Price Setting when Expectations are Unanchored

by Abib, Ayres, Bonomo, Carvalho, Eusepi, Matos, and Perrupato

Ina Hajdini*

*Federal Reserve Bank of Cleveland

Bank of Canada Annual Economic Conference

November 7-8, 2024

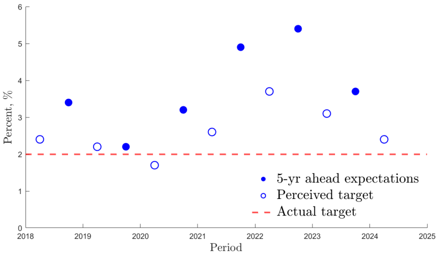
Motivation

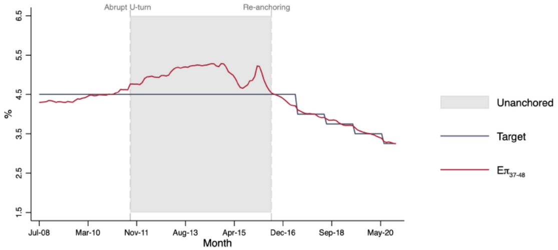
Optimal price under Calvo:

$$p_t = P_t + (1 - \zeta\beta) mc_t + \beta\zeta \mathbb{E}_t \pi_{t+1} + (1 - \zeta\beta)\mathbb{E}_t \sum_{j=1}^{\infty} (\zeta\beta)^j mc_{t+j} + \beta\zeta \mathbb{E}_t \sum_{j=1}^{\infty} (\zeta\beta)^j \pi_{t+j+1}$$

- Optimal price depends on a **lot** more than just current marginal cost & short-term inflation expectations.
- Long-term inflation expectations matter!
- Long-term inflation expectations change over time.

Motivation





Sources: Survey of Firms Inflation Expectations (SoFIE), Federal Reserve Bank of Cleveland; Abib et al. (2024).

SoFIE questions

- During such episodes: need to understand whether/how prices respond differently to shocks to better understand inflation dynamics.

This paper

Q: Do prices respond differently to inflationary shocks when expectations are unanchored versus anchored?

How? Use two datasets:

- Long-run inflation expectations: Focus Survey of professional forecasters.
- Firm prices: PPI micro data.

This paper

Q: Do prices respond differently to inflationary shocks when expectations are unanchored versus anchored?

Yes! Following an exchange rate shock, prices increase by 50% - 60% more in unanchored regimes compared to anchored regime.

	$\Delta_{\tau_i} e_t$ - Nominal Exchange Rate			$\Delta_{\tau_i} e_t$ - Instrumented FX		
Dependent variable: $\Delta_{\tau_i} p_{it}$	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta_{\tau_i} e_t$	0.0410***	0.0225***	0.00822	0.0855***	0.0684***	0.0566***
	(0.00393)	(0.00545)	(0.00568)	(0.00596)	(0.00812)	(0.00886)
$\Delta_{\tau_i} e_t \times \mathbb{1}_t^{Unanch}$		0.0460***	0.0322***		0.0431***	0.0243**
		(0.00805)	(0.00844)		(0.0115)	(0.0120)

Source: Abib et al. (2024).

This paper

Q: Do prices respond differently to inflationary shocks when expectations are unanchored versus anchored?

Yes! Following an exchange rate shock, prices increase by 50% - 60% more in unanchored regimes compared to anchored regime.

	$\Delta_{\tau_i} e_t$ - Nominal Exchange Rate			$\Delta_{\tau_i} e_t$ - Instrumented FX		
Dependent variable: $\Delta_{\tau_i} p_{it}$	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta_{\tau_i} e_t$	0.0410***	0.0225***	0.00822	0.0855***	0.0684***	0.0566***
	(0.00393)	(0.00545)	(0.00568)	(0.00596)	(0.00812)	(0.00886)
$\Delta_{\tau_i} e_t \times \mathbb{1}_t^{Unanch}$		0.0460***	0.0322***		0.0431***	0.0243**
		(0.00805)	(0.00844)		(0.0115)	(0.0120)

Source: Abib et al. (2024).

Replicate results using a fairly standard small-scale New Keynesian model calibrated to Brazilian economy.

$\rightarrow$ agents do not directly infer the inflation target from the policy rule.

Discussion

- Great paper
  - Contributes to our understanding of firms' pricing decisions.
  - Evidence that prices respond more to inflationary shocks in unanchored regimes.
  - Structural interpretation through the lens of a NK model.
- Comments
  1. Price stickiness in anchored vs un-anchored regimes.
  2. Implications for monetary policy.

Comment I: Price stickiness

$$\hat{p}_t = p_t - P_t = (1 - \zeta\beta)\mathbb{E}_t \sum_{j=0}^{\infty} (\zeta\beta)^j mc_{t+j} + \beta\zeta\mathbb{E}_t \sum_{j=0}^{\infty} (\zeta\beta)^j \pi_{t+j+1}$$

$$\mathbb{E}_t \pi_{t+h} = \begin{cases} \approx \pi_t^* = 0 & \text{anchored} \\ \pi_{t|t-1}^* + \bar{g}(\pi_t - \pi_{t|t-1}^*), \ \bar{g} > 0 & \text{unanchored} \end{cases}$$

- no shocks to marginal costs
- inflationary shock: $\pi_t - \pi_{t|t-1}^* = \varepsilon_t$

Comment I: Price stickiness

$$\hat{p}_t = p_t - P_t = (1-\zeta\beta)\mathbb{E}_t\sum_{j=0}^{\infty}(\zeta\beta)^j mc_{t+j} + \beta\zeta\mathbb{E}_t\sum_{j=0}^{\infty}(\zeta\beta)^j \pi_{t+j+1}$$

$$\mathbb{E}_t\pi_{t+h} = \begin{cases} \approx \pi_t^* = 0 & \text{anchored} \\ \pi_{t|t-1}^* + \bar{g}(\pi_t - \pi_{t|t-1}^*),\ \bar{g} > 0 & \text{unanchored} \end{cases}$$

- no shocks to marginal costs
- inflationary shock: $\pi_t - \pi_{t|t-1}^* = \varepsilon_t$

$$\hat{p}_t = \frac{\zeta\beta}{1-\zeta\beta}\bar{g} \times \varepsilon_t \tag{1}$$

1. firms with unanchored expectations ($\bar{g} > 0$) respond more
2. firms with longer price duration (higher ζ) should respond more

Price stickiness in the data

Nakamura et al. (QJE, 2018):

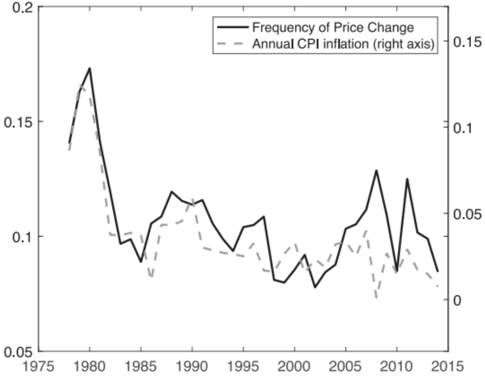


FIGURE XIV

Frequency of Price Change in U.S. Data

Frequency of price change (ζ) is

- not constant.
- co-moves with trend inflation.

consistent w/ Romer (EL, 1990)

Price stickiness in the data

Nakamura et al. (QJE, 2018):

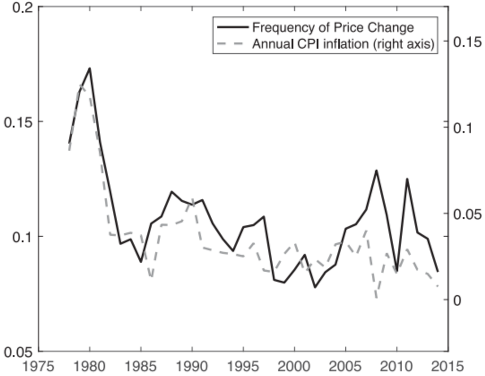


FIGURE XIV

Frequency of Price Change in U.S. Data

Frequency of price change (ζ) is

- not constant.
- co-moves with trend inflation.

consistent w/ Romer (EL, 1990)

Q: Characteristics of the price change frequency in Brazil?

Price stickiness and implications

Suppose ζ is a decreasing function of $\bar{g}$:

$$\hat{p}_t = \frac{\zeta(\bar{g})\beta}{1-\zeta(\bar{g})\beta}\bar{g} \times \varepsilon_t$$

Price stickiness and implications

Suppose ζ is a decreasing function of $\bar{g}$:

$$\hat{p}_t = \frac{\zeta(\bar{g})\beta}{1-\zeta(\bar{g})\beta}\bar{g} \times \varepsilon_t$$

$$\frac{\partial \hat{p}_t}{\partial \varepsilon_t} = \frac{\zeta(\bar{g})\beta}{1-\zeta(\bar{g})\beta}\bar{g} > 0$$

Price stickiness and implications

Suppose ζ is a decreasing function of $\bar{g}$:

$$\hat{p}_t = \frac{\zeta(\bar{g})\beta}{1-\zeta(\bar{g})\beta}\bar{g} \times \varepsilon_t$$

$$\frac{\partial \hat{p}_t}{\partial \varepsilon_t} = \frac{\zeta(\bar{g})\beta}{1-\zeta(\bar{g})\beta}\bar{g} > 0$$

$$\frac{\partial^2 \hat{p}_t}{\partial \bar{g}\partial \varepsilon_t} = \underbrace{\frac{\zeta(\bar{g})\beta}{1-\zeta(\bar{g})\beta}}_{(+)} + \underbrace{\frac{\beta\bar{g}}{(1-\zeta(\bar{g})\beta)^2}\frac{\partial\zeta(\bar{g})}{\partial\bar{g}}}_{(-)}$$

Unanchoring of inflation expectations

- amplifies the response of prices to ε_t (intensive margin)
- mitigates the response of prices to ε_t (extensive margin)

Price stickiness and implications

Baseline specification:

$$\Delta_{\tau_i} p_{it} = \alpha_i + \gamma_t + \beta_1 \Delta_{\tau_i} \hat{e}_t + \beta_2 \Delta_{\tau_i} \hat{e}_t \times \mathbf{1}_t^{Unanch} + other\ controls_{it} + \epsilon_{it}$$

- $\Delta_{\tau_i} p_{it} = p_{it} - p_{it-\tau_{it}}$
- τ_{it} – price spell of item i that ends in period t
  $\Rightarrow \hat{\beta}_2$ accounts for both intensive and extensive marginal effects.
  $\Rightarrow \hat{\beta}_2$ is a lower bound for the effect of the unanchored regime on the intensive margin.

Price stickiness and implications

Baseline specification:

$$\Delta_{\tau_i} p_{it} = \alpha_i + \gamma_t + \beta_1 \Delta_{\tau_i} \hat{e}_t + \beta_2 \Delta_{\tau_i} \hat{e}_t \times \mathbf{1}_t^{Unanch} + other\ controls_{it} + \epsilon_{it}$$

- $\Delta_{\tau_i} p_{it} = p_{it} - p_{it-\tau_{it}}$
- τ_{it} – price spell of item i that ends in period t
  $\Rightarrow \hat{\beta}_2$ accounts for both intensive and extensive marginal effects.
  $\Rightarrow \hat{\beta}_2$ is a lower bound for the effect of the unanchored regime on the intensive margin.

Empirically, the authors can separate the two channels.

Comment II: Implications for monetary policy

- Keeping long-term inflation expectations anchored matters. Why?
  - All else equal, harder to keep control of inflation otherwise...

Comment II: Implications for monetary policy

- Keeping long-term inflation expectations anchored matters. Why?
  - All else equal, harder to keep control of inflation otherwise...
- Go back to the idea that $\zeta(\bar{g})' < 0$

$$\pi_t = \kappa(\bar{g})y_t + \beta(1 - \zeta(\bar{g}))\mathbb{E}_t \sum_{h=0}^{\infty} (\beta\zeta(\bar{g}))^h \pi_{t+h+1} + \textit{expected future output}$$

- Slope of PC $\kappa(\bar{g})$ increasing in $\bar{g}$.
  - L'Huillier and Schoenle (2024): implications of $\zeta'(\bar{g}) < 0$.
  - Hajdini (2023): estimates of inflation dependence on mc, short- and long-term inflation expectations.
- A bit of a self-correcting mechanism... so maybe no need to worry as much.

Comment II: Implications for monetary policy

- Keeping long-term inflation expectations anchored matters. Why?
  - All else equal, harder to keep control of inflation otherwise...
- Go back to the idea that $\zeta(\bar{g})' < 0$

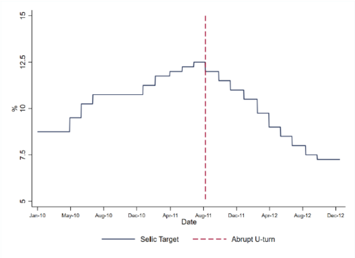
$$\pi_t = \kappa(\bar{g})y_t + \beta(1-\zeta(\bar{g}))\mathbb{E}_t \sum_{h=0}^{\infty}(\beta\zeta(\bar{g}))^h \pi_{t+h+1} + \textit{expected future output}$$

- Slope of PC $\kappa(\bar{g})$ increasing in $\bar{g}$.
  - L'Huillier and Schoenle (2024): implications of $\zeta'(\bar{g}) < 0$.
  - Hajdini (2023): estimates of inflation dependence on mc, short- and long-term inflation expectations.
- A bit of a self-correcting mechanism... so maybe no need to worry as much.
- Then, why were inflation expectations unanchored for half-a-decade?

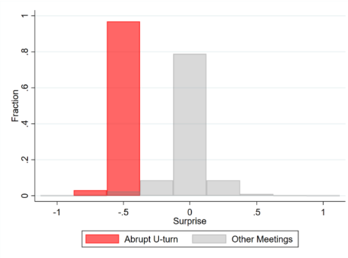
The other side of the coin

... when policy accommodates inflationary shocks: more upward pressure on inflation due to heightened long-term inflation expectations + higher PC slope

(a) *Policy reversal*



(b) *Large market surprise*

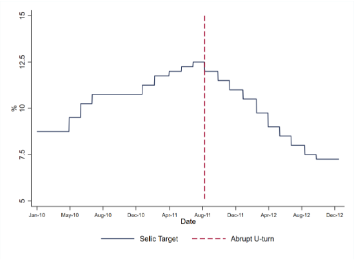


Source: Abib et al. (2024).

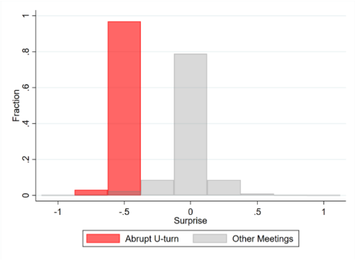
The other side of the coin

… when policy accommodates inflationary shocks: more upward pressure on inflation due to heightened long-term inflation expectations + higher PC slope

(a) *Policy reversal*



(b) *Large market surprise*



Source: Abib et al. (2024).

Can use the micro data (comment I) and the model to understand this.

Main Takeaways

KEY INSIGHT: prices are significantly more responsive to inflationary shocks when long-term expectations are unanchored.

MAIN COMMENT: Take advantage of the rich micro price data to explore the role of unanchored inflation expectations on price stickiness.

- Nuanced effect of inflationary shocks on prices when unanchored expectations.
- Implications for monetary policy.

SoFIE questions

- *What do you think will be the average inflation rate (for the Consumer Price Index) over the next 5 years? Please provide an answer in an annual percentage rate.*
- *What annual inflation rate do you think the U.S. Federal Reserve is trying to achieve on average?*

Back to monetary policy implications