# Extending the Range of Robust PCE Inflation Measures

Sergio Ocampo
University of Western Ontario

Raphael Schoenle
Brandeis University, CEPR

Dominic Smith
Bureau of Labor Statistics

CEBRA Annual Meeting 2023

New York, July 7, 2023

# Robust Measures of PCE Inflation

- Judging the behavior of trend inflation is remarkably hard
- (Headline) Inflation averages all expenditure categories
  - Many expenditure categories experience extraordinarily high or low changes
  - Many such changes are only transitory
- In response, policy makers have developed robust measures of inflation
  - Easy to communicate to public when talking about “inflation”
  - Heightened attention: *“I want to see inflation, and median and trimmed mean, compellingly headed back to our target”* (Barkin, January 2023)

# Robust Measures of PCE Inflation

- Robust Measures of Inflation:
  - Drop some expenditure categories from inflation
  - Eliminate transitory variation and provide information on trend movements
  - **Examples:**
    Trimmed mean inflation (Dallas Fed), median inflation (Cleveland Fed), core inflation

- Statistical alternatives based on factor models:
  - Underlying Inflation Gauge (UIG, NY Fed) – not this paper

# What We Do

1. Construct long series of robust PCE inflation 1960-2022
   - This increases the series' length by 40% adding periods of high inflation
2. Properties of Official Trimmed Mean and Median inflation
   - Substantial disagreement in many months
   - Trimmed mean slightly better than median inflation at capturing trend inflation
3. Which Alternative Trimmed Mean Measures are Optimal?
   - Choose trims targeting trend inflation and evaluate according to RMSE
   - Best trims are slightly asymmetrical and higher when targeting future trend inflation

# Alternative Trimmed Mean Measures — Key Findings

1. A range of trims deliver similar prediction error over time, including official measures.
2. However, significant variation in level predictions in any month
   - Differences between 0.5pp–1pp.
3. Deeper reason: discreteness of inflation series distribution

   e.g. trimming more on upper tail raises variance relative to series mean while average error remains similar across trims
4. Results robust to different targets, periods

# PCE Inflation Data

- Personal Consumption Expenditure (PCE) data from NIPA
  - Produced and revised by the Bureau of Economic Analysis
  - Preferred inflation measure used by the Federal Reserve
- Extended sample: January 1959 $\longrightarrow$ October 2022
  - Official Trimmed Mean/Median series only from 1977 (our sample 40% longer)
  - Extended data available at ▸ https://ocamp020.github.io/Robust_Inflation_Series.xlsx
- Capture additional periods of rising and high inflation
  - 1960-1977 period contains two episodes of rising inflation (1968 and 1973)
  - 44 months with inflation higher than 5% (about one-fifth of full sample)

# Construction of Trimmed Mean Inflation Series

1. Remove $\alpha\%$ of expenditure with the lowest inflation
2. Remove $\beta\%$ of expenditure with the highest inflation
3. Weight and average monthly inflation of remaining categories

$$\pi_t^{tm,mo} = \sum_i \omega_t^i \frac{p_t^i}{p_{t-1}^i}$$

4. Chain monthly rates, $\pi_t^{tm,mo}$, to get yearly inflation

$$\pi_t^{tm} = \prod_{s=0}^{11} \pi_{t-s}^{tm,mo}$$

# Construction of Official Robust Inflation Series

## Dallas FED Trimmed Mean Inflation:

- Trim out the $\alpha = 24\%$ lowest and $\beta = 31\%$ highest inflation categories
- Trims chosen based on prediction of trend inflation (1977-2005)
  - Centered moving average ($\pm 16$*months*)
  - 12-month forward-moving average of headline inflation

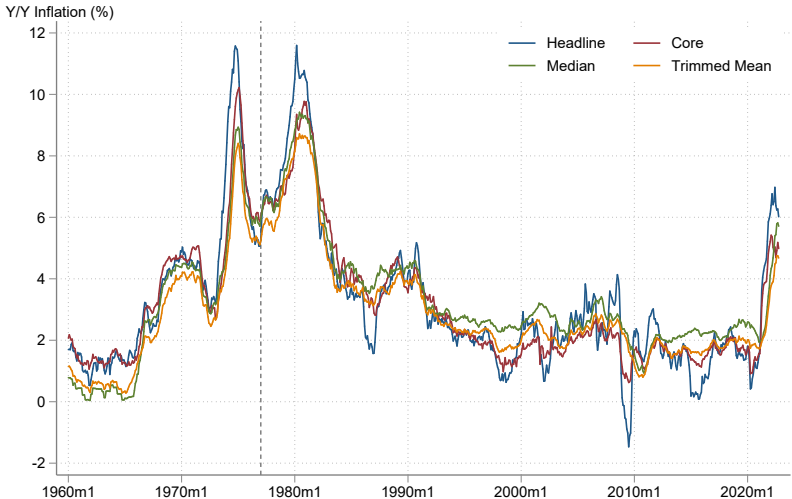
## Cleveland FED Median Inflation:

- Equivalent to trimming out trimmed mean inflation with $\alpha = \beta = 50\%$

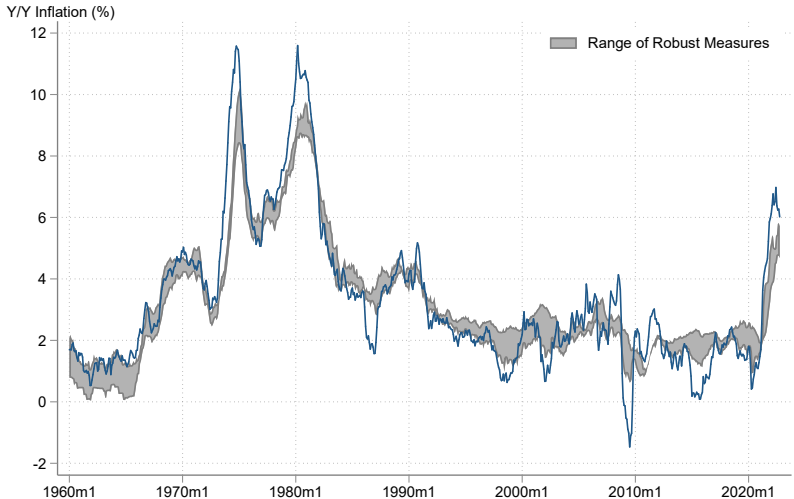
# Excluded Categories

| | Median | Trimmed Mean | Middle 80% ($\alpha, \beta = 10\%$) |
|---|---|---|---|
| | | **Most Commonly Excluded** | |
| 1 | | Eggs | Eggs |
| 2 | 71 series | Food on farms | Vegetables |
| 3 | never median | Vegetables | Food on farms |
| 4 | | Fruit | Used auto margin |
| 5 | | Gasoline | Fuel oil |
| | | **Most Commonly Included** | |
| 1 | Owner-occ homes | Owner-occ homes | Owner-occ homes |
| 2 | Other purch meals | Other purch meals | Other purch meals |
| 3 | Tenant-occ homes | Owner-occ mobile hms | Tenant-occ homes |
| 4 | Nonprofit hospitals | Casino gambling | Casino gambling |
| 5 | Physician services | Tenant-occ homes | Lotteries |

# Long Series of Robust Measures of Inflation



# Agreement Between Series




1. Robust series differ often from (more volatile) headline inflation
2. Range across series≈0.8pp

# (Re-)Evaluating Robust Measure of Inflation

**Objective:** Match measures of current and future trend inflation ($\bar{\pi}$)

1. Current trend inflation: Centered moving average ($\pm$16 months)
   - Alternative: band-pass filter, Christiano and Fitzgerald (2003)
2. Future trend inflation: Forward moving average (13-24 months ahead)
   - Alternative: forward moving average (0-24 months ahead)

**Three Samples:** 1970-2022 1970-1989 2000-2022

$$rmse^i = \sqrt{\frac{1}{T}\sum_t (\pi_t^i - \bar{\pi}_t^j)^2}$$

with current/future target $\bar{\pi}^j$ and $\pi_t^i$ robust measure

Exclude pre-1970 data (series with no monthly price changes)

# Re-Evaluating Robust Measures of Inflation

**Two measures:**

1. Official robust measures
2. Wide range of trims

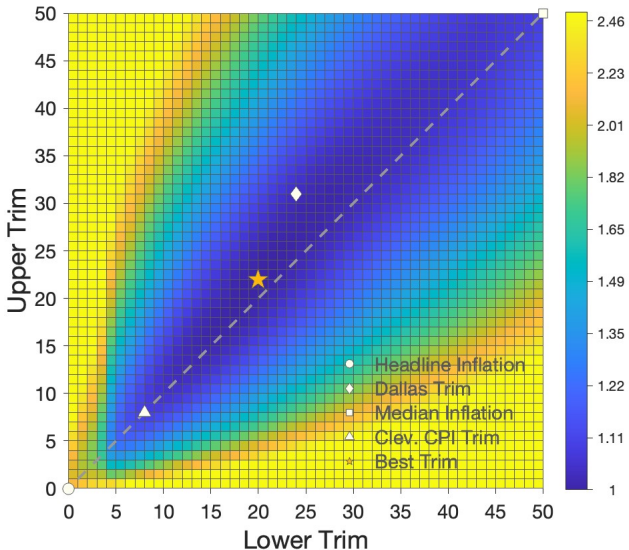
# Performance of Official Measures details

| Trend | Sample | PCE Inflation Measure | | | DM Test |
|---|---|---|---|---|---|
| | | Headline | Trim. Mean | Median | $\Pr(z > \lvert DM \rvert)$ |
| Current | 1970-2022 | 2.20 | 1.10 | 1.16 | 0.066 |
| | 1970-1989 | 2.28 | 1.62 | 1.51 | 0.047 |
| | 2000-2022 | 2.47 | 0.75 | 0.95 | 0.000 |
| Future | 1970-2022 | 2.93 | 2.12 | 2.14 | 0.476 |
| | 1970-1989 | 3.48 | 3.02 | 3.00 | 0.841 |
| | 2000-2022 | 2.93 | 1.59 | 1.61 | 0.561 |

- Trimmed Mean and Median inflation are much better than no trimming
- Trimmed Mean is slightly better than Median inflation (DM test)
  - Mainly due to recent period and current trend inflation target

# Optimal Trims for Predicting Current trend 1970-2022

RMSE relative to optimal trim




- Wide range with similar RMSE (blue area)
- Slightly asymmetrical trims are optimal (higher upper trim)
- Optimal Trim: $(\alpha, \beta) = (20\%, 22\%)$
- Range of best 50 trims $\approx$ within 40bp

Predicting Future Trend

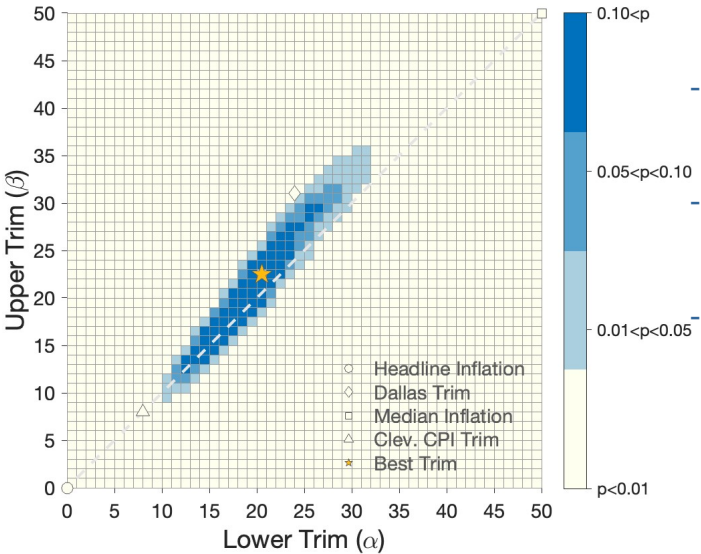
# Optimal Trims details

| Trend | Sample | Best Trims | | | DM Test |
|---|---|---|---|---|---|
| | | Lower | Upper | RMSE | $\Pr(z > \lvert DM \rvert)$ |
| Current | 1970-2022 | 20 | 22 | 1.06 | 0.014 |
| | 1970-1989 | 18 | 16 | 1.44 | 0.238 |
| | 2000-2022 | 21 | 27 | 0.74 | 0.474 |
| Future | 1970-2022 | 28 | 33 | 2.09 | 0.192 |
| | 1970-1989 | 15 | 17 | 2.91 | 0.560 |
| | 2000-2022 | 28 | 32 | 1.55 | 0.302 |

- Optimal trims vary widely from the official ones (and across time)
  - Dallas $(\alpha, \beta) = (24, 31)$, Cleveland $(\alpha, \beta) = (50, 50)$
- However, optimal trims are only *slightly better* than official measures
  - Diebold–Mariano test against min(RMSE)

# Range of Equivalent Trims: Current trend 1970-2022

Test of RMSE relative to optimal trim

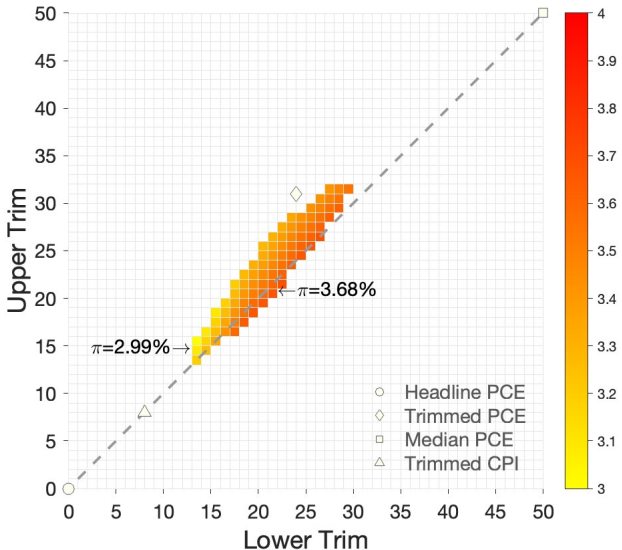



- Diebold-Mariano test for difference of RMSE
- Set of equivalent trims is wide ($\alpha, \beta \in [10, 30]$)
- Av. Range of equiv. trims $\approx$ 60bp

Level Range

# What About Implied Levels of Current Trend?

Trimmed Mean inflation May 2023 for Best trims



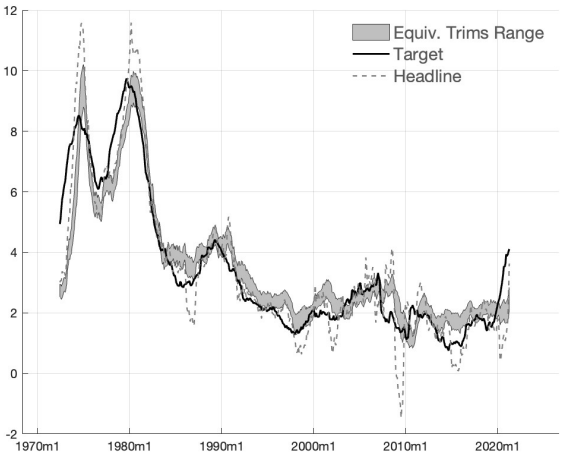

- Asymmetrical trims: Trim more high-inflation Between 12-30%
- Range≈0.70pp across best trim combinations

One-month inflation (annualized):

- Headline: 1.6%
- Median: 3.6%
- Trimmed Mean: 3.2%

# Time Series of Robust Inflation Range

## Range Targets Current Trend 1970-2022




- Av. Range of equiv. trims $\approx$ 60bp
- Range goes up to 1.16pp for future trend
- Range lags changes in trend inflation (more so for future trend)

Future trend series

# Conclusion

We extend robust measures of inflation back to 1960 and evaluate them

- Official robust inflation measures are near-optimal when matching trend
- However, average prediction error hides differences in series' behavior

1. Wide range of trims delivers similar error rates
2. Different trims imply different predictions (but similar prediction error)

# Appendix

# Summary Statistics back

| | Inflation Measures | | | |
|---|---|---|---|---|
| | Headline | Core | Median | Trimmed Mean |
| | Full Sample (748 months) | | | |
| Mean | 3.27 | 3.21 | 3.33 | 2.96 |
| Std. Dev. | 2.42 | 2.13 | 2.01 | 1.86 |
| Coeff. Var. | 0.74 | 0.66 | 0.60 | 0.63 |
| | $\pi < 2.5\%$ (373 months) | | | |
| Mean | 1.55 | 1.73 | 2.01 | 1.72 |
| Std. Dev. | 0.67 | 0.53 | 0.95 | 0.70 |
| Coeff. Var. | 0.43 | 0.31 | 0.47 | 0.41 |
| | $\pi \geq 5\%$ (123 months) | | | |
| Mean | 7.76 | 7.09 | 6.85 | 6.31 |
| Std. Dev. | 2.00 | 1.59 | 1.60 | 1.57 |
| Coeff. Var. | 0.26 | 0.22 | 0.23 | 0.25 |

# Performance of official measures - Details back

| Trend | Sample | PCE Inflation Measure | | | DM Test |
|---|---|---|---|---|---|
| | | Headline | Trim. Mean | Median | $\Pr(z > \lvert DM \rvert)$ |
| Current | 1970-2022 | 2.20 | 1.10 | 1.16 | 0.066 |
| | 1970-1989 | 2.28 | 1.62 | 1.51 | 0.047 |
| | 2000-2022 | 2.47 | 0.75 | 0.95 | 0.000 |
| Band Pass | 1970-2022 | 2.11 | 1.25 | 1.30 | 0.066 |
| | 1970-1989 | 1.98 | 1.65 | 1.55 | 0.035 |
| | 2000-2022 | 2.42 | 1.01 | 1.18 | 0.000 |
| Future | 1970-2022 | 2.93 | 2.12 | 2.14 | 0.476 |
| | 1970-1989 | 3.48 | 3.02 | 3.00 | 0.841 |
| | 2000-2022 | 2.93 | 1.59 | 1.61 | 0.561 |
| Forward | 1970-2022 | 2.43 | 1.62 | 1.66 | 0.181 |
| | 1970-1989 | 2.74 | 2.38 | 2.34 | 0.393 |
| | 2000-2022 | 2.56 | 1.09 | 1.21 | 0.000 |

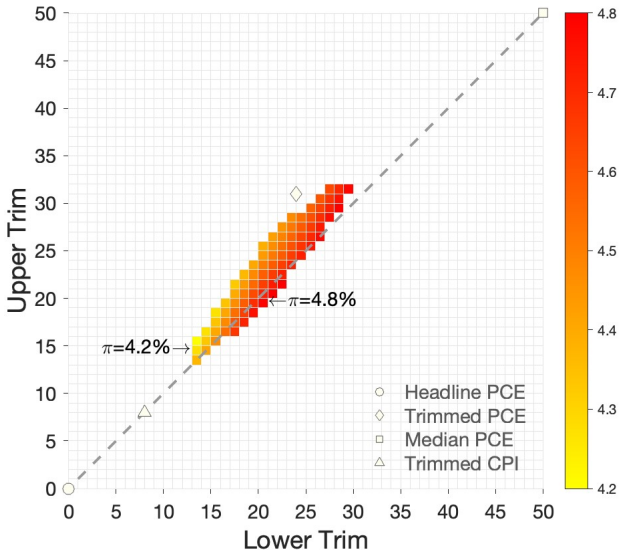
# Best trims details

details

| Trend | Sample | Best Trims | | | DM Test |
|---|---|---|---|---|---|
| | | Lower | Upper | RMSE | $\Pr(z > \lvert DM \rvert)$ |
| Current | 1970-2022 | 20 | 22 | 1.06 | 0.014 |
| | 1970-1989 | 18 | 16 | 1.44 | 0.238 |
| | 2000-2022 | 22 | 29 | 0.74 | 0.474 |
| Band Pass | 1970-2022 | 11 | 11 | 1.12 | 0.000 |
| | 1970-1989 | 12 | 10 | 1.36 | 0.003 |
| | 2000-2022 | 15 | 18 | 0.97 | 0.050 |
| Future | 1970-2022 | 27 | 32 | 2.09 | 0.192 |
| | 1970-1989 | 49 | 50 | 2.90 | 0.560 |
| | 2000-2022 | 28 | 32 | 1.55 | 0.302 |
| Forward | 1970-2022 | 15 | 17 | 1.59 | 0.150 |
| | 1970-1989 | 13 | 13 | 2.26 | 0.158 |
| | 2000-2022 | 24 | 31 | 1.09 | 0.815 |

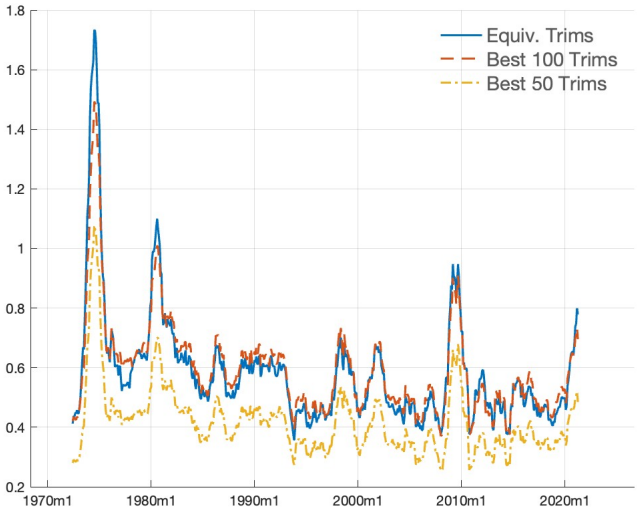
# What About Implied Levels of Current Trend?

Trimmed Mean inflation May 2023 for top 50 trims




- Asymmetrical trims: Trim more high-inflation
- Trim between 12-30%
- Range≈60bp for trimmed mean across these best trim combinations
- Headline inflation was 4%

# Range of Inflation Predictions

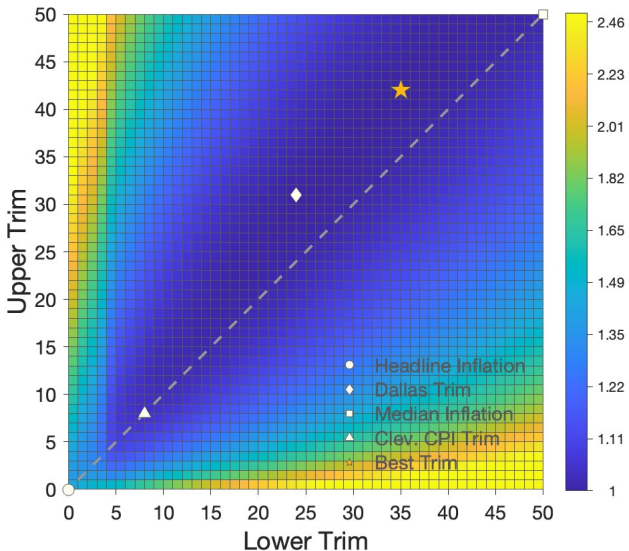



- Range≈40bp for trimmed mean across these 50 trim combinations
- Range≈60bp for trimmed mean across trims statistically equivalent to best trim
- Large spikes overtime on the range

Back to Current Trend

# Optimal Trims for Implied Future Trend 1970-2022

RMSE relative to optimal trim

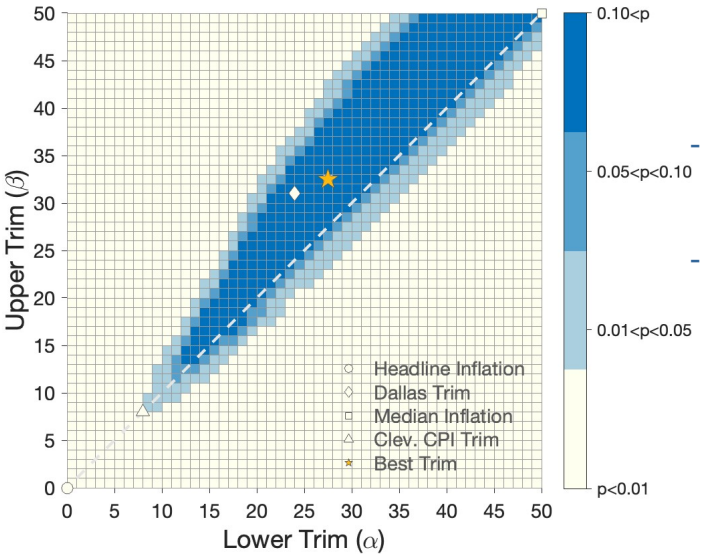



- Optimal Trim: $(\alpha, \beta) = (27\%, 32\%)$
- Forecasting is an equalizer for the error

Level Range Details | Back to Current Trend

# Range of Equivalent Trims: Future trend 1970-2022

Test of RMSE relative to optimal trim

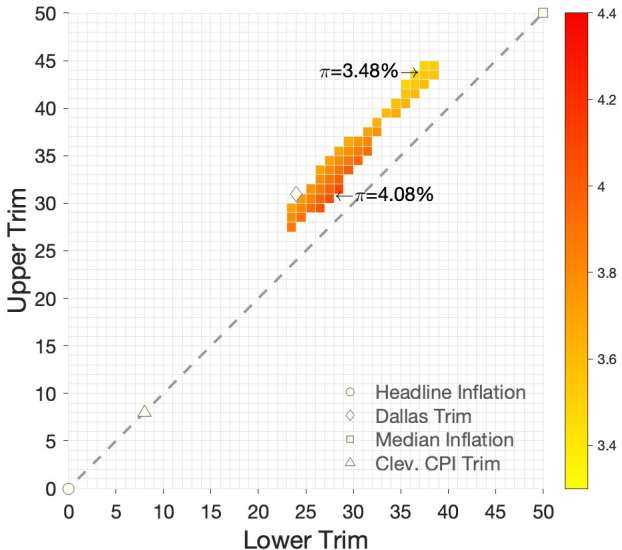



- Diebold-Mariano test for difference of RMSE
- Set of equivalent trims is wider! ($\alpha, \beta \in [10, 50]$)

Back to Current Trend

# What About Implied Levels of Future Trend?

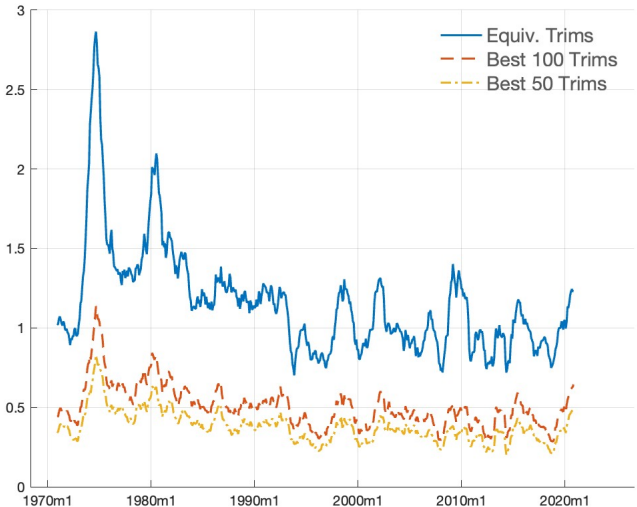
Trimmed Mean inflation October 2022 for top 50 trims




- **More** asymmetrical trims
- Trim between 22-45%
- Still ≈40bp range

Back to Future Trend

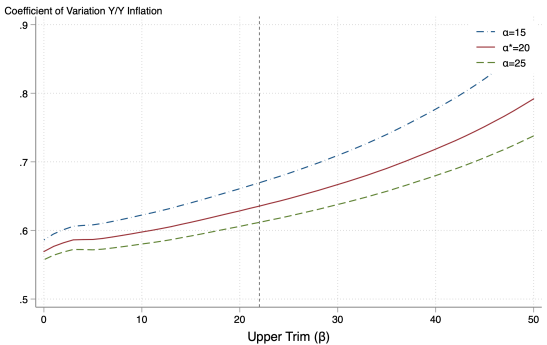
# Range of Inflation Predictions

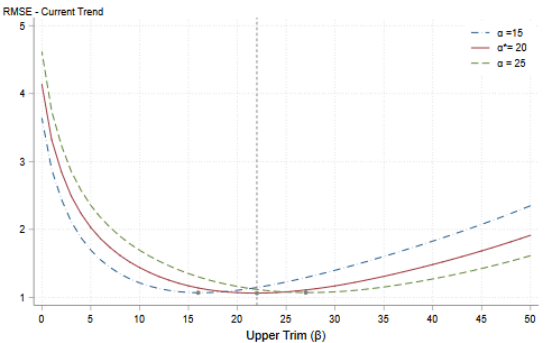



- Range$\approx$50bp for trimmed mean across these 50 trim combinations
- Range$>$100bp for trimmed mean across trims statistically equivalent to best trim
- Large spikes overtime on the range

Back to Current Trend

# Why Do So Many Trims Deliver Similar Outcomes?



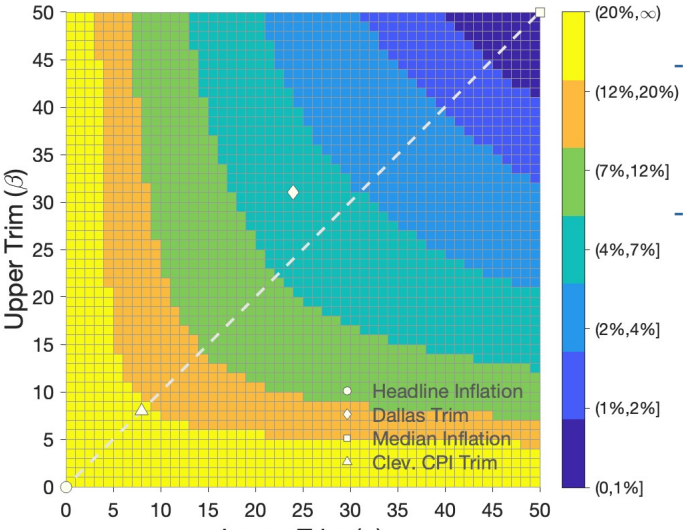




Back to Current Trend

# Why Do So Many Trims Deliver Similar Outcomes?

Range of Average Inflation Levels by Trim:

$$\pi_{1-\beta} - \pi_{\alpha}$$

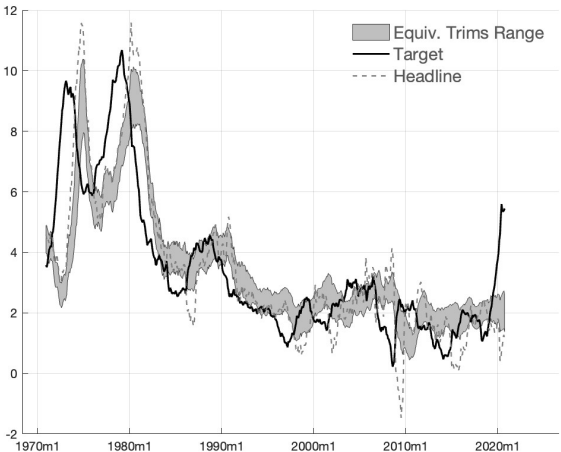



- Small differences in inflation range $\longrightarrow$ Small differences in RMSE
- Robust inflation range $< 7pp$ for most trims
  - Compare with 3.5% ave. monthly inflation

Back to Current Trend

# Time Series of Robust Inflation Range: Future Trend

Range Targets Future Trend 1970-2022




- Av. Range of equiv. trims $\approx$ 60bp
- Range goes up to 1.16pp for future trend
- Range lags changes in trend inflation (more so for future trend)

Back to current trend series