the corresponding RPPs (chart 3). Similar results are also seen in international results obtained using PPPs.³

Chart 3. RPPs and Per Capita Personal Income, 2022



In 2022, per capita PCE for California was \$60,272, more than 40 percent higher than for Arkansas, which was \$42,245. California's RPP of 112.5 was the highest across states, while Arkansas' was the lowest, at 86.6. After adjusting with the RPPs, the difference in their per capita PCE estimates narrows, and California's result (\$53,589) was only about 10 percent higher than Arkansas' (\$48,783).

States with higher per capita PCE tend to have higher RPPs and are adjusted downwards, while those with lower per capita PCE tend to have lower RPPs and are adjusted upwards, narrowing the range. This is seen in the per capita PCE results, where the range across states drops from \$46,055 before adjustment to \$30,537 afterwards.

Real PCE and personal income

The RPP-adjusted estimates are converted to constant dollars by division with the U.S. PCE price index. The real results can also be obtained by dividing current-dollar estimates by BEA's implicit regional price deflator (IRPD), the product of each region's RPP, and the U.S. PCE price index.⁴ The IRPD links the independent sets of annual RPPs across years with a reference equal to the U.S. price level in 2017. The year-to-year change in the IRPDs is a measure of regional price change over time.

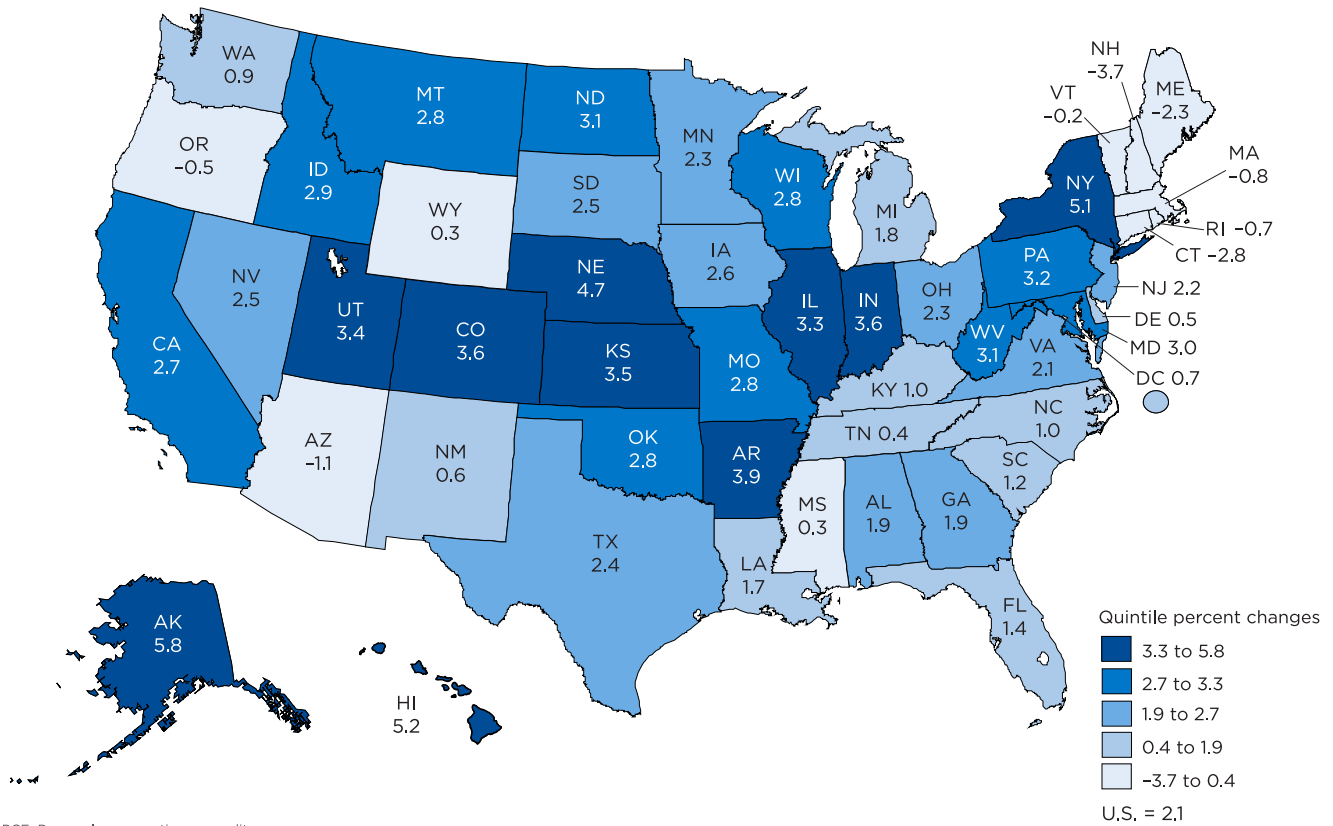
Within each period, the IRPD retains the RPPs' directly measured geographic relationships. However, the IRPD's time-to-time measurements are indirect, depending on comparisons of regional IRPDs linked across years through the U.S. PCE price index. They are not based on detailed comparisons of regional price and expenditure data across years.⁵ In 2022, the year-over-year percent change in the IRPD increased across all states, ranging from 11.8 percent in New Hampshire to 3.6 percent in Alaska (table 2).

In 2022, real per capita PCE increased in 42 states and District of Columbia (chart 4). Alaska had the highest growth rate at 5.8 percent, and New Hampshire had the largest decline at 3.7 percent. These states had the lowest and highest percent change in their IRPDs, respectively. In general, higher growth rates in the IRPDs are associated with lower annual percent change for real per capita PCE (chart 5).

Real per capita personal income declined in 46 states and the District of Columbia (chart 6). North Dakota had the highest growth rate at 2.8 percent, and Rhode Island had the largest decline at 8.7 percent. North Dakota's IRPD change was 3.8 percent, and Rhode Island's was 9.2 percent.

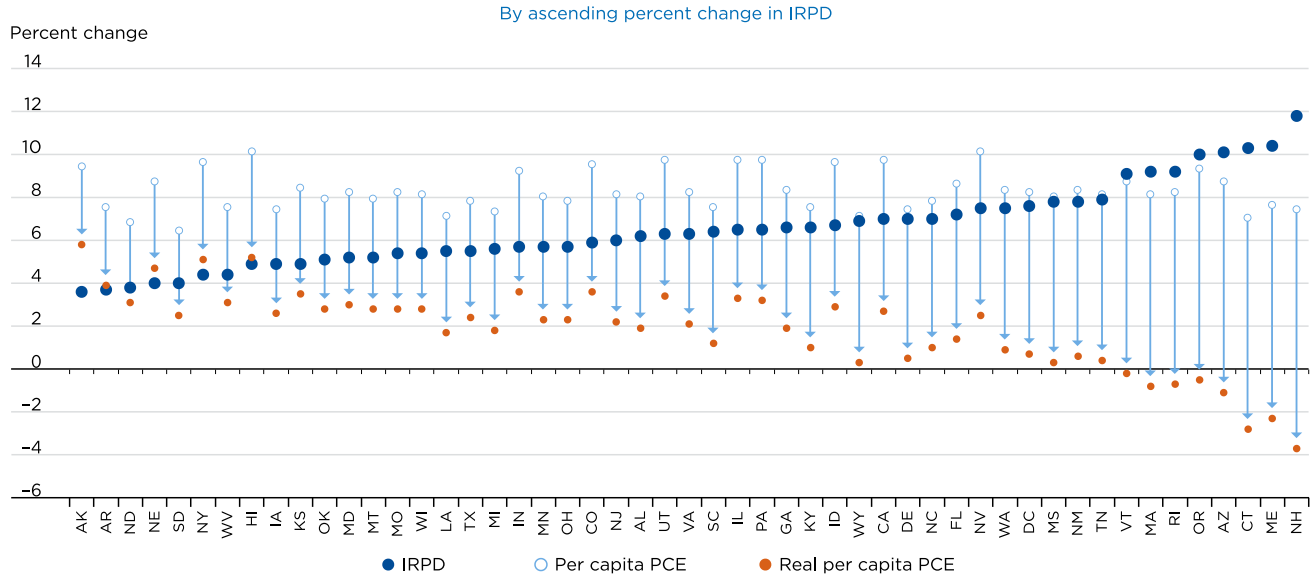
The real growth rates for PCE and personal income are impacted by the growth of the current-dollar estimates and the IRPD.⁶ In 2022, current-dollar PCE grew 9.2 percent, faster than the 6.4 percent growth rate in the U.S. PCE price index, and most states had increasing growth in their real estimates.⁷ On the other hand, current-dollar personal income only grew 2.0 percent in 2022, slower than the U.S. price growth, and most states had declining rates of change in their real estimates.

Chart 4. Real Per Capita PCE for States: Percent Change, 2021-2022



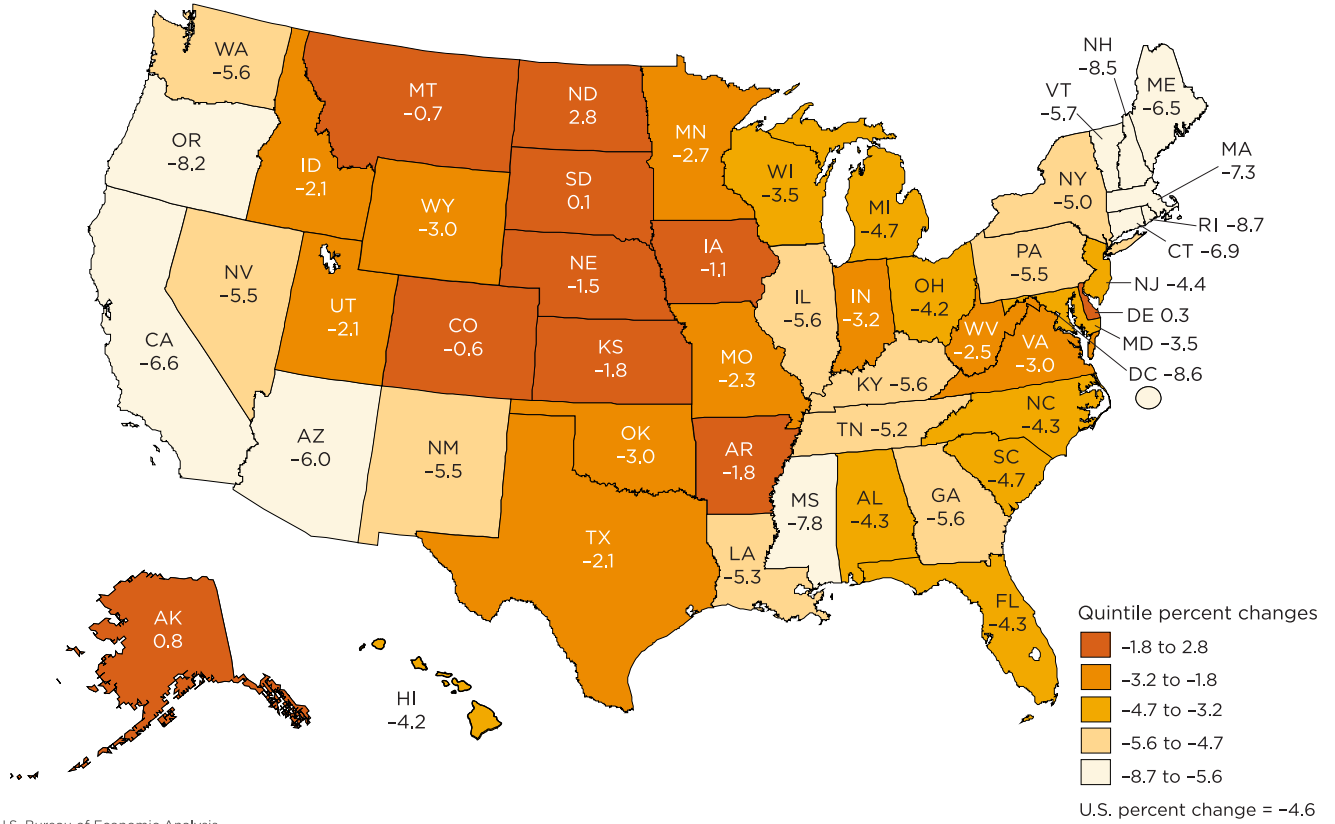
PCE Personal consumption expenditures
U.S. Bureau of Economic Analysis

Chart 5. Percent Change in IRPDs, Per Capita PCE, and Real Per Capita PCE, 2021-2022



IRPD Implicit regional price deflator
PCE Personal consumption expenditures
U.S. Bureau of Economic Analysis

Chart 6. Real Per Capita Personal Income for States: Percent Change, 2021-2022



U.S. Bureau of Economic Analysis

Table 2. RPP, IRPD, and Real Per Capita PCE and Personal Income by State: 2021–2022

State	RPP		IRPD			Real per capita PCE (constant (2017) dollars)			Real per capita personal income (constant (2017) dollars)		
	2021	2022	2021	2022	Percent change	2021	2022	Percent change	2021	2022	Percent change
United States	100.0	100.0	109.0	116.0	6.4	44,328	45,279	2.1	59,110	56,419	-4.6
Alabama	88.0	87.8	95.9	101.9	6.2	40,827	41,618	1.9	52,290	50,053	-4.3
Alaska	104.8	102.0	114.2	118.4	3.6	47,267	50,003	5.8	57,623	58,069	0.8
Arizona	96.6	99.9	105.3	115.9	10.1	43,701	43,239	-1.1	53,694	50,480	-6.0
Arkansas	88.9	86.6	96.9	100.5	3.7	40,473	42,039	3.9	53,390	52,430	-1.8
California	111.9	112.5	122.0	130.5	7.0	44,965	46,181	2.7	63,271	59,103	-6.6
Colorado	102.9	102.3	112.1	118.7	5.9	48,267	50,016	3.6	64,282	63,875	-0.6
Connecticut	102.8	106.4	112.0	123.5	10.3	50,331	48,924	-2.8	72,206	67,254	-6.9
Delaware	97.5	98.0	106.2	113.7	7.0	47,721	47,973	0.5	55,553	55,709	0.3
District of Columbia	111.7	112.8	121.7	131.0	7.6	64,996	65,469	0.7	80,287	73,383	-8.6
Florida	101.4	102.1	110.5	118.5	7.2	46,172	46,837	1.4	57,193	54,746	-4.3
Georgia	95.7	95.8	104.4	111.2	6.6	41,853	42,629	1.9	53,954	50,954	-5.6
Hawaii	112.5	110.8	122.7	128.6	4.9	40,393	42,493	5.2	50,224	48,095	-4.2
Idaho	91.6	91.8	99.9	106.6	6.7	39,698	40,830	2.9	54,349	53,199	-2.1
Illinois	101.3	101.3	110.4	117.5	6.5	44,782	46,247	3.3	61,090	57,654	-5.6
Indiana	92.5	91.8	100.8	106.5	5.7	42,218	43,717	3.6	56,596	54,811	-3.2
Iowa	89.8	88.4	97.9	102.6	4.9	43,171	44,300	2.6	59,451	58,769	-1.1
Kansas	91.3	90.0	99.5	104.4	4.9	42,653	44,131	3.5	58,997	57,958	-1.8
Kentucky	89.2	89.4	97.3	103.7	6.6	42,183	42,620	1.0	53,132	50,138	-5.6
Louisiana	91.4	90.6	99.6	105.1	5.5	42,275	42,986	1.7	54,860	51,925	-5.3
Maine	97.3	100.8	106.0	117.0	10.4	48,794	47,676	-2.3	55,479	51,855	-6.5
Maryland	106.2	105.0	115.7	121.8	5.2	41,951	43,229	3.0	59,801	57,736	-3.5
Massachusetts	106.6	109.4	116.2	126.9	9.2	50,994	50,585	-0.8	71,971	66,701	-7.3
Michigan	94.2	93.4	102.7	108.4	5.6	44,822	45,641	1.8	55,251	52,679	-4.7
Minnesota	98.4	97.7	107.2	113.4	5.7	45,545	46,604	2.3	62,468	60,785	-2.7
Mississippi	86.2	87.3	94.0	101.3	7.8	39,036	39,154	0.3	49,677	45,818	-7.8
Missouri	92.0	91.1	100.3	105.7	5.4	44,704	45,976	2.8	56,045	54,753	-2.3
Montana	91.4	90.3	99.6	104.7	5.2	48,203	49,560	2.8	58,704	58,297	-0.7
Nebraska	92.0	89.8	100.2	104.2	4.0	45,366	47,520	4.7	62,680	61,750	-1.5
Nevada	95.4	96.4	104.0	111.8	7.5	44,402	45,529	2.5	58,810	55,582	-5.5
New Hampshire	102.5	107.6	111.7	124.9	11.8	50,566	48,696	-3.7	64,766	59,247	-8.5
New Jersey	109.2	108.8	119.1	126.2	6.0	46,594	47,607	2.2	64,046	61,250	-4.4
New Mexico	89.8	91.0	97.9	105.6	7.8	40,809	41,047	0.6	52,357	49,501	-5.5
New York	109.7	107.6	119.6	124.9	4.4	44,627	46,909	5.1	63,666	60,472	-5.0
North Carolina	93.8	94.2	102.2	109.3	7.0	43,331	43,757	1.0	55,605	53,226	-4.3
North Dakota	90.9	88.7	99.1	102.9	3.8	49,640	51,158	3.1	66,621	68,481	2.8
Ohio	92.1	91.5	100.4	106.1	5.7	44,021	45,013	2.3	56,903	54,516	-4.2
Oklahoma	89.9	88.8	98.0	103.0	5.1	39,685	40,816	2.8	56,420	54,724	-3.0
Oregon	103.1	106.6	112.4	123.7	10.0	42,400	42,179	-0.5	54,976	50,448	-8.2
Pennsylvania	96.2	96.2	104.8	111.7	6.5	46,626	48,097	3.2	61,233	57,849	-5.5
Rhode Island	102.1	104.7	111.3	121.5	9.2	43,776	43,474	-0.7	57,342	52,380	-8.7
South Carolina	93.6	93.6	102.1	108.6	6.4	42,061	42,576	1.2	51,875	49,456	-4.7
South Dakota	90.1	88.0	98.2	102.1	4.0	46,797	47,986	2.5	66,784	66,857	0.1
Tennessee	90.6	91.8	98.8	106.5	7.9	43,281	43,446	0.4	57,819	54,794	-5.2
Texas	98.4	97.5	107.3	113.2	5.5	42,375	43,376	2.4	56,565	55,382	-2.1
Utah	94.6	94.5	103.1	109.6	6.3	42,529	43,957	3.4	55,448	54,307	-2.1
Vermont	98.6	101.1	107.5	117.3	9.1	47,631	47,516	-0.2	57,077	53,806	-5.7
Virginia	102.3	102.1	111.5	118.5	6.3	43,037	43,921	2.1	60,057	58,281	-3.0
Washington	108.8	109.8	118.6	127.5	7.5	43,967	44,377	0.9	62,680	59,175	-5.6
West Virginia	91.0	89.2	99.2	103.6	4.4	41,620	42,931	3.1	49,594	48,337	-2.5
Wisconsin	93.2	92.3	101.6	107.1	5.4	44,769	46,009	2.8	59,557	57,465	-3.5
Wyoming	91.5	91.9	99.7	106.6	6.9	48,993	49,136	0.3	70,876	68,772	-3.0
Maximum	112.5	112.8	122.7	131.0	11.8	64,996	65,469	5.8	80,287	73,383	2.8
Minimum	86.2	86.6	94.0	100.5	3.6	39,036	39,154	-3.7	49,594	45,818	-8.7
Range	26.3	26.3	28.7	30.5	8.2	25,960	26,315	9.5	30,693	27,565	11.5

IRPD Implicit regional price deflators
PCE Personal consumption expenditures
RPP Regional price parities

Notes. Per capita personal income uses U.S. Census Bureau midyear population estimates available at the time of the release of the RPPs for 2022 on December 14, 2023.

The implicit price deflator for the United States is equal to the national PCE price index, with a base of 2017.

Per capita values, ranges, and percent changes are computed from unrounded data.

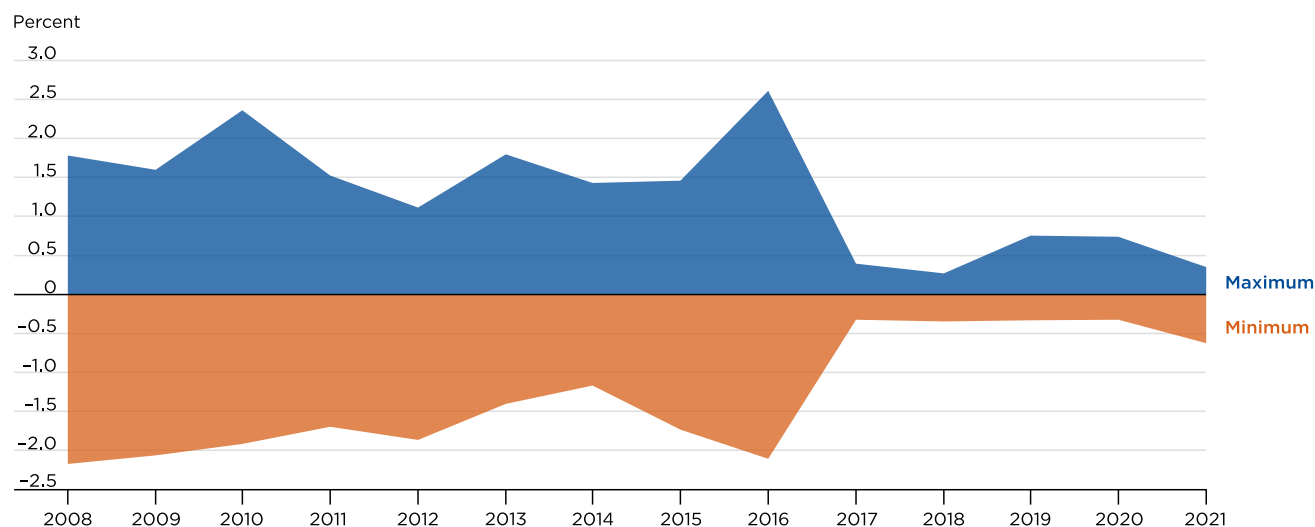
Revisions to Housing Services Input to the RPPs

The RPPs released in December 2023 incorporate an improvement to the estimation of housing rent and utility expenditures. Since 2021, BEA has used the American Community Survey's public use microdata sample to create a streamlined and integrated approach to measuring housing services across all BEA's data programs. That approach includes an adjustment to tenant rents observations if the reported rent includes utility costs. For these observations, the included utility costs are imputed and subtracted from the rent expenditure.

The improvement more precisely imputes these utility costs. Previously, the imputation was based on reported utility payments for similar housing units, without regard to how many utilities were consumed. The new method bases the imputed cost on the specific combination of utilities consumed. For example, if the tenant rent for a housing unit includes electricity and water costs, the imputation is based on reported utility payments in similar housing units that consume only those two utilities.

Revisions to RPPs from 2008 to 2016 have a larger range than those from 2017 to 2021 (chart 7). All years incorporate the improvement described above, but the earlier period also carries back revisions originally introduced in December 2022.⁸ The revisions from 2017 to 2021 primarily reflect the utility imputation improvement. These are small and do not exceed 1.0 percent in any year (table 3).

Chart 7. Percent Revision to RPPs for States, 2008–2021



RPPs: Regional price parities
U.S. Bureau of Economic Analysis

Table 3. Percent Revision to RPPs by State, 2017–2021

State	2017	2018	2019	2020	2021
United States	0.0	0.0	0.0	0.0	0.0
Alabama	0.2	0.3	0.0	0.1	-0.1
Alaska	-0.1	0.0	0.2	0.5	0.3
Arizona	0.1	-0.2	-0.1	-0.1	-0.1
Arkansas	0.4	0.0	0.0	-0.1	-0.6
California	0.0	0.1	0.1	0.0	0.1
Colorado	0.0	0.1	0.1	-0.1	-0.1
Connecticut	0.0	-0.1	0.2	0.2	0.1
Delaware	0.0	0.0	0.1	0.2	-0.2
District of Columbia	0.0	-0.2	-0.3	-0.3	0.3
Florida	-0.1	-0.1	-0.1	-0.1	0.0
Georgia	0.0	0.1	0.1	0.1	0.0
Hawaii	0.0	0.0	0.1	0.4	-0.6
Idaho	0.0	0.0	0.0	0.1	-0.2
Illinois	-0.2	-0.2	-0.2	-0.3	-0.1
Indiana	-0.1	0.0	0.0	-0.2	-0.3
Iowa	-0.1	0.1	0.2	0.6	0.2
Kansas	0.0	0.1	0.0	0.1	0.1
Kentucky	0.2	0.1	0.1	0.1	0.1
Louisiana	0.0	0.0	-0.1	0.2	0.1
Maine	0.3	0.1	0.8	0.2	0.1
Maryland	-0.1	0.0	-0.1	0.0	0.0
Massachusetts	0.0	-0.3	-0.3	-0.1	0.1
Michigan	0.1	0.1	0.0	-0.2	-0.1
Minnesota	0.0	-0.2	-0.2	0.1	0.0
Mississippi	0.2	0.1	0.1	-0.3	-0.5
Missouri	-0.1	-0.1	0.0	0.0	0.0
Montana	0.1	0.0	0.0	0.3	-0.2
Nebraska	0.1	0.1	0.2	0.5	0.2
Nevada	-0.1	0.0	0.0	0.1	-0.1
New Hampshire	0.1	-0.2	-0.1	0.0	0.0
New Jersey	0.0	0.1	0.0	0.0	0.1
New Mexico	0.0	0.0	0.2	0.2	-0.1
New York	0.1	0.0	0.0	0.0	0.2
North Carolina	-0.1	0.1	0.0	-0.1	0.0
North Dakota	0.1	0.0	-0.1	-0.3	-0.2
Ohio	0.0	0.0	0.0	-0.2	-0.3
Oklahoma	0.0	-0.2	-0.3	-0.2	-0.4
Oregon	0.0	0.1	-0.1	-0.2	0.1
Pennsylvania	0.0	0.0	0.0	-0.1	-0.2
Rhode Island	0.0	-0.2	-0.1	-0.2	0.0
South Carolina	0.0	0.0	0.0	-0.2	-0.1
South Dakota	-0.3	-0.2	0.0	0.7	-0.1
Tennessee	0.0	0.1	0.1	0.0	-0.3
Texas	-0.1	-0.1	-0.1	0.1	-0.1
Utah	-0.1	0.2	0.1	0.1	0.0
Vermont	0.1	-0.1	0.1	0.1	0.0
Virginia	-0.2	-0.1	0.0	-0.1	0.0
Washington	0.0	0.0	0.0	-0.1	-0.1
West Virginia	0.2	0.2	0.3	0.0	0.2
Wisconsin	0.0	0.0	-0.1	0.0	-0.1
Wyoming	0.1	0.2	0.3	0.5	0.1
Maximum	0.4	0.3	0.8	0.7	0.3
Minimum	-0.3	-0.3	-0.3	-0.3	-0.6
Range	0.7	0.6	1.1	1.0	0.9

RPPs Regional price parities

Note. Percent revision and ranges are computed from unrounded data.

Acknowledgments

The authors gratefully acknowledge the contribution of Bettina H. Aten to the development of BEA's regional price parities and the preparation of results for 2022.

We gratefully acknowledge the collaboration of the U.S. Bureau of Labor Statistics (BLS). In particular, we thank the staff of the Consumer Price Index program in the Office of Prices and Living Conditions at BLS who allowed access to their microdata and collaborated on processing the results.

Footnotes

1. RPP-adjusted estimates are presented here for methods illustration and are not available on BEA's website.
2. For more information on the estimation of RPPs, see "[Regional Price Parities, Real Personal Consumption Expenditures, and Real Personal Income](#)" on BEA's website.
3. For an analysis of the relationship between PPPs and income, see "[What are PPP adjustments and why do we need them?](#)" on the Our World in Data website.
4. The price adjustment of personal income requires a small rebalancing. See "[Regional Price Parities, Real Personal Consumption Expenditures, and Real Personal Income](#)" on BEA's website.
5. The growth rate of the IRPDs will not necessarily equal the region or metropolitan area price deflators published by the Consumer Price Index (CPI) program at the U.S. Bureau of Labor Statistics. These deflators are calculated directly from extensive CPI price and expenditure microdata. The IRPDs are based on indirect comparisons of regional price levels that incorporate data from the American Community Survey, the Energy Information Administration, and BEA's PCE by state results, in addition to the CPI microdata.
6. The implicit price deflator for the United States is equal to the U.S. PCE price index, with a base of 2017.
7. For more information on the state estimates of current-dollar PCE and personal income, see [BEA's Interactive Data Application](#) and select "Regional Estimates."
8. This is the second of two improvements to the imputation. For information on the first, see Bettina Aten and Eric Figueroa, "[Revisions to Source Data for Regional Price Parities: Updates Back to 2017](#)," *Survey of Current Business* (April 20, 2023).



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