# Adjusting Inequalities for Regional Price Parities: Importance and Implications

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**Abstract**

Corrections to CPS data dramatically change the geographic distribution of the top and bottom deciles of the income distribution. We correct the measure of real personal and household income with regional price indices from BEA. Uncorrected figures have poorer states overrepresented in the bottom decile, while corrected figures have much of that decile living in urban areas in NY and CA. We draw policy-relevant conclusions from these facts, mostly with regard to housing policy.

## 1 Introduction

A growing number of studies have attempted to import insights from regional economics to explain the rise of income inequality. This generated some key stylized facts like that a handful of counties in the United States drive a large share of the increase in inequality (Galbraith (2012):144) and that the increase in inequality has been accompanied with a reversal in regional income convergence across the United States (Ganong and Shoag, 2017; Hsieh and Moretti, 2015). These have complemented other stylized facts like that housing inequality tracks income inequality (Albouy and Zabek, 2016) and that the increase in the share of capital[1] in total income seems to be explained largely by the rising share of housing capital (Rognlie, 2015). All of these studies have the common feature of attempting to consider subnational patterns and trends as well as housing issues to explain inequality.

In this paper, we seek to expand on their contribution by considering the effects of using regional price deflators on the examination of inequality in the United States. We argue that using national deflators or nominal figures will generate misleading levels and geographic patterns of inequality if there are important price differences within the country. Using the Current Population Survey of March 2012 in combination with the regional price parities produced by the Bureau of Economic Analysis (Aten and Figueroa, 2014; Aten, 2017), we show that not using regional price deflators leads to a modest overestimation of the level of income inequality. More importantly, we show that not using regional price deflators leads us to to geographically misplace individuals at the very bottom and the very top of the income distribution. Rather than being located in low-income states, we find that the bottom ten percent of the population is more heavily concentrated in high-income states. The top ten percent of the population is more evenly spread. We argue that this fact is important, because it leads us to a different interpretation of the solutions to rising inequality, especially with regards to housing policy.

[1] Argued by some like Piketty (2014) to be an indicator of rising inequality.

## 2 Regional Price Deflators and Inequality

The choice of price deflators to compare incomes across regions has received great emphasis in the literature concerning the measurement of inequality (Deaton, 1997). This is especially true in the case of international comparisons in which incomes are deflated using purchasing power parities rather than exchange rates (Jenkins and van Kerm (2009):45). However, intra-national price level differentials have been less discussed.

While prices of tradable goods should converge across regions, prices of services and housing should be more resistant to price convergence, as arbitrage opportunities are harder to exploit. Yet, real incomes should still converge. In an integrated economy, convergence occurs through migration. Individuals will emigrate towards high-income regions and housing prices there will increase (because of greater demand), while the regions suffering emigration will see housing prices fall (because of diminishing demand). In such a situation, deflating income by regional prices will show convergence in real incomes between regions. Evidence provided by economic historians shows that convergence is sometimes underestimated if one uses a unique deflator rather than a vector of regional deflators (Mitchener and McLean, 1999). The implications with regard to inequality should be clear. If there are wide disparities in prices across regions, we could overstate the incomes of the rich and underestimate those of the poor. Generally, most of the differences are driven by housing costs and local services (Aten et al., 2014; Aten, 2017).[2] Aten et al. (2013) found that the price gap in 2011 for rents between the states with the highest (Hawaii) and lowest (South Dakota) rent was 114% while the same gap for other services (New York and Missouri) was 26%.

There have been some attempts to consider the role of intra-national price differences on inequality in recent times. For the United States, a strong piece of evidence is provided by Moretti (2013), who deflated US wages using a new consumer price index that reflects regional price differentials in order to study the real returns from going to college. In doing so, he found that half the increase in the return to college disappears. Using regional price deflators for China, Démurger et al. (2006) found that inequality evaluations overstated both the level and the trend of inequality. For Canada, Pendakur (2002) showed that the use of regional price deflators changed both the level and trend of inequality. However, there is also some evidence that the effects are much smaller. Slesnick (2002) showed the magnitude of the change in inequality was minimal with the use of regional price deflators in the US (although he did find significant effects on the estimates of poverty).

Nevertheless, none of these papers have been concerned with the geographical patterns of inequality, only with the level and trend. Knowing the geographic patterns of inequality is essential for understanding the issue. Knowing where the top and bottom ten percent of the population are located can help governments and charities to direct their efforts wisely.

Normally, surveys find that poor individuals are located in non-metropolitan areas and that poverty rates are higher there than in metropolitan areas. However, adjusting for the regional cost of living shows a complete reversal of the situation (Jolliffe, 2006). This has important policy implications. In his work, Jolliffe (2006) has pointed out that this reversal of poverty rankings between non-metropolitan and metropolitan areas means that poverty-reduction measures are not properly targeting the poorest. It is implied that a larger share of the bottom ten percent of the US income distribution is located in metropolitan areas rather than non-metropolitan areas. This is consistent with a new literature emerging regarding poverty whereby, instead of linking poverty to inner cities or rural areas, more focus is directed toward metropolitan suburban areas (Kneebone and Berube, 2013). That line of research has uncovered that suburban areas are where most of the increase in poverty in the United States has occurred since 2000.[3]

Moreover, it implies that the rich, who are mostly situated in cities (Moretti, 2013), also have overestimated incomes without corrections for the price level. This is quite consequential for the study of inequality. Galbraith (2012) showed that most of the divergence between counties in the United States was driven by just a few key counties. Although Galbraith does not discuss the issue of regional prices, the counties he

[2] Although there are minor intra-national price differences for tradable goods like food items (see De Carli (2010) regarding the Italian experience). In the case of the United States, Aten et al. (2013) pointed out that in 2011 there was a price gap for goods between the state with the highest prices and the state with the lowest prices of 16%.

[3] It is also worth pointing out the forthcoming work of Murphy (2016), who calculated state-level misery indexes (price level changes plus unemployment rates) that adjusted for regional purchasing power parities and showed outcomes that were similar to those mentioned here.

mentioned are all high-density urban areas, like New York or Washington D.C., which have appreciably higher prices. Proper corrections for this issue could affect conclusions such as those of Galbraith.

Our goal is to provide such corrections to incomes in order to properly account for regional price differences. In achieving this goal, we hope to see how much regional prices matter for the level of inequality, and where the poorest are located.

# 3 Data

To enact our corrections, we will combine two datasets which we have made available online.[4] The first is the commonly used Current Population Survey (CPS) of March 2012. The data in that set are well known and often used for measurements of inequality. However, it is necessary to mention that numerous individuals have criticized the use of the CPS for top incomes. Up to the 99th percentile, CPS datasets seem to be able to track income as well as tax data sources do (Burkhauser et al., 2012), but the top 1% is problematic and the sources diverge. We are aware of this problem, but for our purposes it is not an issue that warrants correction. Our sights being firmly aimed at the bottom 10%, the issue is moot.

We rely on individual income rather than household income. The RPPs we used (Aten and Figueroa, 2014) corrected for owner-equivalent rents (see notably Aten (2017) for a detailed description of the method used). In the CPS dataset, the income definition we used (INCTOT) includes adjustments for owner-occupied housing (Census Bureau, 2017). As such, we are avoiding the problem of docking the income of low income homeowners in rich areas without crediting them with the imputed rent of owning a home. The price data corrections we use are provided by the Bureau of Economic Analysis (Aten and Figueroa, 2014).[5] These corrections rely heavily on the data constructed for the Consumer Price Index (CPI) which are not meant to capture regional differences. To construct the final estimates, the BEA first corrects for the fact that some items with identical characteristics are not found everywhere using a hedonic price model. From there, sixteen expenditure classes are constructed for 38 urban areas. Each county is matched with its urban areas and the appropriate prices, and then state-level estimates of regional price parities are derived (see Aten and Figueroa (2014) for details of the methodology). The data show significant differences ranging from Missouri and Alabama, with price levels equal to 88.1% of the US level in 2012, to Hawaii and New York, with price levels equal to 117.2% and 115.4% of the US price level. To deflate incomes, we used Table 1 from Aten and Figueroa's appendix which expressed regional prices in terms of US dollars of 2010 (US 2010=100). They find that there is a significant narrowing of differences between states that arises from using regional price deflators. This suggests the relevance of such data.

# 4 Results

Deflating incomes by the state-level purchasing parities generates three key results. The first is that the thresholds to enter each income decile do not change evenly. The second is that the overall level of inequality falls by 0.5%. The third is that the geographical pattern of inequality changes dramatically.[6] Shifting from the unadjusted to the adjusted measures of income reduces all thresholds, but not evenly. More precisely, the thresholds for the bottom deciles and the top deciles change more dramatically than those in the middle, as can be seen in Figure 4.

[4] Readers interested in full tables of the changes in deciles (and rank) by state will find Excel workbook online at `https://github.com/youcefm/inequality_regional_prices`. In addition, readers will also find our do-files and the details of how we made our computations.

[5] We preferred the RPPs over cost of living adjustments (as seen in Jolliffe (2006)). The methodological differences between the two are not substantial for the purposes of the present paper (correcting one year to observe national and regional differences). However, to the best of our knowledge, there are no state-level equivalents as produced by Jolliffe (2006) for the year 2012. As the 2012 RPPs produced by Aten and Figueroa (2014) have been published by the Bureau of Economic Analysis and have also been published in peer-reviewed journals (see Aten (2017)), we preferred to use these measures.

[6] A narrower disaggregation at the county-level would increase the amplitude of this correction. However, as there are areas with no data at the sub-state level, we would have an incomplete national correction. As such, we kept our attention on the national figures corrected for RPPs at the state-level only.

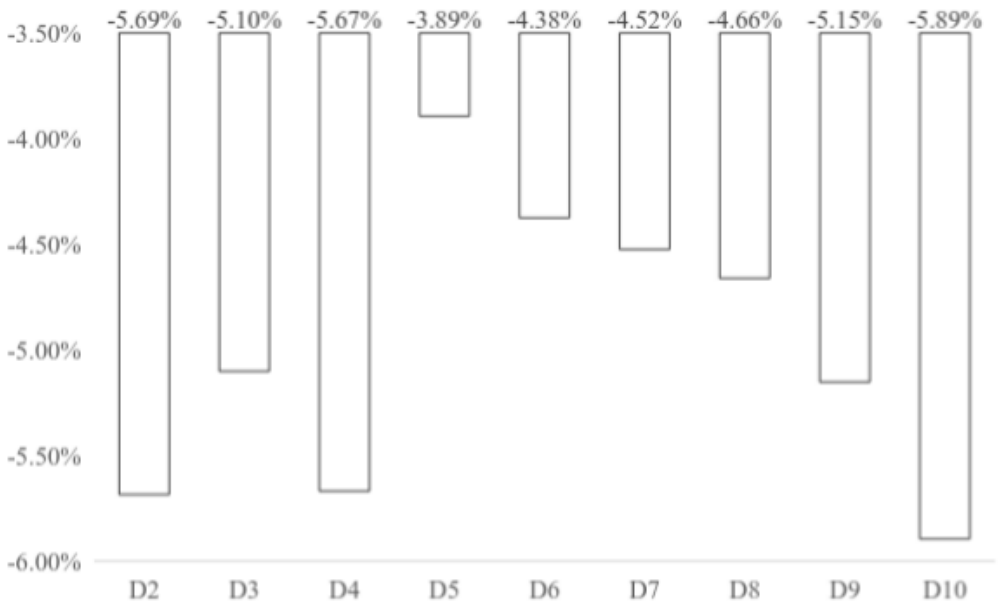


Figure 1: Change in the thresholds of each income decile resulting from correction for regional purchasing parities, United States, 2012.

The last threshold is lower by 5.89% while the threshold to move from the first to second decile drops by 5.69%. These differences suggest that shifting to purchasing power parities lessens the level of income inequality. The two extreme thresholds change in similar proportion which suggests a relatively similar distance between the two extremes. However, the smaller changes in the middle suggest that the thresholds have grown more evenly spaced. This implies slightly lower levels of inequality. Overall, the gini coefficient falls slightly from 0.4908 to 0.4885 (roughly 0.5%) (see Table 1).

Table 1: Effects of correcting for regional purchasing power parities on national measures of income inequality, 2012

| | No correction | RPP correction |
|---|---|---|
| Gini | 0.491 | 0.489 |
| 90/10 ratio | 12.032 | 11.975 |

The third key result is that the geographical distribution of deciles changes dramatically. In his research, Jolliffe (2006) showed that adjusting for price-level differences did not change the overall level of poverty dramatically, but it did show that instead of being located primarily in low density areas, the poor were primarily situated in rich urban areas. In our case, we see a similar change. Table 2 shows the changes in the number of individuals who are, nationally, in the bottom 10% and top 10% of the income distribution. As one can see, the richer states of New York and California have a significant increase in the number of individuals in the bottom 10% of the US income distribution who live within their boundaries. The solid black line shows the change in the number of individuals who are in the top 10% of Americans. What is very striking is that poor states like West Virginia see a 57% increase in the number of their citizens who are part of the national top 10%, and states like New York see a drop of 28%. These changes suggest a considerably different regional pattern of inequality.

Another way to grasp the magnitude of this change is to relate the change to the population shares of each decile by state as illustrated in Tables 3 (top decile) and 4 (bottom decile). For example, New York had 6.29% of the US population in 2012 and 6.61% of all Americans in the bottom 10% of the income distribution

Table 2: Change (in percent) of the number of individuals per state who are in the top/bottom deciles of the national income distribution as a result of adjusting for regional purchasing parities, 2012

| State | Difference in Top 10% | Difference in Bottom 10% | State | Difference in Top 10% | Difference in Bottom 10% |
|---|---|---|---|---|---|
| Alabama | 31.00% | -6.00% | Missouri | 37.70% | -14.60% |
| Alaska | -13.60% | 8.60% | Montana | 13.20% | -4.30% |
| Arizona | 2.10% | -1.90% | Nebraska | 23.30% | -8.60% |
| Arkansas | 41.20% | -6.60% | Nevada | 8.30% | -1.40% |
| California | -24.60% | 15.40% | New Hampshire | -16.40% | 5.90% |
| Colorado | -1.70% | 0.60% | New Jersey | -25.00% | 13.90% |
| Connecticut | -11.20% | 18.20% | New Mexico | 8.50% | -4.00% |
| Delaware | -7.00% | 2.30% | New York | -27.40% | 19.10% |
| District of Columbia | -25.40% | 23.30% | North Carolina | 15.10% | -10.60% |
| Florida | 6.00% | -3.40% | North Dakota | 25.30% | -11.10% |
| Georgia | 16.70% | -9.80% | Ohio | 38.80% | -11.30% |
| Hawaii | -25.70% | 22.40% | Oklahoma | 30.50% | -12.20% |
| Idaho | 12.00% | -10.60% | Oregon | 10.60% | -0.90% |
| Illinois | 0.00% | -0.10% | Pennsylvania | 5.40% | -1.70% |
| Indiana | 20.80% | -12.80% | Rhode Island | 4.90% | -2.20% |
| Iowa | 32.20% | -12.10% | South Carolina | 17.00% | -14.80% |
| Kansas | 25.60% | -15.60% | South Dakota | 39.90% | -12.20% |
| Kentucky | 45.60% | -10.90% | Tennessee | 20.60% | -8.30% |
| Louisiana | 21.20% | -15.80% | Texas | 9.80% | -3.50% |
| Maine | 7.10% | -3.30% | Utah | 8.40% | -0.50% |
| Maryland | -22.80% | 18.50% | Vermont | 0.00% | 1.60% |
| Massachusetts | -7.50% | 10.70% | Virginia | -3.10% | 1.90% |
| Michigan | 16.90% | -7.40% | Washington | -7.20% | 2.20% |
| Minnesota | 11.50% | -1.10% | West Virginia | 57.70% | -11.40% |
| Mississippi | 30.70% | -20.10% | Wisconsin | 16.00% | -8.70% |
| | | | Wyoming | 10.90% | -0.30% |

before adjusting for regional purchasing parities. After adjusting however, New York's share of the bottom 10% surges to 7.88%. This means that prior to proper adjustments, New York's share of the bottom 10% of Americans was equal to 105% of its share of total US population. After adjustment, this increased to 125%.

# 5 Policy Implications

The geographical misplacement of the two extremes of the income distribution when we fail to correct for regional price differentials can be linked largely to housing. As housing services cannot be subjected to arbitrage, we should expect wider spatial differences in prices. These differences serve to equalize incomes. Higher productivity regions command higher income and they will attract individuals from poorer regions that are less productive. As poor individuals migrate to rich states, they drive up prices in their state of destination and drive down prices in their state of origin. Thus, the income differentials should be minimized.

However, if the housing supply is inelastic, the income differentials may become capitalized in housing prices. Housing constraints induced by land-use regulations that reduce the elasticity of the housing supply will yield price increases that only high-skilled workers may afford. In terms of inequality, this yields two important observations relevant to the topic of inequality.

The first is that homeowners in areas undergoing increases in productivity will see a significant increase in their net worth through the appreciation of their houses. Overall, the incomes of these rich individuals will be lower than it first appears. This is exemplified by the reduction in the number of the top 10% in high-price states like New York and California. However, their relative position will be more stable. These differences in living costs reduce the odds of internal migration (Cebula, 2014) and the effects will be largely concentrated on low-skill and low wage workers from poorer regions who cannot easily move in as the high cost of housing prevents mobility (Ganong and Shoag, 2017). Restrictions on the housing supply thus allow those who were initially in the high-productivity areas to gain through higher housing values. This will prevent the convergence of nominal incomes (Hsieh and Moretti, 2015) by preventing poorer individuals

Table 3: State shares of top income decile relative to share of US population before and after adjustments for regional purchasing power parities, 2012

| State | Top 10% No Adjustment | Top 10% With Adjustments | State | Top 10% No Adjustment | Top 10% With Adjustments |
|---|---|---|---|---|---|
| Alabama | 79.7% | 104.4% | Missouri | 81.5% | 112.1% |
| Alaska | 99.2% | 85.7% | Montana | 49.0% | 55.4% |
| Arizona | 107.2% | 109.4% | Nebraska | 86.5% | 106.6% |
| Arkansas | 61.6% | 87.0% | Nevada | 81.6% | 88.4% |
| California | 125.6% | 94.7% | New Hampshire | 107.3% | 89.7% |
| Colorado | 130.2% | 128.0% | New Jersey | 156.6% | 117.4% |
| Connecticut | 154.7% | 137.4% | New Mexico | 102.9% | 111.7% |
| Delaware | 82.5% | 76.7% | New York | 108.6% | 78.9% |
| District of Columbia | 215.3% | 160.7% | North Carolina | 84.8% | 97.7% |
| Florida | 86.8% | 92.0% | North Dakota | 92.1% | 115.4% |
| Georgia | 96.8% | 113.0% | Ohio | 70.1% | 97.3% |
| Hawaii | 98.1% | 72.9% | Oklahoma | 78.9% | 102.9% |
| Idaho | 71.8% | 80.4% | Oregon | 85.1% | 94.1% |
| Illinois | 105.7% | 105.7% | Pennsylvania | 94.2% | 99.3% |
| Indiana | 80.4% | 97.1% | Rhode Island | 106.2% | 111.4% |
| Iowa | 68.7% | 90.8% | South Carolina | 51.0% | 59.7% |
| Kansas | 82.5% | 103.6% | South Dakota | 55.5% | 77.6% |
| Kentucky | 51.9% | 75.5% | Tennessee | 61.5% | 74.1% |
| Louisiana | 74.1% | 89.8% | Texas | 94.8% | 104.0% |
| Maine | 68.8% | 73.7% | Utah | 92.9% | 100.7% |
| Maryland | 146.5% | 113.0% | Vermont | 76.7% | 76.7% |
| Massachusetts | 143.5% | 132.8% | Virginia | 149.0% | 144.5% |
| Michigan | 91.5% | 107.0% | Washington | 116.1% | 107.7% |
| Minnesota | 93.7% | 104.5% | West Virginia | 59.2% | 93.4% |
| Mississippi | 63.5% | 82.9% | Wisconsin | 78.6% | 91.2% |
| | | | Wyoming | 86.5% | 95.9% |

Table 4: State shares of bottom income decile relative to share of US population before and after adjustments for regional purchasing power parities, 2012

| State | Bottom 10% No Adjustment | Bottom 10% With Adjustments | State | Bottom 10% No Adjustment | Bottom 10% With Adjustments |
|---|---|---|---|---|---|
| Alabama | 103.8% | 97.5% | Missouri | 102.3% | 87.4% |
| Alaska | 118.3% | 128.5% | Montana | 106.8% | 102.2% |
| Arizona | 111.4% | 109.2% | Nebraska | 72.3% | 66.1% |
| Arkansas | 106.9% | 99.8% | Nevada | 88.7% | 87.4% |
| California | 106.7% | 123.2% | New Hampshire | 69.7% | 73.8% |
| Colorado | 98.3% | 98.9% | New Jersey | 95.8% | 109.2% |
| Connecticut | 85.2% | 100.8% | New Mexico | 127.6% | 122.4% |
| Delaware | 87.6% | 89.6% | New York | 105.1% | 125.2% |
| District of Columbia | 92.7% | 114.4% | North Carolina | 110.3% | 98.6% |
| Florida | 101.3% | 97.9% | North Dakota | 63.5% | 56.5% |
| Georgia | 107.8% | 97.2% | Ohio | 101.1% | 89.7% |
| Hawaii | 101.0% | 123.6% | Oklahoma | 86.3% | 75.8% |
| Idaho | 109.1% | 97.6% | Oregon | 102.1% | 101.2% |
| Illinois | 94.8% | 94.8% | Pennsylvania | 96.2% | 94.6% |
| Indiana | 98.9% | 86.2% | Rhode Island | 98.8% | 96.7% |
| Iowa | 82.6% | 72.6% | South Carolina | 101.5% | 86.5% |
| Kansas | 94.7% | 79.9% | South Dakota | 84.2% | 73.9% |
| Kentucky | 99.3% | 88.5% | Tennessee | 108.8% | 99.7% |
| Louisiana | 98.9% | 83.2% | Texas | 103.7% | 100.1% |
| Maine | 100.7% | 97.3% | Utah | 111.6% | 111.1% |
| Maryland | 79.0% | 93.6% | Vermont | 68.3% | 69.4% |
| Massachusetts | 72.7% | 80.5% | Virginia | 89.3% | 91.0% |
| Michigan | 105.9% | 98.0% | Washington | 112.6% | 115.0% |
| Minnesota | 77.2% | 76.3% | West Virginia | 107.4% | 95.2% |
| Mississippi | 117.8% | 94.1% | Wisconsin | 82.1% | 75.0% |
| | | | Wyoming | 102.8% | 102.4% |

from migrating to high-productivity areas, and the richer individuals reap a greater share of the benefits of high productivity areas. Essentially, the people who buy land before a city takes off get an entrepreneurial rent. Land use regulations secure that rent against new development that would increase housing supply and push prices down (Ikeda and Washington, 2015). This explains why some scholars find that housing inequality tracks income inequality (Albouy and Zabek, 2016; Rognlie, 2015).

The second is that low-income residents of high-productivity areas are hurt by higher prices. As they tend to be renters, the burden of housing costs will be high and it will reduce their real incomes. This is exemplified by the increase of the number of individuals in the bottom 10% of the population in states like New York and California. This will induce migration to low-productivity areas where prices are low enough to compensate for the nominal income loss.

The correction for regional price differences unveils these realities. While it shows smaller differences across states, the geographical pattern of where the bottom 10% and top 10% are is highly correlated with restrictions on the housing supply (Glaeser and Gyourko, 2002; Ganong and Shoag, 2017). The unadjusted pattern of inequality suggests that the bottom 10% are disproportionately in poor states, which is not the case when we adjust for price differences. This suggests that any policy aimed at reducing inequality should attempt to tackle housing supply constraints.

# 6 Conclusion

The main takeaway from this paper is that cost of living adjustments matter when discussing income inequality and policies surrounding that issue. Ignoring them means that we end up looking for low-income individuals in the wrong places and thus design flawed policies (Janskỳ and Kolcunová (2017) provide an important illustration of such resulting flaws in policy in the case of the EU's European regional cohesion policy).

With only state-level adjustments for price differences, a minor share of the total level of inequality evaporates. Obviously, with more fine-grained price-level adjustments this share might grow larger. More important is the geographic reshuffling of individuals in the bottom 10% of the income distribution. Instead of being situated disproportionately in poor states, the bottom 10% become more disproportionately located in rich states. As most of the living cost adjustments relate largely to housing, our work suggests a key role for policy in that area.

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