Background

- Need for inter-area price parities to adjust personal incomes of states and metro areas.
- BEA-BLS-Census collaborative agreements enable us to estimate item stratum level inter-area price indexes.
- From these we construct aggregate inter-area price parities that satisfy transitivity.
- Possible problem of inconsistency of changes in inter-area price parities with story told by area-specific CPIs.
We experimented with alternative methods for constructing transitive sets of inter-area indexes:

1. **Fisher-GEKS.** Uses geometric average of all possible bases for comparisons.
2. **Törnqvist-GEKS.**
3. **Weighted country-product dummy (CPD).**
4. **Geary(-Khamis or GK).** Uses fixed “world” prices; has convenient property of additivity.
5. **Geary-Allen (or GAIA).** Uses world prices; substitutes predicted quantities implied by a demand model for observed quantities.
Problems to look for in results

- Sensitivity to outliers.
- Inconsistency of yearly changes in regional price parities (RPPs) with area-specific CPIs. *But even with best possible data and method, differences in weights and approach to quality adjustment could cause time inconsistency.*
- GK is susceptible to Gershenkron effect, but GAIA avoids this problem.
- GAIA expected to have fewer inexplicable inconsistencies in yearly changes in RPPs.
What the results suggest

- Fisher-GEKS more sensitive to outliers and more likely to be inconsistent with area CPIs.
- Although GAIA closer to Törnqvist-GEKS than GK, the difference is small. (NB: this result may change when we use improved data.)
- Convenient properties of GK don’t seem to come at a cost of much worse performance.
- Good results for time consistency achieved with multi-year averaging of AHS shelter cost data.
## Single-Year Time Inconsistencies

<table>
<thead>
<tr>
<th></th>
<th>Törnqvist GEKS</th>
<th>Fisher GEKS</th>
<th>Geary</th>
<th>GAIA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Houston, 2006</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Actual</td>
<td>97.6</td>
<td>103.4</td>
<td>95.8</td>
<td>95.4</td>
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<tr>
<td>Predicted</td>
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<td>96.2</td>
<td>94.8</td>
<td>94.4</td>
</tr>
<tr>
<td>Difference</td>
<td>2.6</td>
<td>7.2</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td><strong>NY suburbs, 2007</strong></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Actual</td>
<td>129.3</td>
<td>127.3</td>
<td>128.3</td>
<td>129.4</td>
</tr>
<tr>
<td>Predicted</td>
<td>135.8</td>
<td>137.5</td>
<td>132.8</td>
<td>133.2</td>
</tr>
<tr>
<td>Difference</td>
<td>-6.5</td>
<td>-10.2</td>
<td>-4.5</td>
<td>-3.8</td>
</tr>
</tbody>
</table>
Time consistency: Multi-year Törnqvist-GEKS

\[ y = 1.0005x - 7 \times 10^{-5} \]

\[ R^2 = 0.996 \]
Time consistency: Multi-year GK

\[ y = 0.9758x + 0.0244 \]

\[ R^2 = 0.9933 \]
Time consistency: Multi-year GAIA

\[ y = 0.9733x + 0.0269 \]

\[ R^2 = 0.9935 \]
1. New **BLS** data
   - Mapping of BLS index areas to all counties in the U.S.
   - Annualized costs weights from expenditure survey
   - Additional weights for rural regions

2. New **Census** data
   - Rents: 5-year rolling average for all counties, including rural areas
Overview of Data

**Consumer Price Index (CPI) micro data on prices from BLS**
- 205 item strata, 38 urban and metropolitan areas (1 million observations per year)
- 2 other item strata: Rents and Owners’ Equivalent Rents (34,000 observations per year)

**Consumer Expenditure Survey (CE) from BLS**
- 207 x 38 area-item level observations
- 207 x 4 rural regions

**American Community Survey (ACS) rents and owner costs of housing from Census**
- 5 year rolling average for all counties
- 10 million observations
1. **First Stage (only BLS data)**
   - Hedonic regressions
   - 38 index areas, 207 item prices
   - Multilateral aggregation to 16 expenditure classes
   - Allocation to counties and averaging to states and metro areas

2. **Second Stage (adding ACS Census data)**
   - Use ACS observed rents instead of BLS allocated rents
   - 51 states, 366 metro areas, micro and rural areas, 16 expenditure classes
   - Multilateral aggregation to overall RPP
First stage: BLS data

1. Hedonic regressions on 207 items
2. Multilateral (Geary) price levels for 38 index areas and 16 expenditure classes
3. Allocate price levels to counties within index areas
   - Assume price levels for each of the expenditure classes except Rents are the same as average of the index area

Example: **Index Area A312: Washington DC-MD-VA-WV**
   - 26 counties, 2 Metro areas (24 counties), 1 Micro area, 1 Rural area
Expenditure Classes

- Rents: 29.0%
- Transportation: 11.8% Goods, 6.2% Services
- Food: 8.7% Goods, 6.5% Services
- Household Items: 3.6% Goods, 9.5% Services
- Medical: 1.5% Goods, 4.3% Services
- Education: 0.5% Goods, 5.3% Services
- Recreation: 2.4% Goods, 3.2% Services
- Apparel: 3.8% Goods, 1.6% Services
- Other: 2.1% Goods, 1.5% Services

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Averaging to States and Metro Areas

Find weighted average of price levels for all expenditure classes except rents by 51 states and 366 metro areas

For example:

1. **DC**: 1 county
2. **MD**: 24 counties in 6 different BLS index areas
   - 6 counties in A312 (Washington-Arlington-Alexandria)
   - 1 county in A102 (Philadelphia-Camden-Wilmington)
   - 7 in A313 (Baltimore-Towson)
   - 1 in X300 (South small metro: Cumberland MD-WV)
   - 6 in D300 (South non-metro urban: Cambridge, Lexington Park, Salisbury, Easton, Ocean Pines)
   - 3 Rural (Caroline, Garrett, Kent)
3. **WV**: 55 counties
   - Only 2 in A312, 19 in other metro, 8 in micro areas, 26 rural
Second stage: ACS Census data

- Repeat for each year between 2005-2009
- For Rents, use direct estimates from ACS instead of allocated averages
- Multilateral (Geary) price levels for all geographies and overall RPP across five years
Second stage: ACS Rent data

BLS
- Weighted aggregation to States and Metro areas
- 15 Expenditure Classes

ACS
- Hedonic Regression at State and Metro level
- Rents
- Estimate Final RPPs
- 2005-2009
Rents: BLS and ACS

ACS vs BLS Rents Only

BLS 5-Year Average Rents vs ACS Multi-Year Rents

- NY City
- Honolulu
- SF
- Boston

Unity point on the diagonal line indicates perfect alignment between BLS and ACS rents.
## Results by Expenditure Class

<table>
<thead>
<tr>
<th>RPPs by Expenditure Class</th>
<th>Rural 10%</th>
<th>Micro 7%</th>
<th>Metro 83%</th>
<th>All 100%</th>
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<tbody>
<tr>
<td>Apparel by Goods</td>
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<tr>
<td>Rural</td>
<td>84</td>
<td>89</td>
<td>103</td>
<td>100.1</td>
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<tr>
<td>Micro</td>
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<td></td>
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</tr>
<tr>
<td>Metro</td>
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<tr>
<td>All</td>
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<tr>
<td>Food by Goods</td>
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<tr>
<td>Rural</td>
<td>95</td>
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<td>Rural</td>
<td>88</td>
<td>91</td>
<td>102</td>
<td>99.9</td>
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<tr>
<td>Rural</td>
<td>67</td>
<td>75</td>
<td>106</td>
<td>100.6</td>
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<td>Rural</td>
<td>98</td>
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<tr>
<td>Rural</td>
<td>90</td>
<td>92</td>
<td>102</td>
<td>100.2</td>
</tr>
<tr>
<td>Overall</td>
<td>84.7</td>
<td>88.1</td>
<td>102.8</td>
<td>100.0</td>
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<tr>
<td>Rental costs are <strong>1.6</strong> times higher on average in Metro vs. Rural areas (106 / 67)</td>
<td>89</td>
<td>103</td>
<td>100.1</td>
<td></td>
</tr>
<tr>
<td>Housing Goods</td>
<td>88</td>
<td>92</td>
<td>102</td>
<td>99.8</td>
</tr>
<tr>
<td>Housing Services</td>
<td>88</td>
<td>91</td>
<td>102</td>
<td>99.9</td>
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<tr>
<td>Rents Services</td>
<td><strong>67</strong></td>
<td>75</td>
<td><strong>106</strong></td>
<td>100.6</td>
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<tr>
<td>Transport Goods</td>
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<td>98</td>
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<tr>
<td>Transport Services</td>
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<td>92</td>
<td>102</td>
<td>100.2</td>
</tr>
<tr>
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<td><strong>88.1</strong></td>
<td><strong>102.8</strong></td>
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<th>Metro 83%</th>
<th>All 100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural areas tend to have more inexpensive services relative to goods.</td>
<td>89</td>
<td>103</td>
<td>100.1</td>
<td></td>
</tr>
<tr>
<td>Food Services</td>
<td>92</td>
<td>97</td>
<td>101</td>
<td>99.7</td>
</tr>
<tr>
<td>Housing Goods</td>
<td>88</td>
<td>92</td>
<td>102</td>
<td>99.8</td>
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<td>Housing Services</td>
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<td>Rents Services</td>
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<td>Transport Goods</td>
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<td>Transport Services</td>
<td>90</td>
<td>92</td>
<td>102</td>
<td>100.2</td>
</tr>
<tr>
<td><strong>Overall</strong></td>
<td><strong>84.7</strong></td>
<td><strong>88.1</strong></td>
<td><strong>102.8</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

Rural areas tend to have more inexpensive services relative to goods.
8 Lowest and 8 Highest Rents

RPPs for Rents, Transportation, and All Other Goods/Services by State
2005 - 2009

- Rents
- Transportation
- All Other

States:
- West Virginia
- South Dakota
- North Dakota
- Kentucky
- Arkansas
- Mississippi
- Alabama
- Oklahoma
- Connecticut
- Maryland
- Alaska
- New York
- DC
- New Jersey
- California
- Hawaii
## RPP Adjusted Personal Income

### State Per Capita Personal Income ($)  

<table>
<thead>
<tr>
<th>State</th>
<th>RPP</th>
<th>2009</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Unadjusted</td>
<td>Adjusted</td>
</tr>
<tr>
<td>State</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>California</td>
<td>114.8</td>
<td>42,395</td>
<td>36,975</td>
</tr>
<tr>
<td>DC</td>
<td>112.2</td>
<td>68,843</td>
<td>61,467</td>
</tr>
<tr>
<td>Maryland</td>
<td>109.7</td>
<td>48,247</td>
<td>44,034</td>
</tr>
<tr>
<td>New York</td>
<td>116.4</td>
<td>46,516</td>
<td>40,018</td>
</tr>
<tr>
<td>Ohio</td>
<td>89.4</td>
<td>35,408</td>
<td>39,679</td>
</tr>
<tr>
<td>Texas</td>
<td>97.1</td>
<td>38,609</td>
<td>39,803</td>
</tr>
<tr>
<td>Virginia</td>
<td>101.5</td>
<td>44,057</td>
<td>43,453</td>
</tr>
<tr>
<td>West Virginia</td>
<td>84.5</td>
<td>32,080</td>
<td>38,001</td>
</tr>
<tr>
<td>All U.S.</td>
<td>100</td>
<td>39,635</td>
<td></td>
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</tbody>
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Future Developments

- Evaluate consistency between 2005-2009 and 2006-2010

- Evaluate using expenditure weights from BEA’s National Income and Product Accounts instead of the Consumer Expenditure survey