How Robust Are Robust Measures of PCE Inflation

Sergio Ocampo
Western University

Raphael Schoenle
Brandeis University and CEPR

Dominic Smith
Bureau of Labor Statistics

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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 institutions develop robust measures of inflation
  - Drop some expenditure categories from inflation
  - Eliminate transitory variation and provide information on trend movements
  - Examples: Trimmed mean inflation, median inflation, core inflation

What We Do

1. Construct long series of 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. Alternative Trimmed Mean Measures
   - Choose trims targeting the behavior of trend inflation
   - A range of trims deliver similar prediction error over time...
     However, significant variation in level predictions in any month
   - Best trims are slightly asymmetrical and higher when targeting future trend inflation

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)
- Capture 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)

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

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

Official Robust Inflation Series

Dallas FED Trimmed Mean Inflation:

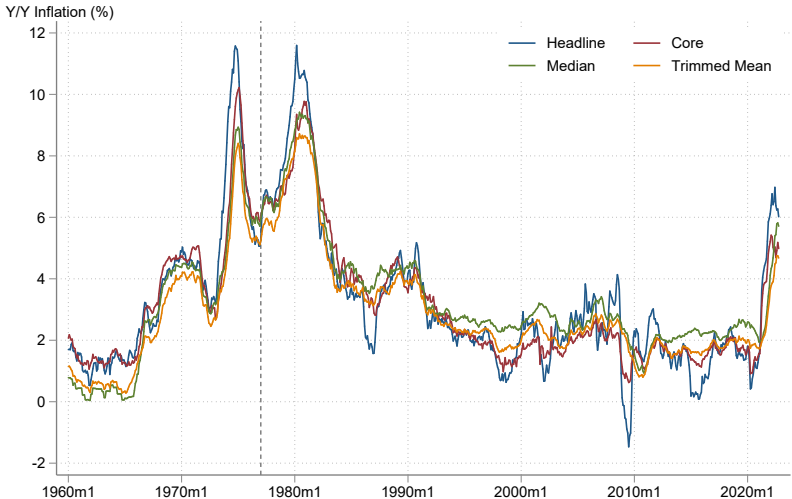
- Trim out the $\alpha = 24\%$ lowest and $\beta = 31\%$ highest inflation categories
- Trims chosen based on prediction of trend inflation (1977-2005)

Cleveland FED Median Inflation:

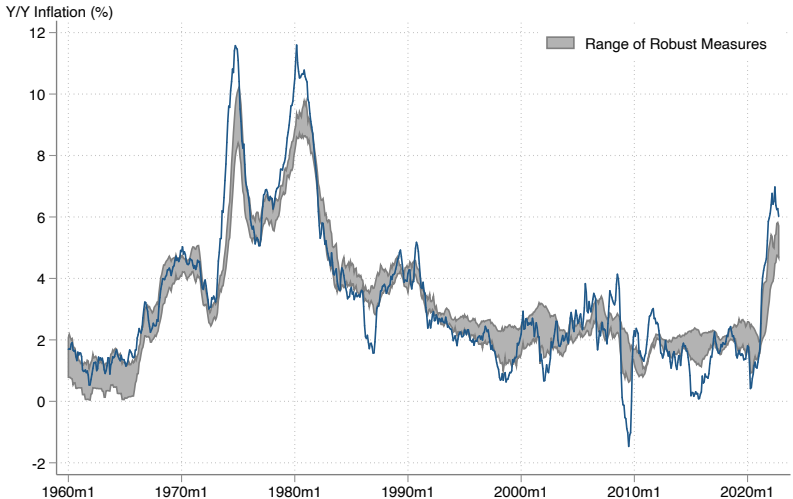
- Equivalent to trimming out trimmed mean inflation with $\alpha = \beta = 50\%$

Excluded Categories

Long Series of Robust Measures of Inflation



Agreement Between Series



Series differ often from headline inflation + Range across series≈0.85pp

(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
2. **Future trend inflation:** Forward moving average (12-24 months ahead)
   - Alternative: forward moving average (0-24 months ahead)

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

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

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

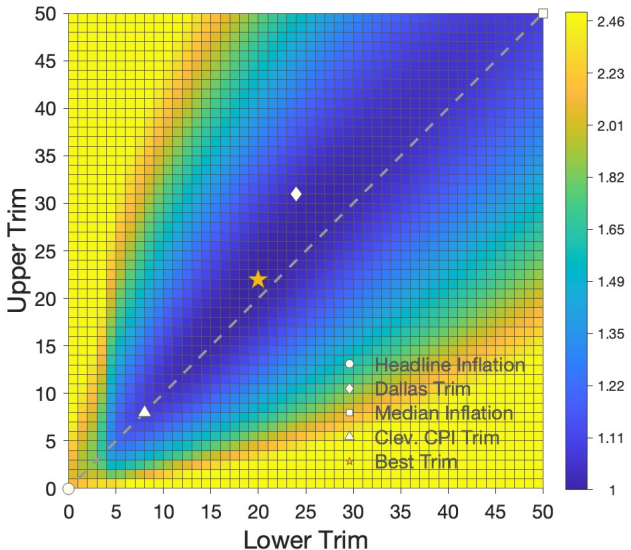
Optimal Trims details

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	22	29	0.74	0.474
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

- 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

Optimal Trims for Predicting Current trend 1970-2022

RMSE relative to optimal trim

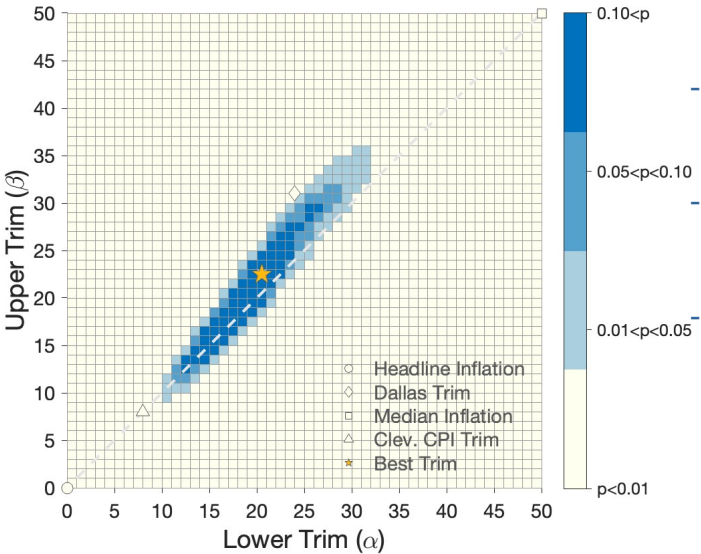


- Wide range with similar RMSE (blue area)
- Slightly asymmetrical trims are optimal (higher upper trim)
- Optimal Trim: $(\alpha, \beta) = (20\%, 22\%)$
- Range of best 50 trims $\approx$ 40bp

Level Range | Predicting Future Trend | Why is RMSE flat?

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 | Predicting Future Trend

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	1.02	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

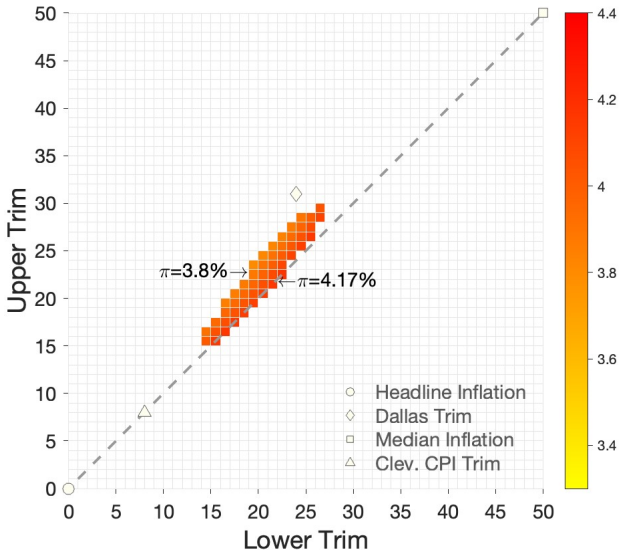
Best trims details

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?

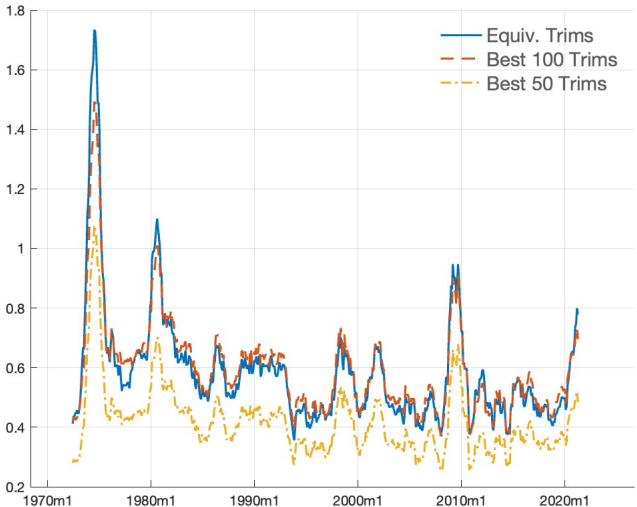
Trimmed Mean inflation October 2022 for top 50 trims



- Asymmetrical trims: Trim more high-inflation
- Trim between 12-27%
- Range≈40bp for trimmed mean across these 50 trim combinations

Back to Current Trend

Range of Inflation Predictions

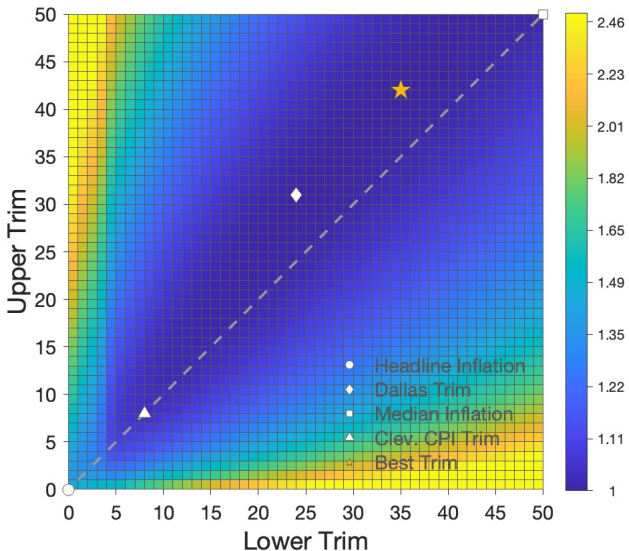


- Range≈40bp for trimmed mean across these 50 trim combinations
- Range≈60bp for trimmed mean across trims statistically equivalent to best trim
- Large spikes overtime on the range

Back to Current Trend

Optimal Trims for Implied Future Trend 1970-2022

RMSE relative to optimal trim

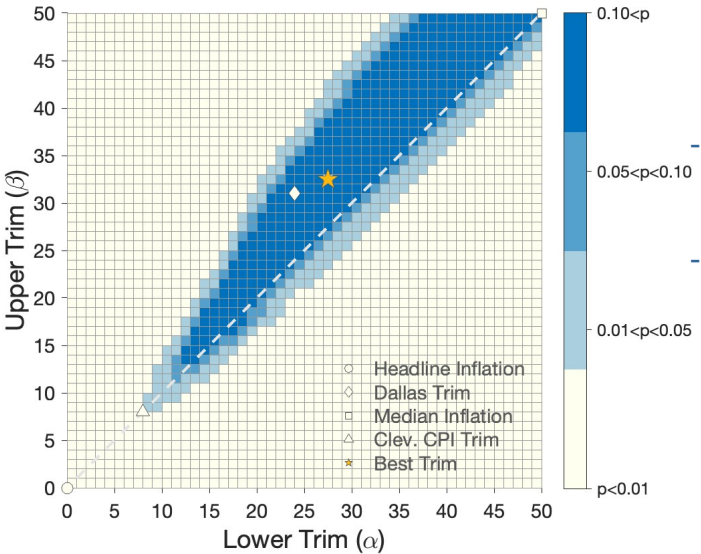


- Optimal Trim: $(\alpha, \beta) = (27\%, 32\%)$
- Forecasting is an equalizer for the error

Level Range Details | Back to Current Trend

Range of Equivalent Trims: Future trend 1970-2022

Test of RMSE relative to optimal trim

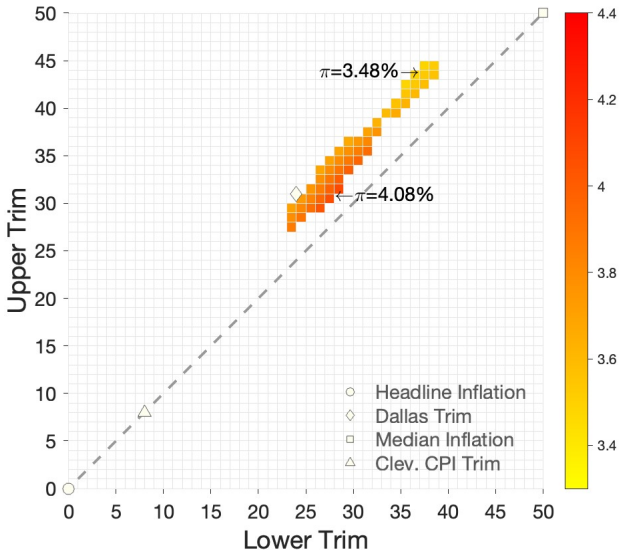


- Diebold-Mariano test for difference of RMSE
- Set of equivalent trims is wider! ($\alpha, \beta \in [10, 50]$)

Back to Current Trend

What About Implied Levels of Future Trend?

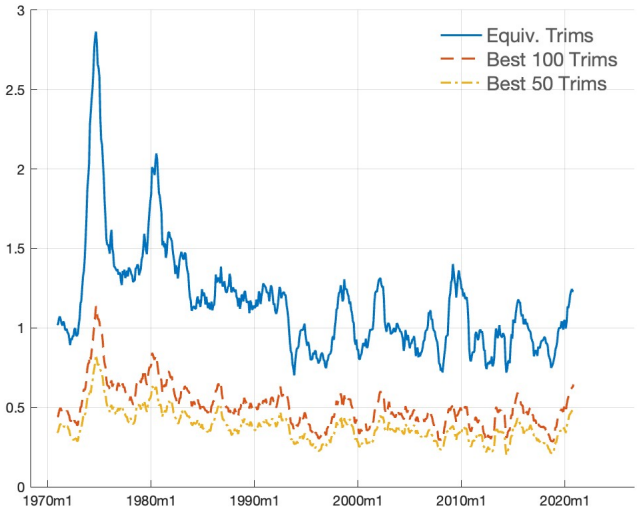
Trimmed Mean inflation October 2022 for top 50 trims



- **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

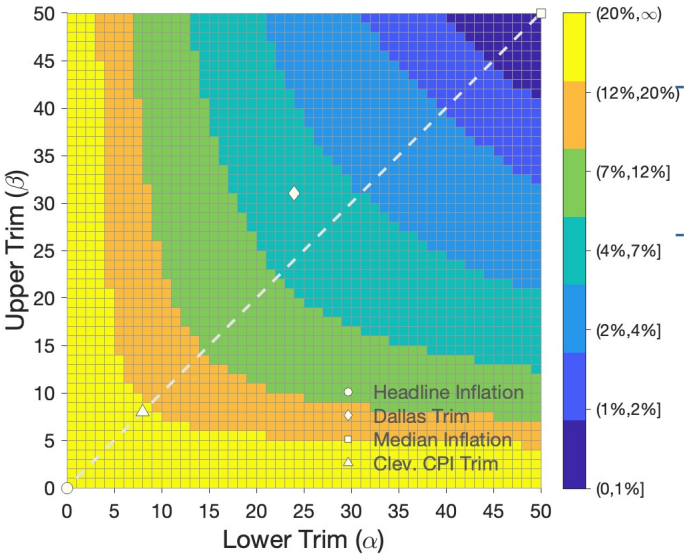
Back to Current Trend

Excluded Categories back

	Median	Trimmed Mean	Middle 90% (10, 10) Trim
		Most Commonly Excluded	
1	71 series	Eggs	Eggs
2	never median	Food on farms	Vegetables
3		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 purchased meals	Other purchased meals	Other purch meals
3	Tenant-occ homes	Owner-occ mobile homes	Tenant-occ homes
4	Nonprofit hospitals	Casino gambling	Casino gambling
5	Physician services	Tenant-occ homes	Lotteries

Why Do So Many Trims Deliver Similar Outcomes?

Range of Inflation by Trim: $\pi_{1-\beta} - \pi_{\alpha}$



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

Back to Current Trend