

ONLINE APPENDIX

One Size Fits All? Monetary Policy and Asymmetric Household Debt Cycles in US States

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1 Construction of the state-level CPI

The Consumer Price Index (CPI) published by the Bureau of Labor Statistics (BLS) measures the average change in prices over time in a fixed market basket of goods and services. In particular, I use in the paper the most commonly used index, the CPI for All Urban Consumers (CPI-U) which covers approximately 89% of the US total population. The CPI is based on prices of wide-ranging goods and services, such as food, clothing, shelter, and fuels, transportation fares, charges for doctors' and dentists' services, drugs, and other goods and services that people buy for day-to-day living. These goods and services are grouped into 211 item strata. Each month, the BLS collects prices in 87 urban areas across the country from about 4,000 housing units and approximately 26,000 retail establishments.¹ These 87 urban areas in which pricing is done for the CPI are called primary sampling units (PSU), corresponding to the Office of Management and Budget (OMB) definition of Metropolitan Areas (MA).²

Each PSU is first classified according to its size: PSUs with a population larger than 1.5 million are classified as self-representing type A;³ types B and C refer to the remaining non-self-representing PSUs, metropolitan and non-metropolitan, respectively. A self-representing area represents only its own area definition, while a non-self-representing area stands for multiple area definitions. 31 out of the sampled 87 urban areas are classified as self-representing Type A areas, of which the BLS makes publicly available the CPI for 27 of them. In all of these PSUs, the CPI prices unique items in all of the 211 main item strata on a monthly, bi-monthly or semi-annual basis. The smaller PSUs in the non-self-representing areas are sampled using optimisation procedures, while the larger PSUs are sampled with certainty, and thus are designated self-representing areas.

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¹In January 2018, the BLS introduced a new geographic area sample for the CPI, consisting of 75 urban areas (large, medium, and small) across the country from about 5,000 housing units and approximately 22,000 retail establishments. The 2018 revision uses the 2010 Decennial Census and incorporates changes in the frequency of publication for several local area indexes, establishes new local area and aggregate indexes, and introduces Census division-level indexes. These changes, however, do not affect my CPI indices given that my dataset finishes in 2017.

²MA are Metropolitan Statistical Areas (MSA), Primary Metropolitan Statistical Areas (PMSA), or Consolidated Metropolitan Statistical Areas (CMSA).

³Anchorage, AK and Honolulu, HI are type A PSUs, although they both have populations smaller than 1.5 million.

In calculating the CPI of the 27 self-representing MSAs, the same procedures and methodologies are adopted as those used for computing the CPI of the US national.⁴ In particular, price changes for the various items in each location are averaged together with weights that represent their importance in the spending of the appropriate population group. But due to the smaller sample size of a given MSA, its CPI is subject to more sampling and measurement error than the national index. As a consequence, the CPIs of the MSAs are more volatile than the national index, although their long-term trends are similar.

To construct a quarterly measure of consumer price inflation at the state-level over 1984q1-2017q4, I make use of 26 MSAs, and not 27, as a result of dropping Phoenix-Mesa, Arizona, given that its CPI is only available from 2002. Although these 26 MSAs cover a sub-set of the US states (30), my sample is quite representative of the US national, with the 30 states together accounting for around 82% of total US GDP. Moreover, the states are reasonably well covered by hard data stemming from the MSAs, with larger states, such as California, New York and Illinois, displaying a better coverage – above 75% as a share of personal income or population – while states with lower coverage, such as West Virginia, Indiana, and Kentucky, tend to have a relatively lower weight in US GDP (Figure 1). Having said this, the next section shows that even states with low coverage tend to capture well the price dynamics within the state.

The original CPI data at the MSA level have different frequencies: monthly, bi-monthly (even or odd months) and semi-annual. I convert the different frequencies into quarterly data: for monthly data I take averages of the 3 months in a given quarter; for bi-monthly data I first interpolate the data to monthly and then calculate 3-month averages for each quarter; for semi-annual data I use the Chow-Lin interpolation method to produce quarterly data points by taking the US aggregate CPI as the indicator variable. Data for all MSAs are available since 1984q1, with the exception of Washington-Baltimore and Tampa-St.Petersburg-Clearwater, which results in the CPIs of Washington D.C., Maryland, Virginia and West Virginia starting in 1996q1, and Florida in 1997q4.

The computation of the state-level CPI requires the mapping of the MSA to the states. Appendix A contains the complete list of the available CPI data for the MSAs with the composition of the counties, and its allocation to the states. When a specific state includes counties from different MSAs, the state CPI will be the weighted average of the CPI of the relevant MSAs, taking personal income of the respective counties as weights. For example, the CPI of Connecticut is the income-weighted average of the counties (Fairfield, Litchfield, Middlesex, and New Haven counties) belonging to the CPI of New York-Northern New Jersey-Long Island, and of Windham county from Boston-Brockton-Nashua (Figure 2 plots the state-level CPIs).

2 State-level CPI vs Implicit Regional Price Deflator

In the main paper I show that my bottom-up-aggregated state-level CPI does a good job at tracking the official CPI, with a correlation of 0.98 over 1984q1-2017q4. In addition, in this section I compare for each individual state the inflation rates between my state-level CPI and

⁴For the complete details on the construction of the CPI for the US national, see Chapter 17 in the BLS Handbook of Methods, available at <https://www.bls.gov/opub/hom/pdf/homch17.pdf>.

the BEA's Implicit Regional Price Deflator (IRPD) over 2009-15.

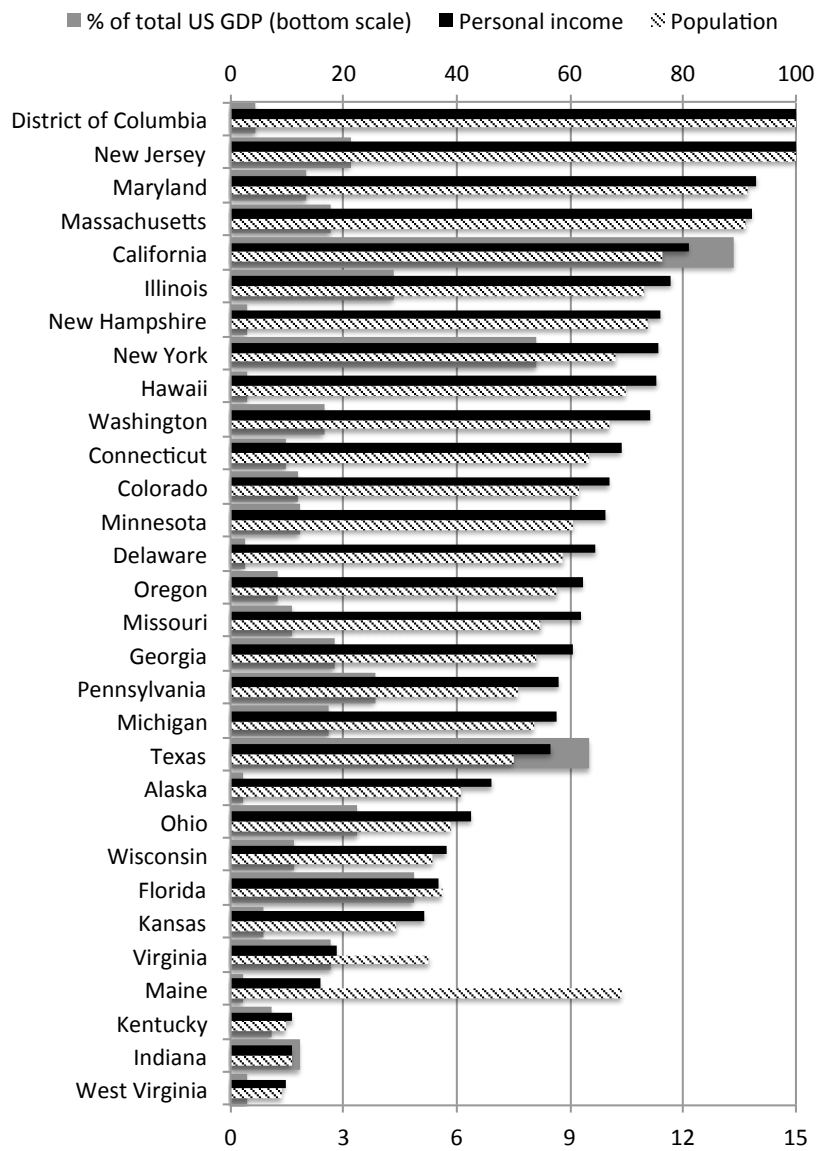
The regional price deflators published by the BEA on an annual basis, which they call Regional Price Parities (RPP), are price indexes that measure geographic price level differences within the United States.⁵ The RPP are calculated using price quotes for a wide range of items from the CPI, which are then aggregated into broader expenditure categories. Since the RPP are expressed as a percentage of the overall national price level, the IRPD are obtained by multiplying the RPP by the national PCE price index.

The annual inflation rates of my state-level CPI are closely in line with those derived from the IRPD (Figure 3). The differences in average inflation over 2009-15 between the two concepts are relatively small, with exception of a few states, particularly Alaska and Hawaii, which together account for less than 1% of US GDP. Overall, average annual inflation computed from my CPI indicator tends to stand above the one from the IRPD, with an average inflation of 1.46% over 2009-15, compared with 1.30% of the IRPD (Table 1). This gap, however, may simply reflect differences in the computation of the indicators, as highlighted by the BEA, *'The growth rate of the implicit regional price deflators will not necessarily equal the region or metro area price deflators published by the BLS. This is because the CPI deflators are calculated directly while the IRPDs are indirect estimates, and because of differences in the source data and methodology.'*

One of the concerns with the computation of the CPI indicator was related to some states having a low coverage by MSA data, which could bias the state CPI if the counties not covered by the MSA data display completely different price dynamics. The comparison between the CPI and the IRPD, however, attenuate these concerns: the inflation rates derived from the IRPD show that states that have a low coverage by MSA data do not exhibit larger differences in the 2009-15 average inflation between the CPI and the IRPD than the other states (Figure 4). In fact, the correlation between the two is close to zero, indicating that there is no association between how much of the state is covered by MSA data and the 'quality' of the resulting CPI inflation when compared with the IRPD. For instance, states with a low coverage, such as West Virginia, Indiana, Kentucky, and Maine, have very similar inflation rates over the 2009-15 period. This gives further reassurance that the CPI indicator I constructed for the states captures adequately the overall price dynamics within a given state.

⁵ Available at <https://www.bea.gov/newsreleases/regional/rpp/2017/pdf/rpp0617.pdf>

Figure 1: State coverage according to personal income and population - in %



Notes: Sorted by decreasing personal income coverage.

Figure 2: State-level CPIs – yoy % change

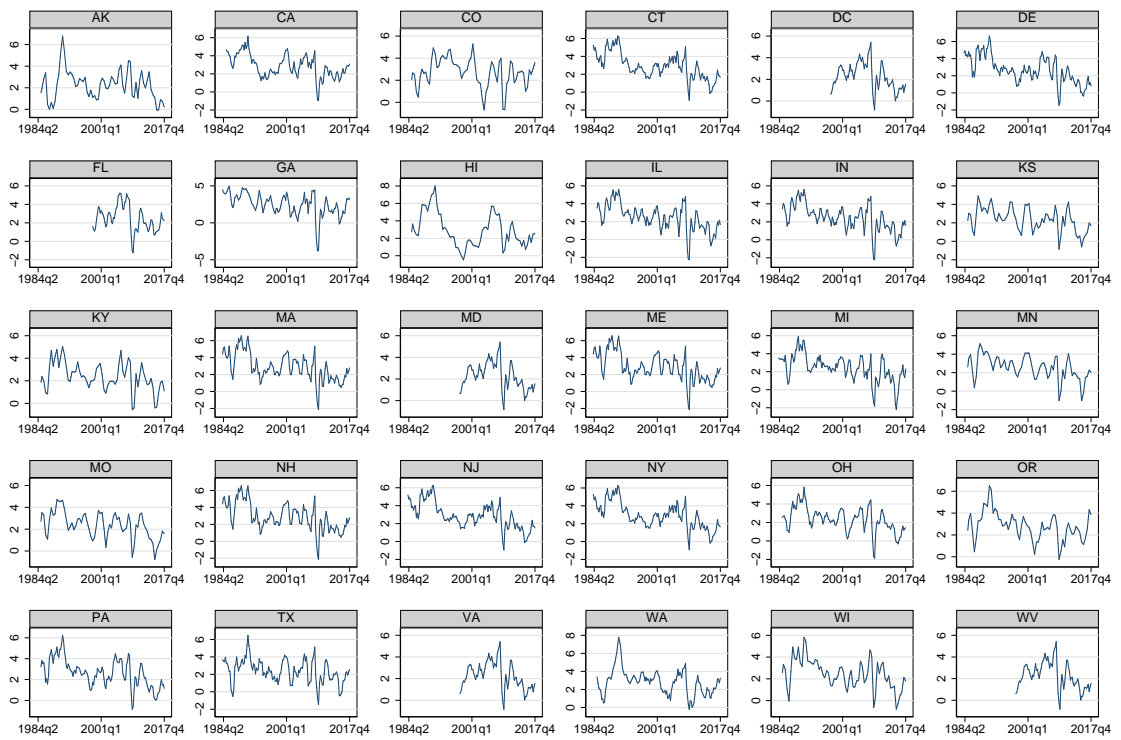


Figure 3: CPI inflation versus Implicit Regional Price Deflator – annual % change

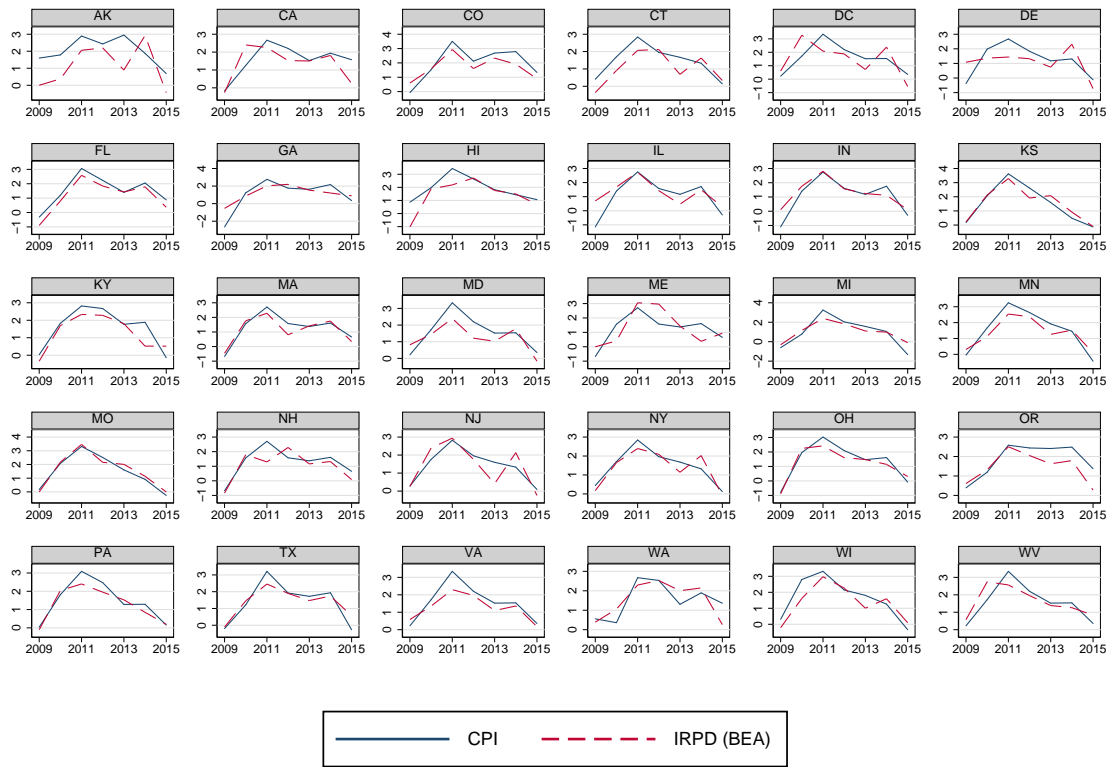


Figure 4: Correlation between state coverage and differences in average CPI inflation and IRPD

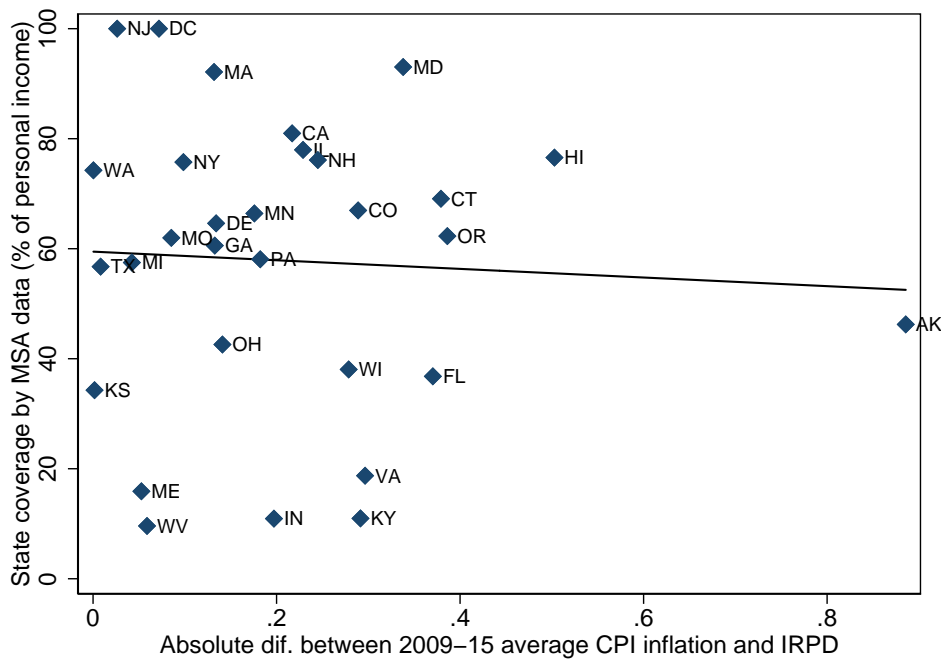


Table 1: CPI inflation versus Implicit Regional Price
Deflator: 2009-15

| State | Correlation | CPI inflation | IRPD inflation | Dif |
|---------|-------------|---------------|----------------|-------|
| AK | 0.58 | 2.03 | 1.15 | 0.89 |
| CA | 0.69 | 1.57 | 1.35 | 0.22 |
| CO | 0.94 | 1.99 | 1.70 | 0.29 |
| CT | 0.81 | 1.44 | 1.06 | 0.38 |
| DC | 0.63 | 1.56 | 1.49 | 0.07 |
| DE | 0.55 | 1.21 | 1.08 | 0.13 |
| FL | 0.99 | 1.50 | 1.13 | 0.37 |
| GA | 0.91 | 1.04 | 1.17 | -0.13 |
| HI | 0.78 | 1.89 | 1.39 | 0.50 |
| IL | 0.80 | 1.03 | 1.26 | -0.23 |
| IN | 0.93 | 1.05 | 1.24 | -0.20 |
| KS | 0.96 | 1.49 | 1.49 | 0.00 |
| KY | 0.85 | 1.55 | 1.26 | 0.29 |
| MA | 0.93 | 1.26 | 1.13 | 0.13 |
| MD | 0.84 | 1.55 | 1.22 | 0.34 |
| ME | 0.67 | 1.26 | 1.31 | -0.05 |
| MI | 0.96 | 0.97 | 1.01 | -0.04 |
| MN | 0.96 | 1.49 | 1.32 | 0.18 |
| MO | 0.98 | 1.48 | 1.56 | -0.09 |
| NH | 0.80 | 1.26 | 1.02 | 0.25 |
| NJ | 0.84 | 1.41 | 1.38 | 0.03 |
| NY | 0.90 | 1.44 | 1.34 | 0.10 |
| OH | 0.96 | 1.33 | 1.19 | 0.14 |
| OR | 0.82 | 1.84 | 1.45 | 0.39 |
| PA | 0.95 | 1.45 | 1.27 | 0.18 |
| TX | 0.96 | 1.36 | 1.36 | 0.01 |
| VA | 0.96 | 1.56 | 1.26 | 0.30 |
| WA | 0.76 | 1.53 | 1.53 | 0.00 |
| WI | 0.89 | 1.62 | 1.34 | 0.28 |
| WV | 0.83 | 1.56 | 1.62 | -0.06 |
| Average | 0.85 | 1.46 | 1.30 | 0.15 |

Appendix

A List of MSA and respective counties

Alaska

Anchorage: Anchorage Borough.

California

Los Angeles-Riverside-Orange County: Los Angeles, Orange, Riverside, San Bernardino, Ventura.

San Francisco-Oakland-San Jose: Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Santa Cruz, Sonoma, Solano.

San Diego: San Diego County.

Colorado

Denver-Boulder-Greeley: Adams, Arapahoe, Boulder, Broomfield, Denver, Douglas, Jefferson, Weld.

Connecticut

New York-Northern New Jersey-Long Island: Fairfield, Litchfield, Middlesex, New Haven.

Boston-Brockton-Nashua: Windham.

Delaware

Philadelphia-Wilmington-Atlantic City: New Castle.

District of Columbia

Washington-Baltimore: District of Columbia.

Florida

Miami-Fort Lauderdale: Broward, Miami-Dade.

Tampa-St. Petersburg-Clearwater: Hernando, Hillsborough, Pasco, Pinellas.

Georgia

Atlanta: Barrow, Bartow, Carroll, Cherokee, Clayton, Cobb, Coweta, DeKalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Henry, Newton, Paulding, Pickens, Rockdale, Spalding, Walton.

Hawaii

Honolulu: Oahu County.

Illinois

Chicago-Gary-Kenosha: Cook, DeKalb, DuPage, Grundy, Kane, Kankakee, Kendall, Lake, McHenry, Will.

St. Louis: Clinton, Jersey, Madison, Monroe, St. Clair.

Indiana

Chicago-Gary-Kenosha: Lake, Porter.

Cincinnati-Hamilton: Dearborn, Ohio.

Kansas

Kansas City: Johnson, Leavenworth, Miami, Wyandotte.

Kentucky

Cincinnati-Hamilton: Boone, Campbell, Gallatin, Grant, Kenton, Pendleton.

Maine

Boston-Brockton-Nashua: York county.

Maryland

Philadelphia-Wilmington-Atlantic City: Cecil County.

Washington-Baltimore: Baltimore, Anne Arundel, Baltimore City, Calvert, Carroll, Charles, Frederick, Harford, Howard, Montgomery, Prince George's, Queen Anne's, Washington.

Massachusetts

Boston-Brockton-Nashua: Essex, Middlesex, Norfolk, Plymouth, Suffolk, Bristol, Hampden, Worcester.

Michigan

Detroit-Ann Arbor-Flint: Genesee, Lapeer, Lenawee, Livingston, Macomb, Monroe, Oakland, St. Clair, Washtenaw, Wayne.

Minnesota

Minneapolis-St. Paul: Anoka, Carver, Chisago, Dakota, Hennepin, Isanti, Ramsey, Scott, Sherburne, Washington, Wright.

Missouri

Kansas City: Cass, Clay, Clinton, Jackson, Lafayette, Platte, Ray.

St. Louis: Crawford, Franklin, Jefferson, Lincoln, St. Charles, St. Louis, Warren, St. Louis City.

New Hampshire

Boston-Brockton-Nashua: Hillsborough, Merrimack, Rockingham, Strafford.

New Jersey

New York-Northern New Jersey-Long Island: Bergen, Essex, Hudson, Hunterdon, Mercer, Middlesex, Monmouth, Morris, Ocean, Passaic, Somerset, Sussex, Union, Warren.

Philadelphia-Wilmington-Atlantic City: Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Salem.

New York

New York-Northern New Jersey-Long Island: Bronx, Dutchess, Kings, Nassau, New York, Orange, Putnam, Queens, Richmond, Rockland, Suffolk, Westchester.

Ohio

Cleveland-Akron: Ashtabula, Cuyahoga, Geauga, Lake, Lorain, Medina, Portage, Summit.

Cleveland-Akron: Brown, Butler, Clermont, Hamilton, Warren.

Oregon

Portland-Salem: Clackamas, Columbia, Marion, Multnomah, Polk, Washington, Yamhill.

Pennsylvania

New York-Northern New Jersey-Long Island: Pike.

Philadelphia-Wilmington-Atlantic City: Bucks, Chester, Delaware, Montgomery, Philadelphia.

Pittsburgh: Allegheny, Armstrong, Beaver, Butler, Fayette, Washington, Westmoreland.

Texas

Dallas-Fort Worth: Collin, Dallas, Denton, Ellis, Henderson, Hood, Hunt, Johnson, Kaufman, Parker, Rockwall, Tarrant.

Houston-Galveston-Brazoria: Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, Waller.

Virginia

Washington-Baltimore: Alexandria City, Arlington, Clarke, Culpeper, Fairfax, Fairfax City, Falls Church City, Fauquier, Fredericksburg City, King George, Loudoun, Manassas City, Manassas Park City, Prince William, Spotsylvania, Stafford, Warren.

Washington

Seattle-Tacoma-Bremerton: Island, King, Kitsap, Pierce, Snohomish, Thurston.

Portland-Salem: Clark county.

West Virginia

Washington-Baltimore: Berkeley, Jefferson.

Wisconsin

Chicago-Gary-Kenosha: Kenosha.

Milwaukee-Racine: Milwaukee, Ozaukee, Racine, Washington, Waukesha.

Minneapolis-St. Paul: Pierce, St. Croix.