Price Setting when Expectations are Unanchored

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Motivation

Long-run inflation expectations do vary over time. That is, they are not perfectly anchored in real economies; moreover, the extent to which they are anchored can change, depending on economic developments and (most important) the current and past conduct of monetary policy.

...[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)*

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- Develop and calibrate a model in which expectations can become unanchored.
  - Model provides structural interpretation of empirical findings.

What we do: Passthrough regressions with PPI 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 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.

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

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- When expectations are unanchored, wholesalers increase passthrough of exchange rate movements into prices. Difference is sizable.
- (Not today:) They also make fewer mistakes when trying to anticipate how they will set their own prices in the future.
- As in the data, our model produces higher exchange rate passthrough when expectations are unanchored. Quantitative effect also sizable.

Related literature and our contributions

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- Literature that documents and studies anchoring and unanchoring of inflation expectations and its macroeconomic implications (e.g. Carvalho, Eusepi, Moench, Preston 2023; Reis 2021).

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- Literature that documents and studies 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 of our main empirical findings.

Outline

- Data
- Abrupt U-turn* in monetary policy: an unanchoring quasi-experiment (Don't try this at your central bank!!!!)
  - A measure of the degree of unanchoring
- Empirical strategy
- Empirical results
- FX passthrough in a model with unanchoring of expectations
- Conclusion

*Technically, this video shows a "Tactical Bootlegger's Turn." As will become clear, this is an accurate description of the abrupt change in monetary policy we study.

PPI microdata (IBRE-FGV)

- Survey of firms from agriculture, mining, and manufacturing.
  - Total of 310 (out of 343) "products" from 21 manufacturing "sectors"

	Total	**Monthly average**	
	Raw data*	Raw data*	Complete price spells
Items	14,164	5,796	1,501
Firms	2,633	1,695	502
Products	310	310	310
Sectors	21	21	21
Price Quotes	883,782		

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  - sector (CNAE 3.0): set of products in the same sector. E.g. Textile products.
  - product (CNAE 2.0): set of items classified as being from the same product. Level at which weights are available. E.g. Cotton fabrics.
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  - For this question we have unique firm identifiers that allow us to associate answers with PPI microdata (only for 167 firms, which produce 489 items).

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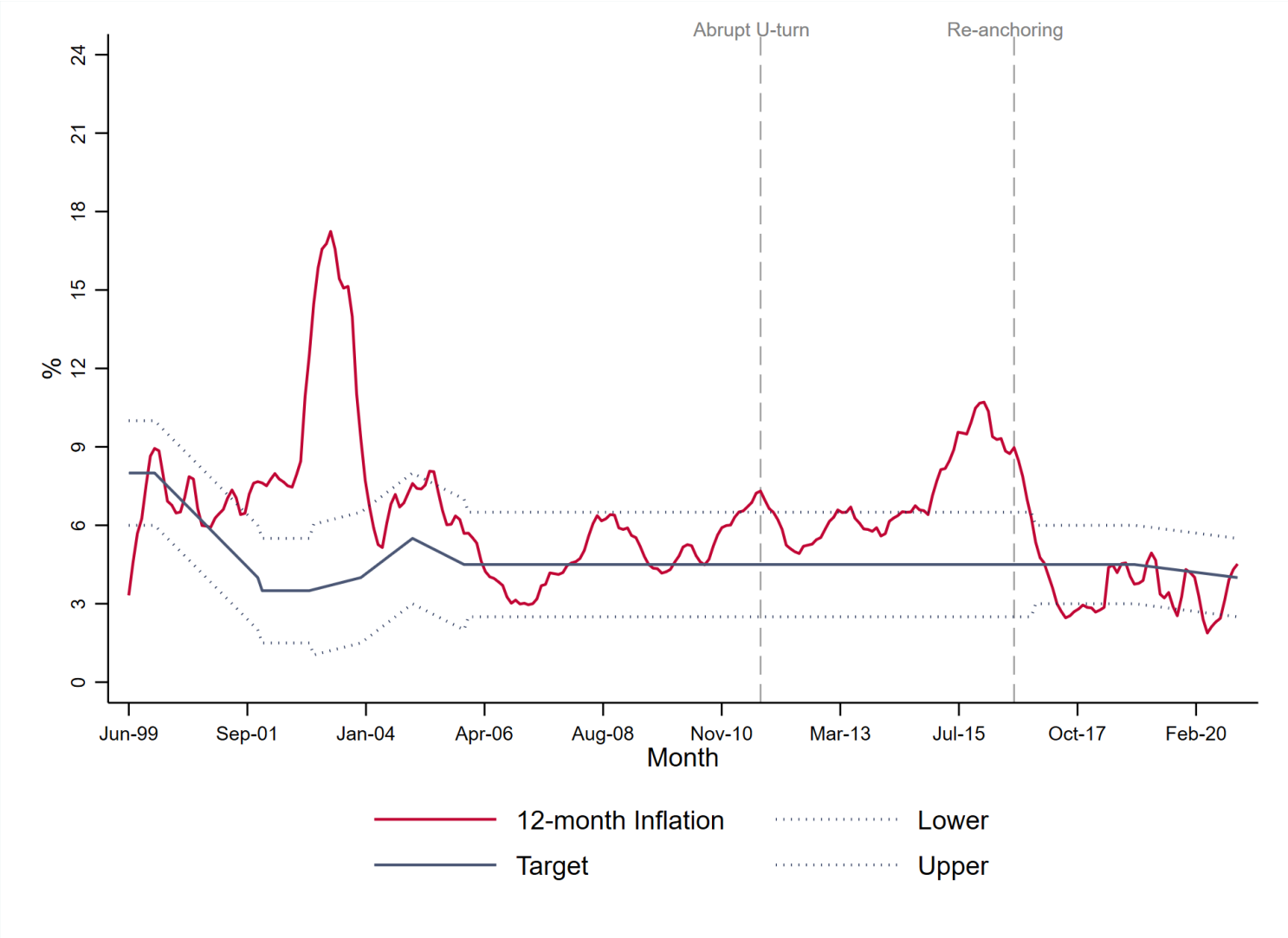
- We use inflation forecasts for various horizons and for the SELIC policy rate.
  - Both aggregate and individual forecasts data.

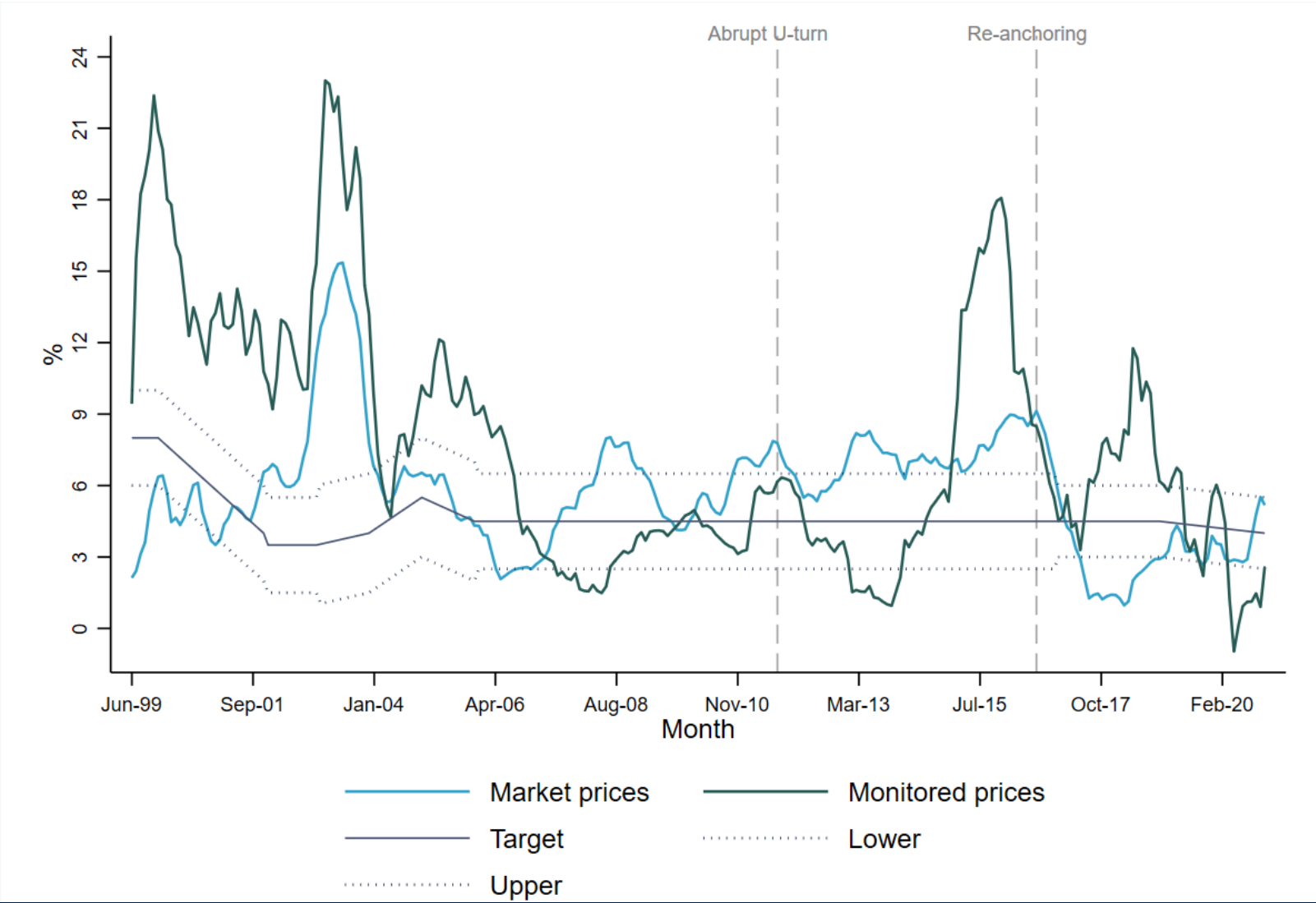
A brief history of Brazil's IT regime

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



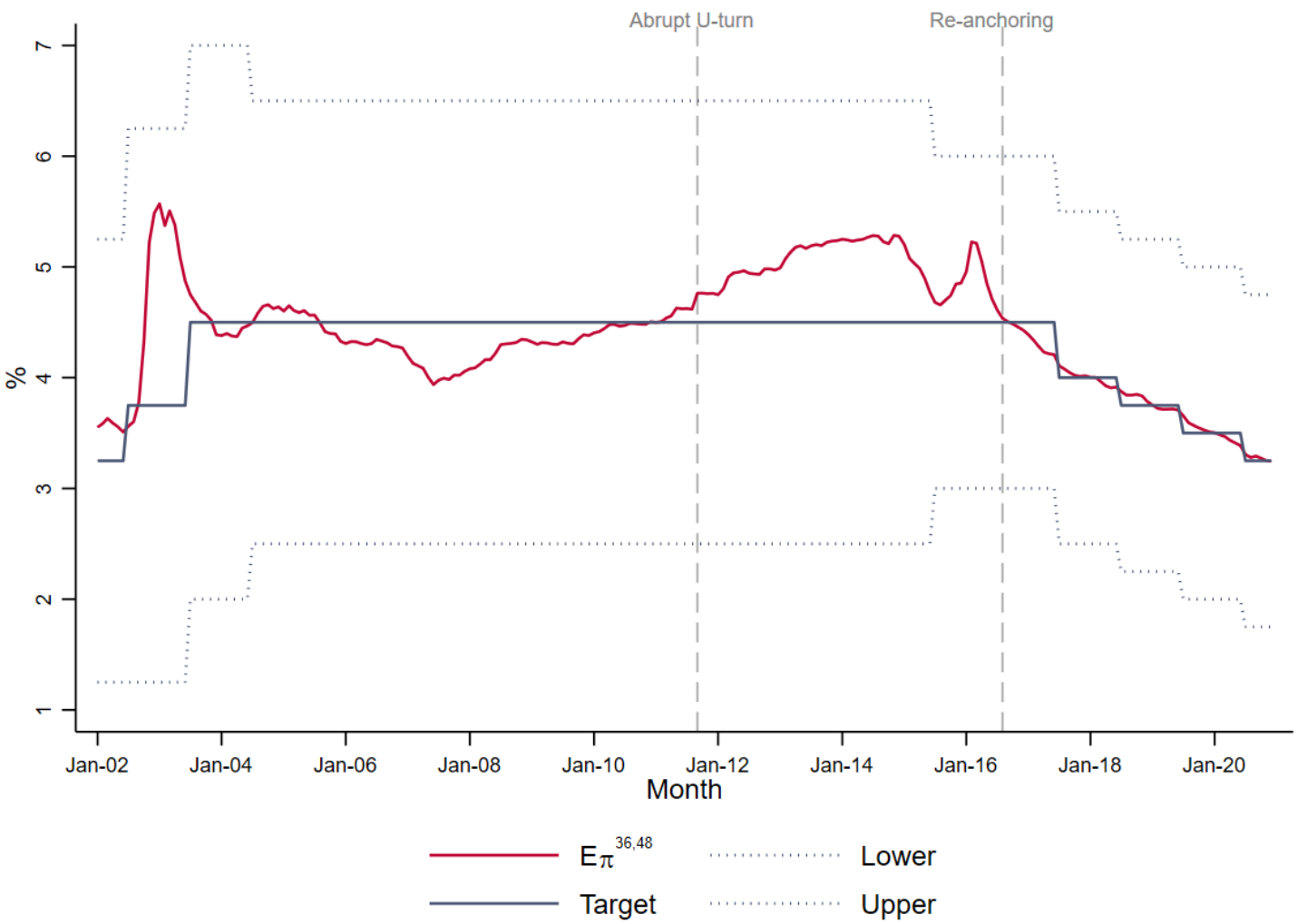
A brief history of Brazil's IT regime – 2

Figure: **Inflation for "Market prices" and "Monitored prices"**



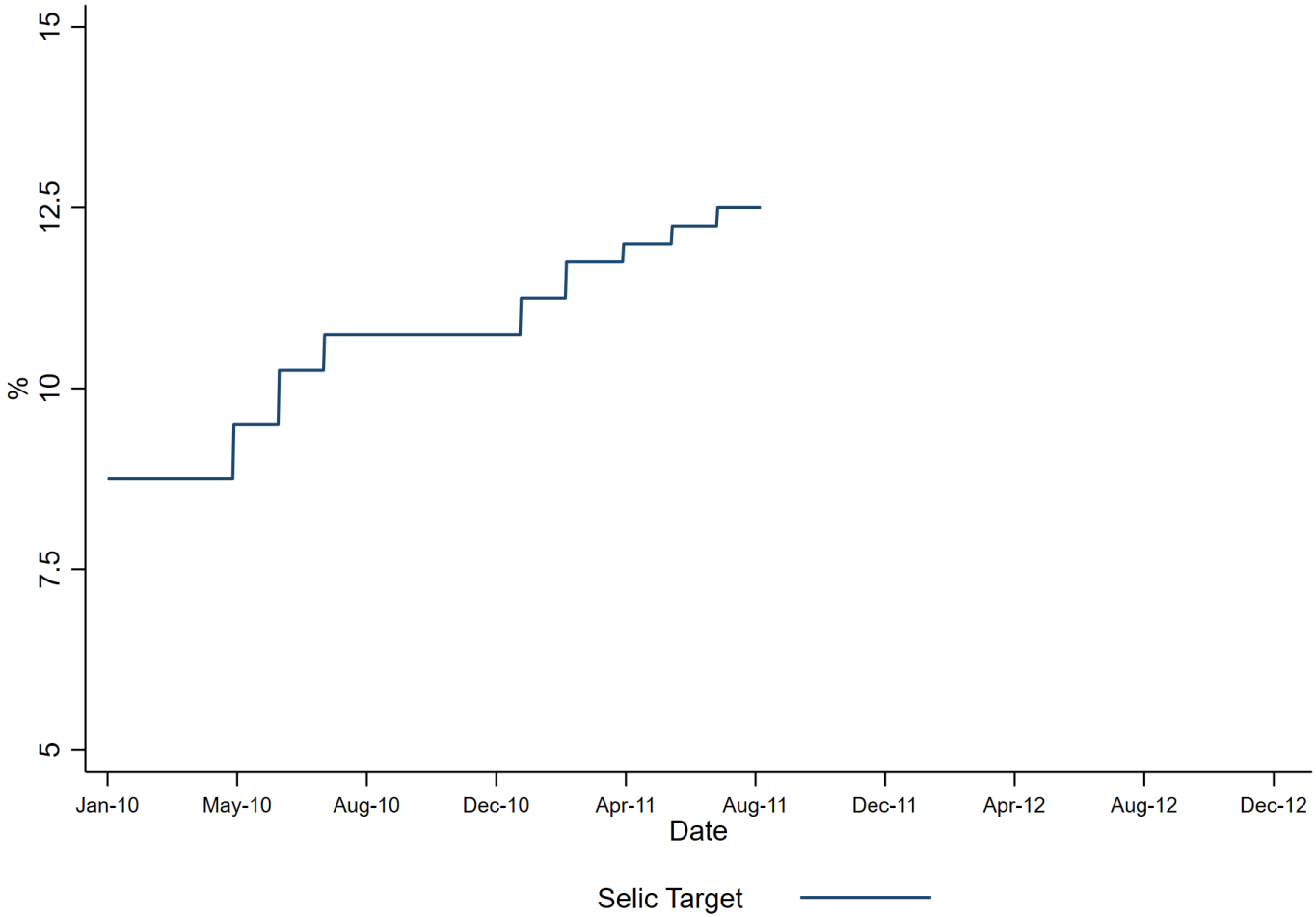
Inflation expectations

Figure: **Expected inflation between months 36-48, target and tolerance bands**



Case study: An abrupt U-turn in monetary policy

- Early 2011, inflation above target and rising; expectations also increasing.
- BCB tightening gradually. In July meeting, BCB hiked 25bps.
- In its August 31 meeting, BCB widely expected to stay put.



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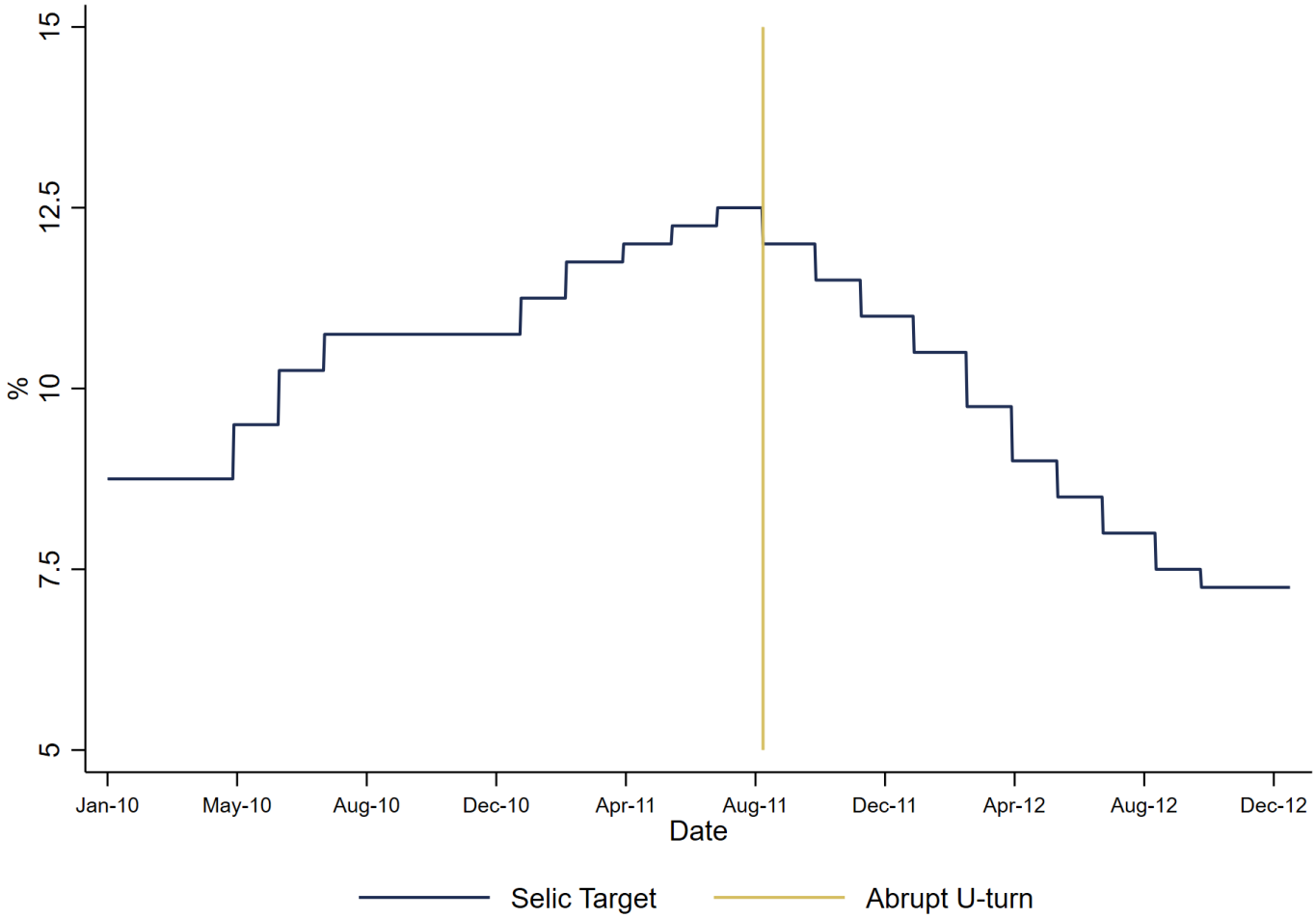


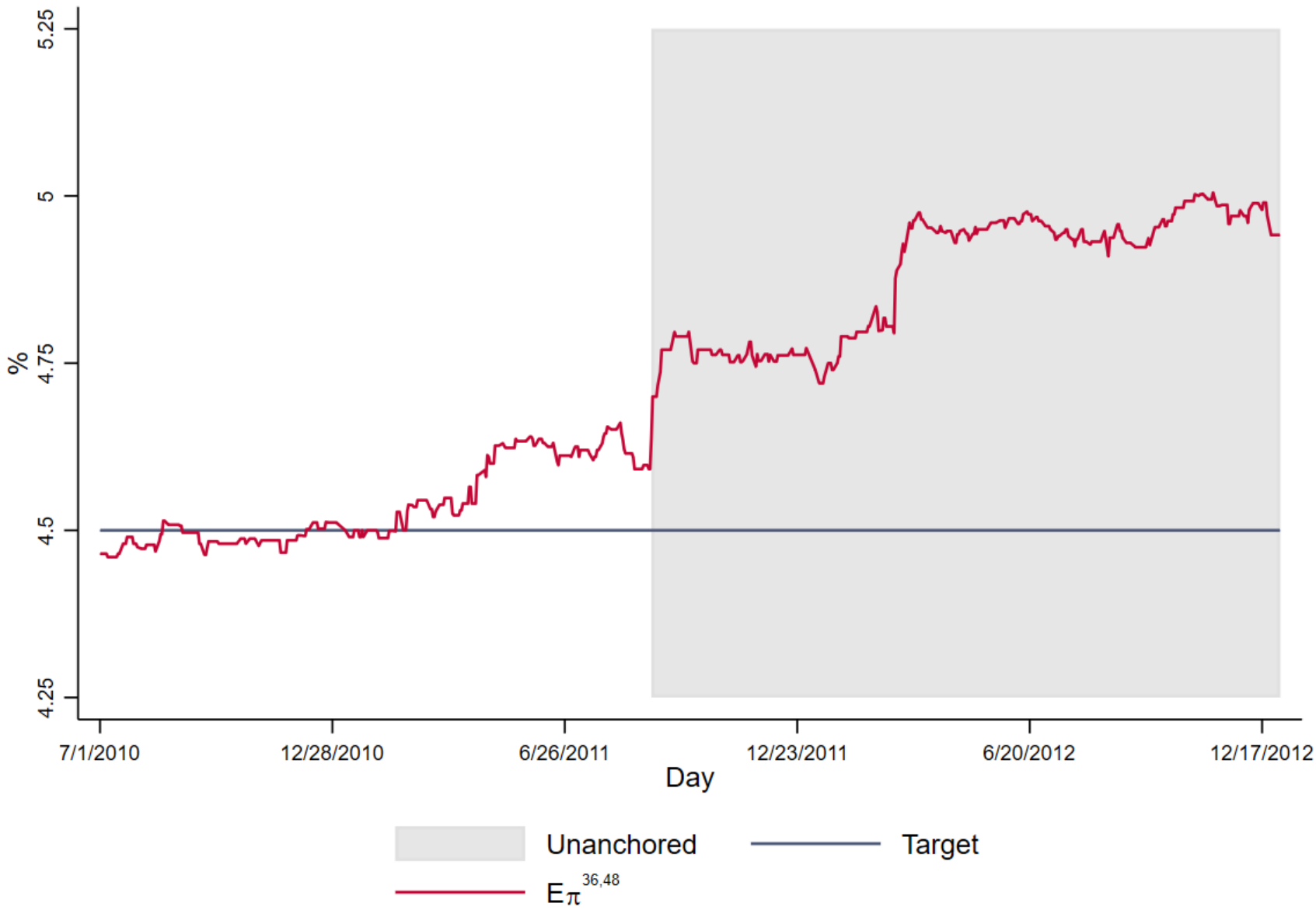
Monetary policy surprises from Focus microdata

- BCB unexpectedly cut policy rate by 50 bps, starting a sizable easing cycle.

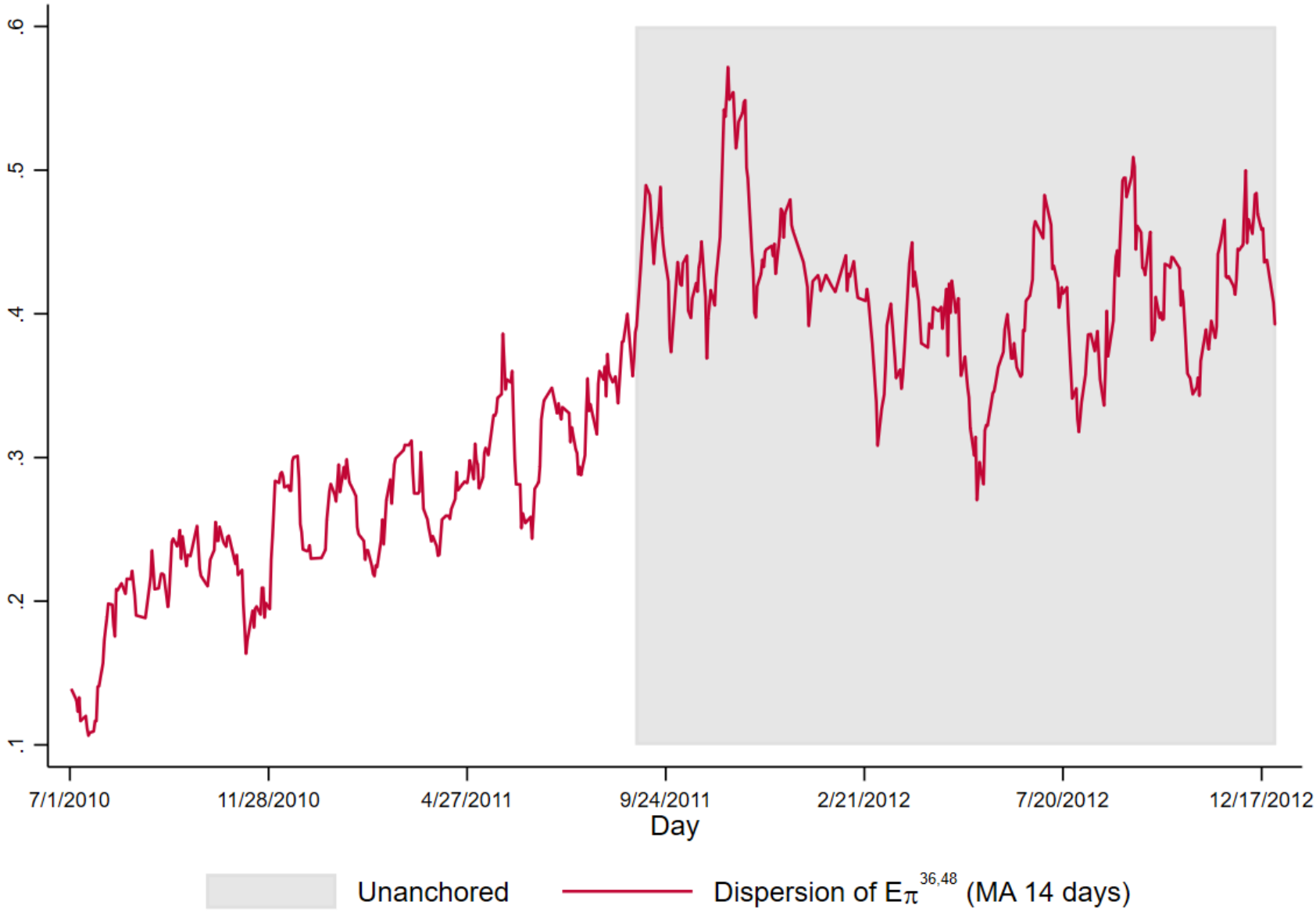
Former Governors' and Deputy Governor's reactions

- "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".

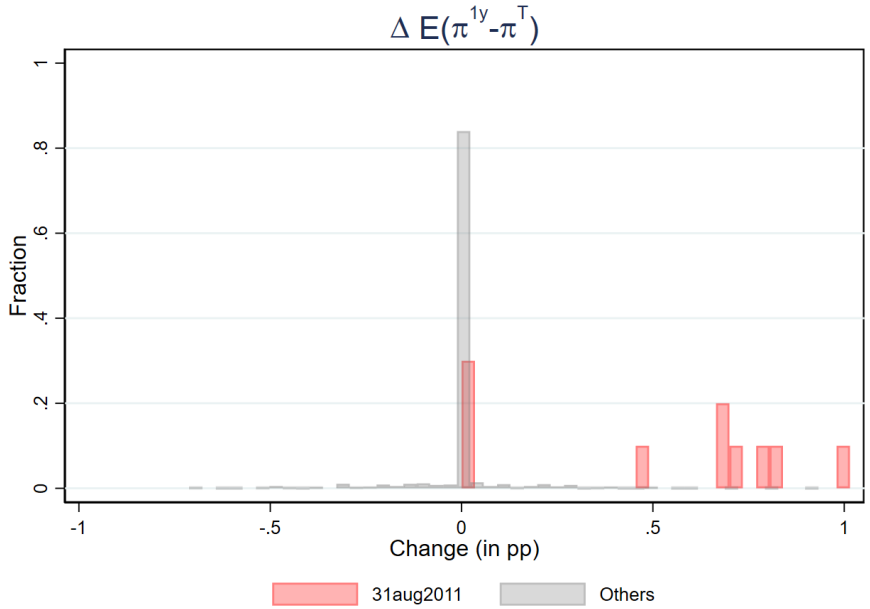
Inflation expectations: Zoom in with daily data

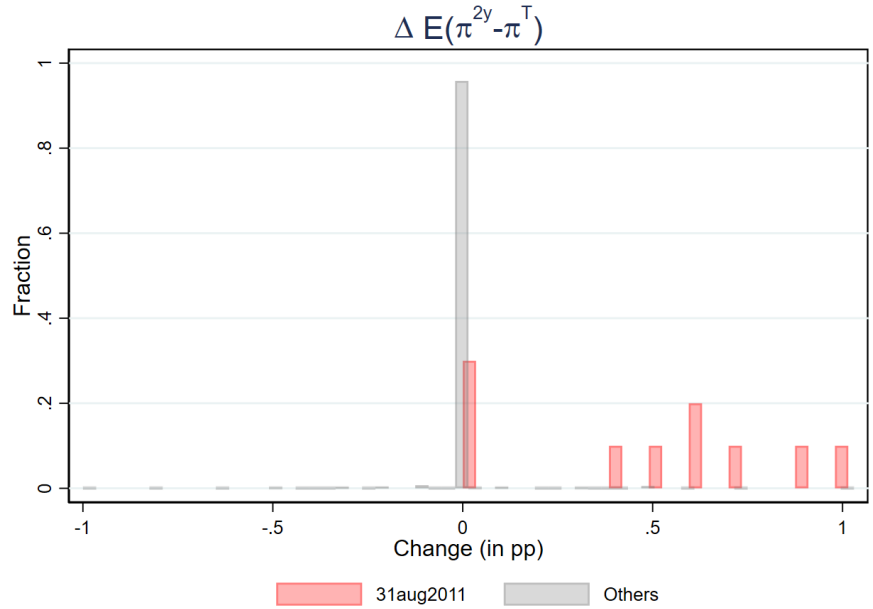


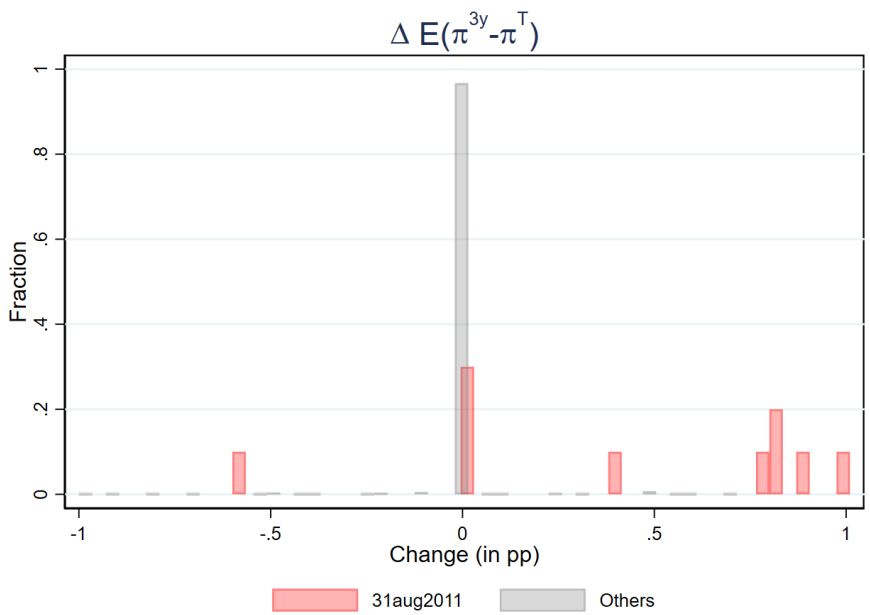
Dispersion of inflation expectations – Zoom in with daily data

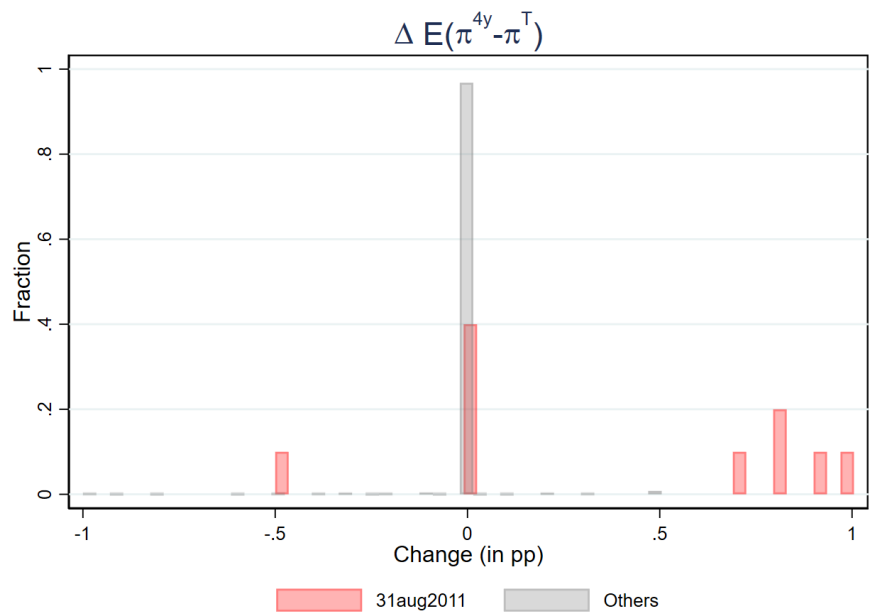


Two-day change in inflation expectations: Fixed events

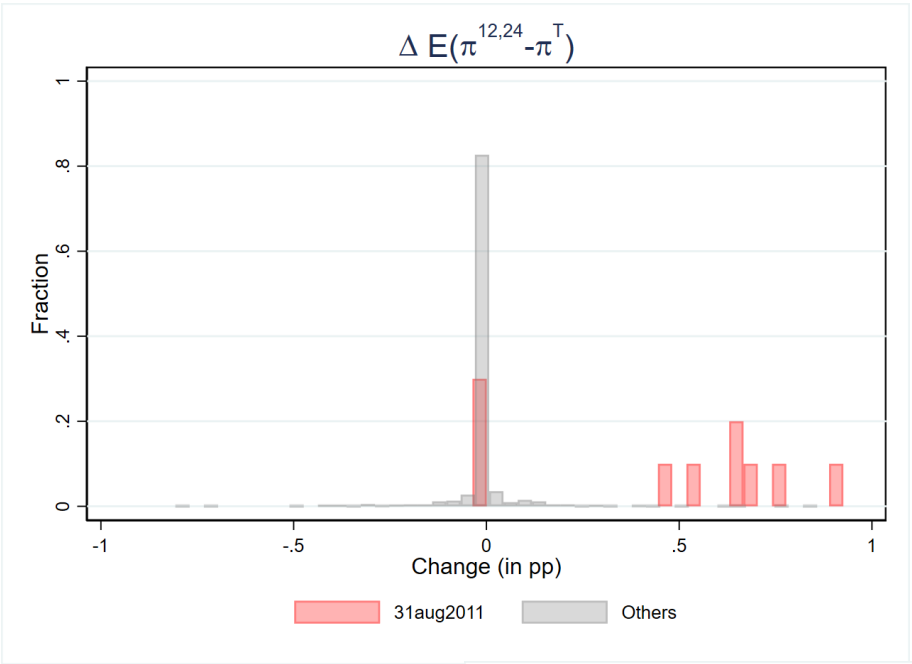


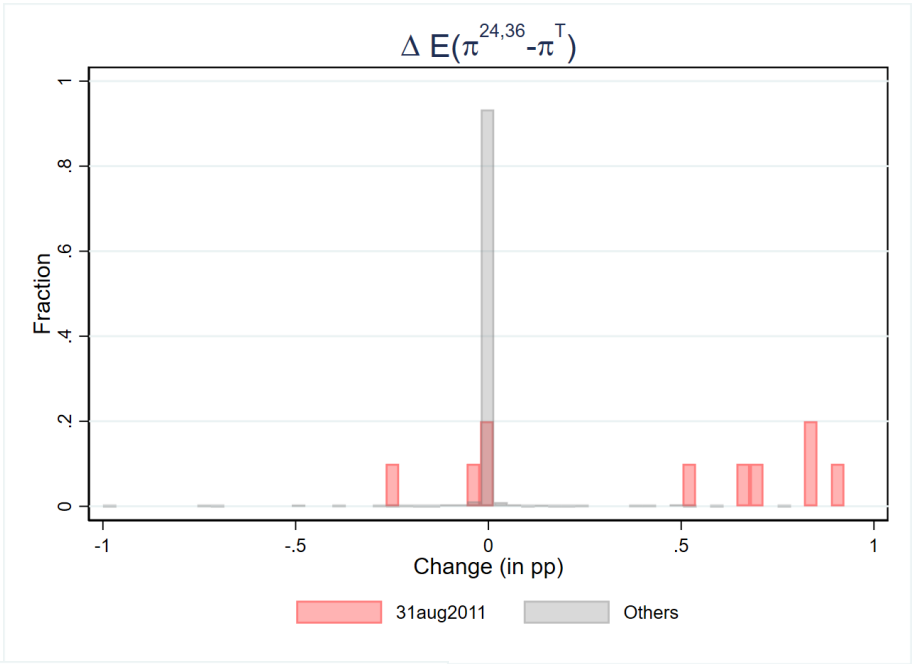


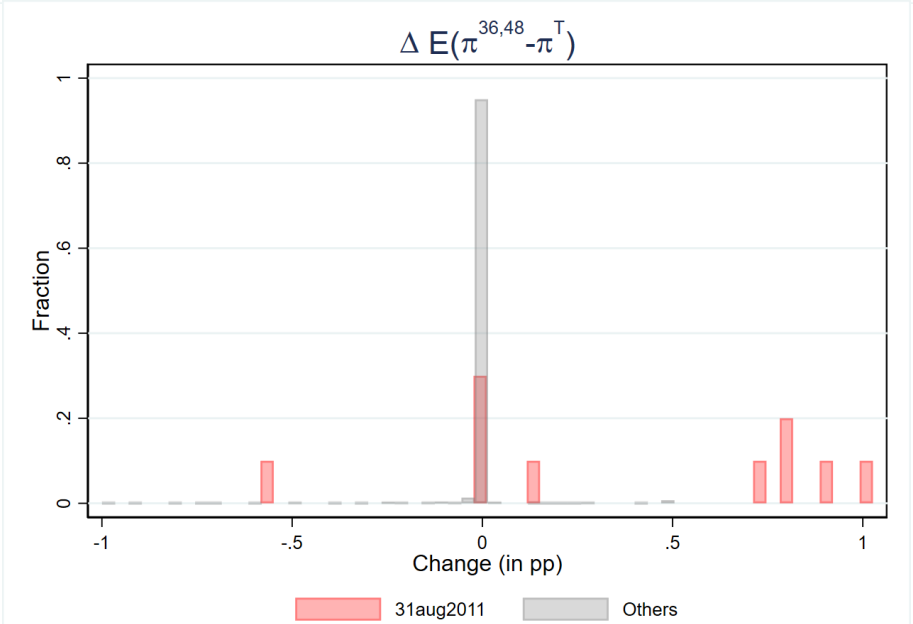




Two-day change in inflation expectations: Fixed horizons







Reanchoring: Regime change

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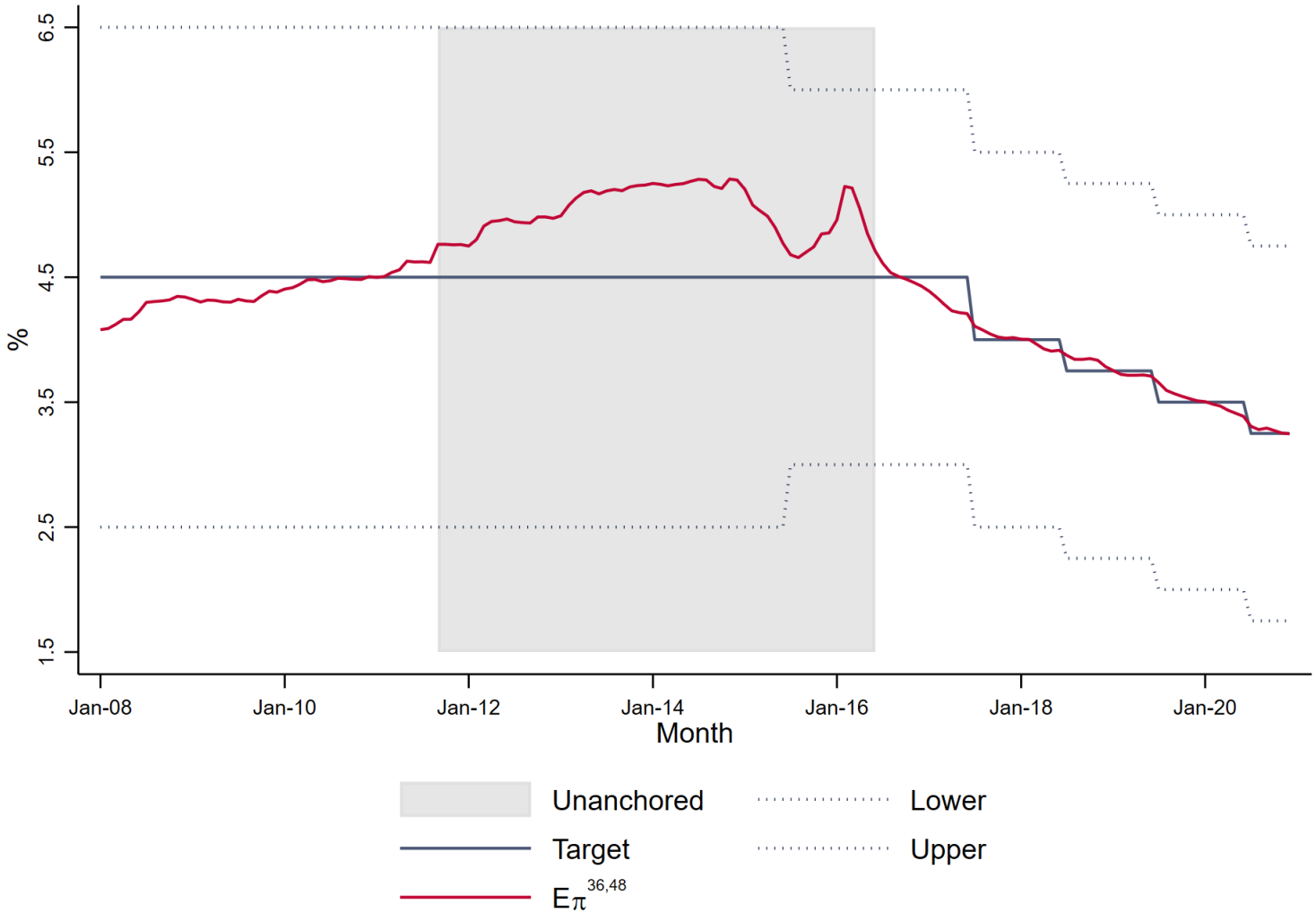
- New economic team, ambitious reform agenda, tight monetary policy
- Expectations reanchored; by August 2016, back to pre U-turn levels

Expected inflation between months 36-48

Figure: **Expected inflation between months 36-48**



Dispersion of inflation expectations

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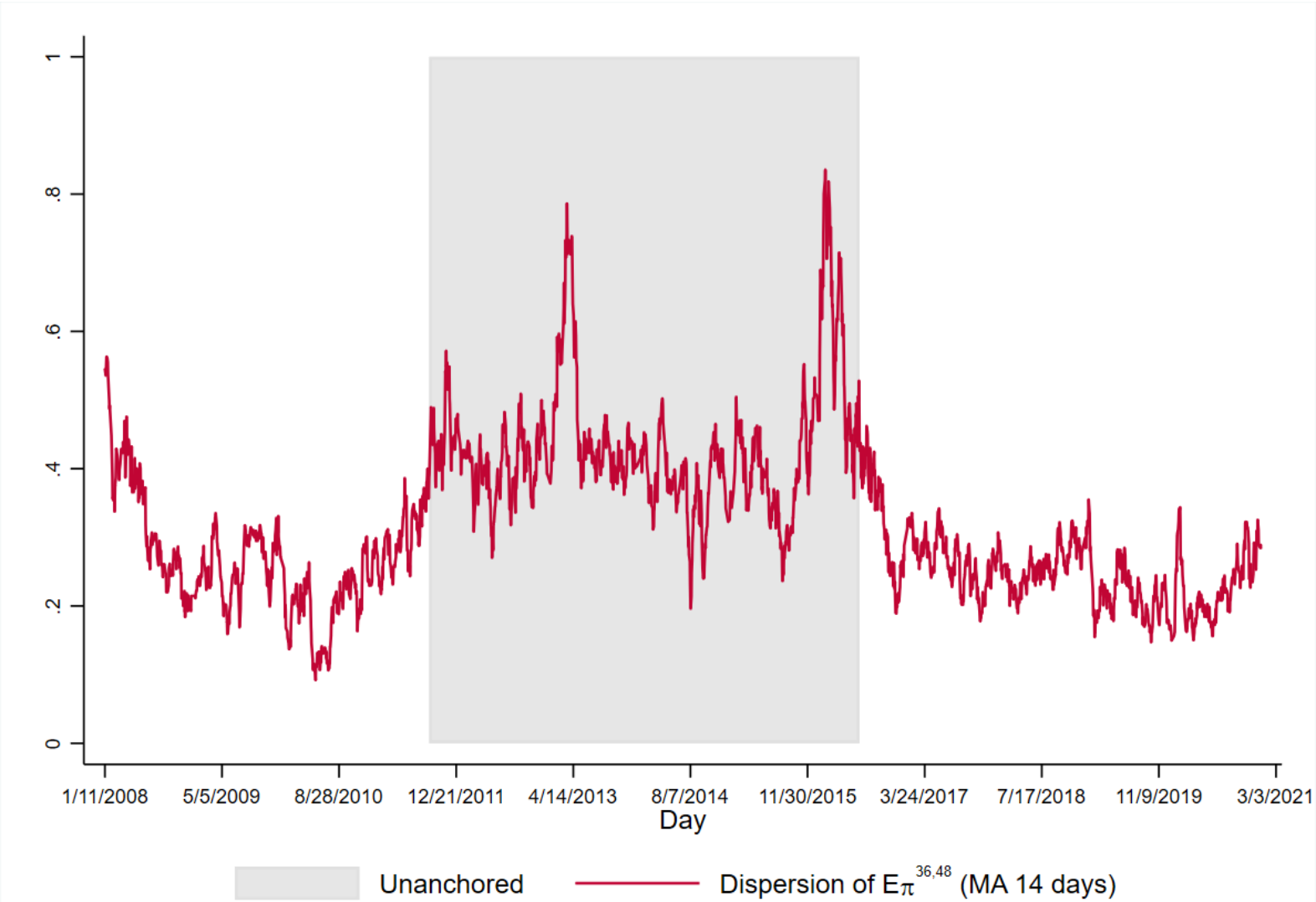

Two-day response of inflation expectations to policy surprises

Table: Two-day response of inflation expectations to monetary surprises – fixed events

Dependent variable	$\Delta E_i\left(\pi^{1y}-\pi^T\right)$	$\Delta E_i\left(\pi^{2y}-\pi^T\right)$	$\Delta E_i\left(\pi^{3y}-\pi^T\right)$	$\Delta E_i\left(\pi^{4y}-\pi^T\right)$
Abrupt U-turn surprise	-0.820***	-0.781***	-0.708***	-0.677**
	(0.142)	(0.209)	(0.273)	(0.314)
Othersurprises $\times\ \mathbb{1}_t^{Unanch}$	-0.489***	-0.417***	-0.317***	-0.165
	(0.126)	(0.115)	(0.0995)	(0.124)
Other surprises$\times\left(1-\mathbb{1}_t^{Unanch}\right)$	-0.0985**	-0.0329	-0.00677	-0.0183
	(0.0392)	(0.0301)	(0.0321)	(0.0513)
Constant	0.00297	0.00979**	0.00346	0.00308
	(0.00456)	(0.00442)	(0.00475)	(0.00569)
Data Structure	Panel	Panel	Panel	Panel
N	1,241	1,100	1,003	755
Adjusted R^2	0.176	0.163	0.0910	0.0883
Individual Fixed Effects	Yes	Yes	Yes	Yes

Two-day response of inflation expect. to policy surprises – 2

Table: Two-day response of inflation expectations to monetary surprises – fixed horizons

Dependent variable	$\Delta E_i\left(\pi^{12,24}-\pi^{T}\right)$	$\Delta E_i\left(\pi^{24,36}-\pi^{T}\right)$	$\Delta E_i\left(\pi^{36,48}-\pi^{T}\right)$
Abrupt U-turn surprise	-0.717***	-0.700***	-0.653**
	(0.154)	(0.248)	(0.323)
Othersurprises $\times\ \mathbb{1}_t^{Unanch}$	-0.511***	-0.440***	-0.244*
	(0.132)	(0.121)	(0.140)
Other surprises$\times\left(1-\mathbb{1}_t^{Unanch}\right)$	-0.0798**	-0.0314	-0.0400
	(0.0347)	(0.0318)	(0.0467)
Constant	0.00810*	0.00851*	0.00281
	(0.00454)	(0.00452)	(0.00568)
Data Structure	Panel	Panel	Panel
N	1,100	1,002	755
Adjusted R^2	0.182	0.143	0.0964
Individual Fixed Effects	Yes	Yes	Yes

Expectations passthrough regressions – reference dates

Dependent variable	$\Delta E_i\left(\pi^{24,36} - \pi^T\right)$	$\Delta E_i\left(\pi^{36,48} - \pi^T\right)$
$\Delta E_i\left[\pi^{12m}\right]$	0.0193	0.00887
	(0.0121)	(0.0164)
$\Delta E_i\left[\pi^{12m}\right] \times \mathbb{1}_t{}^{Unanch}$	0.180***	0.146***
	(0.0330)	(0.0319)
Constant	-0.00103	-0.00152
	(0.00359)	(0.00363)
N	2,899	2,518
Adjusted R^2	0.0454	0.0207
Individual Fixed Effects	Yes	Yes

Expectations passthrough regressions – 30-day rolling windows

Dependent variable	$\Delta E_i\left(\pi^{24,36} - \pi^T\right)$	$\Delta E_i\left(\pi^{36,48} - \pi^T\right)$
$\Delta E_i\left[\pi^{12m}\right]$	0.0271***	0.00707***
	(0.00179)	(0.00204)
$\Delta E_i\left[\pi^{12m}\right] \times \mathbb{1}_t{}^{Unanch}$	0.143***	0.102***
	(0.00541)	(0.00413)
Constant	-0.000399	-8.19e-05
	(0.000399)	(0.000417)
N	205,018	169,006
Adjusted R^2	0.0557	0.0325
Individual Fixed Effects	Yes	Yes

A measure of the degree of unanchoring

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

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$E_t\left[\pi_{t+s}\right]$: 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 "full unanchoring". For Brazil, we pick the top of the tolerance band.

A measure of the degree of unanchoring

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

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

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

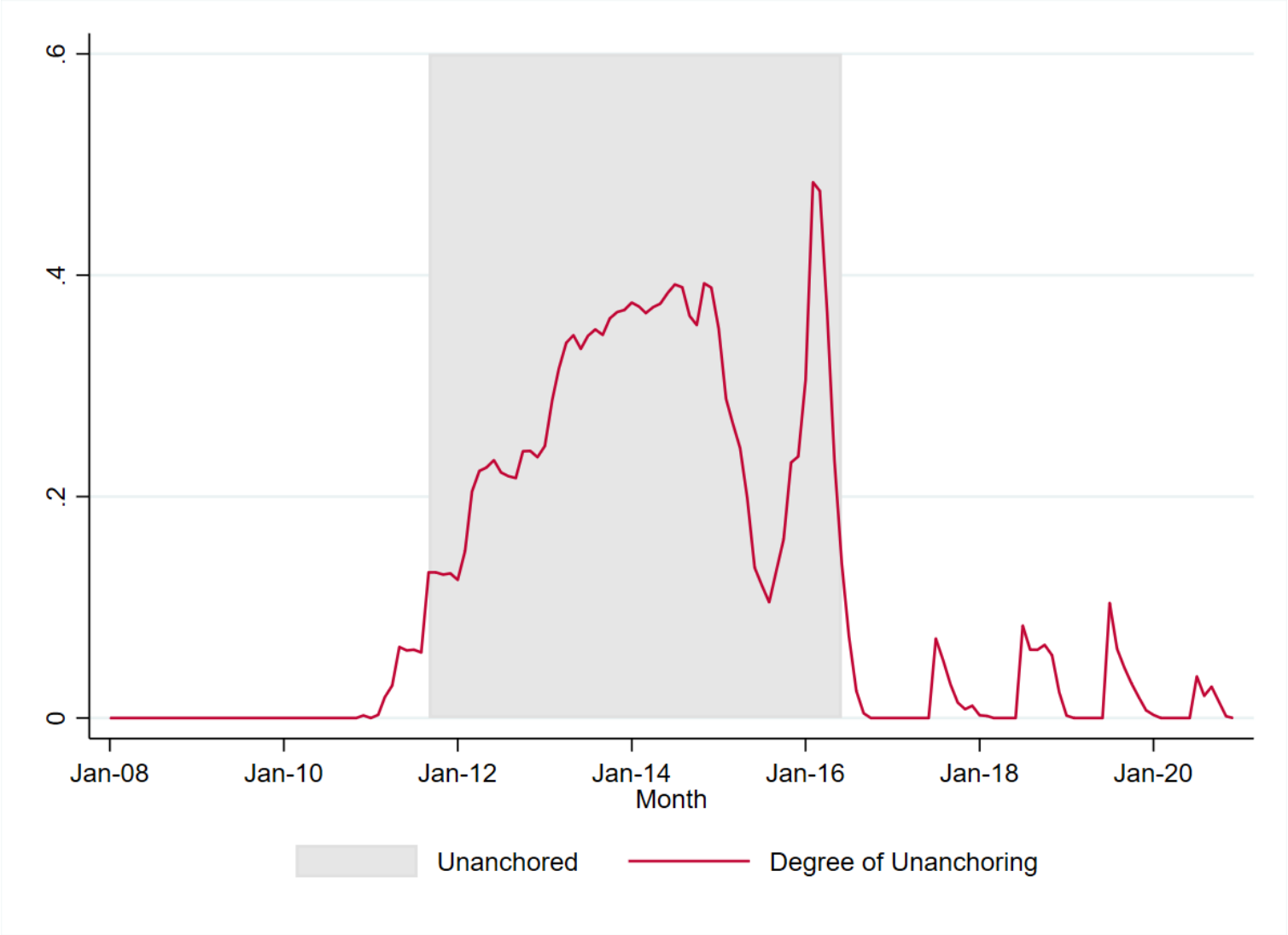
π^{T}_{t+s}: inflation target for $t+s$,

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

- Expectation horizon: not too short
  - Short horizons: temporary shocks to which CB may do well not to respond to.
  - BCB formally focuses on inflation between 6 and 18 months ahead.
  - Our choice: Inflation between 36 and 48 months ahead (longest available).

Expectational regimes and degree of unanchoring

Figure: **Anchored/unanchored regimes and degree of unanchoring**



Empirical strategy

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

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

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

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

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

Also, specifications with the continuous measure of degree of unanchoring in place of $\mathbb{1}_t^{Unanch}$. And versions with basket of EM currencies as instrument for $\Delta_{\tau_i} e_t$.

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

Baseline passthrough regressions

	$\Delta_{\tau_i} e_t$ - 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	0.0626***	0.0378***	0.0237***
	(0.00393)	(0.00545)	(0.00568)	(0.00576)	(0.00790)	(0.00846)
$\Delta_{\tau_i} e_t \times \mathbb{1}_t^{Unanch}$		0.0460***	0.0322***		0.0614***	0.0416***
		(0.00805)	(0.00844)		(0.0113)	(0.0119)
$\Delta_{\tau_i} p_{it-\tau_{it}}$			-0.122***			-0.123***
			(0.00521)			(0.00520)
τ_{it}			0.000359***			0.000302***
			(0.0000974)			(0.0000992)
$\Delta_{\tau_i} ULC_t$			0.0289***			0.0237***
			(0.00608)			(0.00619)
Δ_{τ_i} *Sectoral cost*$_t$			0.0347***			0.0372***
			(0.0104)			(0.0103)
Sectoral inventory$_t$			-0.000177***			-0.000177***
			(0.0000184)			(0.0000183)
Sectoral demand$_t$			0.000325***			0.000326***
			(0.0000288)			(0.0000288)
Constant	0.0435***	0.0428***	0.00214	0.0446***	0.0436***	0.00304
	(0.00245)	(0.00245)	(0.00380)	(0.00245)	(0.00246)	(0.00381)
N	192502	192502	178442	192502	192502	178442
Adjusted R^2	0.049	0.049	0.065	0.049	0.050	0.065
Individual Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes

Passthrough regression with degree of unanchoring

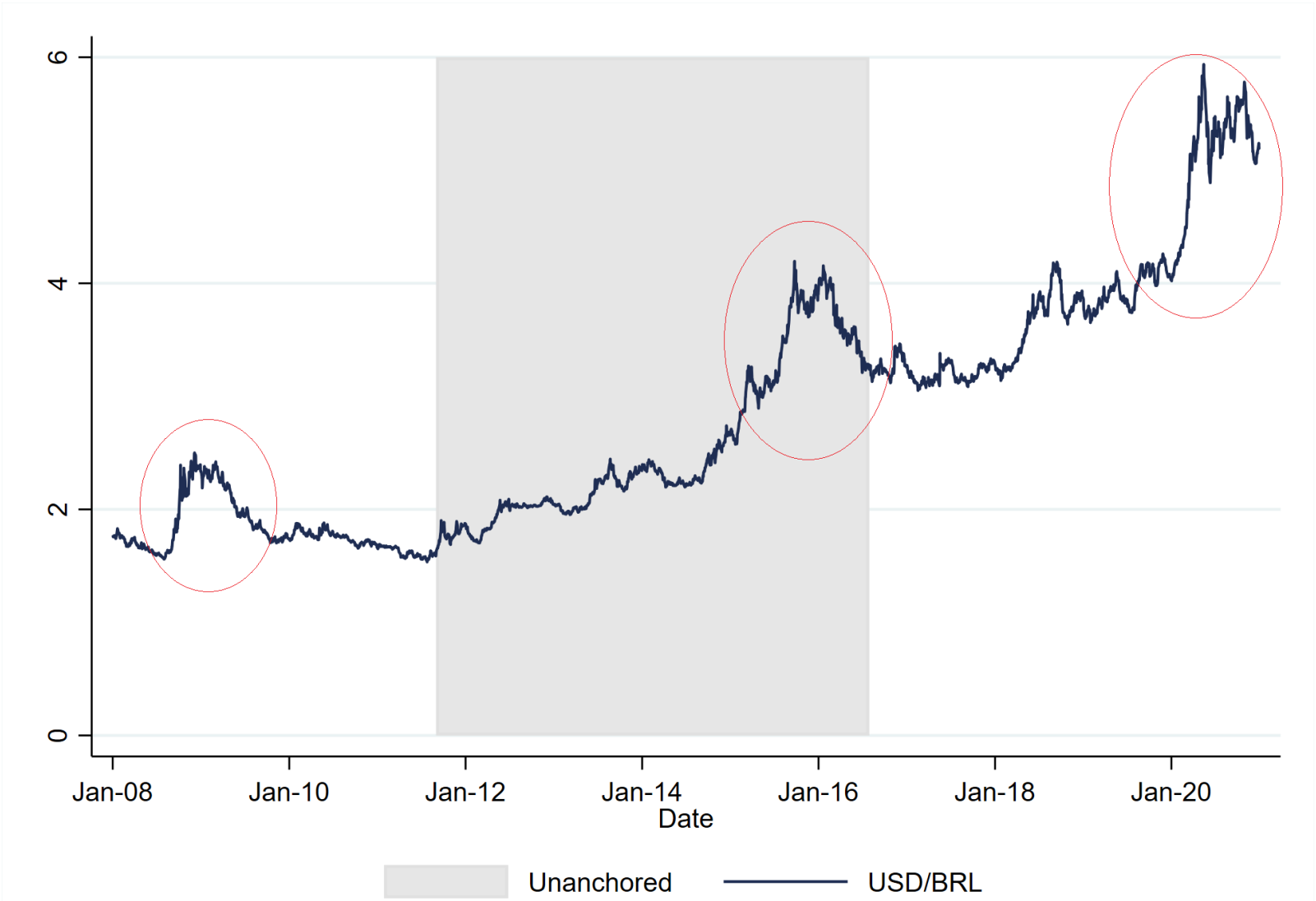
	$\Delta_{\tau_i} e_t$ - Nominal Exchange Rate			$\Delta_{\tau_i} e_t$ - Instrumented FX		
Dependent variable: $\Delta_{\tau_i} p_{it}$	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta_{\tau_i} e_t$	0.0410***	0.0185***	0.00626	0.0626***	0.0336***	0.0211***
	(0.00393)	(0.00523)	(0.00543)	(0.00576)	(0.00756)	(0.00809)
$\Delta_{\tau_i} e_t \times Unanch_t$		0.199***	0.133***		0.250***	0.169***
		(0.0271)	(0.0285)		(0.0367)	(0.0381)
$\Delta_{\tau_i} p_{it-\tau_{it}}$			-0.122***			-0.123***
			(0.00521)			(0.00520)
τ_{it}			0.000344***			0.000293***
			(0.0000978)			(0.0000994)
$\Delta_{\tau_i} ULC_t$			0.0295***			0.0239***
			(0.00608)			(0.00617)
$\Delta_{\tau_i} Sectoral\ cost_t$			0.0341***			0.0370***
			(0.0103)			(0.0103)
$Sectoral\ \ inventory_t$			-0.000178***			-0.000177***
			(0.0000183)			(0.0000183)
$Sectoral\ \ demand_t$			0.000325***			0.000325***
			(0.0000287)			(0.0000288)
Constant	0.0435***	0.0426***	0.00210	0.0446***	0.0434***	0.00301
	(0.00245)	(0.00245)	(0.00380)	(0.00245)	(0.00246)	(0.00381)
N	192502	192502	178442	192502	192502	178442
Adjusted R^2	0.049	0.050	0.065	0.049	0.050	0.065
Individual Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes

Passthrough regression with lagged FX change

	$\Delta_{\tau_i} e_t$ - Nominal Exchange Rate			$\Delta_{\tau_i} e_t$ - Instrumented FX		
Dependent variable: $\Delta_{\tau_i} p_{it}$	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta_{\tau_i} e_t$	0.0416***	0.0197***	0.0111*	0.0632***	0.0332***	0.0274***
	(0.00425)	(0.00594)	(0.00627)	(0.00611)	(0.00856)	(0.00937)
$\Delta_{\tau_i} e_{t-\tau_{it}}$	0.00989***	-0.000976	0.00459	0.00147	-0.0113*	0.00434
	(0.00335)	(0.00435)	(0.00440)	(0.00470)	(0.00605)	(0.00633)
$\Delta_{\tau_i} e_t \times \mathbb{1}_t^{Unanch}$		0.0505***	0.0369***		0.0691***	0.0464***
		(0.00854)	(0.00873)		(0.0116)	(0.0122)
$\Delta_{\tau_i} e_{t-\tau_{it}} \times \mathbb{1}_t^{Unanch}$		0.0277***	0.0316***		0.0336***	0.0310***
		(0.00648)	(0.00648)		(0.00864)	(0.00878)
$\Delta_{\tau_i} p_{it-\tau_{it}}$			-0.123***			-0.123***
			(0.00521)			(0.00522)
τ_{it}			0.000392***			0.000312***
			(0.0000978)			(0.000100)
$\Delta_{\tau_i} ULC_t$			0.0279***			0.0219***
			(0.00610)			(0.00623)
$\Delta_{\tau_i} Sectoral\ cost_t$			0.0311***			0.0355***
			(0.0104)			(0.0103)
$Sectoral\ \ inventory_t$			-0.000178***			-0.000177***
			(0.0000184)			(0.0000184)
$Sectoral\ \ demand_t$			0.000328***			0.000329***
			(0.0000288)			(0.0000289)
Constant	0.0384***	0.0381***	0.00196	0.0446***	0.0439***	0.00297
	(0.00246)	(0.00245)	(0.00382)	(0.00246)	(0.00246)	(0.00383)
N	192502	192502	178442	192501	192501	178442
Adjusted R^2	0.049	0.050	0.065	0.049	0.050	0.065
Individual Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes

Unanchoring or non-linearity?

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



Unanchoring or non-linearity?

	$\Delta_{\tau_i} e_t$ - Nominal Exchange Rate					$\Delta_{\tau_i} e_t$ - Instrumented FX				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$\Delta_{\tau_i} e_t$	0.0410***	0.0225***	0.0315***	0.0193***	0.00989	0.0626***	0.0378***	0.0527***	0.0341***	0.0281***
	(0.00393)	(0.00545)	(0.00495)	(0.00582)	(0.00602)	(0.00576)	(0.00790)	(0.00776)	(0.00913)	(0.00951)
$\Delta_{\tau_i} e_{t-\tau_{it}} \times \mathbb{1}_t^{Unanch}$		0.0460***		0.0425***	0.0337***		0.0614***		0.0595***	0.0428***
		(0.00805)		(0.00834)	(0.00853)		(0.0113)		(0.0113)	(0.0118)
$(\Delta_{\tau_i} e_t)^2$			0.0455***	0.0220	-0.0135			0.0568	0.0257	-0.0346
			(0.0163)	(0.0170)	(0.0188)			(0.0353)	(0.0357)	(0.0406)
$\Delta_{\tau_i} p_{it-\tau_{it}}$					-0.122***					-0.122***
					(0.00521)					(0.00520)
τ_{it}					0.000388***					0.000340***
					(0.000106)					(0.000108)
$\Delta_{\tau_i} ULC_t$					0.0288***					0.0236***
					(0.00608)					(0.00619)
Δ_{τ_i} *Sectoral cost*$_t$					0.0344***					0.0367***
					(0.0104)					(0.0103)
Sectoral inventory$_t$					-0.000177***					-0.000178***
					(0.0000183)					(0.0000183)
Sectoral demand$_t$					0.000325***					0.000326***
					(0.0000287)					(0.0000288)
Constant	0.0435***	0.0428***	0.0431***	0.0426***	0.00225	0.0446***	0.0436***	0.0441***	0.0434***	0.00329
	(0.00245)	(0.00245)	(0.00246)	(0.00246)	(0.00380)	(0.00245)	(0.00246)	(0.00249)	(0.00249)	(0.00382)
N	192502	192502	192502	192502	178442	192502	192502	192502	192502	178442
Adjusted R^2	0.049	0.049	0.049	0.049	0.065	0.049	0.050	0.049	0.050	0.065
Individual Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Unanchoring or asymmetric response to FX?

$\Delta_{\tau_i} e_t$ - **Nominal Exchange Rate**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta_{\tau_i} e_t$	0.0410***		0.0225***	0.0226***		0.00822	0.00838	
	(0.00393)		(0.00545)	(0.00545)		(0.00568)	(0.00568)	
$\Delta_{\tau_i} e_t^{app}$		0.00792			0.00709			0.0108
		(0.00964)			(0.0103)			(0.0112)
$\Delta_{\tau_i} e_t^{dep}$		0.0531***			0.0310***			0.00692
		(0.00501)			(0.00730)			(0.00819)
$\Delta_{\tau_i} e_{t-\tau_{it}} \times \mathbb{1}_t^{Unanch}$			0.0460***			0.0322***		
			(0.00805)			(0.00844)		
$\Delta_{\tau_i} e_{t-\tau_{it}}^{app} \times \mathbb{1}_t^{Unanch}$				0.0117	0.0264		0.00839	0.00626
				(0.0254)	(0.0268)		(0.0259)	(0.0274)
$\Delta_{\tau_i} e_{t-\tau_{it}}^{dep} \times \mathbb{1}_t^{Unanch}$				0.0494***	0.0423***		0.0348***	0.0357***
				(0.00859)	(0.00948)		(0.00904)	(0.00971)
$\Delta_{\tau_i} p_{it-\tau_{it}}$						-0.122***	-0.122***	-0.122***
						(0.00521)	(0.00521)	(0.00521)
τ_{it}						0.000359***	0.000351***	0.000362***
						(0.0000974)	(0.0000980)	(0.000111)
$\Delta_{\tau_i} ULC_t$						0.0289***	0.0287***	0.0286***
						(0.00608)	(0.00610)	(0.00611)
Δ_{τ_i} *Sectoral cost*$_t$						0.0347***	0.0348***	0.0347***
						(0.0104)	(0.0103)	(0.0104)
Sectoral inventory$_t$						-0.000177***	-0.000177***	-0.000177***
						(0.0000184)	(0.0000184)	(0.0000183)
Sectoral demand$_t$						0.000325***	0.000325***	0.000325***
						(0.0000288)	(0.0000287)	(0.0000287)
Constant	0.0435***	0.0423***	0.0428***	0.0428***	0.0422***	0.00214	0.00215	0.00226
	(0.00245)	(0.00248)	(0.00245)	(0.00245)	(0.00249)	(0.00380)	(0.00380)	(0.00381)
N	192502	192502	192502	192502	192502	178442	178442	178442
Adjusted R^2	0.049	0.049	0.049	0.049	0.050	0.065	0.065	0.065
Individual Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Unanchoring or above-average monthly inflation?

	$\Delta_{\tau_i} e_t$ - Nominal Exchange Rate					$\Delta_{\tau_i} e_t$ - Instrumented FX				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$\Delta_{\tau_i} e_t$	0.0410***	0.0225***	0.0125*	0.0111	-0.00281	0.0626***	0.0378***	0.0294***	0.0271***	0.0147
	(0.00393)	(0.00545)	(0.00755)	(0.00758)	(0.00732)	(0.00576)	(0.00790)	(0.0103)	(0.0103)	(0.0102)
$\Delta_{\tau_i} e_{t-\tau_{it}} \times \mathbb{1}_t^{Unanch}$		0.0460***		0.0355***	0.0224**		0.0614***		0.0500***	0.0325**
		(0.00805)		(0.00921)	(0.00976)		(0.0113)		(0.0132)	(0.0139)
$\Delta_{\tau_i} e_t \times \pi_t$			0.0547***	0.0299**	0.0282**			0.0647***	0.0299*	0.0240
			(0.0111)	(0.0127)	(0.0125)			(0.0149)	(0.0173)	(0.0170)
$\Delta_{\tau_i} p_{it-\tau_{it}}$					-0.122***					-0.122***
					(0.00520)					(0.00520)
τ_{it}					0.000365***					0.000305***
					(0.0000975)					(0.0000993)
$\Delta_{\tau_i} ULC_t$					0.0303***					0.0247***
					(0.00608)					(0.00616)
Δ_{τ_i} *Sectoral cost*$_t$					0.0333***					0.0365***
					(0.0104)					(0.0103)
Sectoral inventory$_t$					-0.000177***					-0.000177***
					(0.0000183)					(0.0000183)
Sectoral demand$_t$					0.000325***					0.000326***
					(0.0000288)					(0.0000288)
Constant	0.0435***	0.0428***	0.0436***	0.0430***	0.00228	0.0446***	0.0436***	0.0447***	0.0438***	0.00316
	(0.00245)	(0.00245)	(0.00245)	(0.00245)	(0.00380)	(0.00245)	(0.00246)	(0.00245)	(0.00246)	(0.00381)
N	192502	192502	192502	192502	178442	192502	192502	192502	192502	178442
Adjusted R^2	0.049	0.049	0.049	0.050	0.065	0.049	0.050	0.050	0.050	0.065
Individual Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Unanchoring or above-average 12m inflation?

	$\Delta_{\tau_i} e_t$ - Nominal Exchange Rate					$\Delta_{\tau_i} e_t$ - Instrumented FX				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$\Delta_{\tau_i} e_t$	0.0410***	0.0225***	-0.0132	0.00216	-0.0249*	0.0626***	0.0378***	-0.0169	0.00392	-0.0117
	(0.00393)	(0.00545)	(0.0106)	(0.0119)	(0.0123)	(0.00576)	(0.00790)	(0.0163)	(0.0175)	(0.0180)
$\Delta_{\tau_i} e_{t-\tau_{it}} \times \mathbb{1}_t^{Unanch}$		0.0460***		0.0298*	0.00565		0.0614***		0.0388*	0.0183
		(0.00805)		(0.0122)	(0.0129)		(0.0113)		(0.0154)	(0.0160)
$\Delta_{\tau_i} e_t \times \pi_t^{12m}$			0.00875***	0.00434	0.00695**			0.0133***	0.00718*	0.00739*
			(0.00155)	(0.00236)	(0.00244)			(0.00257)	(0.00349)	(0.00363)
$\Delta_{\tau_i} p_{it-\tau_{it}}$					0.000421***					0.000332***
					(0.000101)					(0.000100)
τ_{it}					-0.122***					-0.123***
					(0.00520)					(0.00520)
$\Delta_{\tau_i} ULC_t$					0.0320**					0.0348***
					(0.0105)					(0.0104)
Δ_{τ_i} *Sectoral cost*$_t$					0.0289***					0.0240***
					(0.00608)					(0.00618)
Sectoral inventory$_t$					-0.000177***					-0.000177***
					(0.0000183)					(0.0000183)
Sectoral demand$_t$					0.000327***					0.000328***
					(0.0000288)					(0.0000288)
Constant	0.0435***	0.0428***	0.0436***	0.0431***	0.00240	0.0446***	0.0436***	0.0449***	0.0441***	0.00337
	(0.00245)	(0.00245)	(0.00245)	(0.00245)	(0.00380)	(0.00245)	(0.00246)	(0.00245)	(0.00246)	(0.00381)
N	192502	192502	192502	192502	178442	192502	192502	192502	192502	178442
Adjusted R^2	0.049	0.049	0.049	0.050	0.065	0.049	0.050	0.050	0.050	0.065
Individual Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

(Degree of) Unanchoring or above-average 12m inflation?

	$\Delta_{\tau_i} e_t$ - Nominal Exchange Rate					$\Delta_{\tau_i} e_t$ - Instrumented FX				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$\Delta_{\tau_i} e_t$	0.0410***	0.0185***	-0.0132	0.00865	-0.0168	0.0626***	0.0336***	-0.0169	0.0115	-0.00390
	(0.00393)	(0.00523)	(0.0106)	(0.0110)	(0.0113)	(0.00576)	(0.00756)	(0.0163)	(0.0166)	(0.0172)
$\Delta_{\tau_i} e_{t-\tau_{it}} \times Unanch_t$		0.199***		0.179***	0.0842*		0.250***		0.213***	0.127**
		(0.0271)		(0.0339)	(0.0362)		(0.0367)		(0.0434)	(0.0451)
$\Delta_{\tau_i} e_t \times \pi_t^{12m}$			0.00875***	0.000196	0.00455*			0.0133***	0.00441	0.00493
			(0.00155)	(0.00193)	(0.00202)			(0.00257)	(0.00304)	(0.00318)
$\Delta_{\tau_i} p_{it-\tau_{it}}$					0.000379***					0.000308**
					(0.000100)					(0.0000999)
τ_{it}					-0.122***					-0.123***
					(0.00521)					(0.00520)
$\Delta_{\tau_i} ULC_t$					0.0324**					0.0354***
					(0.0104)					(0.0104)
$\Delta_{\tau_i} Sectoral\ cost_t$					0.0296***					0.0243***
					(0.00608)					(0.00618)
$Sectoral\ \ inventory_t$					-0.000178***					-0.000178***
					(0.0000183)					(0.0000184)
$Sectoral\ \ demand_t$					0.000326***					0.000327***
					(0.0000287)					(0.0000288)
$Constant$	0.0435***	0.0426***	0.0436***	0.0427***	0.00222	0.0446***	0.0434***	0.0449***	0.0437***	0.00318
	(0.00245)	(0.00245)	(0.00245)	(0.00245)	(0.00380)	(0.00245)	(0.00246)	(0.00245)	(0.00246)	(0.00381)
N	192502	192502	192502	192502	178442	192502	192502	192502	192502	178442
Adjusted R^2	0.049	0.050	0.049	0.050	0.065	0.049	0.050	0.050	0.050	0.065
Individual Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	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 assume in reality it doesn't).
- 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_{it}:

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

L_{it}: labor
I_{it}: domestic intermediate inputs (source of real rigidities)
M_{it}: imported input
A_{it}, A_t: firm-specific and aggregate productivity processes.

- Firm i's real marginal cost:

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

w_t: real wage
q_t: real exchange rate.

- Nominal exchange rate follows persistent AR(1) process.

- Calvo pricing.

Central bank and expectation (un)anchoring

- Taylor rule:

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

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

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

$\bar{g} > 0$: 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.

Model calibration

- Model calibrated to Brazilian economy.
- We simulate the model, sample a panel of 5800 firms over 2000 periods, assume windows of anchored/unanchored/anchored expectations as in the data, and run passthrough regressions analogous to empirical specifications (proper Monte Carlo in progress).
- In anchored regime, $\hat{c}_q = 0$, whereas in unanchored regime $\hat{c}_q > 0$ is pinned down by internal calibration (ratio of volatility of "medium run" inflation expectations in unanchored vs anchored regimes).

Calibration results

Parameters	Description		Parameters	Description	
$1-\alpha$	import elasticity	0.140	σ_{π^*}	vol. π_t^* shock	0.052
β	discount rate	0.995	σ_R	vol. mp shock	0.050
$1-\theta$	freq. Δp^i	0.300	ρ_E	persistence E_t	0.890
$1-\eta$	interm. inputs	0.200	ρ_a	persistence a_t	0.672
ϕ_π	TR: $\pi_t - \pi_t^*$	1.300	ρ_a	persistence a_{it}	0.700
ϕ_y	TR: y_t	0.008	σ_E	vol. E_t shock	3.475
ρ_i	TR: R_{t-1}	0.534	σ_a	vol. a_t shock	1.201
$\hat{c}_q$	unanchoring	0.004	σ_{a_i}	vol. a_{it} shock	7.500

Moments	Model	Data
$\sigma(\pi_t)$	0.300	0.300
$\sigma(R_t)$	0.493	0.260
$\sigma(E_t)$	7.802	7.800
$\sigma(\hat{y}_t)$	2.431	2.400
$\sigma(\mathbb{E}^{Anc}\pi)$:	0.100	0.100
$\sigma(\mathbb{E}^{Unanc}\pi)$:	0.300	0.300
$\rho(\pi_t, \pi_{t-1})$:	0.556	0.570
$\rho(R_t, R_{t-1})$:	0.823	0.950
$\rho(\hat{y}_t, \hat{y}_{t-1})$:	0.934	0.750
$\rho(E_t, E_{t-1})$:	0.891	0.890
$\mathbb{E}(\lvert\Delta p_t^i\rvert)$:	5.352	6.000

Passthrough regressions with model-generated data

Dependent variable: $\Delta_{\tau_i} p_{it}$	**(1)**	**(2)**
$\Delta_{\tau_i} e_t$	0.0301***	0.0481***
	(0.00123)	(0.00145)
$\Delta_{\tau_i} e_t \times \mathbb{1}_t^{Unanch}$	0.0339***	0.0525***
	(0.00202)	(0.00240)
$\Delta_{\tau_i} e_{t-\tau_{it}}$		0.0244***
		(0.000989)
$\Delta_{\tau_i} e_{t-\tau_{it}} \times \mathbb{1}_t^{Unanch}$		0.0241***
		(0.00163)
$\Delta_{\tau_i} p_{it-\tau_{it}}$	-0.294***	-0.295***
	(0.000515)	(0.000515)
constant	0.842***	0.816***
	(0.129)	(0.130)
N	3,480,942	3,480,942
Num. of Items	5,800	5,800
Adjusted R^2	0.108	0.109
Individual Fixed Effects	No	No
Time Fixed Effects	Yes	Yes

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Conclusion

- Present evidence that inflation expectations matter for individual pricing decisions.
- In such circumstances, wholesalers increase passthrough of costs (exchange rate movements) into prices.
- 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.
  - Sizable quantitative effects.