



Tradeoffs and Sacrifice over Rate Cycles: *Activity, Inflation and the Price Level*

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Motivation



- **Understand tradeoffs facing central banks around activity & inflation**
 - Why do they vary over time & across countries?
 - Focus: strategies for monetary policy during tightening phases
- **Extensive literature on monetary policy tradeoffs**
 - ***too many papers to cite***
 - *Phillips curve tradeoff* between activity and inflation
 - “*Sacrifice ratio*” measuring output losses per inflation reduction
Ball 1994, Cecchetti and Rich 2001, Cecchetti et al 2023, Tetlow 2024
 - *Literature on what affects these tradeoffs*
 - Inflation expectations (Reis 2022, Afrouzi et al. 2024, Beaudry et al 2024, Romer & Romer 2024)
 - Shocks affecting economy (Adolfson et al 2008, Bandera et al 2023, Forbes et al 2024)
 - Slower moving factors: globalization, labor market, exchange rate



This Paper: Role of the Price Level



- **An additional factor in evaluating tradeoffs: Δ PRICE LEVEL**
 - Accumulated change in inflation rates (above 2%)
 - “Successful” return of inflation to target can correspond to very different changes in price level

- **Recent research (and votes) highlights the importance of the price level for households, firms, politics....**
 - Households believe inflation diminishes purchasing power and is “unfair”
Coibion et al 2023, Stantcheva 2024, Binetti et al 2024; Cournede & Moccero 2009, Honkapohja & Mita 2020
 - Non-linear effects of price shocks: larger shocks cause more frequent price adjustments, more attention to inflation, weaken inflation anchor
Khalil and Lewis 2024, Alvarez et al 2024, Burns et al 2021, Beaudry et al 2024
 - Elevated inflation → voting gains for anti-system & populist parties
Federle, Mohr and Schularick (2024)



Approach: 4 Sections of Paper



- 1. Construct a new database of “rate cycles” for 24 advanced economies**
 - A rate cycle consists of a tightening and easing phase
 - Monthly data for 1970-2024
- 2. Analyze these “rate cycles” over time & across countries**
 - Central bank strategies
 - Macroeconomic developments
- 3. Study the tradeoffs for central banks during tightening phases**
 - Inflation, output gaps, Sacrifice Ratios and **price level**
- 4. Examine why these tradeoffs change over time and vary across countries**
 - Focus: role of different central bank strategies
 - Simple regressions + FRB/US simulations



Key Findings



Characteristics of Rate Cycles have evolved over time

- Had become more muted.....until post-pandemic tightening

Unusual macro tradeoffs during post-pandemic tightening

- Sharp reductions in inflation combined with historically low output losses
 - record low Sacrifice Ratios
- But largest increases in price level since early 1980's
- Most of adjustment through prices (vs. activity/employment)

What explains these patterns & tradeoffs across countries and time?

- Central bank strategy: timing of “liftoff” and aggressiveness of rate hikes
- Central bank credibility
- Consistent with post-pandemic adjustment & FRB/US

Implications for central bank strategies for tightening & frameworks

- More consideration of accumulated impact **on price level**
 - Albeit not necessarily price level or nominal GDP targeting





Defining Rate Cycles

(update from Sintra 2024 paper, “Rate Cycles”)



Methodology and Data



Adapt business cycle methodology identifying local peaks/troughs in policy interest rates

- Use BBQ algorithm proposed by Bry and Boschan (1971) and developed in Harding and Pagan (2002)
- Incorporate information on balance sheet policies

Sample: 24 advanced economies, data from Jan 1970 – Dec 2024

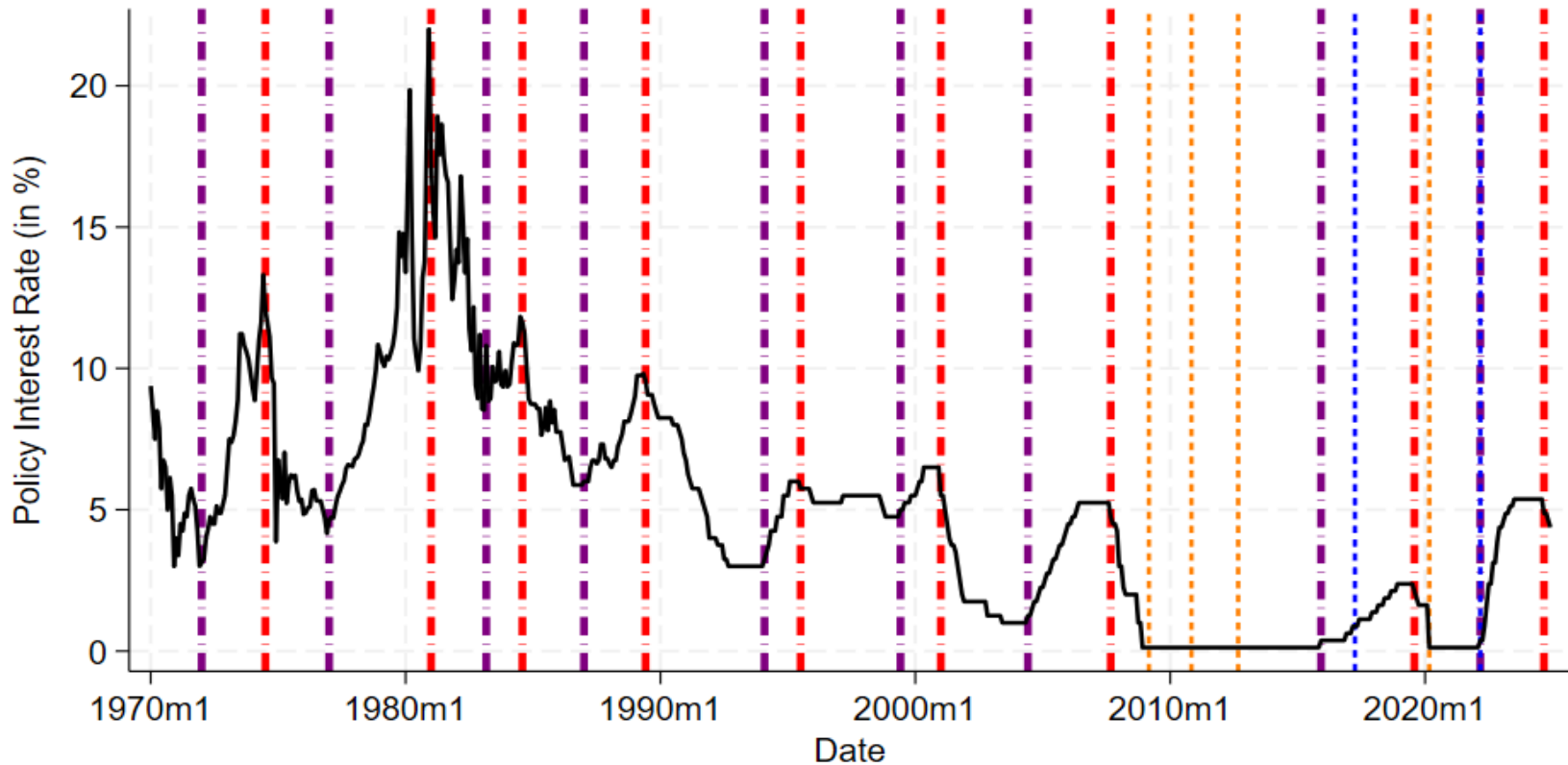
- Individual euro area countries through 1998, euro area from 1999

Result: a database of “rate cycles”

- 223 distinct phases (112 tightening and 111 easing)
- **Useful tool for future research**



Rate Cycles in the US



Notes: Purple/red are start of hiking/easing phases. Orange/blue are dates of QE/QT announcements.





Characteristics of Rate Cycles



Characteristics of Rate Cycles



Statistics on central bank strategies

- *Duration*: length of phase
- *Amplitude*: total change in rates
- *Number of rate changes*
- *Pace*: average size of rate changes
- *Initial velocity*: rate change over 1st 6 months
- *Holding period*: length rates on hold at phase end

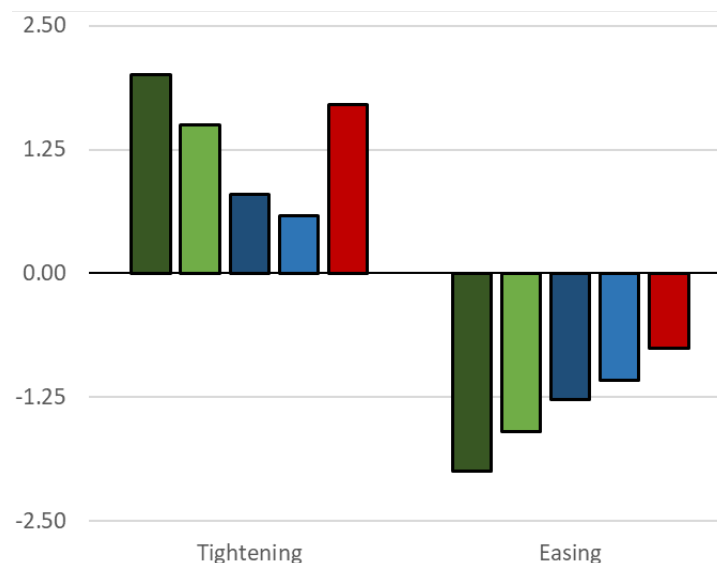
Evolution of macroeconomic variables

- Activity (GDP & IP growth)
- Labor market (employment, unemployment)
- Inflation (headline, core)

Many comparisons

- Across countries
- Across easing & tightening phases
- Changes over time

Initial Velocity of Rate Phases
Hikes over 1st 6 months of tightening phase



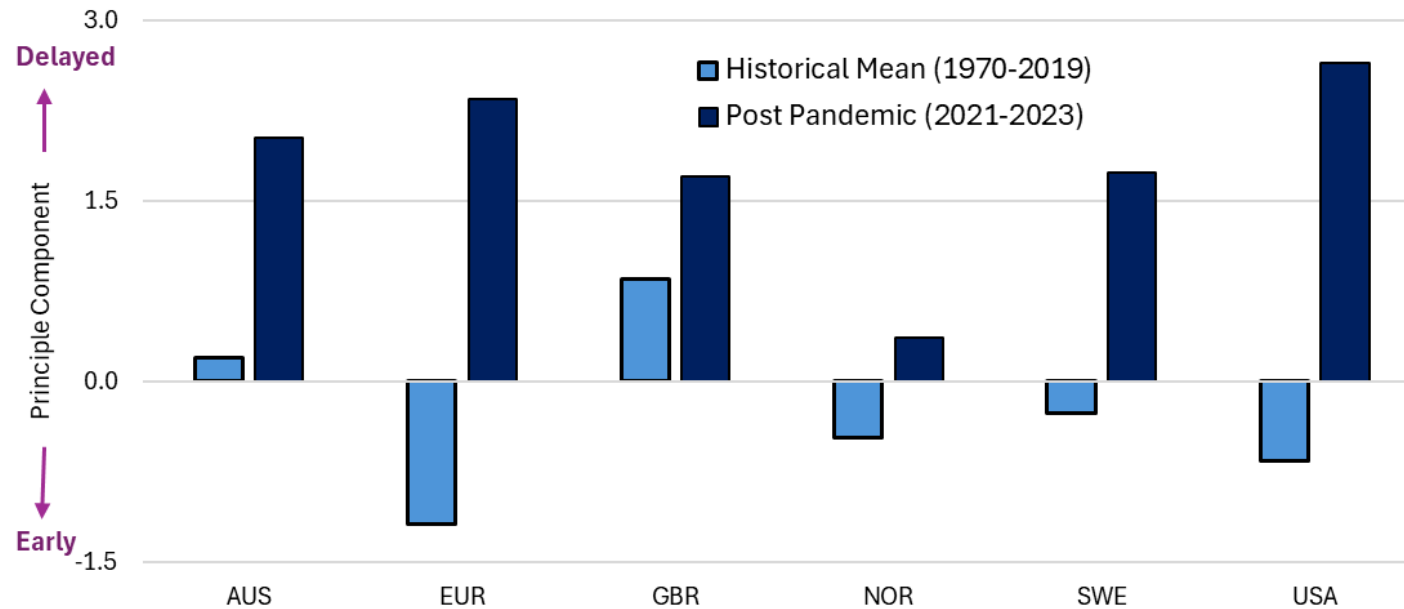
■ 1970-1984 ■ 1985-1998 ■ 1999-2007 ■ 2008-2019 ■ 2020-2024



New Measure: Timing of First Rate Hike



Timing of First Rate Hike
(Relative to macroeconomic indicators)



Notes: A higher value of the index indicates a slower start to the tightening phase based on the underlying macroeconomic variables. This index is calculated as the first principal component of four macroeconomic indicators that can influence the timing of the first rate hike: headline inflation, core inflation, the unemployment gap, and output gap.





Tradeoffs over *Tightening* Phases



Sacrifice Ratios, Inflation & Negative Output Gaps



For each country and tightening phase (plus 12-month lag):

Inflation Reduction (IR): $IR_{cp} = \pi_{cp}^{IP} - \pi_{cp}^{IT}$

with *Inflation Peak* $= \pi_{c,p}^{IP} = \max(\pi_{cp})$ and *Inflation Trough (subsequent)* $= \pi_{c,p}^{IT} = \min(\pi_{c,p,t})$

Based on monthly CPI index (PCE for US) or core

Accumulated Negative Output Gap (ANOG): $ANOG_{cp} = (\sum_{t=0}^x OG_{ct})/12$, for $OG_t < 0$

with OG_{ct} = output gap in month t for country c

Baseline measure of output gap: HP filter, based on data from Havers

- 5 alternate measures: other filters (Hamilton, Baxter-King); other data sources & calculation methods; unemployment & employment gaps

Sacrifice Ratio (SR): $SR_{cp} = ANOG_{cp} / IR_{cp}$

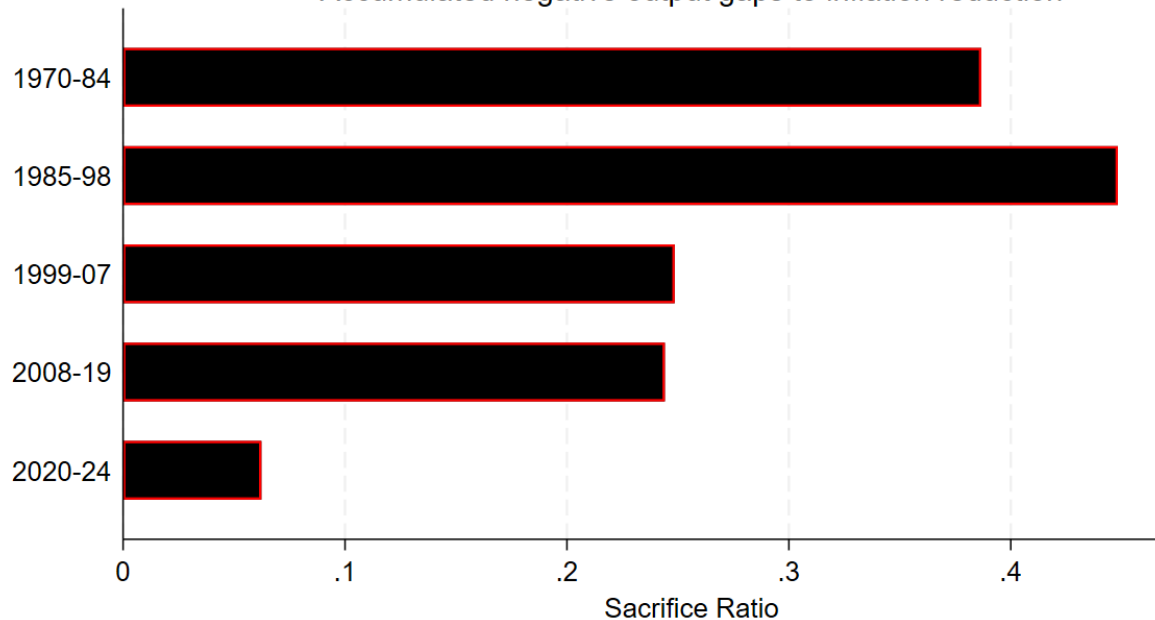
Cumulative output losses per inflation reduction



Median Sacrifice Ratios over Time



Median Sacrifice Ratios During Tightening Phases
Accumulated negative output gaps to inflation reduction

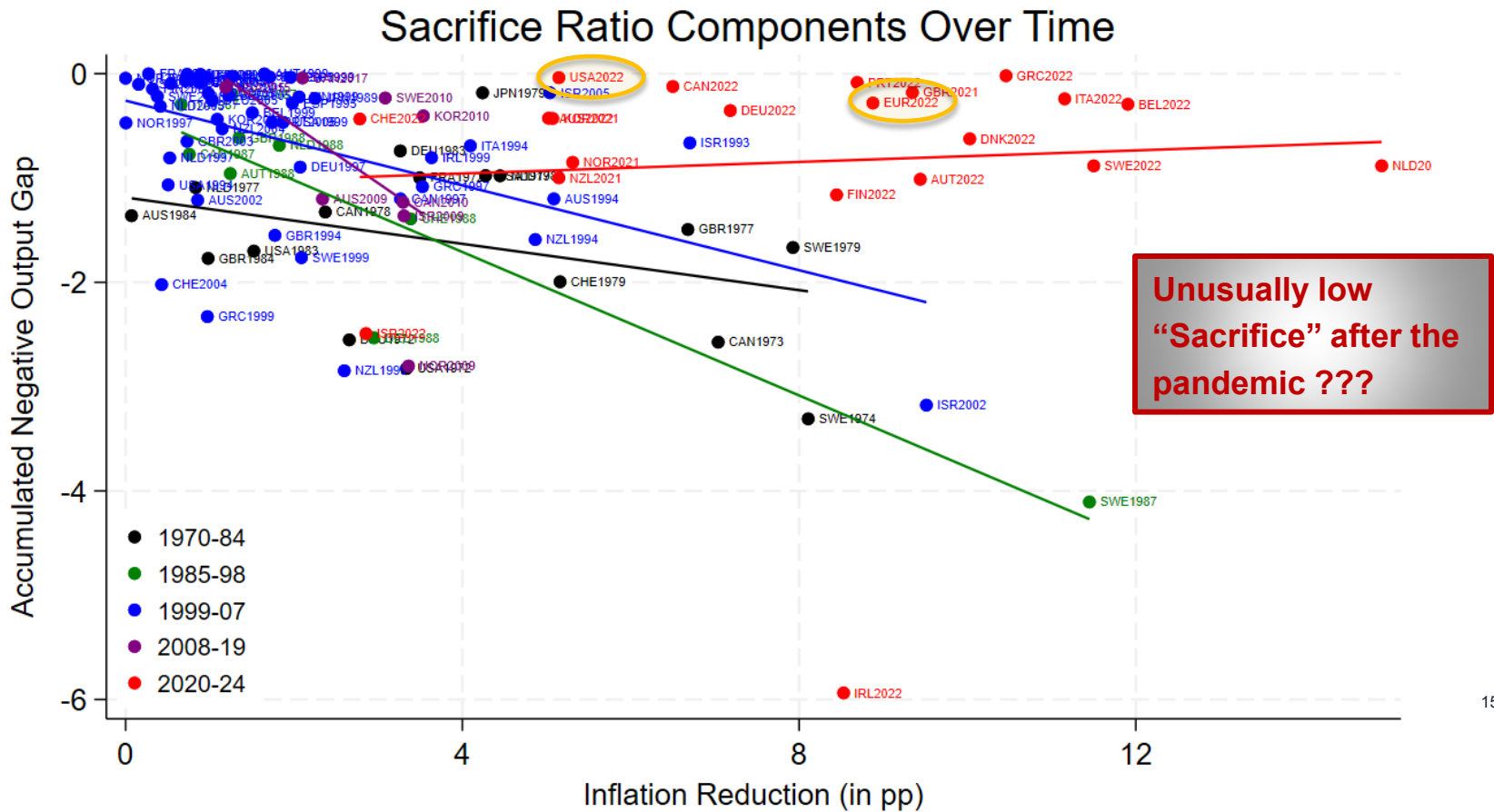


Pattern holds for core inflation & 6 measures of output gap

Notes: Sample of 24 advanced economies. Inflation is from peak to subsequent trough for CPI inflation (and PCE for US). Output gaps based on HP filter. Window is each country's tightening phase plus a 12-month lag.



Closer Look at Sacrifice Ratio Components



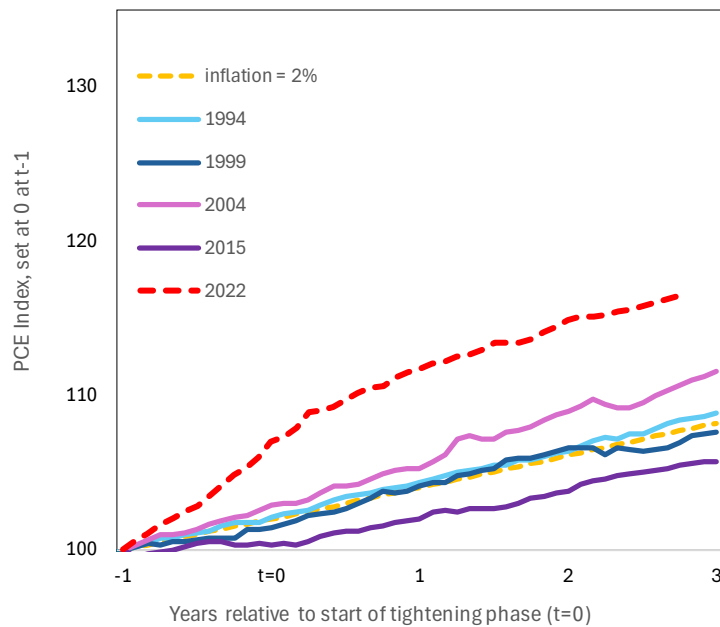
What's Missing? Impact on the Price Level



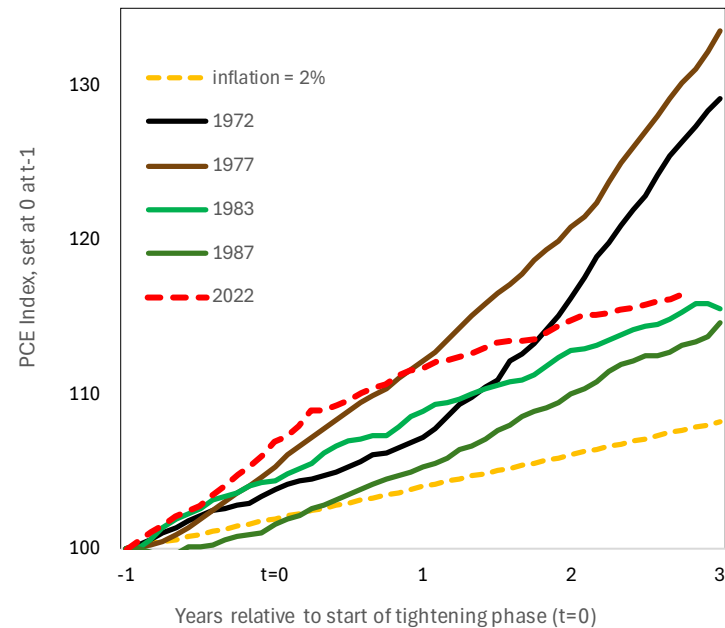
The Evolution of the US Price Level

Based on the PCE price index

Post-1990 Tightening Phases



Pre-1990 Tightening Phases

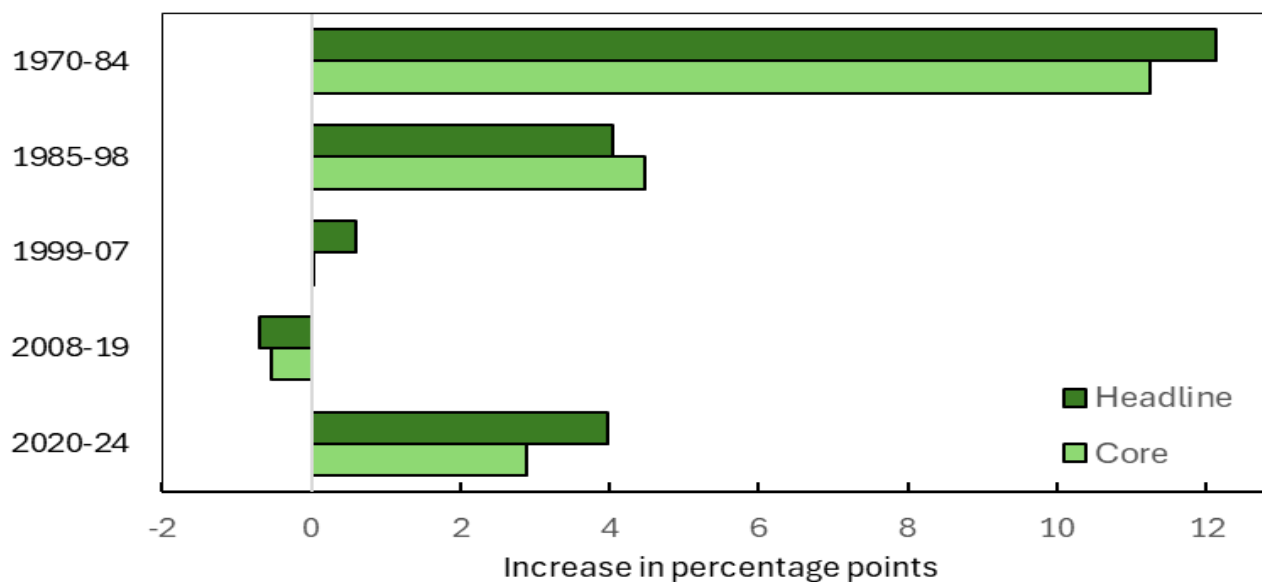


Impact on the Price Level: Across Countries



Median Accumulated Excess Price Level Change during Tightening Phases

(Annualized, in excess of inflation at 2%)



Notes: Median across the sample of 24 advanced economies. Excess price level change is calculated over each country-phase for tightening periods, starting from a 12-month lead before the first rate hike and ending after a 12-month lag after the tightening phase ends.

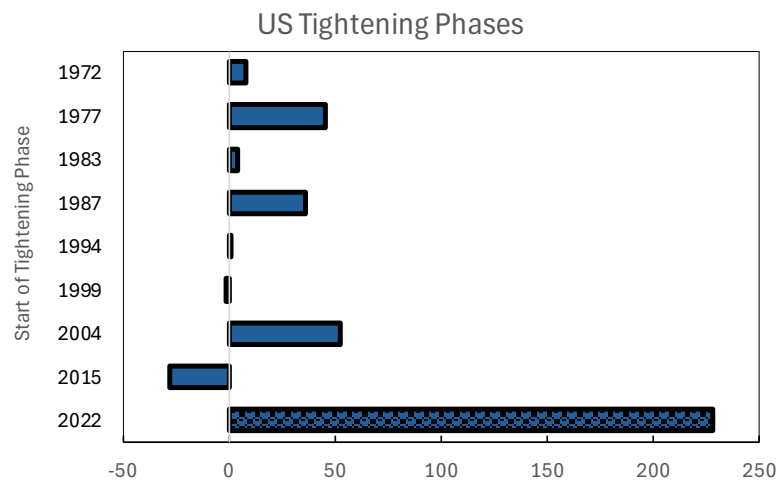
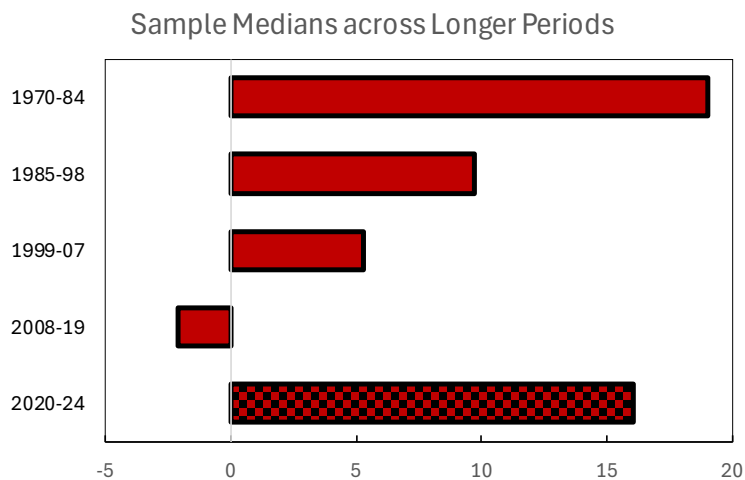


Post-Pandemic: Different Tradeoff



Price-Output Tradeoff Ratios during Tightening Phases

(Ratio of Excess Price Level Change to ANOG)



Closest precedent: “Phillips curve multiplier” in Barnichon and Mesters (2021): expected cumulative change in inflation caused by a monetary shock that lower expected unemployment by 1pp

Notes: The Price-Output Tradeoff Ratio is calculated as the ratio of the Excess Price Level Change (relative to that which would occur if inflation was 2%) to the Accumulated Negative Output Gap (ANOG) over each tightening phase. Output gaps are based on the HP filter. The headline and core price indices are based on the monthly CPI indices for all economies except the US (which is based on the PCE indices).





Explaining Tradeoffs



Explaining Tradeoffs across Countries and Time



What drives these “Tradeoffs” over time and across countries?

– For Sacrifice Ratio (and components) and Accumulated Price Level Change (vs 2%)

$$\text{Tradeoff}_{cp} = \alpha + \beta * \text{CB_Strategy}_{cp} + \delta * \text{Country_Characs}_{cp} + \gamma * \text{OilShocks}_{cp} + \varepsilon_{cp}$$

- **Focus: Central Bank Strategy**

- **Timing of first rate hike:** relative to evolution of macroeconomic variables
- **Aggressiveness of rate hikes:** first principal component based on 5 characteristics of rate cycles (from above)
 - # rate hikes, pace, total amplitude, initial velocity, use of “supersized” hikes

- **Other control variables:**

- Country Characteristics (from prior literature explaining traditional Sacrifice Ratio): **central bank credibility**, trade and financial openness, exchange rate regime, labor market flexibility
- Shocks: focus on global oil shocks (normalized in terms of total variance); many others

- **Details:** Data for 1970-2024 for 23 countries (include individual EA members)

- Standard errors clustered by country and over the five long periods



Key Results



Policy <i>green/good, red/pain</i>	Sacrifice Ratio	Output Losses (accumulated)	Inflation Reduction	Excess Price Level Change (accumulated)
Delayed liftoff	Green	Grey	Green	Red
More aggressive hikes	Red	Red	Green	White
Central bank credibility	Green	Green	White	Light Green

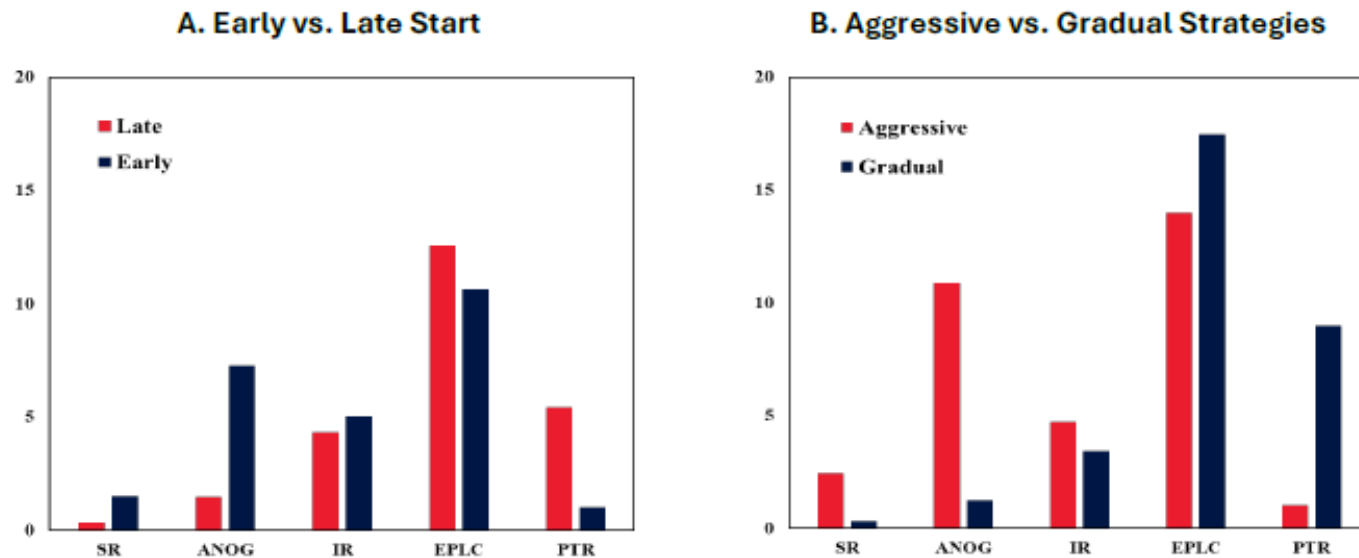
- **Important caveats:**
 - Limited observations/omitted variables, endogeneity
 - No controls for fiscal/other govt policies & easing of supply constraints
- **Results robust to extensive series of sensitivity checks**
- **Results consistent with post-pandemic adjustment**
- **Results supported by simulations with FRB/US model**



Consistent with FRB/US Simulations



Simulated Effects of Different Rate Central Bank Strategies on Tradeoff Variables



Source: Authors' calculations based on the FRB/US model as explained in Brayton, Laubach, and Reifschneider (2014) and Laforte (2018). See underlying simulations in Appendix Figure 2. **Notes:** The estimates are based on the impulse response functions of US variables following the simulated impacts of a monetary policy tightening of 450 bps. The total increase in interest rates is the same in both scenarios, but has different starting dates for the first rate hike for Panel A and has a different aggressiveness of tightening (i.e., path for the rate hikes) for Panel B. "IR" = Inflation Reduction (in pp), "ANOG" = Accumulated Negative Output Gap (in % of GDP), "EPLC" = Excess Price Level Change (in % in excess of 2%), "SR" = Sacrifice Ratio (calculated as the ANOG/IR), and "PTR" = Price-Output Tradeoff Ratio (calculated as the EPLC/ANOG).





Conclusions and Policy Implications



Final Thoughts



New database and information on “Rate Cycles” over 55 years

- Useful to address range of questions

Central banks often face tradeoffs during tightening phases

- Central bank credibility is the one “pain free” policy

Central bank strategy post-2020 helps explain subsequent macroeconomic developments

- Delayed “lift off” followed by aggressive hikes in “credible” central banks
→ low Sacrifice Ratios (but partly from inflation swings) & large increase in price level

More attention should be paid to price level when weighing tradeoffs for monetary policy (ie, length of time and extent to which inflation deviates from target)

- Does not imply strict price level targeting
- But could involve:
 - More explicit discussion/modelling in communication
 - Clarify “price stability” is not just inflation, but length/magnitude of inflation deviations
 - Commit to “more forceful” response when inflation deviates by more/longer in **both** directions
 - Remove constraints in frameworks that limit ability to respond by demoting price stability

Lessons for today?

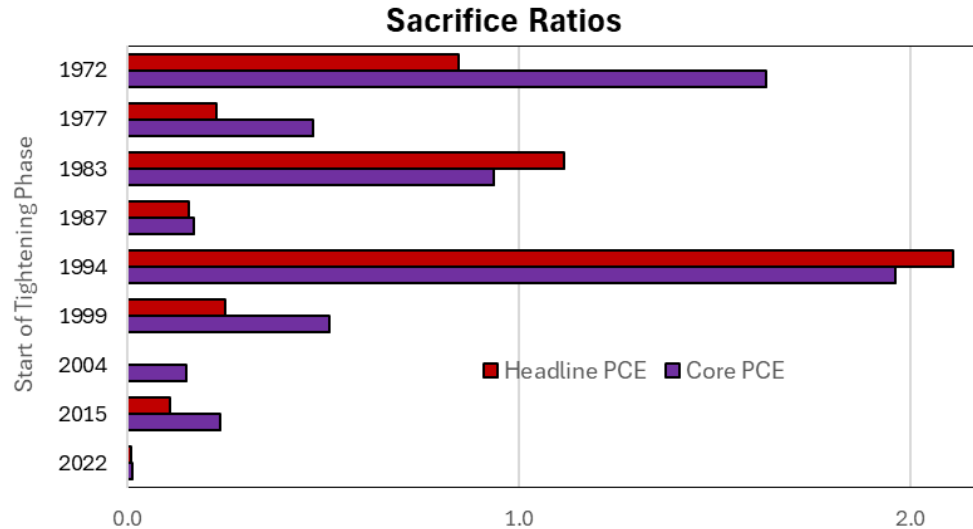




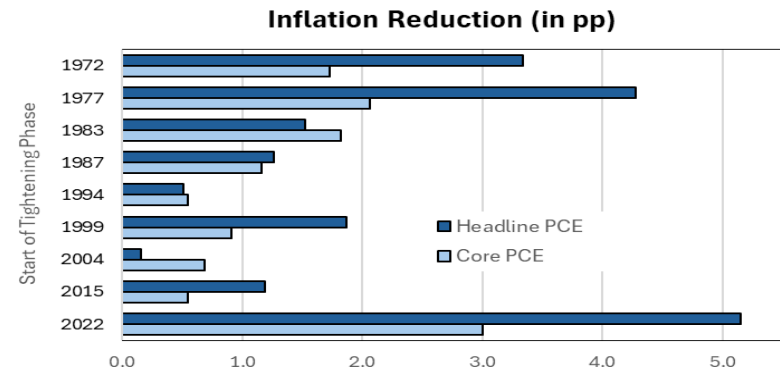
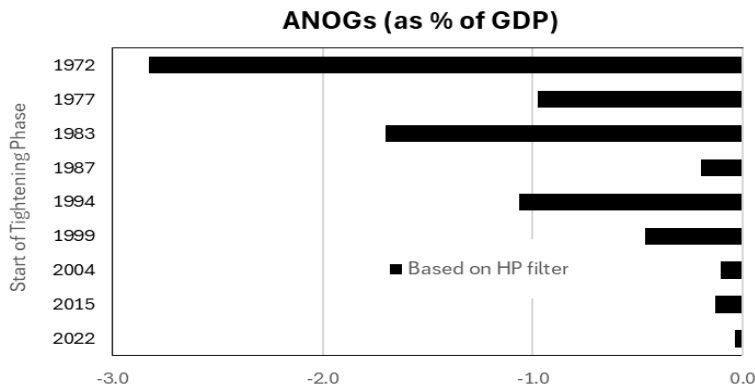
EXTRA



Closer Look at US in Historical Context



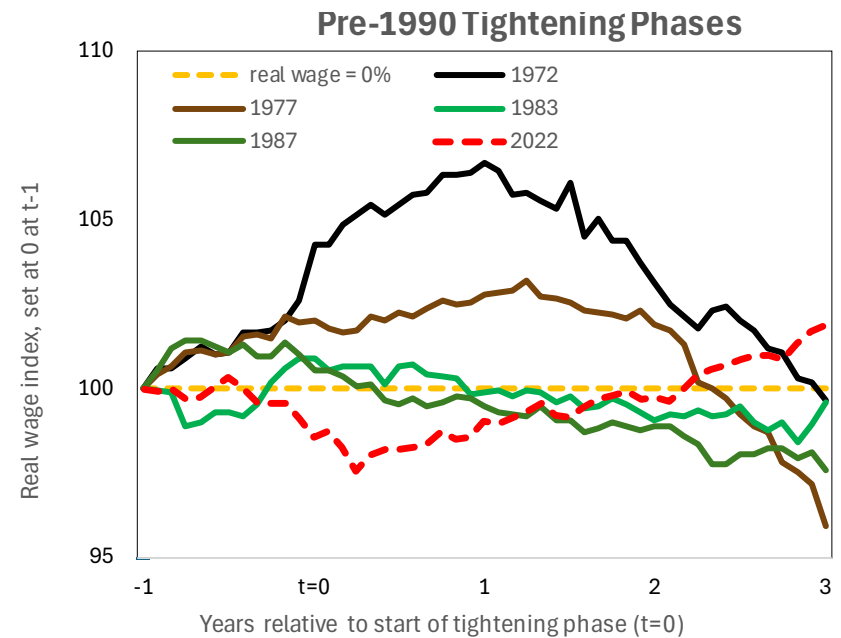
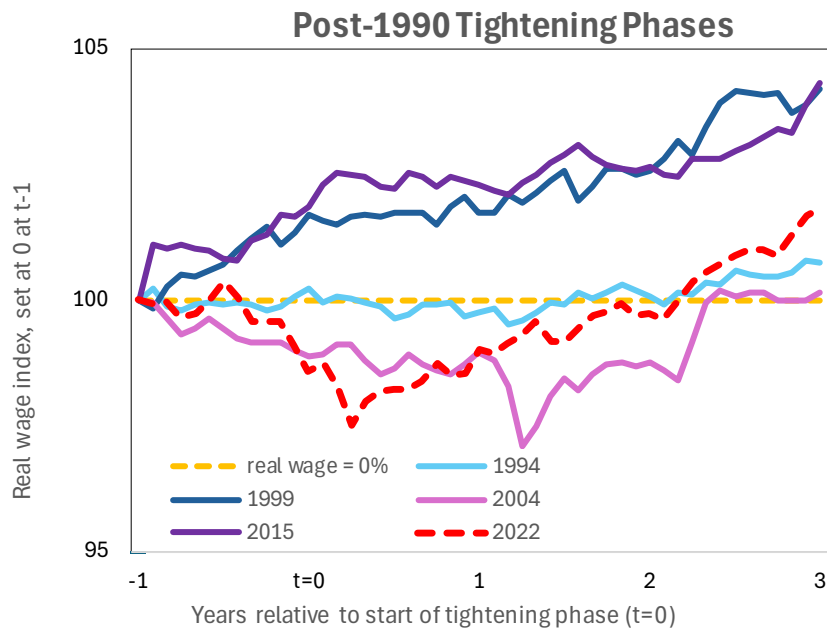
Unusually low
"Sacrifice" after the
pandemic ???



Impact on US Real Wages



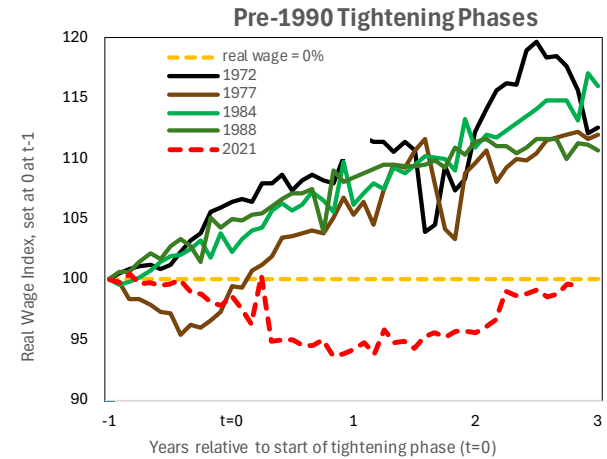
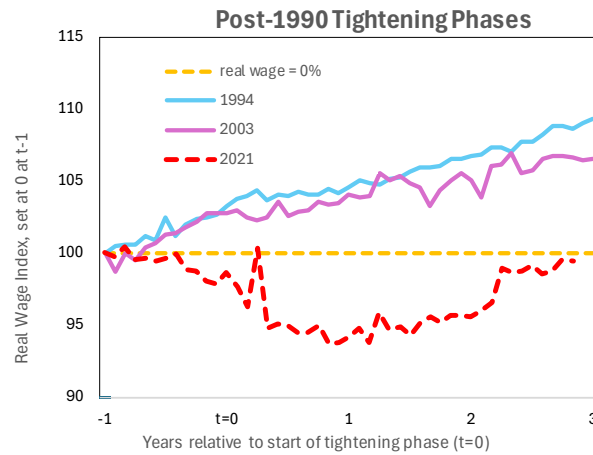
The Evolution of US Real Wages



Impact on Real Wages in UK and Germany



UK Real Wages



German Real Wages

