

Regional Price Parities and Real Regional Income for the United States

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Abstract The success and expansion of the International Comparison Program (ICP) has led to an increase in interest and effort on the estimation of sub-national price levels and purchasing power parities (PPPs). The ICP highlighted a difficulty that large countries such as Brazil, Russia, India and China face during the price-collection phase, namely how to obtain average prices when there are large disparities in many types of expenditure categories, such as housing prices between rural and urban settings. The fact that such disparities were in evidence led to more research on within-country PPPs, or regional price parities (RPPs). The difference between a RPP and the PPPs is simply that the former are in the same currency, while PPPs are usually converted to a reference country or currency by the exchange rate, such as the United States Dollar or the Euro. This paper describes the methodology used to estimate the RPPs within the United States, and shows their effect on measures of income adjusted to constant dollars, termed real regional incomes.

Keywords Regional price parities · Spatial price comparisons · Inter area price comparisons · Sub national PPPs · Sub national price comparisons · Multilateral price indexes · Price adjusted incomes

Disclaimer: The BEA Regional Price Parity statistics are based in part on restricted access Consumer Price Index data from the Bureau of Labor Statistics. The BEA statistics expressed herein are products of BEA and not BLS.

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1 Introduction

In April 2014, the RPPs and the price-adjusted estimates of regional personal income became official statistics of the United States Bureau of Economic Analysis (BEA), and will be published annually on a regular basis (Aten and Figueroa 2015). The estimates are based on Consumer Price Index micro data which are not publicly available and on rent data from the Census that are accessible to users.¹ In addition, the methodology adopted BEA's national personal consumption expenditure (PCE) price index as the measure of aggregate annual price change for the U.S. An aggregate price index for the U.S. is necessary in order to express the current dollar RPP-adjusted incomes in each region in constant dollars. The results shown here are for the latest year, 2013, and highlight RPPs for several expenditure categories and real per capita income growth and levels.

There have been many studies on measuring or controlling for regional price differentials within countries, see for example, the comprehensive literature review in Deaton and Dupriez (2011) and Biggeri and Laureti (Biggeri et al. 2015). Geographically large countries such as India (Deaton 2003; Deaton and Tarozzi 2005), Brazil (Deaton and Dupriez 2011, Aten 1999), Indonesia (Arndt and Sundrum 1975), the United States (Koo et al. Koo 2000), and Australia (Wingfield et al. 2005; Waschka et al. 2003) as well as geographically smaller ones like the United Kingdom (Fenwick and O'Donogue 2003), Germany (Roos 2006), the Philippines (McCarthy 2010), and Italy (Biggeri and Laureti . 2009; Biggeri et al. 2015), appear to have significant sub-national differences.

One of the major challenges both across and within countries is to obtain consistent and representative price data from multiple sources and outlets, and to match these observations with weights that reflect actual consumption patterns. There are services that are particularly difficult to compare, such as construction, housing, education, medical and government services, and the documentation and research on handling these categories of consumption is extensive, dating back to the origins of the ICP (Kravis et al. 1982).

The Consumer Price Index calculated by most national statistical offices is the most obvious source of price data, but it is often collected in a manner that makes it difficult for estimating spatial price differences. Researchers have turned to private survey companies, to scanner data and internet scraping projects, but their data are not necessarily representative of the entire country or of the average consumer. Deaton (2006), Deaton and Dupriez (2011), and more recently the World Bank (2015), have matched detailed consumer expenditure household surveys with ICP product specifications, thus tracking both the spending patterns of particular populations and their relative price levels.

Another motivation for obtaining accurate measures of regional price levels is their relevance to assessing poverty levels and income inequality indicators within countries. The former has a long history in the U.S., beginning with landmark study in the 1960s (Orshansky 1969). More recently, following a report by the National Academy Panel on Poverty and Family Assistance (Citro and Kalton 2000), the Census Bureau began publishing research and estimates on alternative poverty measures that take into account geographic price differences (Short and O'Hara 2008, Renwick 2011, 2015).

The BEA, in a joint project with the Bureau of Labor Statistics (BLS), first estimated regional price parities for consumption goods and services for 38 metropolitan and urban areas of the U.S. for 2003 and 2004 (Aten 2005, 2006). These areas, for which BLS

¹ The CPI microdata are available to us through an interagency agreement, between the Bureau of Labor Statistics (BLS) and BEA, while the rent data are also microdata but closely match those from the PUMS (Public Use Microdata Sample) of the Census Bureau.

produces the Consumer Price Index (CPI), represent about 87 % of the total population. The method was expanded to cover the remaining nonmetropolitan portions of each state. Estimates for 2005 and 2006 were reported in the Survey of Current Business in November 2008 (Aten 2008, Aten and D'Souza 2008). Experimental estimates for 2007 incorporate the multi-year American Community Survey (ACS) from the Census Bureau, as do official estimates for 2008 forward.²

The methods and results differ from versions prior to 2014 because they include a two-stage, rolling average estimation process. The first stage estimates annual multilateral price level indexes for CPI areas³ and for several consumption expenditure classes such as apparel, food and transportation. In the second stage, the price levels and expenditure weights⁴ are allocated from CPI areas to all counties in the United States.⁵ They are then recombined for regions, such as states and metropolitan areas, and merged with data on rents from the Census Bureau's American Community Survey (ACS). The ACS provides a broader geographic coverage than the CPI areas, including county-level data, thus allowing us to augment the allocated CPI price levels with observed housing observations.

The final RPPs are obtained by stacking the 5 years of the first-stage results, plus the annual rent indexes, and calculating the multilateral aggregate price index for all goods and services and rents. For example, the 2010 RPP is a 5-year average of the 2008–2012 CPI-derived price indexes for goods and services excepting rents, plus the 2010 rent indexes from the ACS.

The following sections describe in more detail the use of the price levels 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.

2 Price Levels for CPI Areas

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), which may be further divided into Clusters. The item strata can be combined into nine expenditure groups: apparel, education, food, housing, medical, recreation, rents, transportation and other goods and services.⁶

Because the CPI was not designed to measure geographic price level differences, items with identical characteristics are not always priced in all areas. Therefore, for the ELIs in the 75 highest item strata (accounting for roughly 85 percent of expenditure weights), we

² Publications describing these results may be found at www.bea.gov/research/topics/regional.htm.

³ The 38 CPI index areas are designed to represent the U.S. urban and metropolitan population. Of the 38 areas, 31 represent large metropolitan areas, 4 represent small metropolitan regions, and 3 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).

⁴ Expenditure weights used in the CPI are known as cost weights, and are derived from BLS Consumer Expenditure (CE) survey data. See the "Consumer Price Index" in the *BLS Handbook of Methods*, Chapter 17 at www.bls.gov.

⁵ For a description of input data and methods used to estimate RPP expenditure weights, see Figueroa, Aten and Martin (2014).

⁶ See the "Consumer Price Index," in the *BLS Handbook of Methods*, chapter 17 at www.bls.gov.

estimate hedonic regressions which take into account the variation in the characteristics of the sampled items.

For the “Women’s Tops Excluding Active and Outerwear” Cluster, for example, we use a hedonic price model to adjust for the type of clothing (jacket, sweater or blouse), the fiber content, the length of the sleeves, the closure type, the size range, the brand category (exclusive/luxury, national or private), country of origin, and the type of outlet where it was sold. An example of an item-specific hedonic regression may be found in Aten (2006).

For the remaining item strata, we use a shortcut approach consisting of a weighted regression on areas and ELIs (and Clusters when available) as independent variables. This regression is a modified version of the weighted Country-Product-Dummy (CPD-W) approach as originally described in Summers (1973), and more recently in Rao (2004), Sergeev (2004), and Diewert (2005). Overall results do not differ greatly whether detailed hedonic regressions are run on all item strata, or on only the top 75 in combination with this shortcut approach (Aten 2006).

After the ELI price levels are estimated, they are aggregated to yield item strata price levels, again using the CPD-W approach, with weights corresponding to the importance of the ELIs within the item strata. Both the ELI and the item strata price levels undergo an outlier checking process described in detail in Aten et al. (2011). It is modeled after the Quaranta tables first used in the OECD-Eurostat basic heading level price comparisons.⁷ We flag observations that are (1) either very large or small relative to the mean in that area and ELI; (2) that are either large or small relative to the variance of the ELI observations; or (3) are large or small once they have been adjusted for the relative price level of the area. It is an iterative process that looks at the raw price data as well as the relative prices after the hedonic adjustment.

The outcome of this process—hedonic and CPD-W regressions - is a matrix of 38 by 200-plus area-item price levels, with the weighted geometric average of the 38 areas in each item strata indexed to one. These are price *relatives*, not prices, for each area-item combination. Any of the 38 areas could be the numeraire, but their geometric average provides a more neutral interpretation.

In order to obtain overall price and quantity indexes that combine the 38 by 200-plus area-item price levels with their corresponding expenditure weights, there are several aggregation methods that could be used. The most well-known are the EKS-Törnqvist and Fisher indexes, the CPD-W approach, the GAIA index and the Geary index. The advantages and disadvantages of these methods and their corresponding statistical and economic properties have been thoroughly reviewed elsewhere, see Kravis et al. (1982), Diewert (1999) and Balk (2009), for example. Aten and Marshall (2010) have shown that the Geary RPPs for the 38 BLS index areas do not deviate significantly from the other possible indexes.⁸

The Geary indexes, in addition to being base-invariant and transitive, are additive, or matrix consistent. The latter means that the values for any item will be directly comparable between areas, and the values for any area will be directly comparable across items. In other words, an overall index for Food can be obtained directly from the values for lesser aggregations within Food, such as Meat, Vegetables and Dairy, and so forth. For the RPPs,

⁷ The process is modeled after the Quaranta method used by the Organisation for Economic Co-operations and Development and Eurostat (OECD 2012), and the International Comparison Program of the World Bank (World Bank 2015).

⁸ The Geary formula is solved simultaneously for the area RPPs and the expenditure class price levels (notation and formulas follow Deaton and Heston 2010).

we aggregate the 200-plus items to 16 expenditure classes, consisting of Food, Apparel, Transport, Housing, Education, Recreation, Medical, Other and Rents. Each of the classes is broken down into Services and Goods, with the exception of Apparel, with only a Goods component, and Rents, with only a Services component.

The Geary multilateral price level index, P_{Geary} , is given by:

$$P_{\text{Geary}}^c = \frac{\sum_{n=1}^N (pq)_n^c}{\sum_{n=1}^N \pi_n q_n^c}$$

$$\pi_n = \sum_{c=1}^M \frac{(pq)_n^c}{P_{\text{Geary}}^c \sum_{d=1}^M q_n^d}$$

where: p is the relative price of the item stratum or 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 the BLS areas, which take a value of 1 through $M = 38$; n is the item stratum, which takes a value of 1 through $N = 200 +$.

In this first stage, we estimate a P_{Geary} , for each of the 38 areas and for each of the 16 expenditure classes.⁹ In the next stage, we combine these price level indexes with expenditure weights, including weights that represent rural regions not in the CPI.

3 Regional Price Parities for States and Metropolitan Areas

The second stage consists of expanding the Geary indexes from the geography of the 38 BLS areas to other more commonly used geographies, such as states and metropolitan areas. It is also here that the 16 price levels for the expenditure classes are augmented by more detailed Rent price levels and expenditure data from the Census Bureau, and where an overall index combining all 16 classes into one 'All Item' RPP index is calculated.

The process 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, therefore 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.¹⁰

Expenditure weights in the second stage include CPI data for rural regions, and thus in combination with the 38 urban areas, cover all U.S. counties.¹¹ Weights are allocated from each CPI area and rural region to the component counties in proportion to household

⁹ We can also estimate an overall P_{Geary} for each of the 38 areas, but only the more disaggregate indexes are used in the second stage.

¹⁰ 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 area for the Northeast.

¹¹ They are derived from the bi-annual Consumer Expenditure survey (CE) but are modified to be consistent with the CPI, and are called Cost Weights.

income.¹² The county-level allocations undergo two adjustments. First, rent weights are replaced with directly observed rent expenditures from the 5-year ACS file *plus* imputed owner-equivalent rent expenditures. The latter are obtained as follows:

1. The ratios of monthly tenant rents to owner-equivalent rents in the BLS CPI housing file are estimated for several types of housing units, from studio apartments to detached houses with three or more bedrooms. The components of these ratios, that is, tenant rents and owner-equivalent rents for each housing type, are the weighted geometric means of all the observations in the CPI.
2. The ratios are applied to the observed unit rents in the ACS, resulting in an estimated monthly owner-equivalent rent value for each housing type, by county;^{13,14}
3. This estimated owner-equivalent rent value is multiplied by twelve and by the number of owner-occupied housing units in each type, resulting in an annual estimate of owner-occupied housing expenditures, by county.

Note that the ratio of tenant rents to owner-equivalent rents is across all BLS sampling areas, that is, there is only one vector of ratios for each housing type. The same ratio is applied to different geographies in the ACS file, with only the distribution of rents and number of units varying across geographies.¹⁵ Total expenditures by tenants and owners are equal to the sum of the observed annual rent expenditures and the estimated owner-occupied expenditures from step 3 above.

The second adjustment to the county level weights is to control the national shares of the 16 expenditure classes to BEA's personal consumption expenditure shares. This yields weights consistent with BEA's national accounts.¹⁶ The adjustment shifts the distribution of weights across expenditure classes, notably reducing the share of rents expenditures from total consumption in the United States from 30.2 to 20.6 %. Conversely, the shares of Food, Recreation, Education and Apparel and Other goods and services are higher in BEA's national accounts.

Once the price levels and expenditure weights have been obtained for each class, year and county, we stack the 5 years and then obtain their weighted geometric means.¹⁷ Rents are treated separately: instead of using the BLS-CPI rents, we insert a new set of Owner Equivalent Rent expenditures, described above, as well as Rent price levels, described below.

¹² The allocation uses county-level ACS Money Income. 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 noncash benefits. For more information, see www.census.gov. In past papers, population was used to distribute the weights; for a comparison, see Figueroa et al. (2014).

¹³ Unit rents are the sum of rent expenditures divided by the number of units of each housing type for each area.

¹⁴ In earlier work (Aten 2005, 2006), we imputed BLS owner-equivalent rent price levels to other geographies. Here, we only use the BLS data to obtain owner-equivalent rent expenditures; we do not impute owner-equivalent rent price levels.

¹⁵ For more information on how the RPP program estimates expenditures on owner-occupied rents, see Figueroa et al. (2014).

¹⁶ The adjustment is based on BLS research providing PCE-valued weights for CPI item strata (Blair 2012).

¹⁷ The weighted geometric means are the least squares marginal means across the 5 years, obtained using a weighted CPD with a dummy variable for the year.

Rent price levels are estimated directly from tenant rent observations in the ACS: annually for states, and across 3 years for metropolitan areas.¹⁸ No imputation of owner-occupied rents is used in the price levels, instead we use rent price levels for both renters and owners.^{19,20} The rent price levels are quality-adjusted estimates using a hedonic model that controls for basic unit characteristics such as the type of structure, the number of bedrooms, the total number of rooms, when the structure was built, whether it resides in an urban or rural location, and if utilities are included in the monthly rent.²¹ Additional research comparing rent price levels using the ACS and CPI Housing surveys is available in Martin et al. (2011).

The second multilateral aggregation uses the 5-year weighted geometric mean of the 15 expenditure classes derived from the BLS CPI, together with the 1-year state level rents and 3-year metropolitan area rents from the Census ACS to estimate the final all items RPPs. This implies that for the reference year 2011, for example, final state-level RPPs are composed of rent price levels in 2011 plus an average of the price levels for goods and services other than rents between 2009 and 2013. Table 1 below illustrates the rolling average combinations of CPI and ACS data.

The second stage Geary multilateral is analogous to the first stage, but instead of $M = 38$ areas and $N = 200$ -plus item strata as inputs and Geary price indexes for 16 expenditure classes as outputs, the inputs are 51 states or 383 metropolitan areas, and $N = 16$ expenditure classes. The resulting P_{Geary} is a single ‘All Items’ price index for each state and each metropolitan area. However, because of the additive properties of the Geary, we are able to obtain the sub-aggregates of the 16 expenditure classes very easily, and do so for several groups: Goods, Services, Rents, as well as eight subgroups—Food, Apparel, Transport, Housing (excluding Rents), Education, Recreation, Medical and all Other goods and services.

4 Using RPPs to Estimate Real Personal Income

An important application of the RPPs is to control for price level differences across regions when measuring economic activity such as income levels. The price level differences measured by the RPPs are specific to one point in time. At BEA, we make an additional adjustment to convert the regional current dollar values to constant values, resulting in price-adjusted regional incomes at chained dollars, which we call “real” personal income.²²

¹⁸ Beginning in November 2015, the three-year MSA files will no longer be available from the Census.

¹⁹ 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 et al. 2011, 2012), only observed 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.

²⁰ ACS data for 2012 did not incorporate a revision made by BEA to its MSA definitions (see Survey of Current Business, “Comprehensive Revision of Local Area Personal Income”, December 2013, page 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. These revisions have now been included in all the estimates going back to 2008.

²¹ The rent observations are the “Contract Rents” in the ACS.

²² Personal income is defined as the income received by all persons from all sources. It is the sum of net earnings by place of residence, property income, and personal current transfer receipts. This article uses personal income estimates released by BEA’s Regional Income Division on September 30, 2014. For more information, see www.bea.gov/regional.

Table 1 Reference years and source data

	2013 Initial	2012 Revised	2011 Final	2010 Final	2009 Final	2008 Final
BLS—CPI		2009–2013		2008–2012	2007–2010	2006–2009
ACS-rents						
MSAs	2011–2013	2010–2012	2009–2011	2008–2010	2007–2009	2006–2008
States	2013	2012	2011	2010	2009	2008

Real personal income in chained (2009) dollars for a region is the current-dollar personal income divided by its RPP for a given year (equal to current dollar income in regional prices), divided by the U.S. PCE price index, which converts the current dollar value to 2009 chained dollars. For the U.S., the nominal and real personal income totals will equal each other in 2009, while the regional nominal and real personal incomes will differ only by the RPP of each region.

An Implicit Regional Price Deflator (IRPD) is derived as the product of the RPP times the national PCE price index. It is equal to personal income divided by real personal income. The growth rate of the IRPD is the change in RPPs between 2 years times the change in the U.S. PCE price index (see Box 1).

5 Selected Results and Conclusions

The results discussed below are constrained to the most recent years for which we have estimates, 2012 and 2013, and to the 51 states.²³ Additional geographies (Metropolitan Statistical Areas or MSAs, and the non-metropolitan and metropolitan portions of states) and additional years (2008–2011) are available.²⁴

5.1 Regional Price Parities

Table 2 shows the overall or All Items RPPs for 2013 for each state. The All Items RPP is subdivided into three groupings: Goods, Rents, and Services other than Rents, followed by eight additional subgroups: Food, Apparel, Transport, Housing (exclusive of Rents), Education, Recreation, Medical, and Other goods and services.

The overall range between lowest and highest RPP is 30.9 between Mississippi (86.8) and the District of Columbia (117.7). Hawaii (116.2) and New York (115.3) are the next highest RPPs. The range for Rents is much wider: 95.8 between Hawaii (158.7) and Arkansas (62.9). With over 20 % of the average expenditures, Rents have the greatest impact on the overall RPP, but Services, excluding Rents, also has a relatively wide spread of 24.8, between South Dakota (91.1) and New Jersey (115.9). Medical and Education also have a large spread, which may reflect the variance in some of the comparison-resistant services, such as Hospital Services and Education Tuition and Fees.

Some of the predominantly rural states, or states with just one or two larger metropolitan areas, such as Alabama, Arkansas, Georgia, Idaho, Indiana, Iowa, Kansas, Kentucky, Louisiana, Missouri, Montana, Nebraska, New Mexico, Ohio, Oklahoma, South

²³ 50 states and the District of Columbia (hereafter referred to as “states”).

²⁴ www.bea.gov/regional under Data: Real Personal Income and RPPs.

Box 1 Implicit price growth rates

The RPP indexes express a region's average price relative to the U.S. average, that is, $RPP_{i,t} = (P_i/P_{US})_t$ where i is the region and t is the time period^a. The implicit price growth or regional inflation may be calculated as: $(P_{i,t}/P_{i,t-1}) = (RPP_{i,t}/RPP_{i,t-1}) \times (P_{US,t}/P_{US,t-1})$, where the US price change is measured by the national PCE price index

^a The RPPs are transitive and base-invariant, meaning any other region may be used as the base. The implicit price growth would then be calculated relative to the price change in that base region and would differ by a constant

Carolina, Tennessee, Wyoming and West Virginia have low rent price levels, and thus also relatively low All Items RPPs, and relatively higher RPPs for Goods compared to Services.

However, the RPPs for the subgroups or RPPs with the exception of Rents are five-year averages of CPI price levels. Thus year to year differences during this five-year period (2009–2013), will only reflect shifts in the expenditure weights, and not actual price level differences of goods and services other than Rents.²⁵ Each of the subgroups corresponds to an expenditure class defined by BLS, and reflects prices and weights from a survey sample that distinguishes only 38 metropolitan and urban areas in the CPI. They are then allocated to counties and recombined to states and MSAs (see Sects. 2, 3). The components in each expenditure group consist of a market basket of goods and services and are described in the CPI Handbook of Methods.²⁶

Table 3 summarizes the RPPs by dividing the 50 states and the District of Columbia, into thirds based on a ranking of their All Items RPPs. Each tercile contains 17 states, and the RPPs shown in this table are the unweighted geometric means of their 2013 RPPs.

The first row of Table 3 shows the breakdown of the mean RPPs for the top 17 states, and these are all above 100, with mean Rents RPPs reaching 122.9, much higher than the All Items RPP of 107.2. This is not true of the second and third rows, showing the middle and bottom terciles, where the Rents RPPs are lower than the All Items RPPs. If we look at the ratio of the Goods RPPs to Other Services RPPs, it is less than one for the top tercile and above one for the other two groups, a pattern that is also found in the international price comparisons literature: the price level of services tends to move in the same direction as that of rents, whereas goods will generally become relatively less expensive as the overall price level increases.

5.2 Total Personal Income

Table 4 shows the impact of applying RPPs to current dollar nominal incomes for the five highest and five lowest states in terms of total current dollar incomes.²⁷ The first three columns of Table 4 are the nominal personal incomes for 2012 and 2013 in millions of current dollars, and the percent change. The middle columns are the real incomes in

²⁵ The main reason for using five-year averages of CPI price levels is for consistency and robustness of the estimates. In some cases, the number of observations for which we can obtain overlap across characteristics and item definition is small. Pooling the data was found to be an effective way to control for sparseness in the geographic coverage for the purposes of the RPPs (see Aten and Marshall 2010).

²⁶ See FAQs, in the Handbook of Methods, http://www.bls.gov/cpi/cpifaq.htm#Question_6.

²⁷ The full tables are available on the web at www.bea.gov. See box titled “Data Availability” on how to access the data.

Table 2 Regional price parities by State, 2013

	All items			Regional price parities							
	Goods	Services (exc. rents)	Rents	Food	Apparel transport	Transport	Housing (exc. rents)	Education	Recreation	Other	Medical
United States	100	99.4	100.1	99.9	100.0	99.6	99.4	100.3	99.5	99.9	99.3
Alabama	87.7	96.4	93.4	95.5	93.6	97.3	92.5	91.7	99.1	94.8	92.8
Alaska	106.0	101.9	98.2	138.8	91.8	101.5	96.1	93.1	96.8	102.7	120.5
Arizona	97.1	99.5	97.9	91.5	102.8	99.7	99.5	87.8	100.6	101.1	108.0
Arkansas	87.5	95.3	92.9	94.4	90.8	98.4	91.1	90.0	98.6	94.0	91.3
California	112.3	103.0	105.7	104.7	107.5	104.0	109.1	100.5	99.7	102.2	107.4
Colorado	102.2	101.4	99.4	98.9	102.5	97.3	94.4	105.1	103.1	95.3	124.1
Connecticut	108.5	104.3	109.0	106.1	105.9	105.7	109.2	108.4	106.7	116.1	93.4
Delaware	101.4	101.4	103.8	102.6	95.7	102.5	108.4	100.6	105.0	100.0	99.6
District of Columbia	117.7	107.9	110.2	113.7	111.7	101.4	108.4	121.5	113.0	103.6	102.6
Florida	98.8	98.2	96.2	99.8	96.1	101.4	94.8	89.5	98.6	95.1	94.0
Georgia	91.9	96.8	93.9	95.6	100.8	95.3	93.7	102.2	100.8	91.2	84.8
Hawaii	116.2	108.3	102.8	111.0	115.9	103.2	107.4	98.9	96.3	108.1	103.4
Idaho	92.8	98.5	96.4	97.0	93.0	98.6	95.4	92.2	96.0	96.6	117.4
Illinois	101.0	101.4	100.8	100.3	108.4	95.3	96.9	108.9	102.7	100.7	108.8
Indiana	91.4	97.0	94.2	95.4	95.3	93.9	94.3	99.8	95.1	96.0	100.8
Iowa	90.3	94.5	91.6	93.9	89.6	93.1	91.1	95.7	91.3	95.7	96.6
Kansas	90.8	95.5	92.7	94.1	94.3	92.2	92.7	97.4	91.6	97.6	100.0
Kentucky	89.1	94.9	92.9	94.7	90.1	97.9	90.8	90.1	97.7	93.7	91.2
Louisiana	91.2	96.6	93.5	95.7	94.1	97.1	92.8	92.0	99.2	95.0	93.1
Maine	97.7	98.1	97.4	98.6	88.9	97.2	101.0	96.3	96.6	114.6	85.4
Maryland	110.9	104.0	109.2	109.6	103.7	103.5	104.3	112.9	107.1	110.1	100.7
Massachusetts	107.3	99.1	108.7	103.4	98.2	99.3	106.0	110.6	102.5	114.7	96.5
Michigan	94.2	98.0	97.0	95.6	97.2	98.4	99.6	100.0	98.4	97.1	93.8

Table 2 continued

	All items	Goods	Services (exc. rents)	Regional price parities								
				Rents	Food	Apparel transport	Transport	Housing (exc. rents)	Education	Recreation	Other	Medical
	97.6	99.4	96.6	95.6	98.7	96.4	95.7	92.7	102.1	96.5	104.1	107.8
Minnesota	86.8	94.7	92.6	63.8	93.8	89.2	99.1	90.2	89.0	98.2	93.7	90.5
Mississippi	89.2	94.1	91.3	75.4	94.9	95.4	90.7	89.7	96.9	90.5	94.9	93.1
Missouri	94.4	98.7	95.0	83.3	96.1	93.1	96.9	92.3	92.8	96.6	97.3	121.6
Montana	90.5	95.2	92.1	75.9	94.1	90.8	93.3	92.1	96.8	92.2	95.5	97.7
Nebraska	98.2	97.6	99.7	96.9	99.6	92.7	102.9	103.6	90.5	94.2	94.2	105.1
Nevada	105.9	98.8	105.6	122.7	102.2	95.8	98.6	104.5	107.0	100.7	114.8	93.3
New Hampshire	114.5	102.2	115.9	135.4	104.6	98.4	107.2	117.2	125.3	108.2	106.3	111.9
New Jersey	95.0	98.0	98.5	83.4	98.5	92.8	101.2	100.3	91.3	95.0	95.3	110.2
New Mexico	115.3	107.7	112.5	135.8	108.7	111.5	108.6	115.1	111.3	109.5	115.1	99.8
New York	91.7	96.5	93.5	79.6	95.5	93.7	97.3	92.6	91.8	99.1	94.9	92.9
North Carolina	91.4	94.3	91.4	82.6	93.8	89.2	93.1	90.8	95.4	91.1	95.8	96.2
North Dakota	89.6	95.5	91.9	73.8	95.3	93.2	92.3	91.9	95.1	93.4	96.0	95.3
Ohio	89.9	95.9	93.2	70.7	95.0	92.4	97.8	91.9	91.0	98.9	94.4	92.1
Oklahoma	98.7	98.6	98.5	99.5	99.3	104.7	96.2	95.3	101.2	97.6	94.6	107.4
Oregon	98.6	99.6	101.6	90.7	102.7	93.3	99.2	105.3	101.1	98.7	107.6	90.9
Pennsylvania	98.1	98.0	97.1	100.1	98.4	88.6	97.2	100.6	96.0	96.5	115.2	85.0
Rhode Island	90.5	96.7	93.6	75.5	95.7	94.2	97.0	92.9	92.1	99.2	95.1	93.2
South Carolina	87.6	94.1	91.1	66.6	93.7	88.7	92.9	90.4	94.8	90.7	95.9	95.8
South Dakota	90.6	96.4	93.4	75.1	95.4	93.5	97.3	92.5	91.6	99.1	94.8	92.7
Tennessee	96.7	97.5	99.2	90.3	96.4	103.7	100.0	98.5	99.4	97.7	93.7	98.5
Texas	97.2	97.8	99.0	92.9	98.9	92.8	101.8	101.5	90.9	94.7	94.8	108.3
Utah	100.2	98.0	97.0	113.2	98.4	88.6	97.2	100.8	95.8	96.4	114.6	85.0
Vermont	103.0	100.4	100.4	113.8	102.3	100.8	99.0	98.0	104.7	104.2	98.1	95.9
Virginia												

Table 2 continued

	All items	Goods	Services (exc. rents)	Regional price parities								
				Rents	Food	Apparel transport	Transport	Housing (exc. rents)	Education	Recreation	Other	Medical
Washington	103.2	102.9	99.9	110.9	102.7	106.4	102.2	98.8	96.4	101.6	96.9	110.2
West Virginia	88.4	95.5	94.1	63.0	95.1	90.8	99.3	91.3	92.1	99.1	94.2	91.2
Wisconsin	92.9	95.8	92.8	86.2	93.8	94.7	94.5	91.5	94.5	94.7	97.5	98.0
Wyoming	95.8	98.6	95.4	89.7	96.4	93.1	97.4	93.3	92.6	96.5	97.0	120.2
Maximum	117.7	108.3	115.9	158.7	113.7	115.9	108.6	117.2	125.3	113.0	116.1	124.1
Minimum	86.8	94.1	91.1	62.9	93.7	88.6	90.7	89.7	87.8	90.5	91.2	84.8
Range	30.9	14.2	24.8	95.8	20.0	27.3	17.8	27.5	37.5	22.5	24.9	39.3

Source: U.S. Bureau of Economic Analysis

Table 3 Summary of state RPPs 2013

Tercile	2013 RPPs				
	All items	Goods	Services (exc. rents)	Rents	Ratio of goods to services
1—Top	107.2	102.4	104.3	122.9	0.98
2—Middle	95.8	98.0	97.0	88.8	1.01
3—Bottom	89.5	95.4	92.7	71.7	1.03
United States	100.0	99.4	100.1	101.1	0.99

RPPs shown here are the unweighted geometric means of the states in each tercile

constant 2009 dollars, together with the corresponding real percent growth for each state. The implicit regional price deflators and growth are shown in the next columns, followed by the RPPs in each year. The U.S. price index rose 1.2 % between 2012 and 2013, while total personal incomes grew by 0.8 % in real terms and 2.0 % in nominal terms for the United States.

California, Texas, New York, Florida and Illinois have the largest total incomes in both current dollars and in real, price adjusted 2009 dollars. The smallest total incomes in current dollars are in Vermont, Wyoming, Alaska, North and South Dakota, but in real terms, Delaware and the District of Columbia supplant the Dakotas, in large part because the RPPs for Delaware and the District of Columbia are above 100 (101.3 and 117.6 in 2013 respectively). In contrast, South Dakota has an RPP of 87.6 and North Dakota 91.3.

The relationship between real income growth and price growth can be seen in Fig. 1, where real personal income growth is plotted on the vertical axis and the implicit price growth is on the horizontal axis. There is a downward trend, as higher price growth is correlated with lower real personal income growth. The axes are centered on the U.S. price growth of 1.2 % and real income growth of 0.8 %.

States with a high implicit price growth tend to have a low or negative real personal income growth. North Dakota is a prime example, a rural state which has had a surge in rents following a boom in natural gas exploration. Although the Rents RPP is still lower (91.4) in North Dakota than the U.S. average, it has seen a high increase compared to its neighbors, such as South Dakota where Rents RPPs are at 66.6. This means that a decline in nominal income translates to a much larger decline in real incomes. North Dakota has also seen a large population growth, and thus the decline in per capita terms is even greater.

The states on the upper right quadrant of Fig. 1, shown as red squares, have above average real income growth and relatively high implicit price growth rates. They are Florida, Nebraska, Georgia, Washington, Oregon, Utah, Texas, Kansas and Colorado.

North Dakota, on the lower right quadrant, has experienced a large decline in real income growth ($< -4\%$ between 2012 and 2013), in part because of its high price growth. The decline is greater than in other areas because its nominal income also declined in 2013.

5.3 Per Capita Personal Income

Table 5 shows the states with the five highest and lowest nominal and real per capita personal incomes. The range of RPPs means that the range of current dollar incomes is reduced when adjusted by the RPPs. DC has the highest nominal *per capita* income at US\$ 75,329 but it drops to US\$ 59,688 in real (2009 dollar) terms. Mississippi has a *per capita*

Table 4 Real personal income and implicit regional price deflators by State, 2012 and 2013

	Personal Income millions of current dollars			Real personal income millions of chained (2009) Dollars			Implicit regional price deflators (2009 = 100)		Regional price parities (US = 100)	
	2012	2013	%	2012	2013	%	2012	2013	2012	2013
United States	1,38,73,161	1,41,51,427	2	1,30,80,227	1,31,84,554	0.8	106.1	107.3	100	100
<i>Highest personal income</i>										
California	18,05,194	18,56,614	2.8	15,08,765	15,42,356	2.2	119.6	120.4	112.8	112.2
Texas	11,27,675	11,60,079	2.9	11,04,217	11,18,896	1.3	102.1	103.7	96.3	96.6
New York	10,59,053	10,70,236	1.1	8,68,645	8,65,578	-0.4	121.9	123.6	115	115.2
Florida	7,92,950	8,11,377	2.3	7,57,474	7,65,662	1.1	104.7	106	98.7	98.7
Illinois	5,92,057	6,05,201	2.2	5,54,793	5,58,626	0.7	106.7	108.3	100.6	100.9
<i>Lowest personal income</i>										
South Dakota	38,096	38,897	2.1	40,561	41,390	2	93.9	94	88.6	87.6
North Dakota	39,493	38,472	2.6	41,074	39,252	-4.4	96.2	98	90.7	91.3
Alaska	36,447	36,867	1.2	32,374	32,430	0.2	112.6	113.7	106.1	105.9
Wyoming	30,255	30,779	1.7	29,729	29,955	0.8	101.8	102.8	96	95.7
Vermont	27,819	28,501	2.5	26,099	26,530	1.6	106.6	107.4	100.5	100.1
<i>Highest real personal income</i>										
California	18,05,194	18,56,614	2.8	15,08,765	15,42,356	2.2	119.6	120.4	112.8	112.2
Texas	11,27,675	11,60,079	2.9	11,04,217	11,18,896	1.3	102.1	103.7	96.3	96.6
New York	10,59,053	10,70,236	1.1	8,68,645	8,65,578	-0.4	121.9	123.6	115	115.2
Florida	7,92,950	8,11,377	2.3	7,57,474	7,65,662	1.1	104.7	106	98.7	98.7
Illinois	5,92,057	6,05,201	2.2	5,54,793	5,58,626	0.7	106.7	108.3	100.6	100.9
<i>Lowest real personal income</i>										
District of Columbia	48,109	48,697	1.2	38,489	38,585	0.3	125	126.2	117.8	117.6
Delaware	40,379	41,487	2.7	37,503	38,143	1.7	107.7	108.8	101.5	101.3
Alaska	36,447	36,867	1.2	32,374	32,430	0.2	112.6	113.7	106.1	105.9

Table 4 continued

	Personal Income millions of current dollars		Real personal income millions of chained (2009) Dollars		Implicit regional price deflators (2009 = 100)		Regional price parities (US = 100)	
	2012	2013	%	2012	2013	%	2012	2013
Wyoming	30,255	30,779	1.7	29,729	29,955	0.8	101.8	102.8
Vermont	27,819	28,501	2.5	26,099	26,530	1.6	106.6	107.4
							96	95.7
							100.5	100.1

Source: U.S. Bureau of Economic Analysis

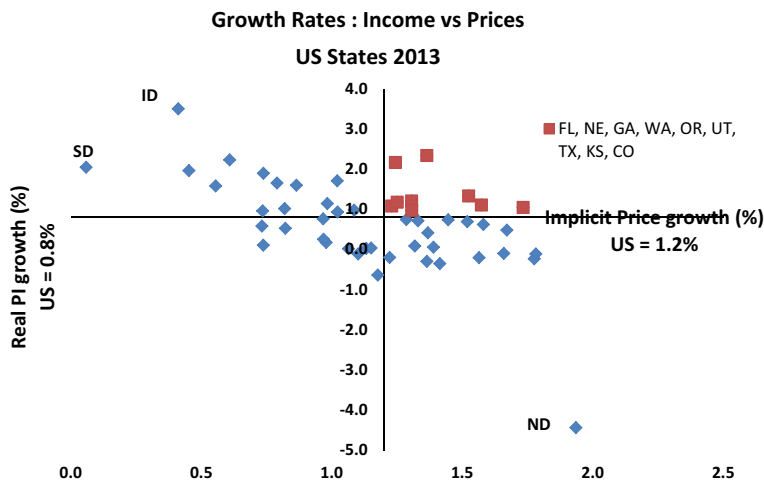


Fig. 1 State total real personal income growth and implicit price growth 2013

nominal income of US\$ 33,913, the lowest of the states, but it increases to US\$ 36,441, and is no longer among the lowest five states in rank.

New Jersey and New York are among the five highest in nominal terms, but are replaced by North Dakota and Wyoming in real per capita terms. Conversely, South Carolina, West Virginia and Mississippi are among the five lowest per capita incomes in nominal dollars, but when converted to real terms, Hawaii, Arizona and Utah take their place.

Figure 2 shows the relationship between the RPPs and *per capita* personal incomes for 2013. The RPPs are plotted on the vertical axis against the real *per capita* personal incomes. The RPPs are in natural logs to more easily interpret the regression coefficients on the trend lines (the U.S. with an RPP = 100 is also plotted on the horizontal axis).²⁸

6 Concluding Remarks

The RPPs currently reflect differences in the price levels of consumer goods and services. They are constrained by the price data available from the CPI survey conducted by the BLS and by the rent data in the ACS from the Census Bureau. A major constraint of the CPI survey is the sampling design that is limited to 38 urban and metropolitan index areas and specifically targeting time-to-time consistency rather than spatial consistency. Thus the robustness of the RPPs would benefit from a place-to-place survey of the goods and services sampled by the CPI, particularly for hard to measure items such as education, food and medical services, and in geographic areas that are sparsely populated and less well-represented in the national surveys, such as rural areas. Augmenting the price observations, possibly by web-scraping and using third-party sources of information might also provide additional consistency checks on the RPPs.

²⁸ The leftward shift along the horizontal axis is equal to the difference between U.S. nominal (\$44,765) and real (2009 dollars, \$41,706) per capita totals for 2013, and reflects the 7.3 % increase in the U.S. PCE price index between 2013 and 2009.

Table 5 Real per capita personal income by state, 2012 and 2013

	Per capita personal income current Dollars			Real per capita personal income chained (2009) Dollars			Regional price parities (US = 100)	
	2012	2013	%	2012	2013	%	2012	2013
United States	44,200	44,765	1.3	41,674	41,706	0.1	100	100
<i>Highest per capita personal income</i>								
District of Columbia	75,950	75,329	-0.8	60,763	59,688	-1.8	117.8	117.6
Connecticut	60,223	60,658	0.7	52,135	52,126	0	108.9	108.4
Massachusetts	56,713	57,248	0.9	50,156	49,744	-0.8	106.6	107.2
New Jersey	54,932	55,386	0.8	45,259	45,113	-0.3	114.4	114.4
New York	54,099	54,462	0.7	44,373	44,047	-0.7	115	115.2
<i>Lowest per capita personal income</i>								
Idaho	35,142	36,146	2.9	35,476	36,340	2.4	93.4	92.7
New Mexico	35,805	35,965	0.4	35,550	35,293	-0.7	95	94.9
South Carolina	35,347	35,831	1.4	36,756	36,940	0.5	90.7	90.4
West Virginia	35,140	35,533	1.1	37,467	37,473	0	88.4	88.3
Mississippi	33,446	33,913	1.4	36,536	36,441	-0.3	86.3	86.7
<i>Highest real per capita personal income</i>								
District of Columbia	75,950	75,329	-0.8	60,763	59,688	-1.8	117.8	117.6
North Dakota	56,310	53,182	-5.6	58,564	54,261	-7.3	90.7	91.3
Connecticut	60,223	60,658	0.7	52,135	52,126	0	108.9	108.4
Wyoming	52,469	52,826	0.7	51,557	51,410	-0.3	96	95.7
Massachusetts	56,713	57,248	0.9	50,156	49,744	-0.8	106.6	107.2
<i>Lowest real per capita personal income</i>								
Idaho	35,142	36,146	2.9	35,476	36,340	2.4	93.4	92.7
Hawaii	44,578	45,204	1.4	35,927	36,267	0.9	117	116.1
Arizona	36,624	36,983	1	35,388	35,537	0.4	97.6	97
New Mexico	35,805	35,965	0.4	35,550	35,293	-0.7	95	94.9
Utah	35,891	36,640	2.1	34,892	35,141	0.7	97	97.1

U.S. Bureau of Economic Analysis

The RPPs reflect the common perception of the relatively high price level in states with large metropolitan areas, such as California, Illinois, Maryland, Massachusetts, New Jersey, New York, Virginia and the District of Columbia. The smaller states in the east and west coasts also have higher rents, for example, New Hampshire, Vermont, as well as Hawaii and Alaska (small only in terms of population, not size). Hawaii and Alaska additionally have Goods price levels which are above the U.S. average, due to their geographical isolation and the added transportation and distribution costs. In the case of Illinois, although rents in Chicago are high, there are many rural counties where the rents are lower, and this is reflected in the Goods RPP being slightly higher than the Services RPP. As shown in Table 3, Fig. 2, the relative price level of Services tends to increase with increasing incomes and with higher Rents, and mirrors the tendency in international comparisons of real incomes and PPPs.

An important extension of this work is to explore the development of RPPs that reflect more than consumption goods and services, such as investment and government price

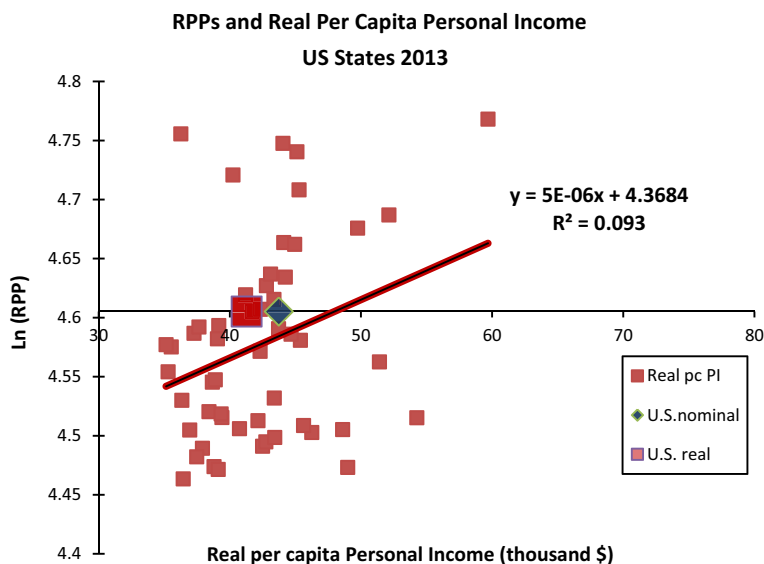


Fig. 2 State RPPs and real per capita personal income

differences. In international comparisons, the price level of consumption is often a good approximation for GDP price levels from the expenditure side. This is because the relative prices of investment and government change systematically in opposite directions when measured across *per capita* incomes. It is not clear whether this pattern would be found across states or metro areas within a country, but it seems worth examining. One approach to this would be to see if there is a geographic pattern in the prices of inputs and outputs related to construction, producers' durable equipment and government compensation.

A separate issue with respect to Rents is how to reconcile the Personal Consumption Expenditure (PCE) weights in the national accounts with the expenditure weights in the Consumer Expenditure (CE) survey. A partial concordance was done by Blair in 2012, but it would be helpful to produce a full and updated mapping for use in the RPPs. Figueroa et al. (2014) have compared the sensitivity of the RPPs to different relative weights, and because the national share of rents out of total expenditures is significantly lower in the PCE than in the CE, this has a significant impact on the RPPs.

Another important research area is the treatment of owner-occupied housing. There are no observed owner-occupied housing observations in the CPI, only imputed values derived from rental housing observations and adjustments for utility cost. These imputed values reflect the shelter flow-of-costs, a concept that has been extensively documented and explained elsewhere (Poole et al. 2005; BLS 2011).

We have attempted to augment rental observations with the Census' ACS information on housing owner-costs, but the information of housing values is self-reported and extremely volatile. It is possible to obtain selected monthly owner costs that include mortgages and taxes and insurance, for example, but without knowing land prices, mortgage terms and rates, it is difficult to obtain house value estimates (Garner and Short 2009). Several online real estate companies do collect actual transaction values in many markets in the US, and if these values could be linked to broad geographies such as states and metropolitan areas, it might be possible to estimate actual owner-occupied housing price levels. At the very least, we would

be able to track both the BLS and ACS rental price levels with owner-occupied housing estimates, and better understand and explain sources of differences.

Lastly, it is not clear whether prices in rural areas for items other than rents are higher or lower than in urban areas, but we currently assume they are the same. The expenditure weights vary, but the trade-off between for example, transport costs and rents, are not included in this analysis. Aten and Marshall (2010) looked at alternative estimates of RPPs using a demand-based model to allow for some substitution across expenditures goods, such as transportation and rents, but the theoretical gains in precision of such a model are offset by the need for broad assumptions about consumer behavior. More data on the prices of goods and services (other than rents) in rural or nonmetropolitan areas would add to the robustness of our current estimates.

7 Data Availability

Real personal income data, regional price parities, and implicit regional price deflators are available through the BEA website. Data are available for 2008 to 2013 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 homepage. At the next screen, select “GDP and Personal Income” under Regional Data. Data are available in two formats through these links:

- *Begin using the data:* interactive tables where users specify data type, region and time period.
- *Download complete data sets:* flat files accessed through Real Personal Income and Regional Price Parities menus.

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

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References

- Arndt, H. W., & Sundrum, R. M. (1975). Regional price disparities. *Bulletin of Indonesian Economic Studies*, 11(2), 30–68.
- Aten, B. H., (1999). Cities in Brazil: An interarea price comparison. In A. Heston & R. Lipsey (Eds.) *International and interarea comparisons of income, output, and prices. National Bureau of Economic Research, studies in income and wealth volume 61*. Chicago: The University of Chicago Press.
- Aten, B. (2005). Report on interarea price levels, 2003, working paper 2005–11, *Bureau of Economic Analysis*, May. http://bea.gov/papers/working_papers.htm.
- Aten, B. (2006). Interarea price levels: an experimental methodology. *Monthly Labor Review*, 129, 47. **Bureau of Labor Statistics, Washington, DC.**
- Aten, B. (2008). Estimates of state and metropolitan price parities for consumption goods and services in the United States, 2005. *Bureau of Economic Analysis*, April. <http://bea.gov/papers>.
- Aten, B. H., & D’Souza, R. J. (2008). Regional price parities: Comparing price level differences across geographic areas. *Survey of current business*, 88(11), 64–74.

- Aten, B. H., & Figueroa, E. B. (2014). Real personal income and regional price parities for states and metropolitan areas, 2008–2012. *Survey of Current Business*, 94(6), 1–8.
- Aten, B. H., & Figueroa, E. B., (2015). Real personal income and regional price parities for state and metropolitan areas, 2009–2013. *Survey of Current Business*, 95(7), 1–4.
- Aten, B., Figueroa, E., Martin, T. (2011). Notes on estimating the multi-year regional price parities by 16 expenditure categories: 2005–2009. *Bureau of Economic Analysis*, April. <http://bea.gov/papers>.
- Aten, B. H., Figueroa, E. B., & Martin, T. M. (2012). Regional price parities for states and metropolitan areas, 2006–2010. *Survey of Current Business*, 92(8), 229–242.
- Aten, B. H., Figueroa, E. B., & Martin, T. M. (2013). Real personal income and regional price parities for states and metropolitan areas, 2007–2011. *Survey of Current Business*, 93, 89–103.
- Aten, B., & Reinsdorf, M. (2010). Comparing the consistency of price parities for regions of the U.S. in an economic approach framework. In *31st general conference of the international association for research in income and wealth*, August. <http://www.bea.gov/papers>.
- Balk, B. (2009). Aggregation methods in international comparisons: An evaluation. In D. S. Prasada Rao (Ed.), *Purchasing power parities of currencies, recent advances in methods and applications*. Cheltenham: Edward Elgar Publishing.
- Biggeri, L., & Laureti, T. (2009). Are integration and comparision between CPIs and PPPs feasible? In L. Biggeri & G. Ferrari (Eds.), *Price indices in time and space*. New York: Springer.
- Biggeri, L., & Laureti, T. (2015). Sub-national PPPs: Methodology and application by using CPI data. Paper presented at the workshop on inter-country and intra-country comparisons of prices & standards of living, Arezzo, Italy, September 2014. www.polo-uniar.it.
- Blair, C. (2012). *Constructing a PCE-weighted consumer price index*. National Bureau of Economic Research (NBER) working paper (March). www.nber.org.
- BLS Handbook of Methods. (2011). *Bureau of labor statistics*. <http://www.bls.gov/opub/hom/homtoc.htm>.
- Citro, C. F., & Kalton, G. (Eds.). (2000). *Small-area income and poverty estimates: Priorities for 2000 and beyond*. Washington, DC: National Academy Press.
- Deaton, A. (2003). Prices and poverty in India, 1987–2000. *Economic and Political Weekly*, 38(4), 362–368.
- Deaton, A. (2006). *Purchasing power parity exchange rates for the poor: Using household surveys to construct Ppps, research program in development studies*. Princeton: Princeton University.
- Deaton, A., & Heston, A. (2010). Understanding PPPs and PPP-based national accounts. *American Economic Journal: Macroeconomics*, 2(4), 1–35.
- Deaton, A., & Oupriez, O. (2011). *Spatial price differences within large countries*. Research program in development studies, Princeton University and World Bank working paper.
- Deaton, A. & Tarozzi, A. (2005). Prices and poverty in India. In A. Deaton & V. Kozel (Eds.), *The great Indian poverty debate*. New Delhi: MacMillan.
- Diewert, W. E. (1999). Axiomatic and economic approaches to international comparisons. In A. Heston & R. Lipsey (Eds.), *International and interarea comparisons of income, output, and prices*, National Bureau of Economic Research, studies in income and wealth (Vol. 61). Chicago: The University of Chicago Press.
- Diewert, W. E. (2005). Weighted country product dummy variable regressions and index number formulae. *Review of Income and Wealth, Series*, 51–4, 561–569.
- Fenwick, D., & O'Donoghue, J. (2003). Developing estimates of relative regional consumer price levels. *Economic Trends*, 599, 72–83.
- Figueroa, E., Aten, B., & Martin, T. (2014). Expenditure weights in the regional price parities. *Bureau of Economic Analysis*, May. <http://bea.gov/papers>.
- Garner, T., & Short, K. (2009). Accounting for owner-occupied dwelling services: Aggregates and distributions. *Journal of Housing Economics*, 18, 233–248.
- Koo, J., Phillips, K. R., & Sigalla, F. D. (2000). Measuring regional cost of living. *Journal of Business and Economic Statistics*, 18(1), 127–136.
- Kravis, I. B., Heston, A., & Summers, R. (1982). *World Product and Income, International comparisons of real gross product*. Baltimore: John Hopkins University Press.
- Martin, T., Aten, B., & Figueroa, E. (2011). Estimating the price of rents in regional price parities. *Bureau of Economic Analysis*, October. <http://bea.gov/papers>.
- McCarthy, P. (2010). Asia and pacific region, sub-national purchasing power parities—Case study for the Philippines. Paper presented at the 2nd ICP technical advisory group meeting, Washington DC, February 17–19.
- OECD/Eurostat. (2012). *Eurostat-OECD methodological manual on purchasing power parities*. Paris: OECD Publishing.
- Orshansky, M. (1969). How poverty is measured. *Monthly Labor Review*, 92, 37.

- Poole, R., Ptacek, F. & Verbrugge, R. (2005). Treatment of owner-occupied housing in the CPI. *Bureau of Labor Statistics*. <http://www.bls.gov/bls/fesacp1120905.pdf>.
- Rao, D. S. (2005). On the equivalence of weighted country-product-dummy (CPD) method and the Rao-system for multilateral price comparisons. *Review of Income and Wealth*, 51(4), 571–580.
- Renwick, T. (2011). *Geographic adjustments of supplemental poverty measure thresholds: using the American community survey five-year data on housing costs*, working paper U.S. Census Bureau, January.
- Roos, Michael. (2006). Regional price levels in Germany. *Applied Economics*, 38(13), 1553–1566.
- Sergeev, S. (2004). *The use of weights within the CPD and EKS methods at the basic heading level*. Working paper, Statistics Austria.
- Short, K. (2015). *The supplemental poverty measure: 2014*”, report number P60-254, Census Bureau, September.
- Short, K., & O'Hara, A. (2008). Valuing housing in measures of household and family economic well-being, *Annual meeting of the allied social sciences associations, society of government economists*, New Orleans, January.
- Summers, R. (1973). International price comparisons based upon incomplete data. *The Review of Income and Wealth*, 19(1), 1–16.
- Waschka, A., Milne, W., Khoo, J., Quirey, T., & Zhao, S. (2003). *Comparing living costs in Australian capital cities*. A progress report on developing experimental spatial price indexes for Australia, Australian Bureau of Statistics.
- Wingfield, D., Fenwick, D., & Smith, K. (2005). Relative regional consumer price levels in 2004. *Economic Trends*, 615, 36–46.
- World Bank. (2015). *Purchasing power parities and the real size of world economies*. A comprehensive report of the 2011 international comparison program (ICP). The International Bank for reconstruction and development/The World Bank.

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