What Can We Learn from 60 Years of PCE Inflation Data?

Raphael Schoenle
Brandeis University and CEPR

Dominic Smith
Bureau of Labor Statistics

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Motivation: Long-Term Changes in “Inflation”

Source: Personal Consumption Expenditure Price Index
A lot is hidden behind aggregate measures of inflation.

The cross-sectional distribution of disaggregated inflation rates has systematically changed between 1960 and 2021.

1. Extreme increases in inflation more rare, extreme decreases appear
2. Inflation is granular, and importance of granularity has increased
3. Ranking of mean versus robust measures of inflation inverts
4. Decreases in variance and covariance of individual series

After 1990 inflationary process driven by idiosyncratic shocks.
This Paper - Model

- A heterogeneous production model with idiosyncratic shocks is needed to analyze the inflation stabilization properties of policy
  - Monetary policy regime and measures of aggregate inflation interact through the distribution of inflation rates

- Analyze interaction of AIT versus Taylor rule with core inflation measure, given shocks to oil producing sector:
  - Targeting core rather than headline inflation achieves much of the inflation stabilization from AIT
  - Additive stabilization gains
Related Literature


- Implications for monetary policy: Pasten et al. (2019), Rubbo (2020), Molavi et al. (2021), Tahbaz-Salehi and La’O (2022)

Contribution: Long time span of analysis and focus on inflation through lens of multi-sector model
Personal Consumption Expenditure Data from BEA

- 196 categories that add up to aggregate inflation:

\[ \pi_t = \sum_i W_{it-12} \pi_{it} \]

- Price index and expenditure weights for each category
  - Revised when methodology changes

- Monthly 1960-2021

- E.g. Owner-occupied stationary homes, physician services, tobacco
Constructed Series Matches PCE Inflation

Our calculation (green) covers published PCE (red)
Shift in Tails of Distribution
Time series of cross-sectional price change distribution

Extreme increases in inflation more rare, extreme decreases appear
Shift in Tails of Distribution

Extreme increases in inflation more rare, extreme decreases appear
Granularity of Inflation Rates: Log-Normal Distribution

- Percentiles very close to 45 degree line
- Actual distribution slightly flatter near 0
Granularity Over Time: Increasing Importance

Inflation decomposition, Foerster et al. (2011):

\[ \pi_t = \sum_i \frac{1}{N}\pi_{it} + \sum_i \left( w_{it} - \frac{1}{N} \right) \pi_{it} \]

- Granular residual is large when series with large weight systematically differ from other series.

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Granular Residual</td>
<td>0.24</td>
<td>0.58</td>
<td>1.01</td>
</tr>
<tr>
<td>Equal Weighted</td>
<td>4.32</td>
<td>1.63</td>
<td>1.64</td>
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</table>
Granularity Over Time: Increasing Importance

Equal-weighted component dominant in the 1970s/1980s
Mean vs Robust Inflation: Ranking Reversals

The graph illustrates the comparison between Median Inflation (dashed line) and Mean Inflation (solid line) over time. The data spans from 1960m1 to 2020m1, showing significant fluctuations in Y/Y inflation (%). The graph highlights the differences in trends and potential reversals in inflation rankings between the two metrics.
Variance and Covariances Decreasing

5-year moving average of series variance and pairwise covariance

Average variance and covariance decline, but covariance more.
Model

- To account for facts: heterogeneous production New Keynesian model with idiosyncratic shocks needed

- Model following Pasten et al. (2019) features heterogeneity in:
  - sector size and sectoral origin of shocks ($N = 341$)
  - intermediate input consumption
  - Calvo pricing frictions

- Monetary policy regime and measures of aggregate inflation interact through the distribution of inflation rates
Monetary Policy and Measures of Inflation

Two monetary policy regimes:

Taylor Rule:

\[ i_t = \phi_c C_t + \phi_{\pi} \pi_t \]

Average Inflation Targeting \((T = 6)\):

\[ i_t = \phi_{\pi} \frac{\sum_{k=0}^{T} \pi_{t-k}}{T + 1} \]

Measures of Inflation:

Headline inflation, and core Inflation
Exercise 1: Idiosyncratic Shocks Needed

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<td>Important Granular Residual</td>
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<tr>
<td>Larger Cov than Var Drop</td>
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<td>158</td>
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<td></td>
<td>X</td>
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To match the facts (tails): idiosyncratic shocks needed
Example: mean and median reversal
Exercise 1: Distribution of Inflation Rates (AIT and Taylor)

- AIT stabilizes more than Taylor rule (center)
Exercise 2: Policy Interaction with Measure of Inflation

<table>
<thead>
<tr>
<th>Inflation Measure</th>
<th>Policy Rule</th>
<th>Inflation Impact</th>
<th>$\sigma(\pi)$</th>
<th>$\sigma(C)$</th>
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<tbody>
<tr>
<td>Overall</td>
<td>Taylor</td>
<td>3.871%</td>
<td>0.192%</td>
<td>0.0036</td>
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<tr>
<td>Overall</td>
<td>AIT</td>
<td>1.711%</td>
<td>0.189%</td>
<td>0.0028</td>
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<td>Core</td>
<td>Taylor</td>
<td>2.244%</td>
<td>0.189%</td>
<td>0.0038</td>
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<tr>
<td>Core</td>
<td>AIT</td>
<td>1.340%</td>
<td>0.188%</td>
<td>0.0025</td>
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</table>

- Moving to AIT reduces inflation volatility mostly on impact by 1/2 and stabilizes consumption.
- Stabilization of core + no regime shift: achieves most of AIT inflation stabilization, leaving consumption volatility unchanged (core focus has similar smoothing properties if non-core shocks).
- Stabilization of core + regime shift: additive stabilization benefits.
Exercise 2: Policy Interaction with Measure of Inflation

- Targeting core rather than headline reduces spread of the distribution (in the center) more for Taylor than AIT.
- Stabilization of core + regime shift: additive stabilization benefits.
The cross-sectional distribution of disaggregated inflation rates has systematically changed between 1960 and 2021.

In multi-sector heterogeneous production model with idiosyncratic shocks, monetary policy regime and measures of aggregate inflation interact through the distribution of inflation rates.

Application: Targeting core rather than headline reduces inflation volatility, and under AIT creates additive inflation stabilization benefits.
Appendix
Mean and Median Reversal

![Graph showing the Mean and Median Reversal over time. The x-axis represents Months After Shock, and the y-axis represents Inflation (Yearly %). The graph displays two lines: one for the Median and another for the Mean. Over time, the difference between the Median and Mean decreases, illustrating the reversal phenomenon.]
Effect on Center of Distribution

![Graphs showing the effect on center of distribution over months after shock.](image-url)
Oil Industries FPA = 0.99

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<th>$\sigma(C)$</th>
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<tbody>
<tr>
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<td>Taylor</td>
<td>6.48</td>
<td>0.231</td>
<td>0.00484</td>
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<td>0.238</td>
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<tr>
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<td>0.231</td>
<td>0.00456</td>
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<td>AIT</td>
<td>3.93</td>
<td>0.237</td>
<td>0.00350</td>
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