Price Setting when Expectations are Unanchored

(Work in progress)

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Motivation

"...[H]ow do changes in various measures of inflation expectations feed through to actual pricing behavior? Promising recent research has looked at price changes at very disaggregated levels for insight into the pricing decision (Bils and Klenow, 2004; Nakamura and Steinsson, 2007). But this research has not yet linked pricing decisions at the microeconomic level to inflation expectations; undertaking that next step would no doubt be difficult but also very valuable." — Bernanke (2007)

What we do

- Present evidence that the **state of inflation expectations** matters for individual pricing decisions and provide the first set of facts about price setting when expectations are unanchored.
- Do so by exploiting various micro datasets over a 15-year time period during which the degree of anchoring of inflation expectations varied significantly in Brazil.
- Present a case study of an episode in which unanchoring was arguably caused by an abrupt change in monetary policy.
- Develop and calibrate a model in which expectations can become unanchored. Model provides structural interpretation for empirical findings.

What we do: Passthrough regressions with microdata

$$\Delta_{\tau_i} p_{it} \equiv p_{it} - p_{it-\tau_{it}} = \alpha_i + \gamma_t + \beta_1 \Delta_{\tau_i} e_t + \beta_2 \Delta_{\tau_i} e_t \times \mathbb{1}_t^{Unanch} + \lambda_x x_{it} + \lambda_\tau x_{\tau_i t} + \epsilon_{it}$$

τ_{it}: item i price spell that ends in period t

$\Delta_{\tau_i} p_{it} \equiv p_{it} - p_{it-\tau_{it}}$: price change over that spell

e_t: nominal exchange rate

$\Delta_{\tau_i} e_t \equiv e_t - e_{t-\tau_{it}}$: change in the exchange rate over the life of that price spell

$\mathbb{1}_t^{Unanch}$: unanchored inflation expectations regime indicator

x_{it}, $x_{\tau_i t}$: control variables

α_i and γ_t: item- and time-fixed effects

ϵ_{it}: error term.

Also run specification with continuous measure of degree of unanchoring instead of $\mathbb{1}_t^{Unanch}$. Various alternative specifications.

What we do: Own-price forecast accuracy

$$Forecast^i_{t,t+1} = \begin{cases} 1 & if \;\; E^i_t[p_{it+1}] > p_{it}; \\ 0 & if \;\; E^i_t[p_{it+1}] = p_{it}; \\ -1 & if \;\; E^i_t[p_{it+1}] < p_{it}, \end{cases}$$

$$Outcome^i_{t+1} = \begin{cases} 1 & if \;\; p_{it+1} > p_{it}; \\ 0 & if \;\; p_{it+1} = p_{it}; \\ -1 & if \;\; p_{it+1} < p_{it}. \end{cases}$$

$$Mistake^i_{t+1} = \begin{cases} 1 & if \; Outcome^i_{t+1} \neq Forecast^i_{t,t+1}; \\ 0 & otherwise, \end{cases}$$

Panel logit regression:

$$Mistake^i_t = F(\alpha_i + \gamma_t + \beta_1 \mathbb{1}_t^{Unanch} + \beta_2 \tau_{it} + \beta_3 x_{it}) + u_{it}.$$

What we find

- When expectations are unanchored, wholesailers increase passthrough of exchange rate movements into prices.
- They also make fewer mistakes when trying to anticipate how they will set their own prices in the future.
- Monetary policy can lead to unanchoring of expectations.
- As in the data, our model produces higher exchange rate passthrough when expectations are unanchored. Quantitative results similar to empirical findings.

Related literature and our contributions

- Empirical literature on price setting (e.g. Bils and Klenow 2004).
- Empirical literature on passthrough from exchange rates into domestic prices using panel regressions with microdata (e.g. Gopinath, Itskhoki, Rigobon 2010).
- Literature that documents and studies the anchoring and unanchoring of inflation expectations and its macroeconomic implications (e.g. Carvalho, Eusepi, Moench, Preston 2023; Reis 2021).
- We document anchoring and unanchoring of inflation expectations in Brazil, provide evidence it was caused by an abrupt change in monetary policy, first set of pricing facts when expectations are unanchored, evidence passthrough increases with unanchoring, present a model that provides a structural interpretation for our main empirical findings.

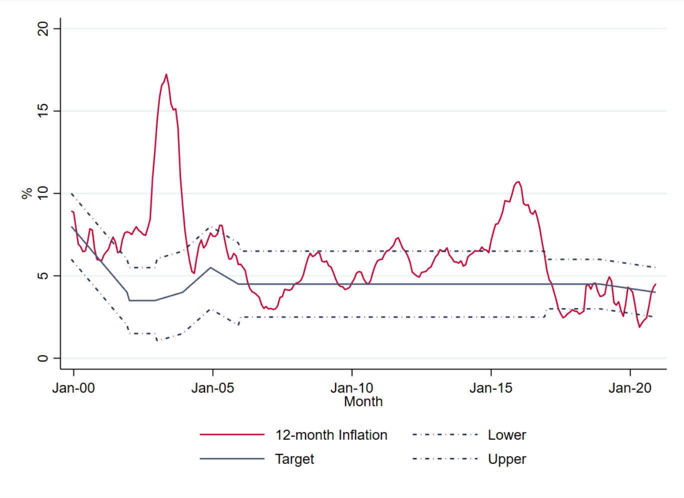
Outline

- A brief history of Brazil's inflation targeting regime
- Data and empirical strategy
  - Measuring the degree of unanchoring
- Empirical results
- A U-turn* in monetary policy: an unanchoring quasi-experiment
  - Don't try this at your central bank!!!!
- The model
- Conclusion

*Technically, this video shows a "Tactical Bootlegger's Turn." This is a better description of the change in BCB's monetary policy.

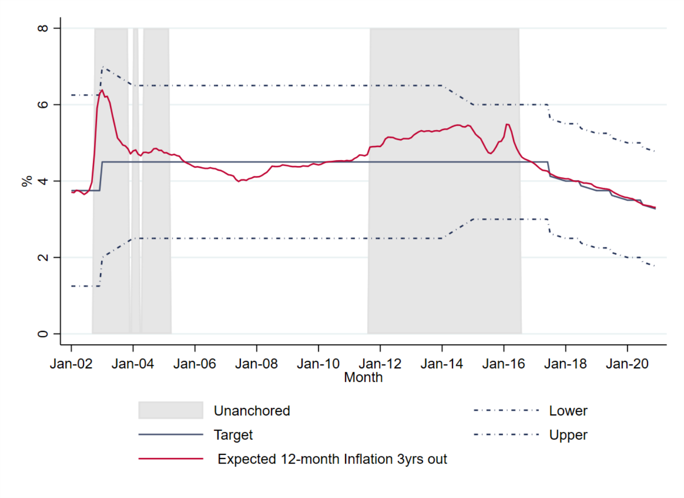
A brief history of Brazil's IT regime

Figure: **Inflation, targets and tolerance bands**



A brief history of Brazil's IT regime

Figure: **Expected 12-month inflation 3yrs out, target and tolerance bands**



PPI microdata (IBRE-FGV)

- Survey of firms from agriculture, mining and manufacturing
  - We use 310 out of 343 "products" from 21 manufacturing "sectors"
- Structure:
  - item: most disaggregated level, individual prices; includes company, model, size, brand, packaging, city, etc.
  - product (CNAE 2.0): set of items classified as being from the same product. Level at which weights are available.
  - sector (CNAE 3.0): set of products in the same sector.
- Sample: January 2008 to December 2020; results from merging active and inactive PPI datasets.
  - Inactive: No price available for long enough period.
- Weights: IBRE-FGV

Manufacturing Industry Survey (IBRE-FGV)

- Monthly survey with manufacturing firms, used to produce leading indicators.
- Questions about:
  - demand
  - inventories
  - capacity utilization
  - employment
  - access to credit
  - general business conditions
- Respondents associated with one out of 63 "industries" defined by IBRE-FGV. We associate each industry with one or more products. Hence, MIS serves as a source of sectoral data for firms in the PPI dataset.
- We also use data from a question included quarterly, about individual firms' pricing intentions (plans to increase, decrease, or keep prices constant in the following quarter)
  - For this question we have unique firm identifiers that allow us to associate answers with PPI microdata (but only for 167 firms, which produce 489 items).

Focus Survey (BCB)

- A suvey of professional forecasters covering many macroeconomic variables; commercial banks, asset management firms, consulting firms and non-financial firms.
- Unbalanced panel.
- From a set of approximately 300 registered institutions in the system, a smaller active group of around 100 institutions update their nowcasts and forecasts frequently (Gaglianone and Issler, 2021).
- Incentives: contest of best forecasters, published by BCB.
- We use inflation forecasts for various horizons and for the SELIC policy rate.
  - Both aggregate forecasts and individual forecast data.

Measuring degree of unanchoring

- Inspired by Cecchetti and Krause's (2002) credibility measure for an inflation targeting central bank:

$$Unanch_t = \begin{cases} 1 & if\ \mathbb{E}_t\left[\pi_{t+s}\right] > \pi^{max}_{t+s}; \\ \frac{\mathbb{E}_t[\pi_{t+s}] - \pi^{T}_{t+s}}{\pi^{max}_{t+s} - \pi^{T}_{t+s}} & if\ \pi^{T}_{t+s} \leq \mathbb{E}_t\left[\pi_{t+s}\right] \leq \pi^{max}_{t+s}; \\ 0 & if\ \mathbb{E}_t\left[\pi_{t+s}\right] < \pi^{T}_{t+s}, \end{cases}$$

$E_t\left[\pi_{t+s}\right]$: inflation expectation at time t for horizon $t+s$,

π^{T}_{t+s}: inflation target for $t+s$,

π^{max}_{t+s}: arbitrary measure associated with complete unanchoring. For Brazil, we pick the top of the tolerance band.

Unanchoring and expectations horizon

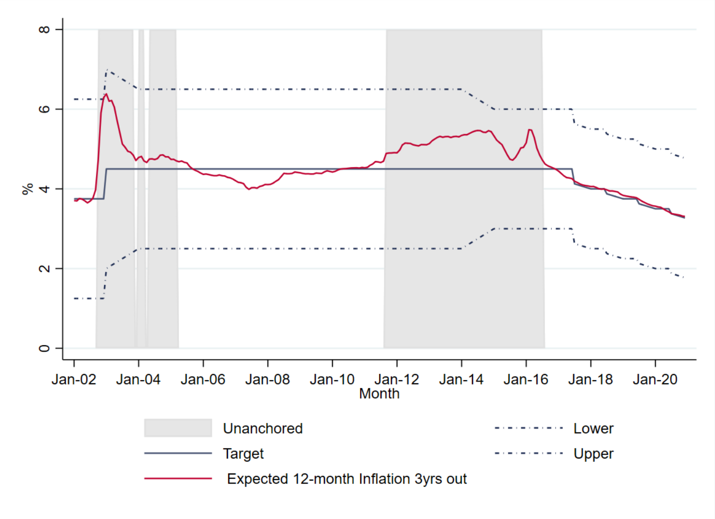
- Appropriate horizon s for expectations in our unanchoring measure?
- Short horizons: can reflect temporary supply and exchange rate shocks to which CB may be unwilling to respond, without compromising convergence to target at a longer horizon.
- Too-long horizons: expectations may be excessively inertial.
- Transmission lags usually thought of as being shorter than two years. Currently, BCB formally conducts monetary policy focusing on cumulative 12-month inflation between months 6 and 18 ahead.
- Our choice: measure of "forward expectations" for the horizon between 24 and 36 months ahead – i.e. "2 years, 1 year forward".
  - Should mitigate some endogeneity concerns – more on this later.
- From calendar-year forecasts to a forward fixed-horizon measure:

$$E_{y,m}\pi^{24,36} = \frac{12-(m-1)}{12} E_{y,m}\pi^{y+2} + \frac{m-1}{12} E_{y,m}\pi^{y+3}.$$

- We construct analogous forward measures for inflation target and bands.

Forward inflation expectations (1y2yfwd)

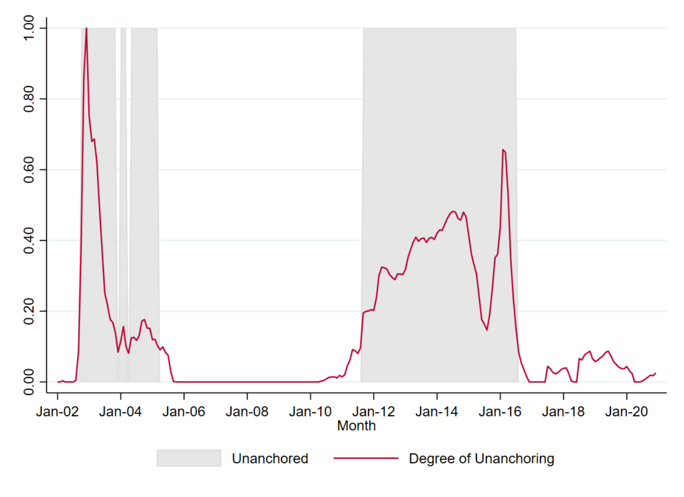
Figure: **Expected 12-month inflation 3yrs out, target and tolerance bands**



- Anchored and unanchored regimes: Unanchored regime if $Unanch_t > 0.1$.

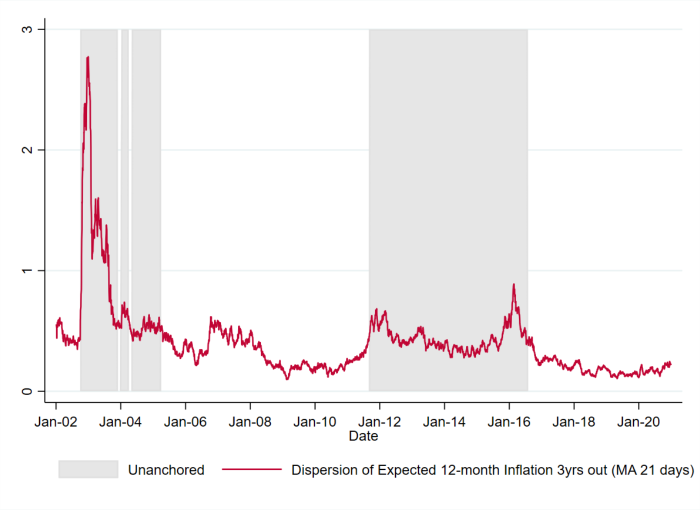
Measure of unanchoring

Figure: **Degree of unanchoring and anchored/unanchored regimes**



Dispersion of inflation expectations

Figure: **Dispersion of inflation expectations**



Empirical strategy

$$\Delta_{\tau_i} p_{it} = \alpha_i + \gamma_t + \beta_1 \Delta_{\tau_i} e_t + \beta_2 \Delta_{\tau_i} e_t \times \mathbb{1}_t^{Unanch} + \lambda_x x_{it} + \lambda_\tau x_{\tau_i t} + \epsilon_{it}$$

$$\Delta_{\tau_i} p_{it} = \alpha_i + \gamma_t + \beta_1 \Delta_{\tau_i} e_t + \beta_2 \Delta_{\tau_i} e_{t-\tau_{it}} + (\beta_3 \Delta_{\tau_i} e_t + \beta_4 \Delta_{\tau_i} e_{t-\tau_{it}}) \times \mathbb{1}_t^{Unanch} + \lambda_x x_{it} + \lambda_\tau x_{\tau_i t} + \epsilon_{it}$$

$$\Delta_{\tau_i} p_{it} = \alpha_i + \gamma_t + \beta_1 \Delta_{\tau_i} e_t + \beta_2 \Delta_{\tau_i} e_t \times \mathbb{1}_t^{Unanch} + \beta_3 (\Delta_{\tau_i} e_t)^2 + \lambda_x x_{it} + \lambda_\tau x_{\tau_i t} + \epsilon_{it}$$

- And specifications with a continuous measure of degree of unanchoring in place of $\mathbb{1}_t^{Unanch}$.

Empirical strategy

$$Forecast^i_{t,t+1} = \begin{cases} 1 & if \;\; E^i_t[p_{it+1}] > p_{it}; \\ 0 & if \;\; E^i_t[p_{it+1}] = p_{it}; \\ -1 & if \;\; E^i_t[p_{it+1}] < p_{it}, \end{cases}$$

$$Outcome^i_{t+1} = \begin{cases} 1 & if \;\; p_{it+1} > p_{it}; \\ 0 & if \;\; p_{it+1} = p_{it}; \\ -1 & if \;\; p_{it+1} < p_{it}. \end{cases}$$

$$Mistake^i_{t+1} = \begin{cases} 1 & if \;\; Outcome^i_{t+1} = Intention^i_{t,t+1}; \\ 0 & otherwise, \end{cases}$$

Panel logit regression:

$$Mistake^i_t = F(\alpha_i + \gamma_t + \beta_1 \mathbb{1}_t{}^{Unanch} + \beta_2 \tau_{it} + \beta_3 x_{it}) + u_{it}.$$

Basic price setting statistics

	Whole Sample		Anchored		Unanchored	
	Mean	**Median**	**Mean**	**Median**	**Mean**	**Median**
Freq. of price changes	0.395	0.317	0.400	0.320	0.384	0.312
Size of price changes	0.057	0.041	0.059	0.043	0.050	0.038

Dependent Variable:	fr_t	fr_t	fr_t^+	fr_t^+	fr_t^-	fr_t^-
π_t	0.0245*	0.0394***	0.0600***	0.0712***	-0.0355***	-0.0318**
	(0.0128)	(0.0165)	(0.0148)	(0.0196)	(0.0112)	(0.0149)
$\mathbb{1}_t^{Unanch}$		-0.0318		-0.0161		-0.0158
		(0.0164)		(0.0195)		(0.0148)
$\pi_t \times \mathbb{1}_t^{Unanch}$		0.00330		-0.00412		0.00741
		(0.0276)		(0.0327)		(0.0249)
constant	0.384***	0.389***	0.217***	0.219***	0.167***	0.170***
	(0.00709)	(0.00786)	(0.00815)	(0.00930)	(0.00619)	(0.00708)
N	150	150	150	150	150	150
R^2	0.024	0.0996	0.1005	0.1197	0.0636	0.0792

Baseline passthrough regression

Dependent variable: $\Delta_{\tau_i} p_{it}$	(1)	(2)	(3)
$\Delta_{\tau_i} e_t$	0.0410***	0.0225***	0.00956*
	(0.00393)	(0.00545)	(0.00567)
$\Delta_{\tau_i} e_t \times \mathbb{1}_t^{Unanch}$		0.0460***	0.0428***
		(0.00805)	(0.00897)
$\Delta_{\tau_i} p_{it-\tau_{it}}$			-0.122***
			(0.00521)
τ_{it}			0.000421***
			(0.0000976)
$\Delta_{\tau_i} ULC_t$			0.0263***
			(0.00613)
$\Delta_{\tau_i} energy_t$			-0.0254***
			(0.00644)
$\Delta_{\tau_i} Sectoral\ cost_t$			0.0369***
			(0.0104)
$Sectoral\ \ inventory_t$			-0.000177***
			(0.0000184)
$Sectoral\ \ demand_t$			0.000324***
			(0.0000287)
constant	0.0435***	0.0428***	0.00208
	(0.00245)	(0.00245)	(0.00380)
N	192502	192502	178442
Adjusted R^2	0.0500	0.0502	0.0655
Individual Fixed Effects	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes

Passthrough regression with degree of unanchoring

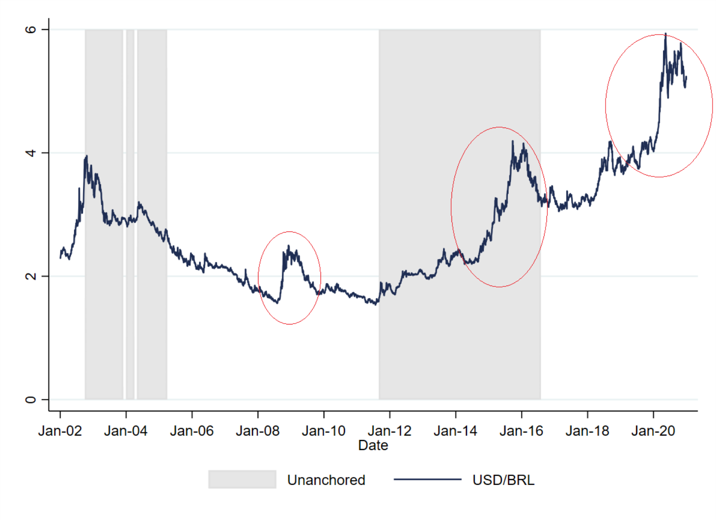
Dependent variable: $\Delta_{\tau_i} p_{it}$	**(1)**	**(2)**	**(3)**
$\Delta_{\tau_i} e_t$	0.0410***	0.0179***	0.00747
	(0.00393)	(0.00529)	(0.00551)
$\Delta_{\tau_i} e_t \times Unanch_t$		0.151***	0.124***
		(0.0210)	(0.0227)
$\Delta_{\tau_i} p_{it-\tau_{it}}$			-0.122***
			(0.00521)
τ_{it}			0.000415***
			(0.0000978)
$\Delta_{\tau_i} ULC_t$			0.0273***
			(0.00613)
$\Delta_{\tau_i} energy_t$			-0.0239***
			(0.00620)
$\Delta_{\tau_i} Sectoral\ cost_t$			0.0351***
			(0.0103)
$Sectoral\ \ inventory_t$			-0.000177***
			(0.0000183)
$Sectoral\ \ demand_t$			0.000324***
			(0.0000287)
constant	0.0435***	0.0426***	0.00201
	(0.00245)	(0.00245)	(0.00380)
N	192502	192502	178442
Adjusted R^2	0.0500	0.0504	0.0655
Individual Fixed Effects	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes

Passthrough regression with lagged FX change

Dependent variable: $\Delta_{\tau_i} p_{it}$	**(1)**	**(2)**	**(3)**
$\Delta_{\tau_i} e_t$	0.0416***	0.0197***	0.0128**
	(0.00425)	(0.00594)	(0.00627)
$\Delta_{\tau_i} e_{t-\tau_{it}}$	0.00989**	-0.000976	0.00490
	(0.00335)	(0.00435)	(0.00440)
$\Delta_{\tau_i} e_t \times \mathbb{1}_t^{Unanch}$		0.0505***	0.0486***
		(0.00854)	(0.00926)
$\Delta_{\tau_i} e_{t-\tau_{it}} \times \mathbb{1}_t^{Unanch}$		0.0277***	0.0324***
		(0.00648)	(0.00648)
$\Delta_{\tau_i} p_{it-\tau_{it}}$			-0.123***
			(0.00522)
τ_{it}			0.000460***
			(0.0000981)
$\Delta_{\tau_i} ULC_t$			0.0250***
			(0.00615)
$\Delta_{\tau_i} energy_t$			-0.0278***
			(0.00643)
$\Delta_{\tau_i} Sectoral\ cost_t$			0.0334**
			(0.0104)
$Sectoral\ \ inventory_t$			-0.000177***
			(0.0000184)
$Sectoral\ \ demand_t$			0.000327***
			(0.0000288)
constant	0.0384***	0.0381***	0.00189
	(0.00246)	(0.00245)	(0.00381)
N	178442	178442	178442
Adjusted R^2	0.0473	0.0477	0.0658
Individual Fixed Effects	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes

Unanchoring or non-linearity?

Figure: **USBBRL and anchored/unanchored regimes**



Unanchoring or non-linearity?

Dependent variable: $\Delta_{\tau_i} p_{it}$	(1)	(2)	(3)	(4)	(5)
$\Delta_{\tau_i} e_t$	0.0410***	0.0225***	0.0315***	0.0193***	0.00937*
	(0.00393)	(0.00545)	(0.00495)	(0.00582)	(0.00603)
$\Delta_{\tau_i} e_t \times \mathbb{1}_t^{Unanch}$		0.0460***		0.0425***	0.0427***
		(0.00805)		(0.00834)	(0.00900)
$(\Delta_{\tau_i} e_t)^2$			0.0455***	0.0220	0.00161
			(0.0163)	(0.0170)	(0.0192)
$\Delta_{\tau_i} p_{it-\tau_{it}}$					-0.122***
					(0.00521)
τ_{it}					0.000417***
					(0.000106)
$\Delta_{\tau_i} ULC_t$					0.0263***
					(0.00613)
$\Delta_{\tau_i} energy_t$					-0.0255***
					(0.00650)
$\Delta_{\tau_i} Sectoral\ cost_t$					0.0370***
					(0.0104)
$Sectoral\ \ inventory_t$					-0.000177***
					(0.0000183)
$Sectoral\ \ demand_t$					0.000324***
					(0.0000287)
constant	0.0435***	0.0428***	0.0431***	0.0426***	0.00207
	(0.00245)	(0.00245)	(0.00246)	(0.00246)	(0.00380)
N	192502	192502	192502	192502	178442
Adjusted R^2	0.0500	0.0502	0.0501	0.0502	0.0655
Individual Fixed Effects	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes

Unanchoring or non-linearity? with continuous measure

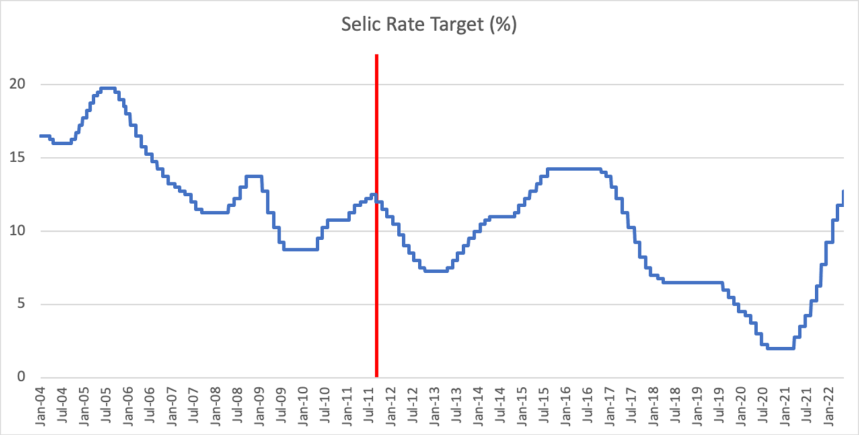
Dependent variable: $\Delta_{\tau_j} p_{it}$	(1)	(2)	(3)	(4)	(5)
$\Delta_{\tau_j} e_t$	0.0410***	0.0179***	0.0315***	0.0152**	0.00752
	(0.00393)	(0.00529)	(0.00495)	(0.00575)	(0.00592)
$\Delta_{\tau_j} e_t \times Unanchor_t$		0.151***		0.145***	0.124***
		(0.0210)		(0.0216)	(0.0227)
$(\Delta_{\tau_j} e_t)^2$			0.0455***	0.0174	-0.000477
			(0.0163)	(0.0169)	(0.0192)
$\Delta_{\tau_j} p_{it-\tau_{it}}$					-0.122***
					(0.00521)
τ_{it}					0.000416***
					(0.000106)
$\Delta_{\tau_j} ULC_t$					0.0273***
					(0.00613)
$\Delta_{\tau_j} energy_t$					-0.0239***
					(0.00628)
$\Delta_{\tau_j} Sectoral\ cost_t$					0.0350***
					(0.0104)
$Sectoral\ \ inventory_t$					-0.000177***
					(0.0000183)
$Sectoral\ \ demand_t$					0.000324***
					(0.0000287)
constant	0.0435***	0.0426***	0.0431***	0.0425***	0.00201
	(0.00245)	(0.00245)	(0.00246)	(0.00246)	(0.00380)
N	192502	192502	192502	192502	178442
Adjusted R^2	0.0500	0.0504	0.0501	0.0504	0.0655
Individual Fixed Effects	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes

Accuracy of firms' own-price forecasts

Dependent Variable: $Mistake_t^i$	**(1)**	**(2)**	**(3)**	**(4)**
$\mathbb{1}_q{}^{Unanch}$	-0.186***			
	(0.08)			
$Unanch_q$		-0.310		
		(0.23)		
$\overline{\mathbb{1}_q^{Unanch}}$			-0.220***	
			(0.08)	
$\overline{Unanch_q}$				-0.398*
				(0.22)
τ_{iq}	-0.0520***	-0.0510***	-0.0523***	-0.0513***
	(0.007)	(0.007)	(0.007)	(0.007)
$\mathbb{1}_{\Delta p_{iq-1}}$	-0.217***	-0.211***	-0.218***	-0.212***
	(0.09)	(0.09)	(0.09)	(0.09)
N	2920	2920	2920	2920
$pseudo.R^2$	0.0172	0.0160	0.0178	0.0164
Individual fixed effects	Yes	Yes	Yes	Yes
Time fixed effects	No	No	No	No

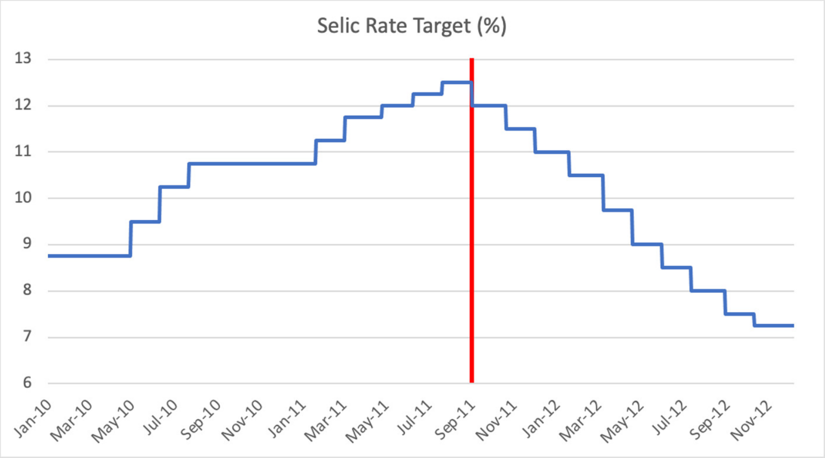
Case study: A U-turn in monetary policy

- During the first semester of 2011, inflation was above target and the BCB was gradually increasing its policy rate.
- In its July meeting, the BCB increased the Selic rate by 25bps.

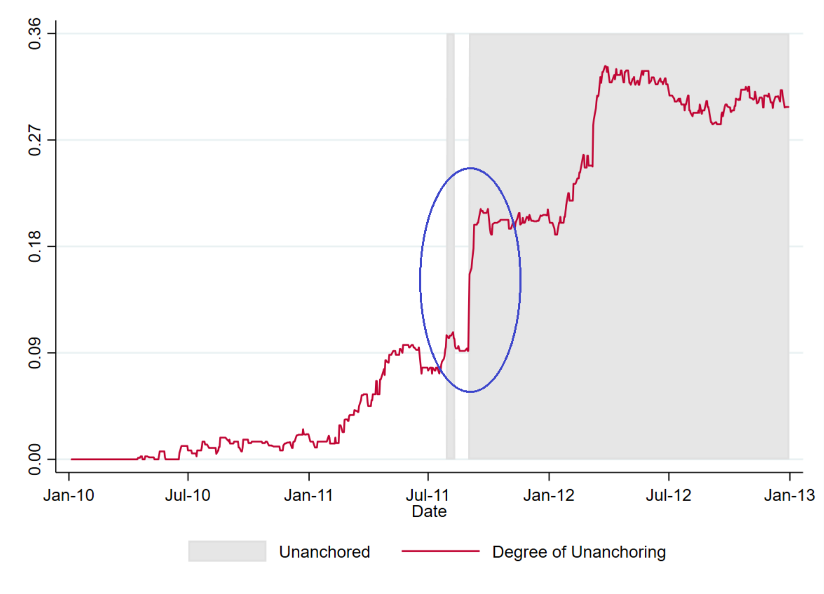


Zooming in on the U-turn

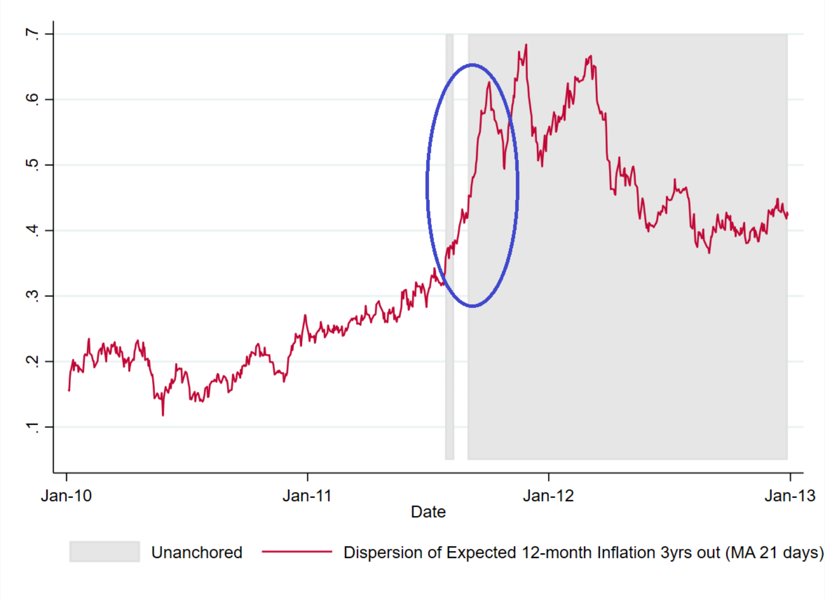
- Most market participants expected BCB to stay put, but it cut the Selic rate by 50 bps.



Measure of unanchoring: Zoom in with daily data



Dispersion of inflation expectations – Zoom in with daily data



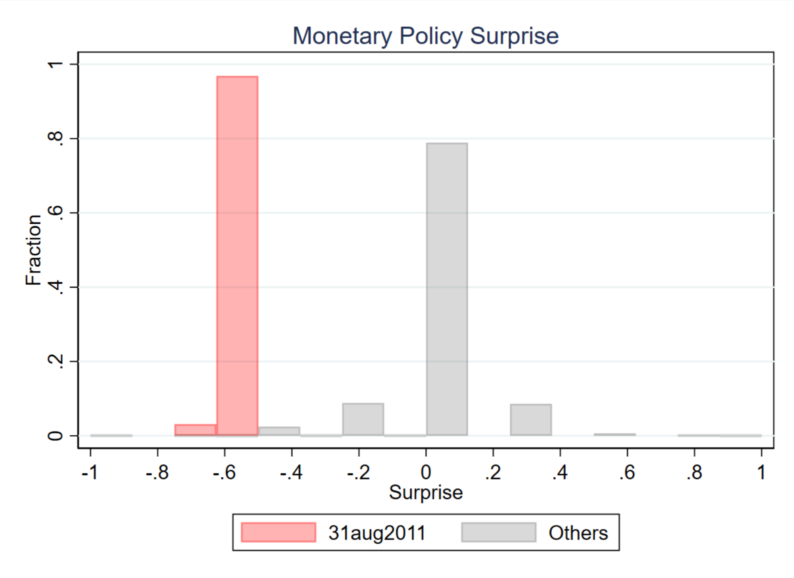
Former Governors' and Deputy Governor's reactions

- "For Loyola, BCB credibility is in check".
- "The inflation target was abandoned, says former BCB Governor's consulting firm".
- "BCB will have problems with inflation expectations, says Schwartsman".
- Newspaper editorial: "BCB under political pressure".
- Newspaper editorial: "BCB caves in to pressure".

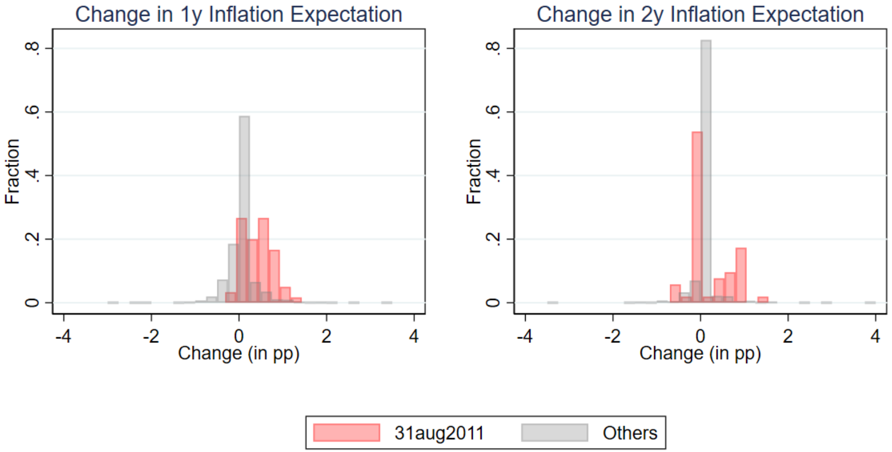
2013 protests in Brazil

- "F..k the bands. The target is 4.5%". "Respect the inflation target". "For an independent BCB: No more discretion".

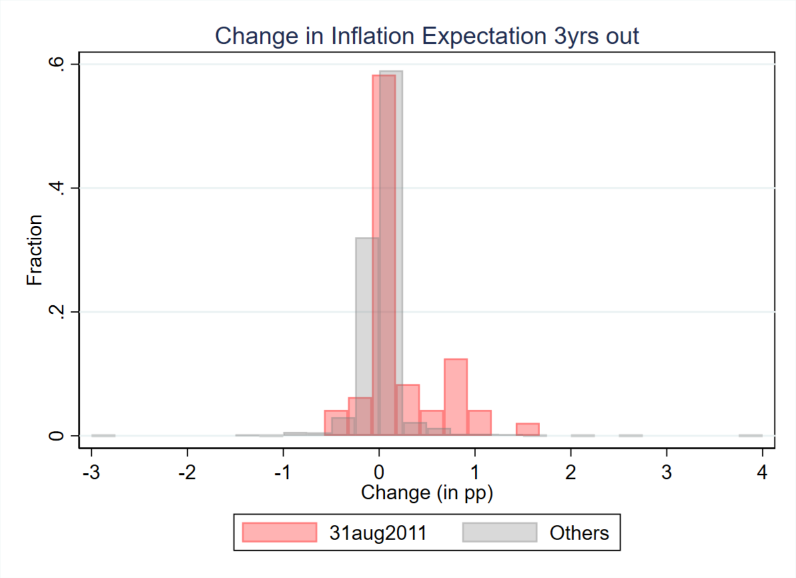
The surprising policy reversal: Focus microdata



The surprising policy reversal: Change in inflation expectations



The surprising policy reversal: Unanchoring



Response of 1y2y fwd inflation expectations to policy surprises

Dependent variable:	$\Delta(E_i\pi^{24,36} - \pi^T)$	$\Delta(E\pi^{24,36} - \pi^T)$
U-turn surprise	-0.362***	-0.475***
	(0.117)	(0.0127)
Other surprises	-0.157***	-0.167
	(0.0388)	(0.125)
constant	0.000626	0.00257
	(0.00358)	(0.00633)
Data structure	Panel	Time Series
N	3,495	104
R^2	0.039	0.157
Adjusted R^2	0.000204	0.140
Individual fixed effects	Yes	No
Time fixed effects	No	No

Response of inflation expectations to policy surprises – 2

- Fixed-event forecasts for 1^{st} and 2^{nd} calendar years ahead.

Dependent variable:	$\Delta(E_i\pi^{1^{st}yr} - \pi^T)$	$\Delta(E_i\pi^{2^{nd}yr} - \pi^T)$
U-turn surprise	-0.720***	-0.450***
	(0.0915)	(0.123)
Other surprises	-0.174***	-0.159***
	(0.0446)	(0.0380)
constant	0.0154***	0.00772**
	(0.00449)	(0.00373)
Data structure	Panel	Panel
N	4,175	3,827
R^2	0.056	0.044
Adjusted R^2	0.0223	0.00850
Individual fixed effects	Yes	Yes
Time fixed effects	No	No

Unanchoring and FX PT: an event-study approach

- Note: Results not as robust as regressions with full sample.

Dependent variable: $\Delta_{\tau_i} p_{it}$	
$\Delta_{\tau_i} e_t$	0.0139*
	(1.71)
$\Delta_{\tau_i} e_t \times \mathbb{1}_t^{Post}$	0.0256*
	(1.82)
$\Delta_{\tau_i} p_{it-\tau_{it}}$	-0.131***
	(-21.09)
τ_{it}	0.000462**
	(3.11)
$\Delta_{\tau_i} ULC_t$	0.0447***
	(4.68)
$\Delta_{\tau_i} energy_t$	-0.0684***
	(-6.49)
$\Delta_{\tau_i} Sectoral\ cost_t$	0.0507***
	(3.33)
$Sectoral\ \ inventory_t$	-0.000237***
	(-9.30)
$Sectoral\ \ demand_t$	0.000418***
	(9.75)
constant	-0.00739
	(-1.50)
N	103554
Adjusted R^2	0.0697
Individual fixed effects	Yes
Time fixed effects	Yes

"Placebo regressions"

- Note: Results not as robust as regressions with full sample.

Dependent variable: $\Delta_{\tau_i} p_{it}$	*Before* ($t = Feb/2010$)	*After* ($t = Apr/2013$)
$\Delta_{\tau_i} e_t$	-0.00170	0.00773
	(-0.16)	(0.46)
$\Delta_{\tau_i} e_t \times \mathbb{1}_t{}^{Post}$	-0.0159	0.0147
	(-0.69)	(0.79)
$\Delta_{\tau_i} p_{it-\tau_{it}}$	-0.140***	-0.197***
	(-17.78)	(-22.93)
τ_{it}	0.00101***	0.000600***
	(3.31)	(2.96)
$\Delta_{\tau_i} ULC_t$	0.0316*	0.0261
	(2.04)	(1.95)
$\Delta_{\tau_i} energy_t$	-0.365***	-0.0456***
	(-5.23)	(-4.12)
$\Delta_{\tau_i} Sectoral\ cost_t$	0.0360	-0.0269
	(1.61)	(-1.51)
Sectoral inventoryt	-0.000266***	-0.0000701**
	(-7.25)	(-2.02)
Sectoral $demand_t$	0.000654***	0.0000585
	(10.08)	(1.08)
constant	-0.0337***	0.00919
	(-4.76)	(1.35)
N	56030	47524
Adjusted R^2	0.0807	0.0557
Individual fixed effects	Yes	Yes
Time fixed effects	Yes	Yes

Model

- Standard new Keynesian model with imported inputs: source of exchange rate passthrough.
- Mechanism for unanchoring: inference about inflation target.
  - In unanchored regime, agents believe the central bank accommodates shocks to exchange rate by changing inflation target.
- We calibrate model to Brazilian economy, simulate artificial data and run passthrough regressions analogous to empirical specifications.
  - Importantly, calibration does not target the effect of unanchoring on passthrough.
- Quantitative results in line with our empirical findings.

Firms' technology and pricing

- Firm i's output $Y_{i,t}$:

$$Y_{it} = A_{it} A_t L_{it}^{\alpha} M_{it}^{(1-\alpha)},$$

L_{it}: labor
M_{it}: imported input
$A_{i,t}, A_t$: firm-specific and aggregate productivity processes.

- Firm i's real marginal cost:

$$mc_{it} \propto A_t^{-1} A_{it}^{-1} w_t^{\alpha} q_t^{1-\alpha},$$

w_t: real wage
q_t: real exchange rate.

- Nominal exchange rate follows AR(1) process.
- Calvo pricing

Central bank and expectation's anchoring

- Taylor rule:

$$R_t = \rho R_{t-1} + \phi_\pi \left(\pi_t - \pi_t^*\right) + \phi_y \hat{y}_t + \varepsilon_t^R$$
$$\pi_t^* = \rho_{\pi_*} \pi_{t-1}^* + c_e \hat{e}_{t-1} + \sigma^{\pi^*} \varepsilon_t^*.$$

- Agents cannot separately identify ε_t^R and π_t^*. Use Kalman filter to estimate current π_t^*

$$\pi_{t+1|t}^* = \rho_{\pi_*} \pi_{t|t-1}^* + \hat{c}_e \hat{e}_t + \bar{g}\left(\tilde{\pi}_t - \pi_{t|t-1}^*\right)$$
$$\tilde{\pi}_t = \pi_t^* + \phi_\pi^{-1} \varepsilon_{R,t},$$

  $\bar{g} > 0$: Kalman gain. Depends both on relative volatility of two exogenous processes and persistence of inflation target. Changes in estimated inflation target driven by temporary monetary policy shocks, by exogenous shifts in inflation target and, when expectations are unanchored, by exchange rate.

- Weak (strong) CB: $c_e > (=) 0$. We assume a strong CB – i.e. $c_e = 0$ always. Discussion about U-turn.
- In unanchored regime, $\hat{c}_e$ ("perceived c_e") > 0.

Model calibration

- Model calibrated to Brazilian economy.

Parameters	Description		Parameters	Description	
$1-\alpha$	import elasticity	0.080	σ_{π^*}	vol. π_t^* shock	0.106
β	discount rate	0.995	σ_R	vol. mp shock	0.991
$1-\theta$	freq. Δp_i	0.300	ρ_E	persistence E_t	0.890
ζ	real rigidities	0.400	ρ_z	persistence z_t	0.989
ϕ_π	TR: $\pi_t - \pi_t^*$	2.473	ρ_a	persistence a_{it}	0.700
ϕ_y	TR: y_t	0.240	σ_E	vol. E_t shock	3.475
ρ_i	TR: R_{t-1}	0.982	σ_z	vol. z_t shock	0.293
$\hat{c}_e$	unanchoring	0.013	σ_a	vol. a_{it} shock	7.500

Moments	Model	Data
$\sigma(\pi_t)$	0.300	0.300
$\sigma(R_t)$	1.109	0.260
$\sigma(E_t)$	7.802	7.800
$\sigma(\hat{y}_t)$	2.434	2.400
$\sigma(\mathbb{E}^{Anc}\pi)$:	0.099	0.100
$\sigma(\mathbb{E}^{Unanc}\pi)$:	0.250	0.250
$\rho(\pi_t, \pi_{t-1})$:	0.768	0.570
$\rho(R_t, R_{t-1})$:	0.884	0.950
$\rho(\hat{y}_t, \hat{y}_{t-1})$:	0.823	0.750
$\rho(E_t, E_{t-1})$:	0.896	0.890
$\mathbb{E}(\lvert\Delta p_t^i\rvert)$:	5.400	6.000

Passthrough regressions with model-generated data

- We simulate the model and run passthrough regressions analogous to empirical specifications. In anchored regime, $\hat{c}_e = 0$, whereas in unanchored regime $\hat{c}_e > 0$. Unanchoring occurs halfway through artificial sample.

	(1)	(2)
$\Delta_{\tau_i} e_t$	0.0215***	0.0329***
$\Delta_{\tau_i} e_t \times \mathbb{1}_t{}^{Unanch}$	0.0319***	0.0560***
$\Delta_{\tau_i} e_{it-\tau_{it}}$		0.0156***
$\Delta_{\tau_i} e_{t-\tau_{it}} \times \mathbb{1}_t{}^{Unanch}$		0.0344***
$\Delta_{\tau_i} p_{it-\tau_{it}}$	-0.295***	-0.296***
Constant	-1.618***	-1.613***
N	3,475,424	3,475,424
Num. of Items	5,800	5,800
Adjusted R^2	0.116	0.117
Individual Fixed Effects	No	No
Time Fixed Effects	Yes	Yes

Conclusion

- We present evidence that the **state of inflation expectations** matters for individual pricing decisions and provide the first set of facts about price setting when expectations are unanchored.
- In such circumstances, wholesailers increase passthrough of exchange rate movements into prices.
- They also make fewer mistakes when trying to anticipate how they will set their own prices in the future.
- Monetary policy can lead to unanchoring of expectations.
- We develop and calibrate a model in which expectations can become unanchored. Model provides structural interpretation for empirical findings.
    - As in the data, our model produces higher exchange rate passthrough when expectations are unanchored.
    - Quantitative results similar to empirical findings.