# Shock Transmissions in Different Inflation Regimes

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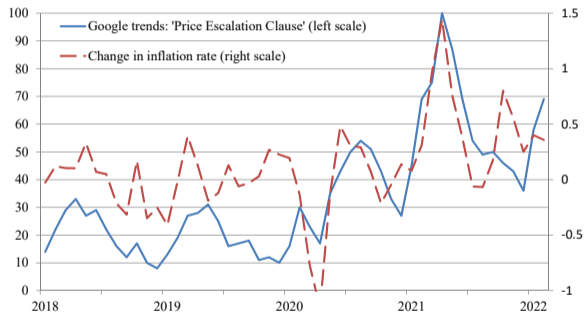
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September 2023 - VfS Regensburg

# Do transmission dynamics change with inflation?

Google Trends Index: 'Price escalation clause'



**Bundesbank Online Panel:**
**34%** of sampled German firms report
to use price escalation clauses from
2021 onward vs. **17%** before 2021

# Policy makers see major changes in inflation dynamics

Philip Lane (November 2022):

"Since the beginning of this year, many contacts also told us that prices would be increased more frequently."

# Inflation Regimes

# Determine inflation regimes via Markov-switching AR

*Aim:* find different inflation dynamics without exogenously conditioning on specific variables

$$\Delta CPI_t = \begin{cases} \nu_1 + A_{1,1}\Delta CPI_{t-1} + \cdots + A_{1,4}\Delta CPI_{t-4} + e_{1,t} & \text{if} \quad s_t = 1 \\ \nu_2 + A_{2,1}\Delta CPI_{t-1} + \cdots + A_{2,4}\Delta CPI_{t-4} + e_{2,t} & \text{if} \quad s_t = 2 \end{cases}$$

$\Delta CPI_t$: CPI in sa mom log differences

# States depend on inflation volatility



State-indicator and monthly CPI growth

State-indicator and inflation volatility
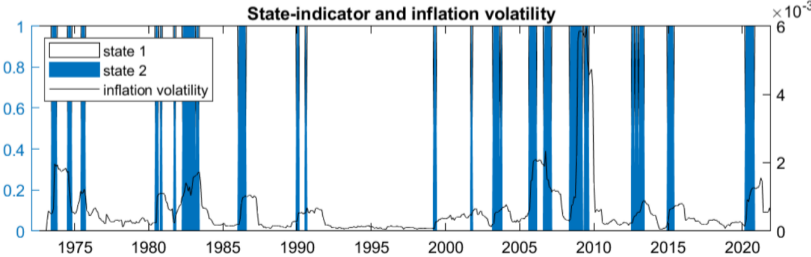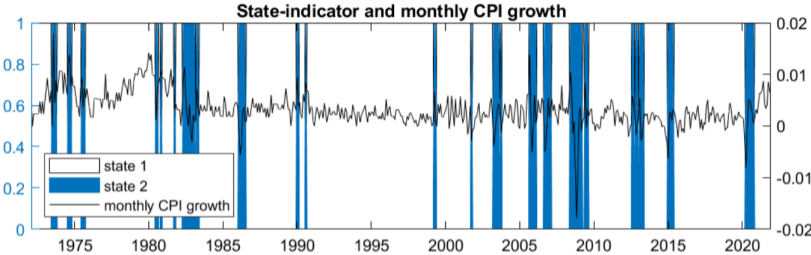
$\rightarrow$ More evidence

# Shock Effects

# Interact fitted values $\hat{x}_t$ with state-indicator $H_t$

*First stage:*

$$x_t = \mu_{FS} + \beta_{FS} Z_t + \sum_{l=1}^{n} \delta_{FS,l}^T W_{t-l} + \epsilon_t \tag{1}$$

*Second stage:*

$$y_{t+h} = \mu_{2,h} + H_t(\beta_{2,h}^1 \hat{x}_t + \sum_{l=1}^{n} \delta_{2,l}^1 W_{t-l})$$
$$+ (1 - H_t)(\beta_{2,h}^2 \hat{x}_t + \sum_{l=1}^{n} \delta_{2,l}^2 W_{t-l}) + u_{t+h} \tag{2}$$

# Data

**Dataset:** CPI, IP & PPI data for stages of production (BLS)

**Stages:** Crude, Intermediate, Finished goods **PPI**
Crude, Primary/semi-finished, Finished goods **IP**

**Coverage:** USA, monthly, 1972M1 - 2021M12

**Controls:** $W_t = 8$ lags of: $y_t$, $Z_t$, $\Delta IP_t$, $\Delta CPI_t$
and $\Delta PPI_t$ of previous & subsequent stage

$\rightarrow$ More details

# Identify PPI shocks with exceptional data movements



**Crude PPI outliers**

Legend: CPI growth, outliers, Crude PPI growth
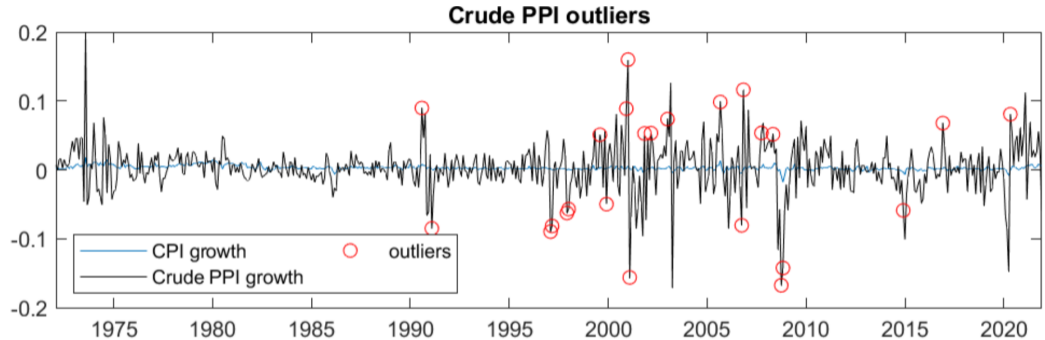
$\rightarrow$ Intermediate and Finished outliers

# Results

# State-dependent effects of PPI shocks on CPI
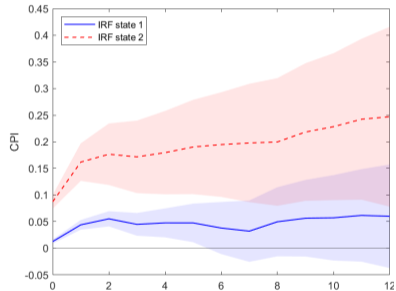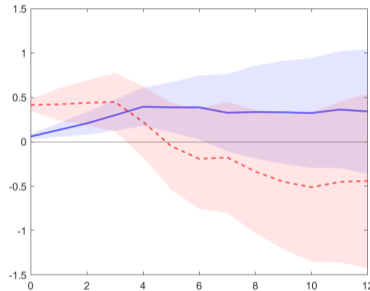


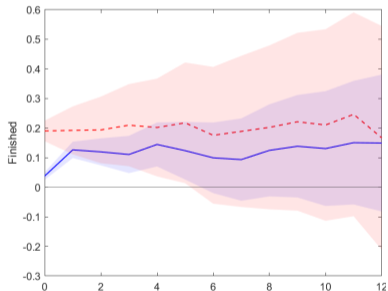Crude PPI　　　　　Intermediate PPI　　　　　Finished PPI
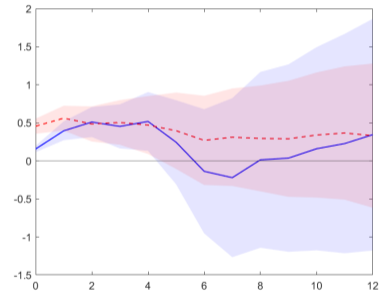
$\rightarrow$ IP response

# Lagging price changes in downstream production stages



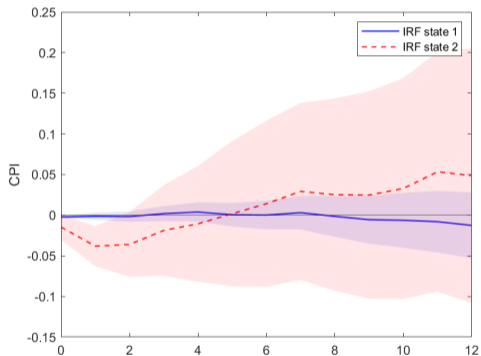Crude → Intermediate PPI      Crude → Finished PPI      Intermediate → Finished PPI
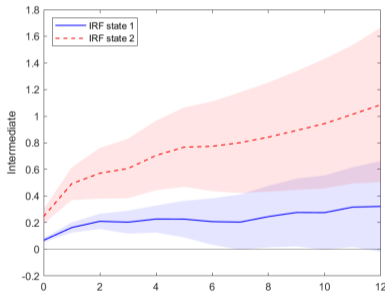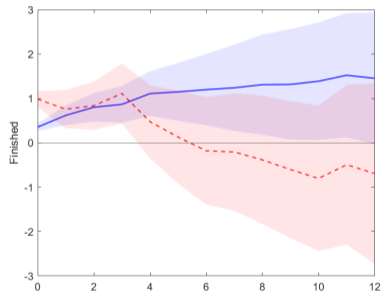
# Monetary Policy

# Using Jarociński & Karadi (2020) monetary policy shocks

$$y_{t+h} = \mu_h + H_t\left(\beta_h^1 shock_t + \sum_{l=1}^{n} \delta_l^1 W_{t-l}\right)$$

$$+ (1 - H_t)\left(\beta_h^2 shock_t + \sum_{l=1}^{n} \delta_l^2 W_{t-l}\right) + u_{t+h}$$

*controls:* 8 lags of IP, CPI, and real exchange rate

# State-dependent effect of an interest-rate increase



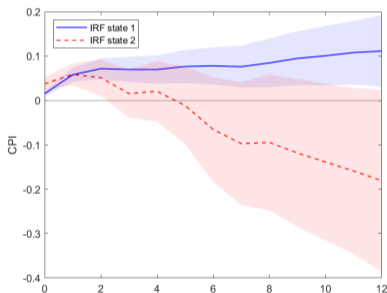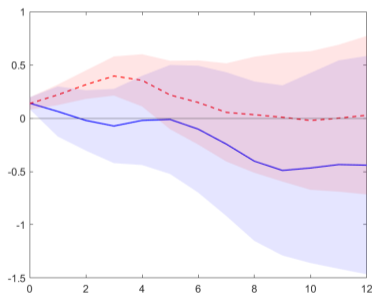Controls w/ $IP_t$ & $CPI_t$

Controls w/o $IP_t$ & $CPI_t$
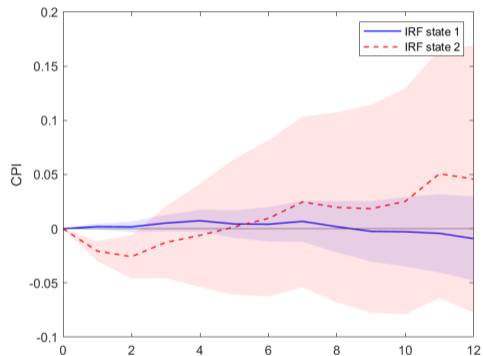
$\rightarrow$ Response of FFR

# Robustness

# *Alternative 1:* regimes depend on *level* of CPI inflation
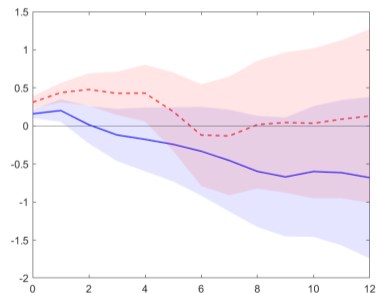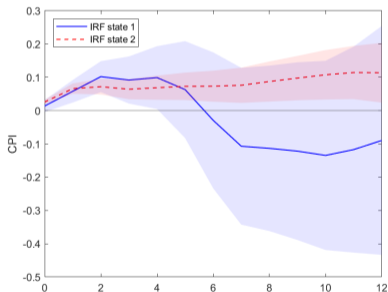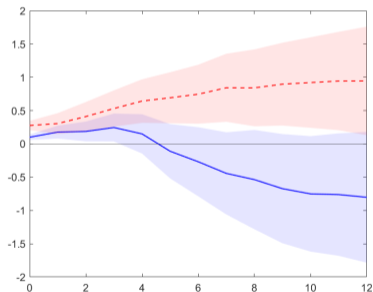
## Regime 1/2: CPI inflation below/above average

# *Alternative 2:* regimes depend on change in *Crude* inflation

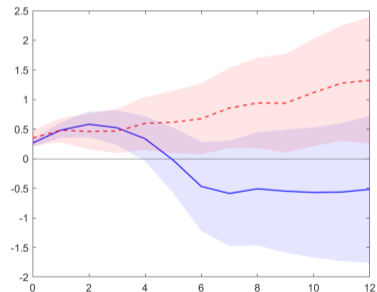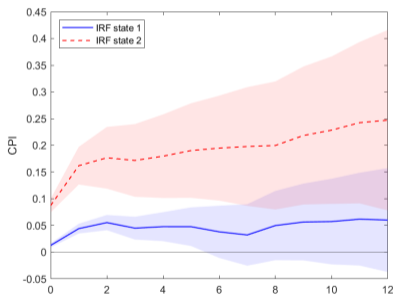Regime 1/2: absolute change in Crude inflation below/above average
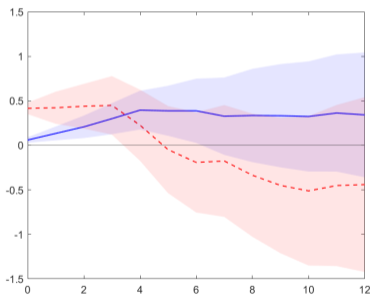
# *Alternative 3:* extended sample length

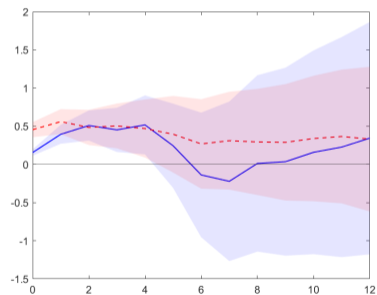## 1948M10 - 2021M12, non-specific IP



Crude PPI       Intermediate PPI       Finished PPI

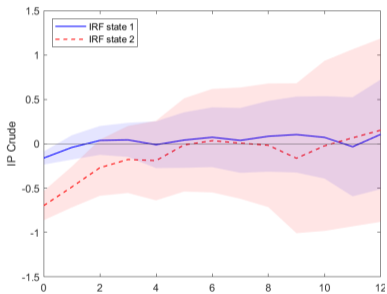$\rightarrow$ More robustness checks

# Conclusion

# Conclusion

We find inflation volatility to change
effects of supply shocks

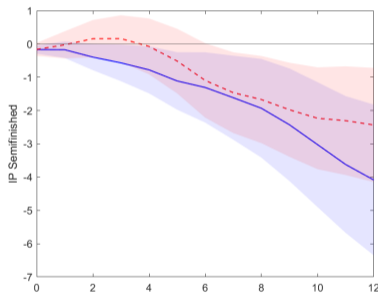$\rightarrow$ Stronger responses in times of high inflation volatility
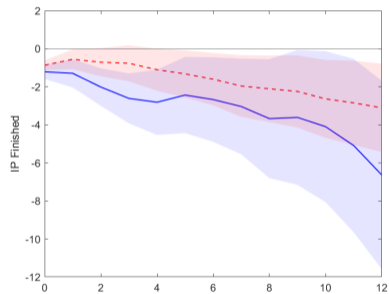
# Appendix

# State-dependent effects of PPI shocks on IP



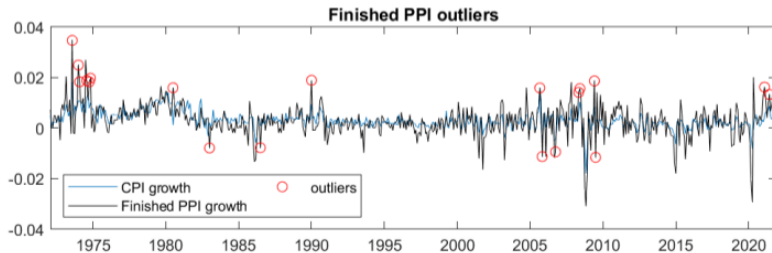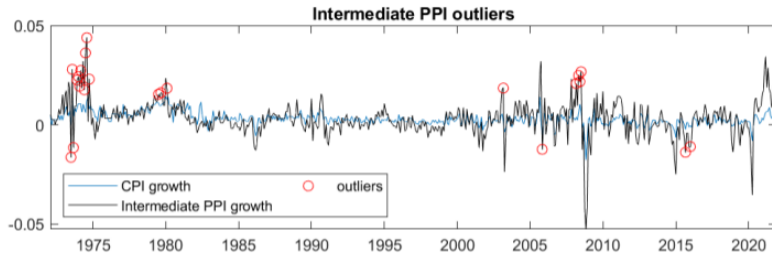Crude PPI · Intermediate PPI · Finished PPI

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# PPI data details

| SOP Code | Title | FD-ID Code | Title |
|----------|-------|------------|-------|
| SOP1000 | Crude materials | ID62 | Unprocessed goods for intermediate demand |
| SOP2000 | Intermediate materials, supplies and components | ID61 | Processed goods for intermediate demand |
| SOP3000 | Finished goods | FD49207 | Finished goods |

Table: Variable description of Crude (SOP1000), Intermediate (SOP2000) and Finished (SOP3000) PPI. More information available here:
https://www.bls.gov/ppi/fd-id/ppi-stage-of-processing-to-final-demand-intermediat
e-demand-aggregation-system-index-concordance-table.htm

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# Outlier in Intermediate & Finished PPI

# States depend on inflation volatility
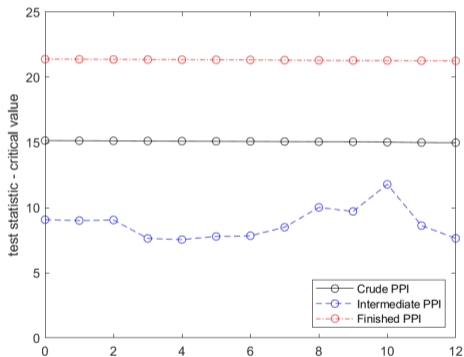
$$Pr(State_t) = c + \sum_{i=0}^{t=10} vol_{t-i}.$$

|         | $\beta$ | p-value |            | $\beta$ | p-value |
|---------|---------|---------|------------|---------|---------|
| const.  | -0.41   | 0.00    | $vol_{t-5}$  | 0.04    | 0.03    |
| $vol_t$   | 0.44    | 0.00    | $vol_{t-6}$  | 0.03    | 0.07    |
| $vol_{t-1}$ | 0.30    | 0.00    | $vol_{t-7}$  | 0.05    | 0.01    |
| $vol_{t-2}$ | 0.18    | 0.00    | $vol_{t-8}$  | 0.05    | 0.01    |
| $vol_{t-3}$ | 0.13    | 0.00    | $vol_{t-9}$  | 0.03    | 0.07    |
| $vol_{t-4}$ | 0.07    | 0.00    | $vol_{t-10}$ | 0.03    | 0.14    |

$R^2$ (and adj. $R^2$)=0.67
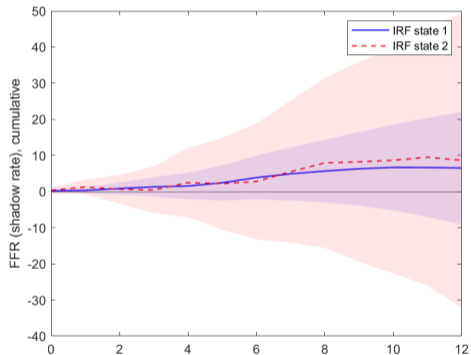
# Weak instrument test (Lewis & Mertens, 2022)
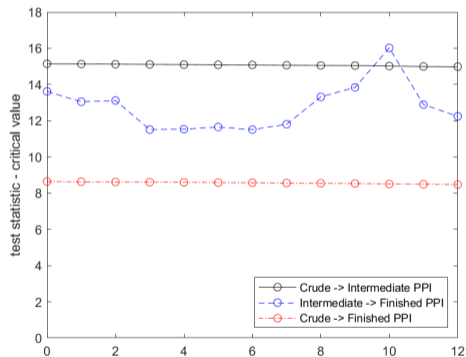
# Effect of an interest-rate increase on the shadow rate

Controls w/ IP$_t$ & CPI$_t$



Controls w/o IP$_t$ & CPI$_t$
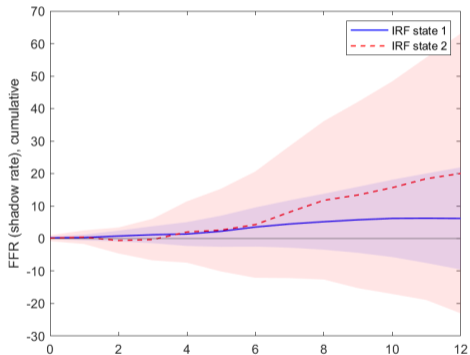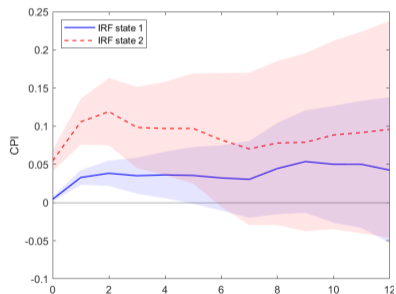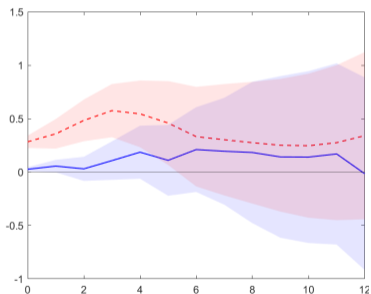


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# Regime definition via inflation volatility

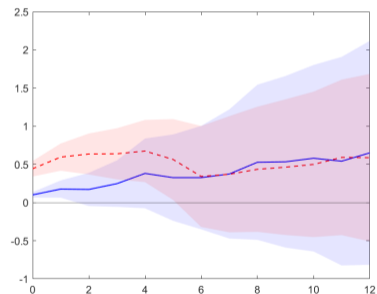Regime 1/2: Crude inflation volatility below/above average
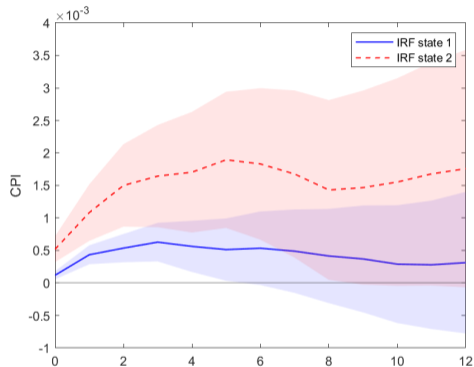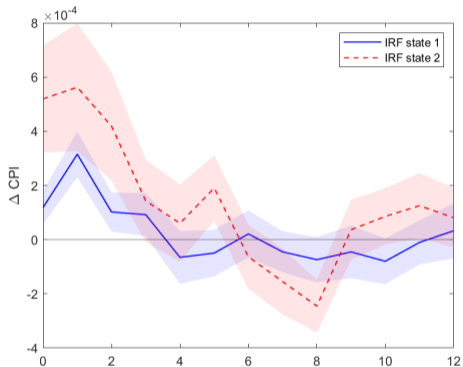


Crude PPI        Intermediate PPI        Finished PPI

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# Effect of an oil-price shock on monthly CPI inflation



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