Extending the Range
of Robust PCE Inflation Measures

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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

$\longrightarrow$ No grounds to select a single series based on forecasting performance

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 (± 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
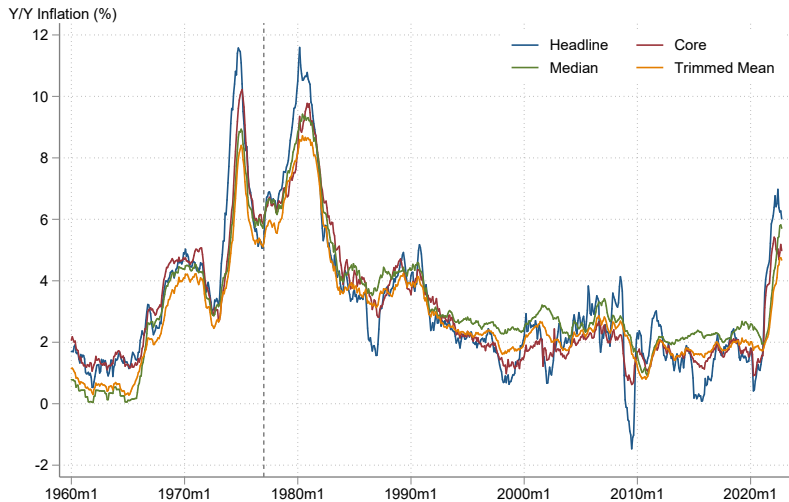
Agreement Between Series
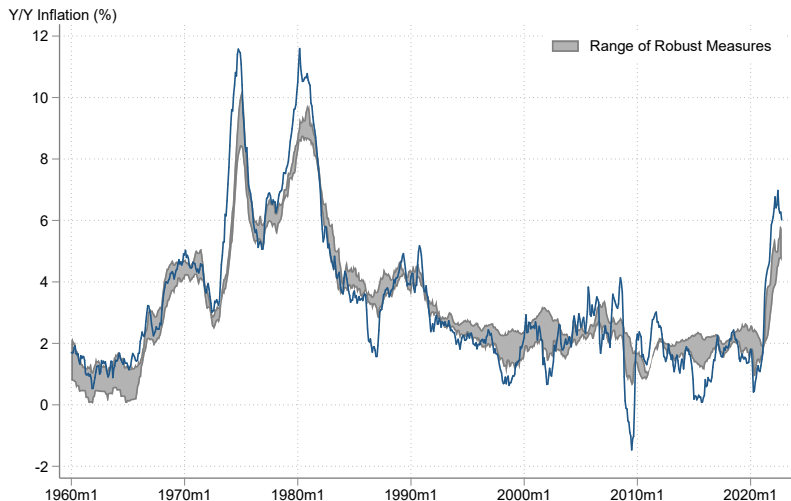
Y/Y Inflation (%)

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 (± 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 π_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 $(z > |DM|)$
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

Performance *Across* Trims: Current Trend 1970-2022

What is the RMSE relative to the optimal trim RMSE?
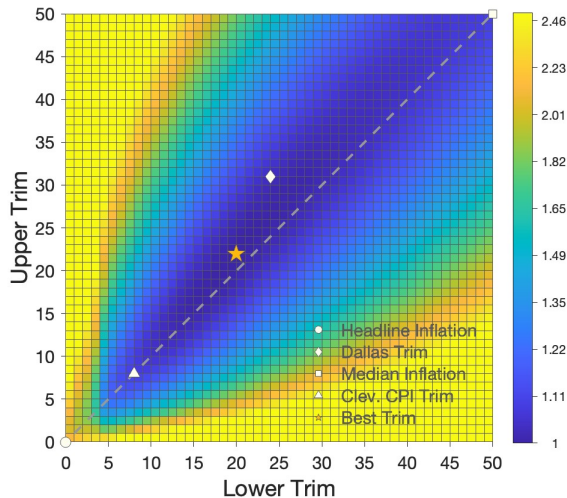
- Wide range with similar RMSE
  (blue area)

- Optimal Trim:

$$(\alpha^\star, \beta^\star) = (20\%, 22\%)$$

Slightly asymmetrical
(higher upper trim)

Predicting Future Trend

What are the *Optimal* Trims? (All Periods) details

Trend	Sample	Best Trims			DM Test
		Lower	Upper	RMSE	$\Pr(z > |DM|)$
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(Trimmed Mean) , RMSE(Median)}

Range of *Best* Trims: Current Trend 1970-2022

Is a given trim's RMSE statistically different from the optimal trim's RMSE?
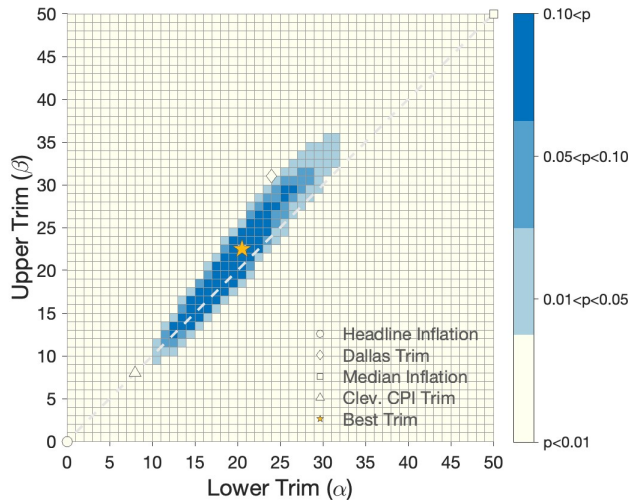
- Diebold-Mariano test for difference of RMSE

- Set of equivalent trims is wide $\alpha, \beta \in [10, 30]$

- Set is asymmetrical:
  Trim more high-inflation
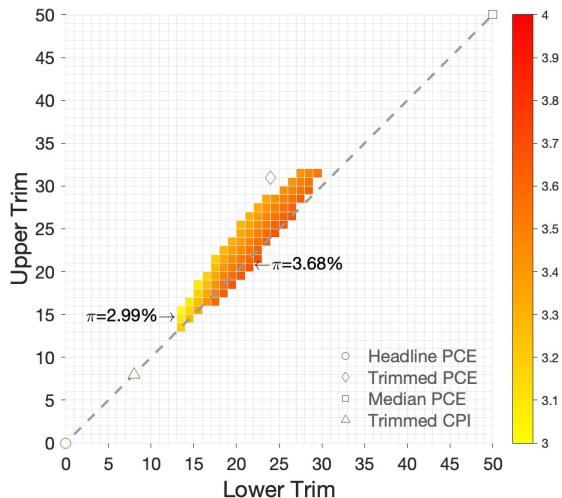
Not All Equivalent Trims Have Same Predictions

Key Takeaway:

Despite similar RMSE across a wide set of trims, for any given month, *levels* of robust inflation can differ substantially

Implied Levels of Current Trend Differ

Trimmed Mean inflation May 2023 for best trims

- Implied range ≈ 0.70pp across best trim combinations

One-month inflation (annualized):

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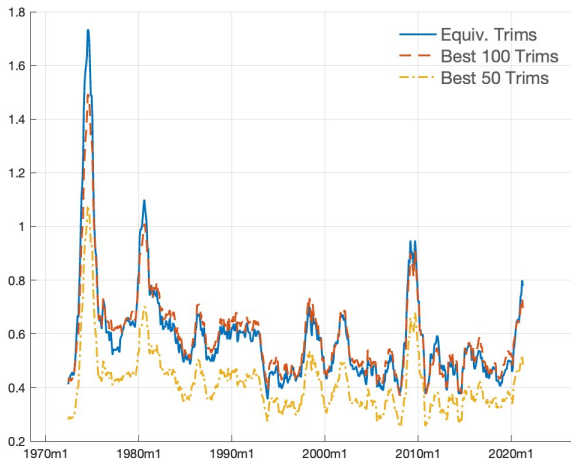- Trimmed Mean: 3.2%

Time Series of Robust Inflation Range

Range Targets Current Trend 1970-2022
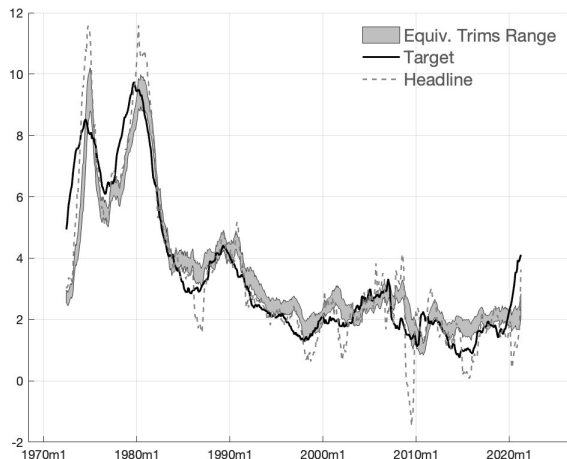
- Average range across best trims ≈ 0.60pp

- Range lags changes in targeted trend inflation
  (more so for future trend)

- Range goes up to 1.16pp for future trend

Future trend series

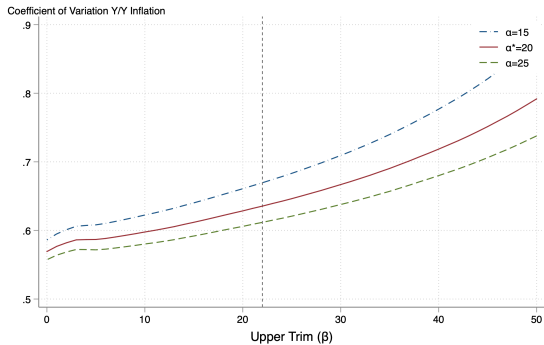# Zooming into the Range of Inflation Predictions
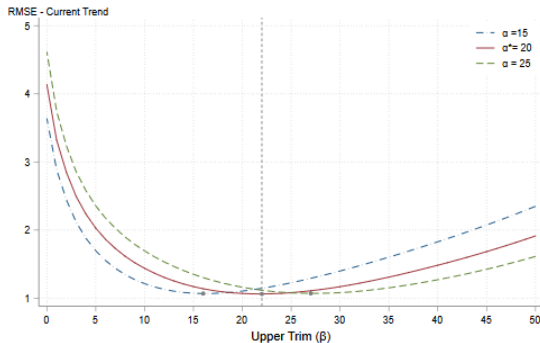

The range is substantial:

- Range≈0.60pp for trimmed mean across trims statistically equivalent to best trim

- Even across top 50 trim combinations, range $\approx$ 0.40pp for trimmed mean across

- Large spikes over time on the range

Why Do So Many Trims Deliver Similar Outcomes?

Coefficient of Variation Across Trims

RMSE Across Trims

- Trimming, for example on upper tail (β), raises trimmed mean series variance relative to series mean (coefficient of variation, left panel)

- At the same time, average error remains similar across trims RMSE is relatively stable around the optimal trim (right panel)

Why Do So Many Trims Deliver Similar Outcomes?

Range of Inflation Category Levels by Trim: $\pi_{1-\beta} - \pi_{\alpha}$
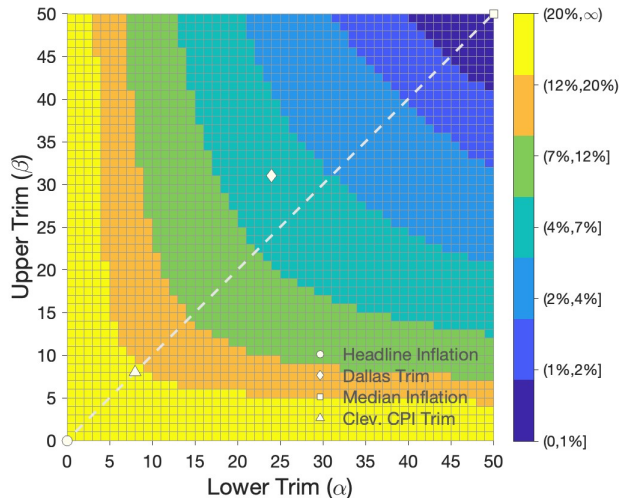
- Small differences in inflation range across categories $\longrightarrow$ Small differences in RMSE

- Robust inflation range $< 7pp$ for most trims

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 RMSEs

- 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	$\Pr(z > |DM|)$
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	$\Pr(z > |DM|)$
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
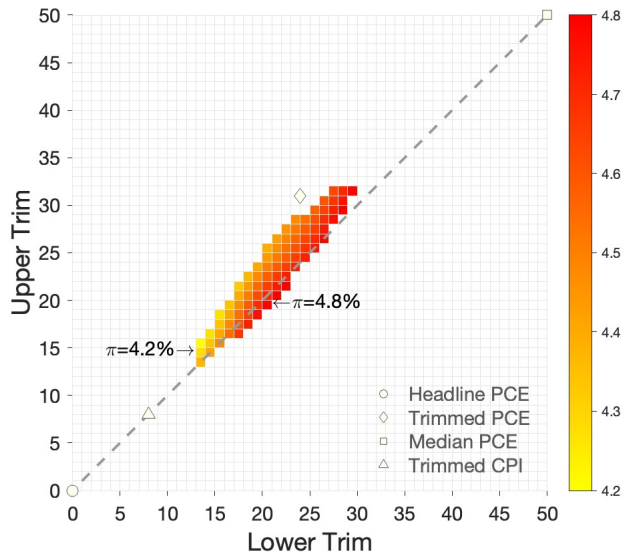
- Asymmetrical trims: Trim more high-inflation

- Trim between 12-30%

- Range≈60bp for trimmed mean across these best trim combinations

- Headline inflation was 4%

Optimal Trims for Implied Future Trend 1970-2022
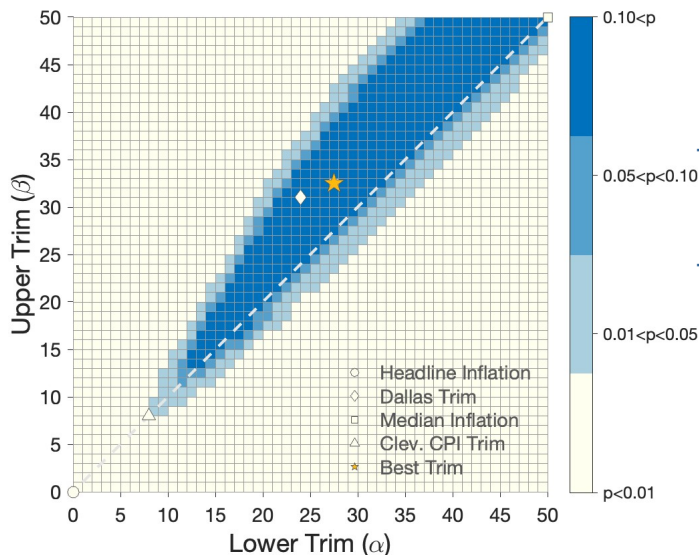
RMSE relative to optimal trim
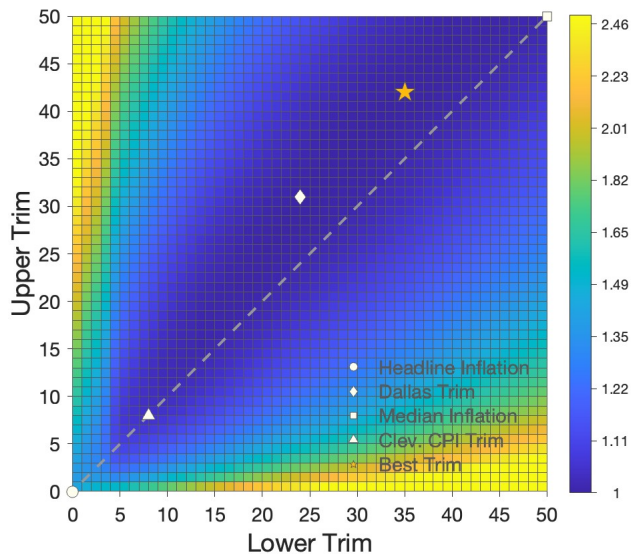
- Optimal Trim:
  $(\alpha, \beta) = (27\%, 32\%)$

- Forecasting is an equalizer for the error

Back to Current Trend

Range of Equivalent Trims: Future trend 1970-2022
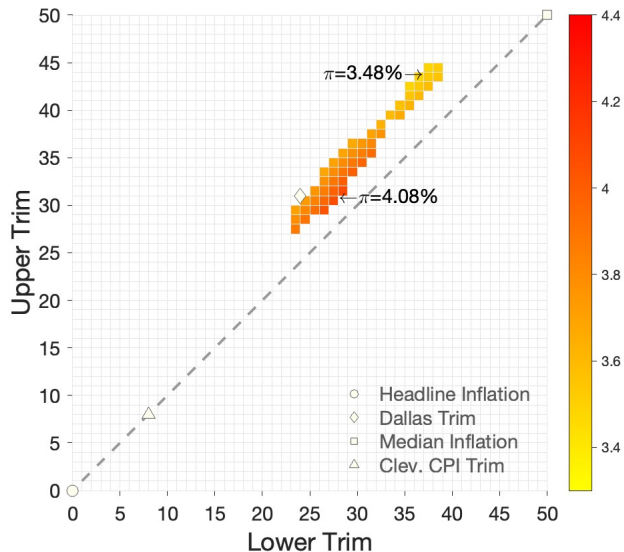
Test of RMSE relative to optimal trim

- Diebold-Mariano test for difference of RMSE

- Set of equivalent trims is wider! ($\alpha, \beta \in [10, 50]$)

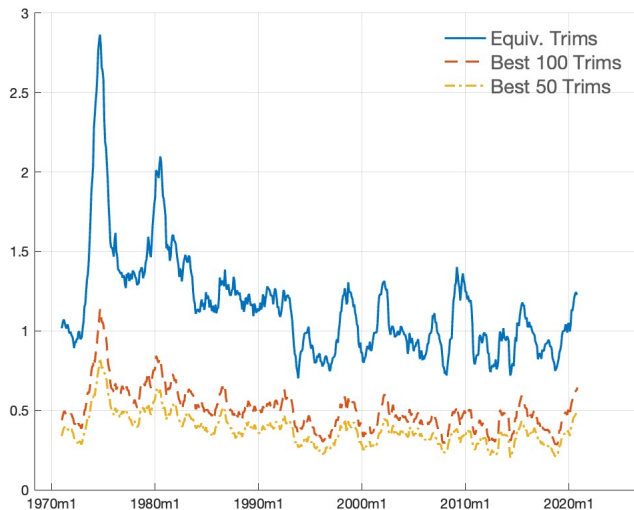Back to Current Trend

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
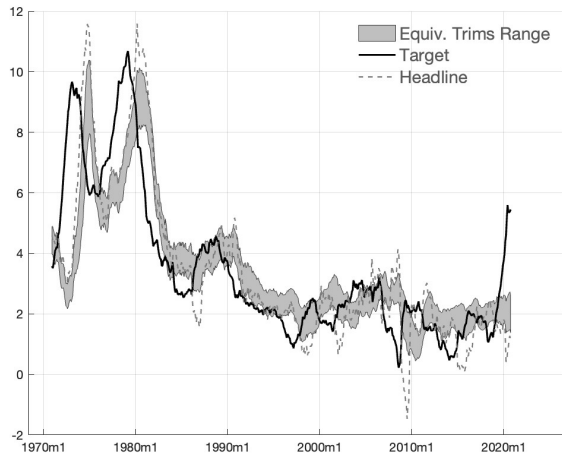
Back to Future Trend

Range of Inflation Predictions

- Range≈50bp for trimmed mean across these 50 trim combinations

- Range>100bp for trimmed mean across trims statistically equivalent to best trim

- Large spikes over time for the range

Back to Current Trend

Time Series of Robust Inflation Range: Future Trend

Range Targets Future Trend 1970-2022

- Average range of equivalent trims $\approx$ 60bp

- Range lags changes in targeted trend inflation (more so for future trend)

- Range goes up to 1.16pp for future trend

Back to current trend series