Price Setting when Expectations are Unanchored*

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Abstract

This paper investigates the role of unanchored inflation expectations in shaping firm pricing decisions. We exploit a quasi-natural experiment in Brazil that features distinct episodes of expectations de-anchoring and re-anchoring, leveraging granular price microdata and survey-based inflation expectations. Our empirical results show that firms' pricing decisions become more responsive to shocks when inflation expectations are unanchored. More specifically, we find increased exchange rate passthrough under those circumstances. Using a calibrated new Keynesian model, we show these empirical findings are consistent with theoretical predictions. The results highlight the importance of anchoring expectations for ensuring macroeconomic stability.

JEL Classification: E53, E65.
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> "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)

1 Introduction

The belief that inflation expectations influence actual inflation dynamics is deeply ingrained among academics and policymakers. This belief rests on the premise that expectations shape forward-looking pricing decisions. When inflation expectations are well-anchored, price setters anticipate that shocks to inflation will be short-lived, leading to less pronounced adjustments in their forward-looking pricing decisions. Consequently, actual inflation becomes more stable, and medium- and long-run inflation expectations exhibit reduced sensitivity to short-run inflationary pressures.[1] Central to this dynamic is the credibility of the central bank in preventing persistent deviations of inflation from its target.

This paper provides empirical evidence that the state of inflation expectations plays a critical role in individual pricing decisions, offering the first set of facts about price-setting behavior when expectations are unanchored. Using a range of micro datasets over a 15-year period in Brazil—during which the anchoring of inflation expectations fluctuated significantly (Bonomo et al., 2024)—we uncover novel insights. Specifically, when inflation expectations are unanchored, wholesalers exhibit a higher passthrough of exchange rate movements to prices. Additionally, firms make fewer errors in predicting their own future pricing behavior, particularly underestimating the frequency of price increases.[2]. Finally, we demonstrate that our empirical results align with predictions from a simple New Keynesian model in which expectations can become unanchored.

Brazil's varying degree of inflation expectations anchoring over time provides a unique setting for studying how different expectation regimes influence price-setting behavior. To analyze this, we combine multiple datasets spanning 2008–2020. For individual pricing decisions, we utilize microdata from the Producer Price Index (PPI) published by IBRE-FGV and survey data on manufacturing firms' demand, costs, inventories, and pricing intentions. For a subset of firms, we merge these datasets to compare intended versus actual pricing decisions. To capture inflation expectations, we rely on both aggregate and individual-level data from the Banco Central do Brasil's Focus Survey. Additionally, we incorporate a variety of aggregate and sectoral data.

We build on (Bonomo et al., 2024), who use the Focus Survey to construct a continuous measure of the degree of expectations unanchoring, along with a regime classification into anchored and unanchored periods based on a threshold for this measure.[3] This measure reflects deviations of three-year-ahead inflation expectations from target. With base on their sample split into anchored and unanchored regimes, we compute descriptive price-setting statistics—such as the frequency and magnitude of price changes—in the spirit of Bils and Klenow

[1] Bernanke (2007) defines anchored inflation expectations as being "relatively insensitive to incoming data." Carvalho et al. (2023) formalize this concept in a model of learning where the degree of anchoring is endogenous and time-varying.

[2] As described in Section **??**, periods of unanchored expectations in Brazil are associated with above-average inflation, which may explain the direction of firms' forecasting errors. In a low-inflation environment with expectations unanchored on the downside, firms might err in the opposite direction.

[3] Our measure of unanchoring builds on Cecchetti and Krause (2002) and can also be interpreted as a proxy for imperfect monetary policy credibility.

(2004).[4]

Our results reveal that the passthrough of exchange rate movements to prices is significantly higher during periods of unanchored expectations. To demonstrate this, we estimate panel regressions in the style of Gopinath et al. (2010) and Gopinath and Itskhoki (2010), leveraging changes in the exchange rate over the life of individual price spells. By controlling for aggregate and sectoral variables during each spell and saturating the model with product- and time-fixed effects, we isolate the effect of unanchored expectations. The interaction of exchange rate changes with the unanchored regime dummy consistently yields positive and significant coefficients, indicating elevated passthrough when expectations are unanchored. Results hold across specifications that use a continuous unanchoring measure and remain robust to controls for inflation levels and non-linear passthrough dynamics.

We further explore firms' price expectations using a subset of the merged PPI-FGV and manufacturing survey datasets. For these firms, we measure forecasting errors by comparing intended price changes with actual pricing decisions. Our analysis shows that firms make fewer forecasting errors in unanchored regimes, possibly reflecting increased attentiveness during periods of heightened uncertainty. Alternatively, unanchored regimes might systematically align firms' expectations with realized pricing dynamics.

Finally, we present a new Keynesian model where inflation expectations can become unanchored. We use the calibrated model to generate artificial microdata featuring an unanchored regime sandwiched between two anchored regimes, as witnessed in Brazil. Simulating passthrough regressions on this synthetic data reproduces the empirical finding of higher passthrough during unanchored periods, with effect sizes comparable to those estimated using actual data. Importantly, our calibration strategy does not target that data moment.

2 Data and Methodology

2.1 Data

Our analysis leverages two primary datasets. The first is firm-level microdata from Brazil's PPI, encompassing pricing information in the agriculture, mining, and manufacturing sectors. The second is the Focus Survey, a daily survey of inflation expectations conducted by the Brazilian Central Bank. These datasets enable an in-depth examination of pricing dynamics during periods of expectations de-anchoring and re-anchoring between 2008 and 2020.

2.1.1 Data treatment We work at the monthly frequency. Hence, for items that are surveyed more than once per month, we choose to keep the last price quote of the items in each month. We assign missing values to outliers. We define as outliers all prices that are higher than 10 times or lower than 0.1 times the preceding price in the item's quote line. This aims at eliminating common typing errors. We further refine our sample by eliminating items with too many or too many consecutive missing prices. We drop items with more than 30% of missing prices, as well as items with more than 12 consecutive missing observations. Moreover, for each item and in each month, we assign missing values to price quotes that are above the 99.5^{th} and below the 0.5^{th} percentiles. The final sample has 14.164 items and 883.782 price quotes.

[4] Barros et al. (2009) present analogous statistics using IBRE-FGV's Consumer Price Index microdata, while Abib and Matos (2022) provide similar analysis for the PPI.

2.2 PPI microdata

The PPI-FGV dataset contains detailed price information from the survey used to construct IBRE-FGV's Producer Price Index. Individual prices are collected through monthly telephone surveys, which target formal firms in the manufacturing sectors that have at least thirty employees.[5] Firms are asked to report the prices of individual goods sold to other firms, alongside a description of the physical characteristics of the goods and information about the transactions.

We refer to the most disaggregated level of our data as an item. An item is associated with a set of characteristics, including the company name, location, product classification, model, size, brand, and packaging. Items are classified into one of 343 products specified in the National Classification of Economic Activities (CNAE).[6] Weights are given at the product level to compute the aggregate producer price index.[7] A few examples of items and products are provided in Table 1.[8]

Table 1: **Examples of items and products in the PPI-FGV dataset**

Item	Printed tricoline fabric (1.5 M)
Producer	XXXXXXXX
Id. code	175068
CNAE (Product)	202213201
Group Name	Textiles Products
Group Code	2022130
Item	GALVANIZED WIRE BWG 18 (T)
Producer	XXXXXXXX
Id. code	319247
CNAE (Product)	202224301
Group Name	Manufacture of fabricated metal products.
Group Code	2022240
Item	AIR CHAMBER FOR TIRE XXXXXXXX (UNIT)
Producer	XXXXXXXX
Id. code	842344
CNAE (Product)	202222104
Group Name	Manufacture of rubber and plastics products.
Group Code	2022220
Item	UREA FOR FERTILIZER XXXXXXXX (T)
Producer	XXXXXXXX
Id. code	694203
CNAE (Product)	202220108
Group Name	Manufacture of chemicals and chemical products.
Group Code	2022200

Our PPI sample covers the period from January 2008 to December 2020. It results from the merging of the (active) dataset currently used to calculate the PPI-FGV with an inactive dataset. The latter comprises those items discontinued from the current dataset, which belonged to the PPI-FGV at some point since January 2008. An item may be deemed inactive if its price has been missing for a long period. A particular feature of this data

[5] Number of employees is based on the Annual Survey of Industry from the Brazilian Institute of Geography and Statistics (PIA-IBGE).

[6] The list of products is chosen by FGV based on their relevance in the Annual Survey of Industry (PIA-IBGE).

[7] Weights are also based on PIA-IBGE.

[8] Information that may identify specific firms or products replaced with "XXXXX".

set is that there is never a substitution of an item by another similar one belonging to the same product category. If a price is not reported in a round of the survey, the quote line will feature a missing value.

2.3 Survey of Industrial Conditions

We use a set of sectoral data that capture relevant information for firms' pricing decisions. Data are from the "Survey of Industrial Conditions," published by IBRE-FGV, to which we have access at a monthly frequency. The survey allows a clear mapping between (a subset of) the products in our PPI price data set and a set of sectoral data. The Survey questionnaire includes questions regarding the main product lines of the firm, which provide information about domestic and external demand, inventory, the business situation, and production.

We also use unpublished data from the Manufacturing Industry Survey provided by IBRE-FGV grouped in 63 sectors, instead of the 19 sectors in the published survey. From this survey, we use indices related to "Total Demand" and "Inventory Level."[9] The "Total Demand" index provides information about sectoral demand that should be relevant for firms' desired prices. Sectoral inventories can also impact firms' pricing decisions.

On a quarterly basis, the survey features additional questions, such as those related to factors limiting the expansion of production, assessments of the supply of raw-materials, and prices in domestic and external markets. In addition, there is one question about the "Tendency of sales prices in the following three months." For all these questions, answers are categorical variables with 3 distinct values, which indicate a positive, neutral or negative outcome.

For a subset of firms, IBRE-FGV provided us with the microdata related to the question about such pricing intentions. The possible answers indicate whether the firm's price is expected to increase, remain constant or decrease. In order to compare the firm's expected price change with actual behavior, we merge this survey with the PPI microdata.

2.4 Additional aggregate and sectoral data

We also include variables to control for other determinants of firms' pricing decisions. We consider cost components common to all firms as well as a sectoral cost measure. Labor and energy costs should affect all firms. For the cost of labor, we use the measure of unit labor costs (ULC) published by the BCB. It is the ratio between industrial wages (deflated by the real exchange rate) and labor productivity.

For energy costs, we use annual average of the industrial electricity tariffs, provided by Ilumina.[10] They updated the methodology of The Brazilian Electricity Regulatory Agency (ANEEL), after ANEEL stopped releasing this information. In order to be able to use monthly data, we interpolate the annual average using monthly energy inflation from IPCA.

To control for sectoral costs, we include in our regressions a variable called "sectoral costs," produced by IBRE-FGV. Following a methodology employed by Banco Central do Brasil, IBRE-FGV constructed proxies for input costs of 30 sectors.[11] The 2015 Industrial Input-Output Matrix allows identification of 127 inputs for each sector. Then, for each input, IBRE-FGV matched the most related price index. They used disaggregated inflation series from Producer Price Index and IPCA, in the case of services inputs. To construct a final monthly cost measure for each sector, they applied constant weights from the 2015 Industrial Input-Output Matrix. For each

[9] In order to construct the inventory index, we consider a "net index": "excessive level" minus "insufficient level".
[10] http://www.ilumina.org.br/a-tarifa-brasileira-em-dados-historicos/.
[11] Sectors' codes and descriptions are given in Appendix Table 18.

sector, the weight corresponds to the share of a specific item in the sector's total intermediate consumption.[12] For instance, for sector 1091 (Slaughter and meat products), the share of organic and chemical fertilizers is 26% in the total intermediate consumption. Moreover, the price index that was used for this input is the PPI product: 202220109 - Organic and chemical fertilizers.[13]

2.5 Expectations data – Focus Survey

Expectations data are from the survey of professional forecasters conducted by the BCB, the *Focus Survey*. It contains forecasts of the main inflation indices, GDP growth, the exchange rate, the policy rate (Selic), as well as fiscal indicators and external sector variables. Forecasts are provided by about 140 institutions, comprising mostly banks and asset managers.[14] To participate in the survey, all candidate institutions must have a research-dedicated unit and a chief economist whose profile must be approved by BCB.

Accredited institutions can update their forecasts at any time through the *Market Expectation System*, and the central bank compiles them every working day. Forecast updates are not mandatory, but BCB devised incentives for participating institutions to update their forecasts frequently. First, it sets a contest date every month, in which forecasts of the specific economic variable are collected and compared to the actual data upon its release. It then publishes a ranking with the names of the five most accurate forecasters (institutions) according to the absolute forecast error.[15] Second, every Monday BCB publishes the *Focus Market Readout* containing a summary of the forecasts, restricting the sample to those forecasts that were updated within the last thirty days. Finally, an institution that does not update its forecasts within six months is excluded from the survey and needs to file a formal renewal request to resume its participation.

We focus on forecasts of IPCA inflation and the Selic policy rate. For the IPCA, participants can report monthly inflation forecasts for each of the next 24 months[16] and annual inflation rates for the current and each of the following 4 years. These annual inflation rates correspond to the calendar years, so we resort to linear interpolation to calculate a time series of inflation forecasts for horizons longer than the monthly forecasting horizon. For the Selic rate, participants report their forecasts of the policy rate that will be decided in each of the following pre-scheduled monetary policy meetings (COPOM) in the next 24 months, as well as the end-of-period and annual average policy rate for the current and each of the following 4 years.

3 Empirical Evidence

3.1 Methodology

To assess the impact of unanchored expectations on pricing behavior, we estimate the following regression model:

$$\Delta p_{i,t} = \alpha_i + \gamma_t + \beta_1 \Delta e_t + \beta_2 (\Delta e_t \times \mathbb{1}_t^{Unanch}) + \lambda X_{i,t} + \epsilon_{i,t},$$

[12] See BCB's March 2021 Quarterly Inflation Report and https://blogdoibre.fgv.br/posts/elevacao-do-custo-dos-insumos-dos-bens-industriais.

[13] A full list of the codes used for matching is provided in Appendix Table 20.

[14] The group of forecasters also includes other institutions such as nonfinancial companies, brokers, and consulting firms.

[15] This contest is highly valuable, as top-five institutions often advertise their accomplishments. See Gaglianone et al. (2020) for a detailed description of the contest.

[16] Initially, the forecasting horizon for monthly inflation was up to 12 months. It was later extended to 18 months, and to 24 months more recently.

where $\Delta p_{i,t}$ denotes price changes, Δe_t captures exchange rate changes, $\mathbb{1}_t^{Unanch}$ is an indicator for unanchored regimes, and $X_{i,t}$ includes control variables such as input costs and sectoral demand.

Exchange rate changes are treated as exogenous cost shocks that are orthogonal to other drivers of price-setting decisions. To address potential endogeneity concerns, we employ an instrumental variable (IV) approach based on a basket of emerging market currencies.

First Stage:

$$\Delta e_t = \theta_0 + \theta_1 \Delta S_t + \varepsilon_t,$$

where $\Delta S_t = \frac{\sum_{k=1}^{7} \Delta s_{k,t}}{7}$ is the monthly variation in a basket of seven emerging market currencies (Colombia, Mexico, Peru, Chile, China, India, and South Africa).

Second Stage:

$$\Delta_{\tau_i} p_{i,t} = \alpha_i + \gamma_t + \beta_1 \Delta_{\tau_i} \hat{e}_t + \beta_2 (\Delta_{\tau_i} \hat{e}_t \times \mathbb{1}_t^{Unanch}) + \lambda X_{i,t} + \lambda_\tau X_{\tau_i,t} + \epsilon_{i,t},$$

where $\Delta_{\tau_i} \hat{e}_t = \hat{e}_t - \hat{e}_{t-\tau_i}$ represents the instrumented change in the exchange rate over the price spell.

3.2 Results

Our findings indicate a marked increase in exchange rate pass-through during unanchored regimes. Price responses to exchange rate shocks are approximately 50% larger when expectations are unanchored. These results are robust to controls for inflation levels, sectoral rigidities, and alternative measures of expectations anchoring.[17]

Table 2 presents the baseline passthrough regressions. The first three columns use nominal exchange rates (BRL/USD), while the remaining three adopt the IV approach. First column shows that, on average, a 10% exchange rate depreciation during a price spell leads to a 0.4% increase in prices at the first price change. When regime-specific effects are introduced, the results indicate that a 10% depreciation of the Brazilian currency results in a 0.22% price increase in anchored regimes but nearly triples to a 0.68% increase in unanchored regimes. Including additional controls in Column 3 further underscores this pattern, as the passthrough coefficient in unanchored regimes rises proportionally from less than 0.01 to 0.04.

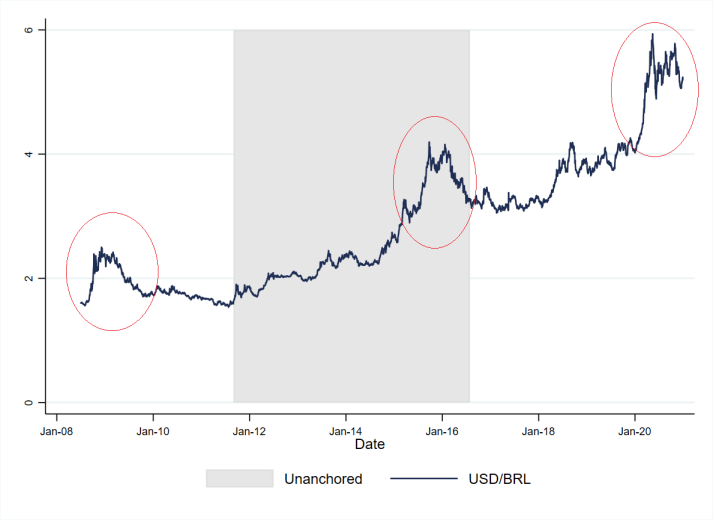
Consistent with these findings, the IV results (Columns 4–6) provide stronger evidence of a larger pass-through in unanchored regimes. On average, a 10% currency depreciation during a price spell leads to a 0.85% increase in prices. During anchored regimes, firms increase prices by 0.68%, while in unanchored periods, the adjustment rises to 1% in response to a 10% exchange rate shock. These results highlight that the difference in pass-through between regimes is approximately 50% larger when using the IV approach, reinforcing the conclusion that expectations anchoring plays a critical role in price setting.

[17] Tables report Huber-White standard errors in parentheses.

Table 2: Baseline pass-through regression

	$\Delta_{\tau_i} e_t$ - 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)
$\Delta_{\tau_i} p_{it-\tau_{it}}$			-0.122***			-0.123***
			(0.00521)			(0.00520)
τ_{it}			0.000359***			0.000244**
			(0.0000974)			(0.000101)
$\Delta_{\tau_i} ULC_t$			0.0289***			0.0160***
			(0.00608)			(0.00618)
$\Delta_{\tau_i} Sectoral\ cost_t$			0.0347***			0.0282***
			(0.0104)			(0.0103)
$Sectoral\ \ inventory_t$			-0.000177***			-0.000178***
			(0.0000184)			(0.0000184)
$Sectoral\ \ demand_t$			0.000325***			0.000327***
			(0.0000288)			(0.0000288)
$Constant$	0.0435***	0.0428***	0.00214	0.0445***	0.0441***	0.00428
	(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	0.0501	0.0502	0.0650
Individual Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time-Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Items/Sectors Controls	No	No	Yes	No	No	Yes

Figure 1: **USDBRL and anchored/unanchored regimes**



3.2.1 Unanchoring or non-linearity in passthrough? It is possible that higher passthrough when expectations are unanchored only reflects larger exchange rate movements during those periods, coupled with a non-linearity in passthrough. Fortunately, Brazil has experienced sizable exchange rate depreciations both in anchored (e.g. in 2008) and unanchored (e.g. in 2015) regimes – see Figure 1. So we can try to tell these two possibilities apart. Results show our findings reflect the state of expectations rather than non-linearity in passthrough.

Table 3: Unanchoring or non-linearity?

	$\Delta_{\tau_i} e_t$ **- Nominal Exchange Rate**				
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***	0.00989
	(0.00393)	(0.00545)	(0.00495)	(0.00582)	(0.00602)
$\Delta_{\tau_i} e_t \times \mathbb{1}_t{}^{Unanch}$		0.0460***		0.0425***	0.0337***
		(0.00805)		(0.00834)	(0.00853)
$(\Delta_{\tau_i} e_t)^2$			0.0455***	0.0220	-0.0135
			(0.0163)	(0.0170)	(0.0188)
$\Delta_{\tau_i} p_{it-\tau_{it}}$					-0.122***
					(0.00521)
τ_{it}					0.000388***
					(0.000106)
$\Delta_{\tau_i} ULC_t$					0.0288***
					(0.00608)
$\Delta_{\tau_i} Sectoral\ cost_t$					0.0344***
					(0.0104)
$Sectoral\ inventory_t$					-0.000177***
					(0.0000183)
$Sectoral\ demand_t$					0.000325***
					(0.0000287)
Constant	0.0435***	0.0428***	0.0431***	0.0426***	0.00225
	(0.00245)	(0.00245)	(0.00246)	(0.00246)	(0.00380)
N	192502	192502	192502	192502	178442
Adjusted R^2	0.0492	0.0495	0.0493	0.0495	0.0645
Individual Fixed Effects	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Items/Sectors Controls	No	No	No	No	Yes

3.2.2 Unanchoring or asymmetric response to FX?

Table 4: Unanchoring or asymmetric response to FX?

	$\Delta_{\tau_i} e_t$ **- Nominal Exchange Rate**					
Dependent variable: $\Delta_{\tau_i} p_{it}$	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta_{\tau_i} e_t$	0.0410***		0.0225***	0.00822		
	(0.00393)		(0.00545)	(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)
$\Delta_{\tau_i} e_t \times \mathbb{1}_t^{Unanch}$			0.0460***	0.0322***		
			(0.00805)	(0.00844)		
$\Delta_{\tau_i} p_{it-\tau_{it}}$				-0.122***		-0.122***
				(0.00521)		(0.00521)
τ_{it}				0.000359***		0.000362***
				(0.0000974)		(0.000111)
$\Delta_{\tau_i} ULC_t$				0.0289***		0.0286***
				(0.00608)		(0.00611)
$\Delta_{\tau_i} Sectoral\ cost_t$				0.0347***		0.0347***
				(0.0104)		(0.0104)
$Sectoral\ inventory_t$				-0.000177***		-0.000177***
				(0.0000184)		(0.0000183)
$Sectoral\ demand_t$				0.000325***		0.000325***
				(0.0000288)		(0.0000287)
$\Delta_{\tau_i} e_t^{app} \times \mathbb{1}_t^{Unanch}$					0.0264	0.00626
					(0.0268)	(0.0274)
$\Delta_{\tau_i} e_t^{dep} \times \mathbb{1}_t^{Unanch}$					0.0423***	0.0357***
					(0.00948)	(0.00971)
Constant	0.0435***	0.0423***	0.0428***	0.00214	0.0422***	0.00226
	(0.00245)	(0.00248)	(0.00245)	(0.00380)	(0.00249)	(0.00381)
N	192502	192502	192502	178442	192502	178442
Adjusted R^2	0.0492	0.0493	0.0495	0.0645	0.0495	0.0645
Individual Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Items/Sectors Controls	No	No	No	Yes	No	Yes

3.2.3 Unanchoring or high inflation? In this section we entertain the possibility our findings of higher passthrough may be due to higher-than-average 12-month inflation rather than unanchored inflation expectations.

Table 5: Unanchoring or higher 12m inflation?

	$\Delta_{\tau_i} e_t$ - Nominal Exchange Rate				
Dependent variable: $\Delta_{\tau_i} p_{it}$	(1)	(2)	(3)	(4)	(5)
$\Delta_{\tau_i} e_t$	0.0410***	0.0225***	-0.0142	-0.000444	-0.0284**
	(0.00393)	(0.00545)	(0.0105)	(0.0116)	(0.0122)
$\Delta_{\tau_i} e_t \times \mathbb{1}_t^{Unanch}$		0.0460***		0.0283**	0.00358
		(0.00805)		(0.0120)	(0.0128)
$\Delta_{\tau_i} e_t \times \pi_{t-1}^{12m}$			0.00891***	0.00485**	0.00763***
			(0.00154)	(0.00230)	(0.00242)
$\Delta_{\tau_i} p_{it-\tau_{it}}$					-0.122***
					(0.00520)
τ_{it}					0.000433***
					(0.000102)
$\Delta_{\tau_i} Sectoral\ cost_t$					0.0317***
					(0.0105)
$\Delta_{\tau_i} ULC_t$					0.0283***
					(0.00607)
$Sectoral\ inventory_t$					-0.000178***
					(0.0000183)
$Sectoral\ demand_t$					0.000327***
					(0.0000288)
Constant	0.0435***	0.0428***	0.0435***	0.0431***	0.00232
	(0.00245)	(0.00245)	(0.00245)	(0.00245)	(0.00380)
N	192502	192502	192502	192502	178442
Adjusted R^2	0.0492	0.0495	0.0495	0.0495	0.0646
Individual Fixed Effects	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Items/Sectors Controls	No	No	No	No	Yes

Table 6: Pass-through regression with lagged FX change

	$\Delta_{\tau_i} e_t$ - Nominal Exchange Rate		
Dependent variable: $\Delta_{\tau_i} p_{it}$	(1)	(2)	(3)
$\Delta_{\tau_i} e_t$	0.0420***	0.0128**	0.00370
	(0.00430)	(0.00650)	(0.00667)
$\Delta_{\tau_i} e_{t-\tau_{it}}$	0.0120***	-0.000287	0.00251
	(0.00348)	(0.00468)	(0.00467)
$\Delta_{\tau_i} e_t \times \mathbb{1}_t{}^{Unanch}$		0.0618***	0.0513***
		(0.00896)	(0.00898)
$\Delta_{\tau_i} e_{t-\tau_{it}} \times \mathbb{1}_t{}^{Unanch}$		0.0277***	0.0375***
		(0.00676)	(0.00672)
$\Delta_{\tau_i} p_{it-\tau_{it}}$			-0.123***
			(0.00539)
τ_{it}			0.000547***
			(0.000103)
$\Delta_{\tau_i} ULC_t$			0.0174***
			(0.00615)
$\Delta_{\tau_i} Sectoral\ cost_t$			0.0166
			(0.0106)
$Sectoral\ inventory_t$			-0.000185***
			(0.0000184)
$Sectoral\ demand_t$			0.000286***
			(0.0000285)
$Constant$	0.00887***	0.00886***	-0.0173***
	(0.00309)	(0.00309)	(0.00446)
N	178973	178973	172850
Adjusted R^2	0.0465	0.0469	0.0639
Individual Fixed Effects	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes
Items/Sectors Controls	No	No	Yes

3.2.4 Specification with exchange rate change over previous price spell

4 Model and Calibration

We develop a New Keynesian model incorporating endogenous expectation anchoring. Firms form beliefs about the central bank's inflation target based on observed shocks. In unanchored regimes, these beliefs become more responsive to shocks, increasing the pass-through of exchange rate changes to prices.

The model is calibrated to match key moments from the Brazilian data, including the volatility of inflation and the sensitivity of prices to exchange rate movements across regimes. Simulated data from the model replicate the empirical findings, providing a structural interpretation of the observed dynamics.

4.1 The model

We study the price-setting implications of unanchored inflation expectations in a simple new Keynesian model, building on Woodford (2003). Households derive utility from a composite consumption good, and incur disutility from supplying labor to firms. Firms produce and sell differentiated goods in a monopolistically competitive environment, subject to Calvo (1983)-type nominal rigidities. The central bank sets the short-term interest rate in response to inflation and output in deviation from their targets. We depart from most common assumptions in two ways. First, following Bonomo et al. (2016), firms use both labor, a domestic and a foreign intermediate good as production inputs. The real exchange rate acts as a cost-push shock in the model, creating a channel for exchange rate passthrough. Second, we model different regimes of inflation expectations that depend on the credibility of the central bank. Households and firms have imperfect information about the central bank's monetary policy rule and, in particular, its inflation target. A regime of "unanchored" expectations corresponds to a loss of central bank credibility, resulting in medium-term expectations that are inconsistent with central bank objectives. Below we discuss the main equations of the model, with emphasis on the anchoring of inflation expectations. Standard equations are presented already in log-linear form. The full model is described in the Appendix.

4.1.1 Private sector

Firm i's output, denoted by Y_{it}, is produced according to the Cobb-Douglas production function

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

based on three sets of factors used in the production process: domestic input, foreign inputs and exogenous productivity. The foreign input is denoted by M_{it} and its share relative to domestic factors is measured by the elasticity parameter $0 < 1 - \alpha < 1$. Domestic inputs include labor, L_{it} and a domestic intermediate input I_{it} – a composite of goods produced by other firms in the economy. Their relative shares are dictated by the parameter $0 < \eta < 1$. Domestic intermediate inputs are a source of real rigidities in the sense of Ball and Romer (1990). Production is subject to shocks to firm-specific ($A_{i,t}$) and aggregate (A_t) productivity.

Firm cost minimization yields real marginal cost:

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

where w_t is the economy-wide real wage and q_t is the real exchange rate. These, together with fluctuations in productivity, are the "fundamental" drivers of inflation in the model. As discussed below, fluctuations in the real exchange rate act as "cost-push" shocks affecting firms pricing decisions.

The model is log-linearized around its non-stochastic steady state.[18] The economy's aggregate output is the sum of private consumption and intermediate inputs

$$\hat{y}_t = \frac{I}{y}\hat{I}_t + \left(1 - \frac{I}{y}\right)\hat{c}_t$$

and aggregate consumption is described by the familiar consumption Euler equation

$$\hat{c}_t = \mathbb{E}_t\hat{c}_{t+1} - (R_t - \mathbb{E}_t\pi_{t+1}),$$

where R_t is the short-term interest rate, π_t is the domestic inflation rate, and $\mathbb{E}_t$ denotes the expectations operator, discussed below.

Firms reset prices with probability $1-\xi$. When resetting its price, firm i's optimal decision is given by

$$\tilde{p}_{it}^{opt} = \mathbb{E}_t \sum_{T=t}^{\infty} (\xi\beta)^{T-t} \left[(1-\xi\beta)\hat{mc}_T^i + \xi\beta\pi_{T+1}\right],$$

where $\tilde{p}_{i,t}^{opt}$ denotes the optimal price relative to the economy-wide price level and where β is the household's discount rate.

Firm i's real marginal cost can be written as

$$\hat{mc}_{it} = \alpha\eta\hat{w}_t + (1-\alpha)\,\hat{q}_t - (\hat{a}_t + \hat{a}_{i,t}).$$

Marginal cost is impacted by exogenous shifts in aggregate ($\hat{a}_t$) and firm-specific ($\hat{a}_{i,t}$) productivity – both modeled as AR(1) processes. The real exchange rate is defined by

$$\hat{q}_t = \hat{e}_t + \hat{p}_t^f - \hat{p}_t,$$

where $\hat{e}_t$ denotes the nominal exchange rate, $\hat{p}_t$ is the domestic price level and $\hat{p}_t^f$ is the foreign price level. We take a partial equilibrium approach and assume the nominal exchange rate and the foreign price level evolve exogenously.[19] Given our focus on movements in the nominal exchange rate, we keep the foreign price level constant – $\tilde{p}_t = 0$. $\hat{e}_t$ evolves according to a persistent AR(1) process.

Aggregating across firms, the equilibrium evolution of domestic inflation is determined according to the forward-looking Phillips curve

$$\pi_t = \beta\mathbb{E}_t\pi_{t+1} + \kappa\alpha\eta\left(\hat{y}_t - \eta^{-1}\alpha^{-1}\hat{a}_t\right) + \kappa(1-\alpha)\hat{q}_t,$$

where $\kappa \equiv \frac{(1-\xi)(1-\xi\beta)}{\xi}\zeta$ denotes its slope, which is decreasing in the degree of nominal rigidities ξ, and $0 < \zeta < 1$ measures real rigidities from domestic roundabout intermediate inputs.[20] Fluctuations in the real exchange rate act as cost-push shocks in the model, while productivity determines the evolution of the natural level of output (the equilibrium output in absence of nominal rigidities or changes in the real exchange rate). The relative importance of the two components is shaped by the share of foreign inputs in the production function and by

[18] Lowercase variables denote logarithms and "hatted" variables denote log-deviations from steady state.
[19] An implicit assumption is that the foreign price level does not respond to movements in the nominal exchange rate.
[20] The appendix shows how ζ depends on the input elasticities, together with the elasticity of demand for the final good.

their volatilities.

4.1.2 Central Bank and expectations' anchoring The degree of expectations' anchoring is determined by agents' perceptions about monetary policy, and in particular, the central bank inflation target. The central bank sets the short-term nominal rate according to a conventional Taylor rule

$$R_t = \rho_i R_{t-1} + (1-\rho_i)\left[\phi_\pi\left(\pi_t - \pi_t^*\right) + \phi_y \hat{y}_t\right] + \varepsilon_t^R,$$

where $0 \leq \rho \leq 1$ measures the degree of interest rate smoothing, and ϕ_π, ϕ_y denote the responses to inflation and output, respectively. In addition, the interest rate is driven by two exogenous processes. The first, ε_t^R, is an i.i.d. monetary policy shock. The second corresponds to the time-varying inflation target π_t^* assigned to the central bank, which evolves according to

$$\pi_t^* = \rho_{\pi_*}\pi_{t-1}^* + \varepsilon_t^*.$$

The inflation target changes in response to exogenous idiosyncratic shifts in decisionmakers' preferences, ε_t^*. Conversely, the monetary policy shock ε_t^R is weakly negatively correlated to the nominal exchange rate' innovation ε_t^e. It can be expressed as $\varepsilon_t^R = -\tau_e \varepsilon_t^e + \varepsilon_t^m$, where ε_t^m is a i.i.d. innovation and where τ_e is relatively 'small'. This captures the central bank incentives to 'accommodate' exchange rate movements by lowering the interest rate. Stochastic deviations from the policy rule make this "weakness" of the central bank in responding to cost-push shocks less obvious to detect from the public. In fact, we assume agents fail to detect this link between exchange rate and policy rate decisions. This is the only form of bounded rationality embedded in the model. As we see below, this provides a simple way to forge a connection between exchange rate movements and the revisions in agents' assessment of the inflation target.

In this simple model, central bank credibility is tied to market participants' *beliefs* about the type of central bank they face. While agents form expectations rationally about every other aspect of the economy, they have incomplete information about the central bank's inflation target. First, agents cannot directly infer the inflation target from the policy rule. In fact, they cannot observe separately monetary policy shocks (ε_t^R) and inflation target (π_t^*). Second, agents expectations can become unanchored when the central bank is *perceived* to be less committed to a stable inflation target. In the "Anchored" regime agents' perceived volatility of the inflation target matched the actual. Expectations are consistent with the central bank policy objectives. Conversely, in the "Unanchored" regime the perceived volatility of the inflation target is substantially higher than the actual. Beliefs about the central bank 'type' are not consistent with actual policy. We do not model directly the cause of loss of credibility: there is no U-turn in our model. Instead, we assume an exogenous switch between "Anchored" and "Unanchored" regimes.

Agents use the Kalman filter to revise their estimate of the inflation target, giving

$$\pi_{t+1|t}^* = \rho_{\pi_*}\pi_{t|t-1}^* + \bar{g}\left(\tilde{\pi}_t - \pi_{t|t-1}^*\right),$$

where the signal

$$\tilde{\pi}_t = \pi_t^* - \frac{1}{(1-\rho_i)\,\phi_\pi}\varepsilon_{R,t},$$

and where $\bar{g} > 0$ denotes the Kalman gain. As shown in the Appendix, the gain depends both on the relative

volatility of the two exogenous processes and the persistence of the inflation target. Changes is the estimated inflation target are driven by temporary monetary policy shocks and by exogenous shifts in the inflation target. In the anchored regime, the perceived volatility of ε_t^* is small and corresponds to actual policy. This results in a small Kalman gain. Conversely, in the unanchored regime the Kalman gain is large, reflecting agents' beliefs that the inflation target is drifting significantly. Given the link with monetary policy shocks, innovations to the exchange rate process lead to revisions to the estimated inflation target, and therefore revisions to long-run inflation expectations. That is, in response to an exogenous exchange rate shock, beliefs are revised

$$\pi^*_{t+1|t} = (\rho_{\pi_*} - \bar{g})\, \pi^*_{t|t-1} + \bar{g}\tau\varepsilon^e_t.$$

In the Anchored regime these revisions are small. However, unanchored expectations imply a high Kalman gain, $\bar{g}^{\text{Unanchored}} >> \bar{g}^{\text{Anchored}}$, boosting the sensitivity of inflation expectations to shocks. This is the main mechanism of shock transmission in the model.

Does this model provide an accurate description of the behavior of medium-term inflation expectations? Carvalho et al. (2023) introduce a model of expectations anchoring based on the idea that firms revise their estimate of the inflation target in response to short-term inflation surprises, driven in large part by cost-push shocks. The model, estimated using US inflation and survey-based *short-term* inflation expectations, predicts very accurately the behavior of *long-run* inflation expectations both for the US economy and other countries spanning the period from the 1970s to 2022. The degree of anchoring is endogenous and depends on the size and persistence of forecast errors. The model detects episodes of unanchoring of expectations in all countries considered. While the expectations formation mechanism presented here abstracts from some of these features, its main predictions are quite similar. This supports our view that results about the effects of unanchoring on firms' pricing decisions obtained with this simple model would also obtain under more complex models of expectations formation and unanchoring.

4.2 The experiment

In order to interpret the empirical evidence presented in Section **??** through the lens of the model, we perform the same regression analysis on simulated data from our simple economy. We first calibrate the model to selected moments from the Brazilian economy. Crucially, in the simulation we discipline the behavior of inflation expectations in both anchored and unanchored regimes using survey data.

To calibrate our model economy we proceed in two steps. First, we fix a subset of a parameters. The volatility of monetary policy innovations is in line with monetary policy surprises inferred from the Focus Survey. We also set the domestic and foreign input shares to induce an empirically plausible degree of real rigidities. Finally we constrain the correlation between the monetary policy shock and the exchange rate to be less then ten percent. The rest of the parameters are chosen to match a set of moments of the Brazilian economy.[21] We discipline the behavior of inflation expectations in both anchored and unanchored regimes using survey data. In particular, we look at the volatility of relatively long-term inflation expectations from BCB's Focus Survey: specifically, 12-month inflation between 36 and 48 months ahead (four years ahead). In a little more detail, we consider Brazilian macroeconomic indicators over the period from July 2008 to December 2020. The inflation rate is based on the consumer price index that Brazil uses to implement its inflation targeting regime, the IPCA, published by

[21] Model-generated statistics are an average over 1000 replications, where each simulation has the same length as the data sample, and where anchored and unanchored regimes are lined up as in the actual data.

the Brazilian Institute of Geography and Statistics (IBGE). The interest rate corresponds to the policy rate set by BCB (Selic). As measures of real de-trended output and nominal exchange rate, we use the Hodrick-Prescott filtered cyclical component of their monthly series.[22] Real output is obtained from the Central Bank Economic Activity Index (IBC-Br), and the nominal exchange rate is the monthly average BRL/USD foreign exchange rate.

As shown in Table 7, which summarizes the calibration exercise, in the unanchored regime medium-term inflation expectations are roughly two times as volatile as in the anchored regime. Despite its extreme simplicity, the model can match reasonably well all of the moments targeted using empirically plausible parameters for the monetary policy rule and the elasticity of the production function to imported inputs.

Table 7: **Model calibration**

Parameters	**Description**		**Parameters**	**Description**	
$1-\alpha$	import elasticity	0.050	ρ_{π^*}	π_t^* shock	0.954
β	discount rate	0.995	σ_R	vol. mp shock	0.141
$1-\xi$	freq. Δp^i	0.200	ρ_e	persistence e_t	0.890
$1-\eta$	interm. inputs	0.200	ρ_a	persistence a_t	0.560
ϕ_π	TR: $\pi_t - \pi_t^*$	1.681	ρ_{a_i}	persistence a_{it}	0.950
ϕ_y	TR: y_t	0.017	σ_e	vol. e_t shock	3.900
ρ_i	TR: R_{t-1}	0.905	σ_a	vol. a_t shock	1.802
$\hat{g}^{\text{Unanchored}}$	Kalman gain	0.156	σ_{a_i}	vol. a_{it} shock	8.108
$\hat{g}^{\text{Anchored}}$	Kalman gain	0.008	$\text{Corr}(\varepsilon_t^R, \varepsilon_t^e)$	corr.	-0.083

Moments	**Model**	**Data**
$\sigma(\pi_t)$	0.439	0.300
$\sigma(R_t)$	0.203	0.260
$\sigma(e_t)$	8.617	8.720
$\sigma(\hat{y}_t)$	2.395	2.400
$\sigma(\mathbb{E}^{Anc}\pi)$:	0.161	0.160
$\sigma(\mathbb{E}^{Unanc}\pi)$:	0.365	0.360
$\rho(\pi_t, \pi_{t-1})$:	0.644	0.570
$\rho(R_t, R_{t-1})$:	0.812	0.950
$\rho(\hat{y}_t, \hat{y}_{t-1})$:	0.655	0.820
$\rho(e_t, e_{t-1})$:	0.862	0.867
$\mathbb{E}(\lvert\Delta p_t^i\rvert)$:	5.326	6.000

Note: The table shows the calibrated parameters used in our simulation, and the statistical moments for key variables implied by the calibration. The model-implied moments are compared with corresponding moments from the data.

We then run the following Monte Carlo analysis. Simulate 1000 artificial economies over a number of periods that matches the size of our data sample used to estimate our panel regressions. We switch the from anchored to unanchored regime, and then back to anchored following the same time as in the data.

From these simulated economies, draw the paths of individual prices for 5800 forms. In each period, select 20% of firms at random to change their prices, while the remaining fraction leaves prices unchanged, as observed in the data. As shown in Table 7, the parameters of firm-specific productivity shocks are calibrated to deliver mean absolute price changes roughly in line with the micro data.

Tables 8 shows the results we obtain when running the analogous regressions we apply to actual data on the artificial data generated from the model. Results show a baseline passthrough coefficient in qualitatively line with empirical estimates. They also show an increase in passthrough in the unanchored regime that significantly increases the baseline level. Importantly, this is an untargeted moment.

[22] We set the smoothing parameter to 14,400.

Table 8: Regressions with artificial microdata

	Model-generated data		**PPI data**	
Dependent variable: $\Delta_{\tau_i} p_{it}$	**(1)**	**(2)**	**(3)**	**(4)**
$\Delta_{\tau_i} e_t$	0.043	0.051	0.0586***	0.0653***
$\Delta_{\tau_i} e_t \times \mathbb{1}_t^{Unanch}$	0.017	0.017	0.0351***	0.0286***
$\Delta_{\tau_i} e_{t-\tau_{it}}$		0.010		0.0244***
$\Delta_{\tau_i} e_{t-\tau_{it}} \times \mathbb{1}_t^{Unanch}$		0.001		0.0386***
$\Delta_{\tau_i} p_{it-\tau_{it}}$	-0.143	-0.143	-0.109***	-0.112***
N	174,357	174,357	178,442	172,850
Individual Fixed Effects	No	No	Yes	Yes
Time-Fixed Effects	Yes	Yes	Yes	Yes
Items/Sectors Controls	No	No	No	No

5 Conclusion

This paper demonstrates that unanchored inflation expectations significantly influence firm pricing decisions, amplifying the pass-through of exchange rate shocks. Using a unique natural experiment in Brazil, we provide both empirical evidence and theoretical validation of these dynamics. The findings offer insights for policymakers aiming to enhance the credibility of monetary policy and maintain price stability.

Future research could extend this analysis by exploring sectoral heterogeneity in pricing responses or examining alternative shocks, such as commodity price fluctuations.

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Appendix

A Additional Results

A.1 Instrumented FX Regressions

Table 9: Unanchoring or non-linearity?

	$\Delta_{\tau_i} e_t$ **- Instrumented FX**				
Dependent variable: $\Delta_{\tau_i} p_{it}$	(1)	(2)	(3)	(4)	(5)
$\Delta_{\tau_i} e_t$	0.0855***	0.0684***	0.0787***	0.0659***	0.0592***
	(0.00596)	(0.00812)	(0.00796)	(0.00919)	(0.00968)
$\Delta_{\tau_i} e_t \times \mathbb{1}_t{}^{Unanch}$		0.0431***		0.0417***	0.0252**
		(0.0115)		(0.0117)	(0.0121)
$(\Delta_{\tau_i} e_t)^2$			0.0400	0.0179	-0.0232
			(0.0361)	(0.0370)	(0.0422)
$\Delta_{\tau_i} p_{it-\tau_{it}}$					-0.123***
					(0.00520)
τ_{it}					0.000272**
					(0.000111)
$\Delta_{\tau_i} ULC_t$					0.0159**
					(0.00619)
Δ_{τ_i} *Sectoral cost*$_t$					0.0280***
					(0.0103)
Sectoral inventory$_t$					-0.000178***
					(0.0000183)
Sectoral demand$_t$					0.000326***
					(0.0000288)
Constant	0.0445***	0.0441***	0.0442***	0.0440***	0.00438
	(0.00245)	(0.00246)	(0.00248)	(0.00248)	(0.00382)
N	192502	192502	192502	192502	178442
Adjusted R^2	0.0501	0.0502	0.0501	0.0502	0.0650
Individual Fixed Effects	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Items/Sectors Controls	No	No	No	No	Yes

Table 10: Unanchoring or asymmetric response to FX?

	$\Delta_{\tau_i} e_t$ **- Instrumented FX**					
Dependent variable: $\Delta_{\tau_i} p_{it}$	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta_{\tau_i} e_t$	0.0855***		0.0684***	0.0566***		
	(0.00596)		(0.00812)	(0.00886)		
$\Delta_{\tau_i} e_t^{app}$		0.0957***			0.0968***	0.0863***
		(0.0149)			(0.0168)	(0.0171)
$\Delta_{\tau_i} e_t^{dep}$		0.0831***			0.0582***	0.0443***
		(0.00644)			(0.00925)	(0.0101)
$\Delta_{\tau_i} e_t \times \mathbb{1}_t{}^{Unanch}$			0.0431***	0.0243**		
			(0.0115)	(0.0120)		
$\Delta_{\tau_i} e_t^{app} \times \mathbb{1}_t{}^{Unanch}$					-0.00285	-0.0339
					(0.0333)	(0.0335)
$\Delta_{\tau_i} e_t^{dep} \times \mathbb{1}_t{}^{Unanch}$					0.0531***	0.0340***
					(0.0123)	(0.0127)
$\Delta_{\tau_i} p_{it-\tau_{it}}$				-0.123***		-0.122***
				(0.00520)		(0.00520)
τ_{it}				0.000244**		0.000313***
				(0.000101)		(0.000106)
$\Delta_{\tau_i} ULC_t$				0.0160***		0.0155**
				(0.00618)		(0.00620)
$\Delta_{\tau_i} Sectoral\ cost_t$				0.0282***		0.0261**
				(0.0103)		(0.0104)
$Sectoral\ inventory_t$				-0.000178***		-0.000179***
				(0.0000184)		(0.0000184)
$Sectoral\ demand_t$				0.000327***		0.000325***
				(0.0000288)		(0.0000287)
$Constant$	0.0445***	0.0447***	0.0441***	0.00428	0.0448***	0.00513
	(0.00245)	(0.00252)	(0.00246)	(0.00381)	(0.00253)	(0.00383)
N	192502	192502	192502	178442	192502	178442
Adjusted R^2	0.0501	0.0501	0.0502	0.0650	0.0502	0.0650
Individual Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Items/Sectors Controls	No	No	No	Yes	No	Yes

Table 11: Unanchoring or higher 12m inflation?

	$\Delta_{\tau_i} e_t$ - **Instrumented FX**				
Dependent variable: $\Delta_{\tau_i} p_{it}$	(1)	(2)	(3)	(4)	(5)
$\Delta_{\tau_i} e_t$	0.0855***	0.0684***	0.00945	0.0129	-0.0123
	(0.00596)	(0.00812)	(0.0166)	(0.0179)	(0.0192)
$\Delta_{\tau_i} e_t \times \mathbb{1}_t^{Unanch}$		0.0431***		0.00684	-0.0211
		(0.0115)		(0.0157)	(0.0168)
$\Delta_{\tau_i} e_t \times \pi_{t-1}^{12m}$			0.0125***	0.0115***	0.0140***
			(0.00255)	(0.00348)	(0.00371)
$\Delta_{\tau_i} p_{it-\tau_{it}}$					-0.123***
					(0.00520)
τ_{it}					0.000336***
					(0.000104)
$\Delta_{\tau_i} Sectoral\ cost_t$					0.0229**
					(0.0104)
$\Delta_{\tau_i} ULC_t$					0.0161***
					(0.00617)
$Sectoral\ inventory_t$					-0.000178***
					(0.0000183)
$Sectoral\ demand_t$					0.000330***
					(0.0000288)
$Constant$	0.0445***	0.0441***	0.0445***	0.0444***	0.00431
	(0.00245)	(0.00246)	(0.00245)	(0.00246)	(0.00381)
N	192502	192502	192502	192502	178442
Adjusted R^2	0.0501	0.0502	0.0502	0.0502	0.0651
Individual Fixed Effects	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Items/Sectors Controls	No	No	No	No	Yes

Table 12: Pass-through regression with lagged FX change

	$\Delta_{\tau_i} e_t$ - **Instrumented FX**		
Dependent variable: $\Delta_{\tau_i} p_{it}$	(1)	(2)	(3)
$\Delta_{\tau_i} e_t$	0.0865***	0.0561***	0.0507***
	(0.00678)	(0.0102)	(0.0110)
$\Delta_{\tau_i} e_{t-\tau_{it}}$	0.0223***	0.0110*	0.0202***
	(0.00510)	(0.00657)	(0.00686)
$\Delta_{\tau_i} e_t \times \mathbb{1}_t{}^{Unanch}$		0.0623***	0.0513***
		(0.0131)	(0.0131)
$\Delta_{\tau_i} e_{t-\tau_{it}} \times \mathbb{1}_t{}^{Unanch}$		0.0276***	0.0357***
		(0.00954)	(0.00968)
$\Delta_{\tau_i} p_{it-\tau_{it}}$			-0.124***
			(0.00539)
τ_{it}			0.000373***
			(0.000108)
$\Delta_{\tau_i} ULC_t$			0.00833
			(0.00626)
$\Delta_{\tau_i} Sectoral\ cost_t$			0.0147
			(0.0105)
$Sectoral\ inventory_t$			-0.000185***
			(0.0000185)
$Sectoral\ demand_t$			0.000289***
			(0.0000286)
$Constant$	0.00460	0.00604*	-0.0194***
	(0.00311)	(0.00314)	(0.00451)
N	178973	178973	172850
Adjusted R^2	0.0471	0.0474	0.0642
Individual Fixed Effects	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes
Items/Sectors Controls	No	No	Yes

A.2 Degree of Unanchoring Regressions

Table 13: Pass-through 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***	0.0195***	0.00755	0.0855***	0.0637***	0.0541***
	(0.00393)	(0.00521)	(0.00542)	(0.00596)	(0.00775)	(0.00850)
$\Delta_{\tau_i} e_t \times Unanch_t$		0.109***	0.0700***		0.107***	0.0613***
		(0.0149)	(0.0157)		(0.0196)	(0.0204)
$\Delta_{\tau_i} p_{it-\tau_{it}}$			-0.122***			-0.123***
			(0.00521)			(0.00520)
τ_{it}			0.000338***			0.000222**
			(0.0000984)			(0.000101)
$\Delta_{\tau_i} ULC_t$			0.0293***			0.0163***
			(0.00608)			(0.00617)
$\Delta_{\tau_i} Sectoral\ cost_t$			0.0353***			0.0290***
			(0.0103)			(0.0103)
$Sectoral\ inventory_t$			-0.000177***			-0.000178***
			(0.0000184)			(0.0000184)
$Sectoral\ demand_t$			0.000324***			0.000326***
			(0.0000287)			(0.0000288)
$Constant$	0.0435***	0.0427***	0.00220	0.0445***	0.0439***	0.00431
	(0.00245)	(0.00245)	(0.00380)	(0.00245)	(0.00246)	(0.00381)
N	192502	192502	178442	192502	192502	178442
Adjusted R^2	0.0492	0.0496	0.0646	0.0501	0.0503	0.0650
Individual Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time-Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Items/Sectors Controls	No	No	Yes	No	No	Yes

A.2.1 Instrumented FX

Table 14: Degree of unanchoring or non-linearity?

	$\Delta_{\tau_i} e_t$ **- Instrumented FX**				
Dependent variable: $\Delta_{\tau_i} p_{it}$	(1)	(2)	(3)	(4)	(5)
$\Delta_{\tau_i} e_t$	0.0855***	0.0637***	0.0787***	0.0615***	0.0567***
	(0.00596)	(0.00775)	(0.00796)	(0.00898)	(0.00942)
$\Delta_{\tau_i} e_t \times Unanch_t$		0.107***		0.105***	0.0623***
		(0.0196)		(0.0198)	(0.0205)
$(\Delta_{\tau_i} e_t)^2$			0.0400	0.0149	-0.0226
			(0.0361)	(0.0369)	(0.0422)
$\Delta_{\tau_i} p_{it-\tau_{it}}$					-0.123***
					(0.00520)
τ_{it}					0.000250**
					(0.000112)
$\Delta_{\tau_i} ULC_t$					0.0162***
					(0.00619)
$\Delta_{\tau_i} Sectoral\ cost_t$					0.0288***
					(0.0103)
$Sectoral\ inventory_t$					-0.000179***
					(0.0000184)
$Sectoral\ demand_t$					0.000325***
					(0.0000288)
$Constant$	0.0445***	0.0439***	0.0442***	0.0439***	0.00440
	(0.00245)	(0.00246)	(0.00248)	(0.00248)	(0.00382)
N	192502	192502	192502	192502	178442
Adjusted R^2	0.0501	0.0503	0.0501	0.0503	0.0650
Individual Fixed Effects	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Items/Sectors Controls	No	No	No	No	Yes

Table 15: Degree of unanchoring or higher 12m inflation?

	$\Delta_{\tau_i} e_t$ **- Instrumented FX**				
Dependent variable: $\Delta_{\tau_i} p_{it}$	(1)	(2)	(3)	(4)	(5)
$\Delta_{\tau_i} e_t$	0.0855***	0.0637***	0.00945	0.0224	0.00311
	(0.00596)	(0.00775)	(0.0166)	(0.0167)	(0.0179)
$\Delta_{\tau_i} e_t \times Unanch_t$		0.107***		0.0737***	0.0190
		(0.0196)		(0.0222)	(0.0238)
$\Delta_{\tau_i} e_t \times \pi_{t-1}^{12m}$			0.0125***	0.00793***	0.00967***
			(0.00255)	(0.00289)	(0.00309)
τ_{it}					0.000277***
					(0.000103)
$\Delta_{\tau_i} p_{it-\tau_{it}}$					-0.123***
					(0.00520)
$\Delta_{\tau_i} Sectoral\ cost_t$					0.0250**
					(0.0104)
$\Delta_{\tau_i} ULC_t$					0.0167***
					(0.00617)
$Sectoral\ inventory_t$					-0.000179***
					(0.0000184)
$Sectoral\ demand_t$					0.000328***
					(0.0000288)
$Constant$	0.0445***	0.0439***	0.0445***	0.0441***	0.00422
	(0.00245)	(0.00246)	(0.00245)	(0.00246)	(0.00381)
N	192502	192502	192502	192502	178442
Adjusted R^2	0.0501	0.0503	0.0502	0.0503	0.0651
Individual Fixed Effects	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Items/Sectors Controls	No	No	No	No	Yes

Table 16: Degree of unanchoring or non-linearity?

	$\Delta_{\tau_i} e_t$ - **Nominal Exchange Rate**				
Dependent variable: $\Delta_{\tau_i} p_{it}$	(1)	(2)	(3)	(4)	(5)
$\Delta_{\tau_i} e_t$	0.0410***	0.0195***	0.0315***	0.0155***	0.00864
	(0.00393)	(0.00521)	(0.00495)	(0.00575)	(0.00594)
$\Delta_{\tau_i} e_t \times Unanch_t$		0.109***		0.104***	0.0708***
		(0.0149)		(0.0151)	(0.0157)
$(\Delta_{\tau_i} e_t)^2$			0.0455***	0.0240	-0.00756
			(0.0163)	(0.0167)	(0.0186)
$\Delta_{\tau_i} p_{it-\tau_{it}}$					-0.122***
					(0.00521)
τ_{it}					0.000355***
					(0.000108)
$\Delta_{\tau_i} ULC_t$					0.0292***
					(0.00608)
$\Delta_{\tau_i} Sectoral\ cost_t$					0.0351***
					(0.0104)
$Sectoral\ inventory_t$					-0.000177***
					(0.0000183)
$Sectoral\ demand_t$					0.000324***
					(0.0000287)
$Constant$	0.0435***	0.0427***	0.0431***	0.0425***	0.00226
	(0.00245)	(0.00245)	(0.00246)	(0.00246)	(0.00380)
N	192502	192502	192502	192502	178442
Adjusted R^2	0.0492	0.0496	0.0493	0.0496	0.0646
Individual Fixed Effects	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Items/Sectors Controls	No	No	No	No	Yes

A.2.2 Nominal FX

Table 17: Degree of unanchoring or higher 12m inflation?

	$\Delta_{\tau_i} e_t$ **- Nominal Exchange Rate**				
Dependent variable: $\Delta_{\tau_i} p_{it}$	(1)	(2)	(3)	(4)	(5)
$\Delta_{\tau_i} e_t$	0.0410***	0.0195***	-0.0142	0.000394	-0.0233**
	(0.00393)	(0.00521)	(0.0105)	(0.0106)	(0.0111)
$\Delta_{\tau_i} e_t \times Unanch_t$		0.109***		0.0898***	0.0373**
		(0.0149)		(0.0174)	(0.0187)
$\Delta_{\tau_i} e_t \times \pi_{t-1}^{12m}$			0.00891***	0.00370**	0.00594***
			(0.00154)	(0.00180)	(0.00190)
$\Delta_{\tau_i} p_{it-\tau_{it}}$					-0.122***
					(0.00520)
τ_{it}					0.000391***
					(0.000101)
$\Delta_{\tau_i} Sectoral\ cost_t$					0.0325***
					(0.0104)
$\Delta_{\tau_i} ULC_t$					0.0290***
					(0.00607)
$Sectoral\ inventory_t$					-0.000178***
					(0.0000183)
$Sectoral\ demand_t$					0.000326***
					(0.0000288)
$Constant$	0.0435***	0.0427***	0.0435***	0.0428***	0.00222
	(0.00245)	(0.00245)	(0.00245)	(0.00245)	(0.00380)
N	192502	192502	192502	192502	178442
Adjusted R^2	0.0492	0.0496	0.0495	0.0497	0.0647
Individual Fixed Effects	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Items/Sectors Controls	No	No	No	No	Yes

B Model Details

B.1 Households

Maximize the utility function

$$U = \mathbb{E}_0 \left\{ \sum_{t=0}^{\infty} \beta^t \left[\log(C_t) - \varphi \frac{L_t^{1+\delta}}{1+\delta} \right] \right\}$$

where $\varphi > 0, \delta \geq 0$ and where the consumption aggregator is

$$C_t = \left[\int_0^1 C_{i,t}^{(\theta-1)/\theta} di \right]^{\theta/(\theta-1)}$$

individual demand with elasticity $\theta > 0$ is

$$C_{i,t} = C_t \left(\frac{P_{i,t}}{P_t} \right)^{-\theta}$$

where

$$P_t = \left[\int_0^1 P_{i,t}^{1-\theta} di \right]^{1/(1-\theta)}.$$

The household budget constraint is

$$R_t^{-1} B_t + P_t C_t = B_{t-1} + W_t L_t + \Gamma_t - T_t$$

where B_t denotes short-term government bonds in zero net supply, R_t is the policy rate, W_t is the wage, Γ_t, T_t are profits and taxes respectively. The government has a balanced budget with zero spending. Linearized first order conditions give

$$\hat{\lambda}_t = -\sigma \hat{c}_t,$$

where variables with the hat are expressed in log-deviations from their steady state. The variable $\hat{\lambda}_t$ is the marginal utility of income where in the second step we use goods market clearing conditions,

$$\hat{\lambda}_t - R_t = \mathbb{E}_t \left(\hat{\lambda}_{t+1} - \pi_{t+1} \right)$$

where π_t is the inflation rate. Labor supply is

$$\delta \hat{L}_t = \hat{w}_t - \sigma \hat{c}_t.$$

B.2 Firms

Intermediate product firms produce using labor hired in competitive markets and both domestic and foreign intermediate inputs. The cost of producing is

$$Q_{i,t} = \frac{W_t L_{i,t}}{P_t} + \frac{e_t M_{i,t}}{P_t} + I_{i,t}$$

where e_t denotes the nominal exchange rate and M_t the foreign intermediate input. The domestic inputs are labor, $L_{i,t}$, and $I_{i,t}$. The latter is an aggregator of all domestically produced goods, defined as

$$I_{i,t} = \left[\int_0^1 I_{i,i',t}^{(\theta-1)/\theta} di\right]^{\theta/(\theta-1)},$$

inducing demand

$$I_{i,i',t} = I_{i,t}\left(\frac{P_{i',t}}{P_t}\right)^{-\theta}.$$

Firm Minimize cost subject to the production function

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

where $A_{i,t}$ denotes firm-specific productivity. This process is made of an aggregate component we define below. The cost-minimization problem yields first order conditions (foc):

$$\begin{aligned}
\frac{W_t}{P_t} &- mc_{i,t}\alpha\eta A_{i,t} L_{i,t}^{\eta-1} I_{i,t}^{1-\eta}\left(L_{i,t}^{\eta} I_{i,t}^{1-\eta}\right)^{\alpha-1} M_{i,t}^{(1-\alpha)} = 0 \\
\frac{e_t}{P_t} &- mc_{i,t}\left(1-\alpha\right) A_{i,t}\left(L_{i,t}^{\eta} I_{i,t}^{1-\eta}\right)^{\alpha} M_{i,t}^{-\alpha} = 0 \\
1 &- mc_{i,t}\alpha\left(1-\eta\right) A_{i,t} L_{i,t}^{\eta} I_{i,t}^{-\eta}\left(L_{i,t}^{\eta} I_{i,t}^{1-\eta}\right)^{\alpha-1} M_t^{(1-\alpha)} = 0.
\end{aligned}$$

From these we determine labor demand and the marginal cost as a function of input prices. Combining the above first order conditions we get

$$mc_{i,t} = \frac{W_t}{P_t}\frac{1}{\alpha\eta A_{i,t}\left(\frac{L_{i,t}}{I_{i,t}}\right)^{-\alpha(1-\eta)}\left(\frac{W_t}{P_t}\frac{P_t}{e_t}\frac{(1-\alpha)}{\alpha\eta}\right)^{1-\alpha}}$$

where

$$\frac{W_t}{P_t} = \frac{\eta}{1-\eta}\left(\frac{I_{i,t}}{L_{i,t}}\right)$$

and finally

$$mc_{i,t} = A_{i,t}^{-1}\left(\frac{W_t}{P_t}\right)^{\alpha\eta}\left(\frac{e_t}{P_t}\right)^{1-\alpha}\left[\alpha\eta\left(\frac{1-\eta}{\eta}\right)^{\eta(1-\alpha)}\left(\frac{(1-\alpha)}{\alpha\eta}\right)^{1-\alpha}\right]^{-1}.$$

In log-linear terms we get

$$\hat{mc}_{i,t} = \alpha\eta\hat{w}_t + (1-\alpha)\hat{q}_t - a_{i,t}$$

where $\hat{q}_t$ denotes the real exchange rate. The exogenous productivity shock evolves according to

$$\begin{aligned} a_{i,t} &= \hat{a}_t + \hat{a}_{i,t} \\ \hat{a}_{i,t} &= \rho_a \hat{a}_{i,t-1} + \varepsilon_t^{a,i} \\ \hat{a}_t &= \rho_A \hat{a}_{t-1} + \varepsilon_t^{A} \end{aligned}$$

so that we can express

$$\begin{aligned} \hat{mc}_{i,t} &= \alpha\eta\hat{w}_t + (1-\alpha)\,\hat{q}_t - \hat{a}_t - \hat{a}_{i,t} \\ &= \hat{mc}_t - \hat{a}_{i,t} \end{aligned}$$

where the aggregate marginal cost is

$$\hat{mc}_t = \alpha\hat{w}_t + (1-\alpha)\,\hat{q}_t - \hat{a}_t$$

and the wage can be expressed as

$$\begin{aligned} \hat{w}_t &= \int \hat{I}_{i,t} - \int \hat{L}_{i,t} \\ &= \hat{I}_t - \hat{L}_t. \end{aligned}$$

Furthermore, express

$$\begin{aligned} \frac{W_t}{P_t} L_{i,t} &= mc_{i,t}\alpha\eta A_{i,t} L_{i,t}^{\eta} I_{i,t}^{1-\eta} \left(\frac{M_{i,t}}{L_{i,t}^{\eta} I_{i,t}^{1-\eta}} \right)^{1-\alpha} \\ &= mc_{i,t}\alpha\eta Y_{i,t}. \end{aligned}$$

In log-linear terms we obtain,

$$\hat{w}_t + \hat{L}_{i,t} = \hat{mc}_{i,t} + \hat{y}_{i,t}.$$

Aggregating and substituting for the marginal cost we get

$$\begin{aligned} \int \hat{w}_t + \int \hat{L}_{i,t} &= \int \hat{mc}_{i,t} + \int \hat{y}_{i,t} \\ \hat{w}_t + \hat{L}_t &= \hat{mc}_t + \hat{y}_t \\ \hat{L}_t &= -(1-\alpha\eta)\,\hat{w}_t + (1-\alpha)\,\hat{q}_t - \hat{a}_t + \hat{y}_t. \end{aligned}$$

Using the aggregate labor supply

$$\delta \hat{L}_t = \hat{w}_t - \sigma \hat{c}_t$$

and substitute labor demand above to get

$$\hat{w}_t = \frac{\delta}{\delta(1-\alpha\eta)+1}\left[(1-\alpha)\hat{q}_t + \hat{y}_{i,t} - \hat{a}_t\right] + \frac{\sigma}{\delta(1-\alpha\eta)+1}\hat{c}_t.$$

We can then substitute for the wage in the aggregate marginal cost to get

$$m\hat{c}_{i,t} = -\hat{a}_{i,t} + \left(1 + \frac{\alpha\eta\delta}{\delta(1-\alpha\eta)+1}\right)\left((1-\alpha)\hat{q}_t - \hat{a}_t\right) + \frac{\alpha\eta}{\delta(1-\alpha\eta)+1}\left(\delta\hat{y}_t + \sigma\hat{c}_t\right).$$

Consider the equilibrium in goods markets. In log-linear terms

$$\hat{y}_t = \frac{I}{y}\hat{I}_t + \left(1 - \frac{I}{y}\right)\hat{c}_t.$$

We use the steady state relationships

$$mc = \frac{\theta - 1}{\theta}$$

$$w = mc \times \alpha\eta\frac{Y}{L}$$

$$w = \frac{\eta}{1-\eta}\frac{I}{L}$$

$$w = \alpha\eta \times mc\frac{y}{I} \times \frac{I}{L}$$

to obtain

$$\frac{I}{y} = \psi = \alpha\frac{\theta - 1}{\theta}(1-\eta).$$

We can then use the above relationships to express

$$\hat{w}_t + \hat{L}_t = \hat{I}_t = m\hat{c}_t + \hat{y}_t.$$

We can the re-write the resource constraint as

$$\hat{y}_t = \psi\hat{I}_t + (1-\psi)\hat{c}_t$$

$$\hat{y}_t = \frac{\psi}{1-\psi}m\hat{c}_t + \hat{c}_t.$$

The firm decision under Calvo is then

$$\mathbb{E}_t \sum_{T=t}^{\infty} \xi^{T-t} \Theta_{t,T} \left[Y_{i,t} \left(P_{i,t} - P_T mc_{i,T} \right) \right],$$

where ξ is the probability of not re-setting the price, subject to the demand constraint from both firms and households

$$Y_{i,t} = Y_t \left(\frac{P_{i,t}}{P_t} \right)^{-\theta}.$$

The first order conditions yield

$$\mathbb{E}_t \sum_{T=t}^{\infty} \xi^{T-t} \Theta_{t,T} \left[Y_T P_T^{\theta} P_{i,t}^{-\theta} \left(\frac{P_{i,t}}{P_t} - \frac{\theta}{1-\theta} \prod_{s=t}^{T-1} \pi_{s+1} mc_{i,T} \right) \right] = 0$$

and in log-linear terms

$$\begin{aligned}
\tilde{p}^r_{i,t} &= \mathbb{E}_t \sum_{T=t}^{\infty} (\xi\beta)^{T-t} \left[(1-\xi\beta) \left(\hat{mc}_T - a_{i,T} \right) + \xi\beta\pi_{T+1} \right] \\
&= -\frac{1-\xi\beta}{1-\xi\beta\rho_a} a_{i,t} + \mathbb{E}_t \sum_{T=t}^{\infty} (\xi\beta)^{T-t} \left[(1-\xi\beta) \hat{mc}_T + \xi\beta\pi_{T+1} \right] \\
\hat{p}^r_{i,t} &= \tilde{p}^r_t + \hat{p}_t - \frac{1-\xi\beta}{1-\xi\beta\rho_a} a_{i,t}
\end{aligned}$$

where the (relative) reset price is $\tilde{p}^r_{i,t} = \hat{p}^r_{i,t} - \hat{p}_t$. Using the log-linearized price index we get

$$\tilde{p}^r_t = \frac{\xi}{1-\xi} \pi_t$$

and aggregating and quasi-differencing we get the familiar Phillips curve gives the familiar

$$\pi_t = \frac{(1-\xi)(1-\xi\beta)}{\xi} \hat{mc}_t + \beta \mathbb{E}_t \pi_{t+1}.$$

Last we define the nominal exchange rate and firms's individual prices as follows. First, the real exchange rate is defined as

$$\hat{q}_t = \hat{e}_t + \tilde{p}_t - \hat{p}_t$$

where $\hat{e}_t$ is the nominal exchange rate, $\tilde{p}_t$ is the log of prices of foreign goods and $\hat{p}_t$ is the log price of domestic goods. Normalizing the price of foreign goods to $\tilde{p}_t = 0$ and assuming the nominal exchange rate evolves according to an AR(1) process

$$\hat{e}_t = \rho_e \hat{e}_t + \varepsilon^e_t$$

the model is closed by the evolution of the nominal exchange rate and prices

$$\hat{p}_t = \pi_t + \hat{p}_{t-1}.$$

$$\hat{p}_t = \pi_t + \hat{p}_{t-1}$$

$$\hat{q}_t = \hat{e}_t - \hat{p}_t.$$

B.3 The slope of the Phillips curve

Recall the marginal cost can be expressed as

$$\begin{aligned} mc_t &= \left(\frac{\delta+1}{\delta(1-\alpha\eta)+1}\right)((1-\alpha)\hat{q}_t - \hat{a}_t) + \frac{\alpha\eta}{\delta(1-\alpha\eta)+1}(\delta\hat{y}_t + \sigma\hat{c}_t) \\ &= ((1-\alpha)\hat{q}_t - \hat{a}_t) + \alpha\eta\sigma\hat{c}_t \end{aligned}$$

where in the last row we assume infinite labor supply elasticity. Now substitute

$$\hat{y}_t = \frac{\psi}{1-\psi}\hat{mc}_t + \hat{c}_t$$

to get

$$\begin{aligned} mc_t &= ((1-\alpha)\hat{q}_t - \hat{a}_t) + \alpha\eta\sigma\left(\hat{y}_t - \frac{\psi}{1-\psi}\hat{mc}_t\right) \\ &= \frac{(1-\alpha)\hat{q}_t - \hat{a}_t}{1+\alpha\eta\sigma\frac{\psi}{1-\psi}} + \frac{\alpha\eta}{1+\alpha\eta\frac{\psi}{1-\psi}}\hat{y}_t \end{aligned}$$

So the Phillips curve becomes

$$\pi_t = \frac{(1-\xi)(1-\xi\beta)}{\xi}\zeta\left[(1-\alpha)\hat{q}_t - \hat{a}_t + \alpha\eta\hat{y}_t\right] + \beta\mathbb{E}_t\pi_{t+1}$$

where

$$\zeta = \frac{1}{1+\alpha\eta\frac{\psi}{1-\psi}}$$

captures the degree of real rigidities.

B.4 Monetary policy

Central bank follows the usual Taylor rule

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

$$\pi_t^* = \rho_{\pi_*} \pi_{t-1}^* + \sigma^{\pi^*} \varepsilon_t^*$$

where π_t^* is a low frequency drift in policy objectives. The 'monetary policy shock' ε_t^R is 'weakly' correlated with the innovation in the exchange rate, reflecting the central bank accommodating exchnage rate changes, so that

$$\sigma^R \varepsilon_t^R = \sigma^m \varepsilon_t^m - \tau_e \sigma^e \varepsilon_t^e$$

where and ε_t^m is an independent normally distributed monetary policy shock.

B.5 Imperfect information and anchoring

Agents cannot separately identify ε_t^R and π_t^* . Importantly, agents are boundedly rational in one dimension: they ignore the correlation between the exchange rate innovation and the monetary policy surprises. The assumption links exchange rate innovation to long-term inflation expectations' revisions. Since the innovation to the exchange rate is perfectly observed, it the agents know of the link between monetary policy and exchange rate innovations, then their estimate of the inflation target would be independent of the exchange rate.

Agent use the Kalman filter to estimate the current π_t^*. Write the agents' estimates of the unobserved processes is

$$\pi_{t|t}^* = \pi_{t|t-1}^* + \bar{g}\left(\tilde{\pi}_t - \pi_{t|t-1}^*\right)$$

$$\varepsilon_{t|t}^R = -\frac{(1-\bar{g})}{\sigma^R}\left(\tilde{\pi}_t - \pi_{t|t-1}^*\right)$$

where

$$\sigma^R = \sqrt{\left(\sigma^m\right)^2 + \left(\tau_e \sigma^e\right)^2}$$

$$\tilde{\pi}_t = \pi_t^* - \frac{1}{(1-\rho)\,\phi_\pi}\sigma^R \varepsilon_t^R.$$

The Kalman gain is obtained as

$$\bar{g} = \frac{-\left(1-\rho_{\pi^*}^2\right) + \sqrt{\left(1-\rho_{\pi^*}^2\right)^2 + 4\rho_{\pi^*}^2 s_n^2}}{2\rho_{\pi^*}^2}$$

where

$$s_n = (1-\rho)\,\phi_\pi \frac{\sigma^{\pi^*}}{\sigma^R}$$

defines the signal-to-noise ration that agents face. In the anchored regime agents signal-to- ratio is model con-

sistent. In the unanchored regime the *perceived* volatility of the inflation target increases to $\tilde{\sigma}^{\pi^*} > \sigma^{\pi^*}$ so that $\bar{g}^{\text{unc}} > \bar{g}^{\text{anc}}$.

In both regimes, the forecast is then

$$\pi^*_{t+1|t} = \rho_{\pi_*}\pi^*_{t|t}$$

Importantly, we can re-write the policy rule in terms of the estimated unobserved processes, that

$$R_t = \rho R_{t-1} + (1-\rho)\left[\phi_\pi\left(\pi_t - \pi^*_{t|t}\right) + \phi_y \hat{y}_t\right] + \sigma^R \varepsilon^R_{t|t}.$$

B.6 Summary of Equations

$$\hat{c}_t = E_t\hat{c}_{t+1} - \mathbb{E}_t\left(R_t - \pi_{t+1}\right) \tag{1}$$

$$\hat{mc}_t = \frac{(1-\alpha)\hat{q}_t - \hat{a}_t}{1+\alpha\eta\sigma\frac{\psi}{1-\psi}} + \frac{\alpha\eta}{1+\alpha\eta\frac{\psi}{1-\psi}}\hat{y}_t \tag{2}$$

$$\hat{y}_t = \frac{\psi}{1-\psi}\hat{mc}_t + \hat{c}_t \tag{3}$$

$$\pi_t = \frac{(1-\xi)(1-\xi\beta)}{\xi}\zeta\left[(1-\alpha)\hat{q}_t - \hat{a}_t + \alpha\eta\hat{y}_t\right] + \beta\mathbb{E}_t\pi_{t+1} \tag{4}$$

$$\tilde{p}^r_t = (1-\xi\beta)\hat{mc}_t + \xi\beta\hat{E}_t\pi_{t+1} + \xi\beta\hat{E}_t\tilde{p}^r_{t+1} \tag{5}$$

$$R_t = \rho R_{t-1} + (1-\rho)\left[\phi_\pi\left(\pi_t - \pi^*_{t|t}\right) + \phi_y\hat{y}_t\right] + \sigma^R\varepsilon^R_{t|t} \tag{6}$$

$$\pi^*_{t+1|t} = \rho_{\pi_*}\pi^*_{t|t} \tag{7}$$

$$\varepsilon^R_{t+1|t} = 0 \tag{8}$$

$$\hat{e}_t = \rho_e\hat{e}_{t-1} + \varepsilon^e_t \tag{9}$$

$$\pi^*_t = \rho_{\pi_*}\pi^*_{t-1} + \sigma^{\pi^*}\varepsilon^*_t \tag{10}$$

$$\pi^*_{t|t} = \pi^*_{t|t-1} + \bar{g}\left(\tilde{\pi}_t - \pi^*_{t|t-1}\right) \tag{11}$$

$$\tilde{\pi}_t = \pi^*_t - \frac{1}{(1-\rho)\phi_\pi}\sigma^R\varepsilon^R_t \tag{12}$$

$$\varepsilon^R_{t|t} = -\frac{(1-\bar{g})}{\sigma^R}\left(\tilde{\pi}_t - \pi^*_{t|t-1}\right) \tag{13}$$

$$\hat{p}_t = \pi_t + \hat{p}_{t-1} \tag{14}$$

$$\hat{q}_t = \hat{e}_t - \hat{p}_t \tag{15}$$

$$\hat{a}_t = \rho_A \hat{a}_{t-1} + \varepsilon^A_t \tag{16}$$

$$\hat{p}^r_{i,t} = \tilde{p}^r_t + \hat{p}_t - \frac{1-\xi\beta}{1-\xi\beta\rho_a} a_{i,t} \tag{17}$$

$$\hat{a}_{i,t} = \rho_a \hat{a}_{i,t-1} + \varepsilon^{a,i}_t \tag{18}$$

We have 18 equations in 18 variables: 1-2. $\zeta_{t+1|t} = \left(\pi^*_{t+1|t}, \varepsilon^m_{t+1|t}\right)'$; 3. $\hat{c}_t$; 4. R_t; 5. $\hat{mc}_t$; 6. $\hat{e}_t$; 7. $\hat{y}_t$; 8. π_t; 9. $\hat{p}^r_t$; 10. $\hat{p}_t$; 11. $\hat{q}_t$; 12. $\hat{\pi}^*_t$; 13. $\hat{\pi}^*_{t|t}$; 14. $\tilde{\pi}_t$; 15. $\varepsilon_{m,t|t}$; 16. $\hat{a}_t$; 17. $\hat{a}_{i,t}$; 18. $\hat{p}^r_{i,t}$.

B.7 Model solution (aggregate economy)

Define the state space as

$$A \begin{bmatrix} z^J_{t+1} \\ z^S_{t+1} \\ \zeta_{t+1|t} \end{bmatrix} = B \begin{bmatrix} z^J_t \\ z^S_t \\ \zeta_{t|t} \end{bmatrix} + C\varepsilon_t$$

where

$$z^J_t = \begin{bmatrix} \hat{c}_t \\ \hat{p}^r_t \\ \hat{y}_t \\ \pi_t \\ \hat{q}_t \\ \hat{mc}_t \end{bmatrix}$$

are jump variables

$$z^S_t = \begin{bmatrix} R_{t-1} \\ \hat{p}_{t-1} \\ \hat{e}_{t-1} \\ \hat{a}_{t-1} \end{bmatrix}$$

and the innovations that are observed

$$\varepsilon_t = \begin{bmatrix} \varepsilon^A_t \\ \varepsilon^e_t \end{bmatrix}$$

are predetermined observable (to the agents) variables and ζ_t are the unobserved variables. The solution yields

$$\begin{aligned} z_t^J &= D\begin{bmatrix} z_t^S \\ \zeta_{t|t} \end{bmatrix} + F\varepsilon_t \\ \begin{bmatrix} z_{t+1}^S \\ \zeta_{t+1|t} \end{bmatrix} &= G\begin{bmatrix} z_t^S \\ \zeta_{t|t} \end{bmatrix} + H\varepsilon_t. \end{aligned}$$

To this we add the evolution of the estimate

$$\zeta_{t|t} = \begin{bmatrix} \pi_{t|t}^* \\ \varepsilon_{m,t|t} \end{bmatrix}.$$

We can then express:

$$\begin{bmatrix} \zeta_{t|t} \\ \pi_t^* \end{bmatrix} = N\begin{bmatrix} \zeta_{t|t-1} \\ \pi_{t-1}^* \end{bmatrix} + O\begin{bmatrix} \epsilon_{R,t} \\ \varepsilon_t^* \\ \varepsilon_t^e \end{bmatrix}$$

$$\begin{aligned} z_t^J &= D\begin{bmatrix} z_t^S \\ \zeta_{t|t} \end{bmatrix} + F\varepsilon_t \\ \begin{bmatrix} z_{t+1}^S \\ \zeta_{t+1|t} \end{bmatrix} &= G\begin{bmatrix} z_t^S \\ \zeta_{t|t} \end{bmatrix} + H\varepsilon_t. \end{aligned}$$

In addition to simulating these variables we need to compute agents' inflation expectations at differnt horizons. We then add

$$\begin{aligned} E_t z_{t+1}^J &= DE_t\begin{bmatrix} z_{t+1}^S \\ \zeta_{t+1|t} \end{bmatrix} \\ E_t z_{t+n}^J &= DG^{n-1}\begin{bmatrix} z_{t+1}^S \\ \zeta_{t+1|t} \end{bmatrix}. \end{aligned}$$

Now, to compute the average yearly inflation three years out we need

$$\frac{1}{12}\sum_{i=25}^{36} E_t z_{t+i}^J = \frac{1}{12}D\left(\sum_{i=25}^{36} G^{i-1}\right)\begin{bmatrix} z_{t+1}^S \\ \zeta_{t+1|t} \end{bmatrix}.$$

We can use

$$\begin{aligned} \sum_{i=25}^{36} G^{i-1} &= \frac{1}{12}(I-G)^{-1}\left(I-G^{36}\right) - \frac{1}{12}(I-G)^{-1}\left(I-G^{24}\right) \\ &= \frac{1}{12}(I-G)^{-1}\left(G^{24}-G^{36}\right) \\ &= \frac{1}{12}(I-G)^{-1}\left(I-G^{12}\right)G^{24}. \end{aligned}$$

In the new version we have

$$\begin{aligned}\sum_{i=37}^{48} G^{i-1} &= \frac{1}{12}(I-G)^{-1}\left(I-G^{48}\right)-\frac{1}{12}(I-G)^{-1}\left(I-G^{36}\right)\\ &= \frac{1}{12}(I-G)^{-1}\left(G^{36}-G^{48}\right)\\ &= \frac{1}{12}(I-G)^{-1}\left(I-G^{12}\right)G^{36}.\end{aligned}$$

Given the solution from the aggregate economy it is then straightforward to simulate individual price decision using

$$\hat{p}^r_{i,t} = \tilde{p}^r_t + \hat{p}_t - \frac{1-\xi\beta}{1-\xi\beta\rho_a}a_{i,t}.$$

C Product codes, description and matching codes

Table 18: **Input-Output Matrix: sector codes and description**

Code	Input-Output Matrix Description
1091	Slaughter and meat products, including dairy and fish products
1092	Manufacture and cane sugar refining products
1093	Manufacture of other food products
1100	Manufacture of beverages
1200	Manufacture of tobacco products
1300	Manufacture of textiles products
1400	Manufacture of wearing apparel and accessories
1500	Manufacture of footwear and leather products
1600	Manufacture of wood products
1700	Manufacture of pulp, paper and paper products
1800	Printing and reproduction of recorded media
1991	Manufacture of coke and refined petroleum products
1992	Manufacture of biofuel products
2091	Manufacture of organic and inorganic chemicals, resins and elastomers
2092	Manufacture of Pesticides, Disinfectants, Various Paints and Chemicals
2093	Manufacture of cleaning products, cosmetics/perfumery and personal hygiene
2100	Manufacture of basic pharmaceutical products and pharmaceutical
2200	Manufacture of rubber and plastic products
2300	Manufacture of non-metallic mineral products
2491	Manufacture of pig iron/ferroalloys, steel and seamless steel tubes
2492	Metallurgy of non-ferrous metals and metal smelting
2500	Manufacture of fabricated metal products, except machinery and equipment
2600	Manufacture of computer, electronic and optical products
2700	Manufacture of electrical equipment
2800	Manufacture of machinery and equipment n.e.c.
2991	Manufacture of automobiles, trucks and buses, except their components parts
2992	Manufacture of parts and accessories for motor vehicles
3000	Manufacture of other transport equipment, except motor vehicles
3180	Manufacture of furniture; other manufacturing
3300	Repair and installation of machinery and equipment

Source: Brazilian Institute of Geography and Statistics (IBGE).

Table 19: **Survey of Industry Conditions: sector codes and description**

Code	Survey Description
101	Slaughter and meat products, including dairy and fish products
104	Manufacture of vegetable and animal fats and oils
105	Manufacture of dairy products
106	Milling, manufacture of starchy products and animal feed
107	Manufacture and cane sugar refining products
100A	Manufacture of other food products
111	Manufacture of alcoholic beverages
112	Manufacture of non-alcoholic beverages
12	Manufacture of tobacco products
13	Manufacture of textiles products
14	Manufacture of wearing apparel and accessories
150A	Manufacture of leather
150B	Manufacture of footwear
16	Manufacture of wood products
171	Manufacture of pulp and pulp for papermaking
172	Manufacture of paper and cardboard
173	Manufacture of paper packaging
174	Manufacture of various paper products
18	Printing and reproduction of recorded media
190A	Manufacture of coke and refined petroleum products
190B	Manufacture of biofuel products
201	Manufacture of inorganic chemicals
202	Manufacture of organic chemicals
203	Manufacture of resins and elastomers
205	Manufacture of Pesticides and Disinfectants,
207	Manufacture of paints, varnishes, enamels, lacquers and related products
200A	Other unspecified chemicals
20B	Manufacture of soaps, detergents, cleaning products, cosmetics, perfumery products
21	Manufacture of pharmaceuticals
22A	Manufacture of rubber products
22B	Manufacture of plastic products
231	Manufacture of glass and glass products
232	Manufacture of cement
233	Manufacture of concrete, cement, fiber cement, plaster and similar materials
234	Manufacture of ceramic products
239	Stone rigging and manufacture of other non-metallic mineral products
244	Metallurgy of non-ferrous metals
240A	Steel industry
240B	Other basic metallurgy products
251	Manufacture of metal structures and heavy boiler works
253	Forging, stamping, powder metallurgy and metalworking services
254	Manufacture of Cutlery, Hand Tools and General Hardware
250A	Manufacture of other fabricated metal products
262	Manufacture of computer equipment and peripherals
263	Manufacture of communication equipment
264	Manufacture of audio and video reception, reproduction, recording and amplification apparatus
260A	Others - electronic material, communication, information technology and optical devices and equipment
271	Manufacture of generators, transformers and electric motors
273	Manufacture of equipment for distribution networks and electricity contro
275	Manufacture of home appliance
270A	Manufacture of other electrical equipment and appliances
281	Manufacture of engines, pumps, compressors and transmission equipment
282	Manufacture of machinery and equipment n.e.c.
283	Manufacture of electrical equipment
285	Manufacture of machinery and equipment for use in mineral extraction and construction
280A	Manufactured of other machines and equipment
291	Manufacture of automobiles, vans and utilities
292	Manufacture of trucks and buses
294	Manufacture of parts and accessories for motor vehicles
290A	Manufacture of other motor vehicles
301	Boat Building
304	Aircraft manufacturing
300A	Manufacture of other transport equipment, except motor vehicles
31	Manufacture of Furniture and Related Products
32	Manufacture of other manufacturing products

Source: Survey of Industrial Conditions - IBRE-FGV.

Table 20: **List of codes correspondence: CNAE - PPI; Survey of Industry Conditions (S) and Input-Output Matrix (IOM)**

CNAE	S	IOM	CNAE	S	IOM	CNAE	S	IOM	CNAE	S	IOM
10101	101	1091	15303	150B	1500	21202	21	2100	26204	262	2600
10102	101	1091	15304	150B	1500	22101	22A	2200	26301	263	2600
10103	101	1091	15401	150B	1500	22102	22A	2200	26302	263	2600
10104	101	1091	16101	16	1600	22103	22A	2200	26303	263	2600
10105	101	1091	16201	16	1600	22104	22A	2200	26304	263	2600
10201	101	1091	16202	16	1600	22105	22A	2200	26305	263	2600
10301	100A	1093	16203	16	1600	22106	22A	2200	26401	264	2600
10302	100A	1093	16204	16	1600	22201	22B	2200	26402	264	2600
10303	100A	1093	16205	16	1600	22202	22B	2200	26403	264	2600
10304	100A	1093	16206	16	1600	22203	22B	2200	26501	260A	2600
10305	100A	1093	17101	171	1700	22204	22B	2200	27101	271	2700
10306	100A	1093	17201	172	1800	22205	22B	2200	27102	271	2700
10401	104	1093	17202	172	1700	22206	22B	2200	27103	271	2700
10402	104	1093	17203	172	1700	22207	22B	2200	27104	271	2700
10403	104	1093	17301	173	1700	22208	22B	2200	27201	270A	2700
10404	104	1093	17302	173	1700	22209	22B	2200	27301	273	2700
10405	104	1093	17303	173	1700	22210	22B	2200	27302	273	2700
10406	104	1093	17401	174	1700	22211	22B	2200	27303	273	2700
10501	105	1091	17402	174	1700	22212	22B	2200	27401	270A	2700
10502	105	1091	17403	174	1700	22213	22B	2200	27501	275	2700
10503	105	1091	17404	174	1700	23101	231	2300	27502	275	2700
10504	105	1091	19201	190A	1991	23102	231	2300	27503	275	2700
10505	105	1091	19202	190A	1991	23103	231	2300	27504	275	2700
10506	105	1091	19203	190A	1991	23104	231	2300	27505	275	2700
10507	105	1091	19204	190A	1991	23201	232	2300	27901	270A	2700
10508	105	1091	19205	190A	1991	23301	233	2300	28101	281	2800
10509	105	1091	19206	190A	1991	23302	233	2300	28102	281	2800
10601	106	1093	19207	190A	1991	23303	233	2300	28103	281	2800
10602	106	1093	19208	190A	1991	23304	233	2300	28104	281	2800
10603	106	1093	19301	190B	1992	23401	234	2300	28105	281	2800
10604	106	1093	19302	190B	1992	23402	234	2300	28106	281	2800
10605	106	1093	19303	190B	1992	23403	234	2300	28107	281	2800
10606	106	1093	20101	201	2091	23404	234	2300	28201	282	2800
10701	107	1092	20102	201	2091	23405	234	2300	28202	282	2800
10702	107	1092	20103	201	2091	23901	239	2300	28203	282	2800
10703	107	1092	20104	201	2091	23902	239	2300	28204	282	2800
10801	100A	1093	20105	201	2091	23903	239	2300	28205	282	2800
10802	100A	1093	20106	201	2091	23904	239	2300	28206	282	2800
10901	100A	1093	20107	201	2091	24101	240B	2491	28207	282	2800
10902	100A	1093	20108	201	2091	24102	240B	2491	28301	283	2800
10903	100A	1093	20109	201	2091	24201	240A	2491	28302	283	2800
10904	100A	1093	20110	201	2091	24202	240A	2491	28303	283	2800
10905	100A	1093	20201	202	2091	24203	240A	2491	28304	283	2800
10906	100A	1093	20202	202	2091	24204	240A	2491	28401	280A	2800
10907	100A	1093	20203	202	2091	24205	240A	2491	28501	285	2800
10908	100A	1093	20204	202	2091	24206	240A	2491	28502	285	2800
11101	111	1100	20205	202	2091	24207	240A	2491	28503	285	2800
11102	111	1100	20206	202	2091	24208	240A	2491	28601	280A	2800
11103	111	1100	20207	202	2091	24209	240A	2491	28602	280A	2800
11104	111	1100	20301	203	2091	24210	240A	2491	28603	280A	2800
11201	112	1100	20302	203	2091	24211	240A	2491	29101	291	2991
11202	112	1100	20303	203	2091	24301	240B	2491	29102	291	2991
11203	112	1100	20304	203	2091	24302	240B	2491	29103	291	2991
12101	12	1200	20305	203	2091	24401	244	2492	29201	292	2991
12201	12	1200	20306	203	2091	24402	244	2492	29202	292	2991
13101	13	1300	20307	203	2091	24403	244	2492	29203	292	2991
13102	13	1300	20401	200A	2091	24404	244	2492	29204	292	2991
13201	13	1300	20501	205	2092	24405	244	2492	29301	292	2991
13202	13	1300	20502	205	2092	24406	244	2492	29302	292	2991
13301	13	1300	20503	205	2092	24407	244	2492	29401	294	2992
13501	13	1300	20504	205	2092	24408	244	2492	29402	294	2992
13502	13	1300	20505	205	2092	24501	251	2492	29403	294	2992
13503	13	1300	20601	20B	2093	25101	251	2500	29404	294	2992
13504	13	1300	20602	20B	2093	25102	251	2500	29405	294	2992
14101	14	1400	20603	20B	2093	25201	251	2500	29406	294	2992
14102	14	1400	20604	20B	2093	25301	253	2500	30901	290A	3000
14103	14	1400	20605	20B	2093	25401	254	2500	30902	290A	3000
14104	14	1400	20606	20B	2093	25402	254	2500	30903	290A	3000
14105	14	1400	20701	207	2093	25403	254	2500	31101	31	3180
14106	14	1400	20702	207	2093	25901	250A	2500	31102	31	3180
14107	14	1400	20703	207	2093	25902	250A	2500	31103	31	3180
14108	14	1400	20704	207	2093	25903	250A	2500	31104	31	3180
14201	14	1400	20901	200A	2092	25904	250A	2500	31105	31	3180
15101	150A	1500	20902	200A	2092	25905	250A	2500	31106	31	3180
15102	150A	1500	20903	200A	2092	26101	262	2600	31107	31	3180
15201	150A	1500	20904	200A	2092	26201	262	2600	31108	31	3180
15301	150B	1500	20905	200A	2092	26202	262	2600			
15302	150B	1500	21201	21	2100	26203	262	2600			

The PPI code (CNAE) in the survey has 9-digits, but for all products from the Manufacturing Industries the four initial code is the same: 2022. For instance, for the CNAE 10101 the complete code is 202210101. Sources: IBRE-FGV and Brazilian Institute of Geography and Statistics (IBGE).

Price Setting when Expectations are Unanchored

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2024 Bank of Canada Annual Economic Conference

Motivation: in the Words of Bernanke (2007)

Long-run inflation expectations are not always anchored to central banks' objectives

> *"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."*

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First-order implications for policy in our models, but...

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First-order implications for policy in our models, but...

...What is the impact of expectations unanchoring on observed firms' pricing decisions?

> *..."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."*

This Paper

Look at Brazilian economy: why?

1. Micro datasets on both *firms' prices* and *survey-based expectations*
2. Episode of persistent expectations' de-anchoring and subsequent re-anchoring

We find

- Significant increase in prices' response to exchange rate "shocks" in the unanchored regime
- Mechanism: calibrated dynamic stochastic general equilibrium model replicates the empirical results quantitatively

De-Anchoring and Firm Pricing: Illustration

1. Pricing decision (individual firm). Optimal price under Calvo (ξ prob of not resetting price)

$$p_t = P_t + \mathbb{E}_t \sum_{j=0}^{\infty} (\xi\beta)^j \left[(1-\xi\beta)mc_{t+j} + \xi\beta\pi_{t+1+j}\right] \qquad [\beta : \text{discount rate}]$$

depends on expected real marginal costs and the expected path of prices

2. Inflation expectations. Depend only on *perceived* CB inflation target $\pi^*_{t|t}$ [$\mathbb{E}_t\left(\text{Shocks}_{t+1}\right) = 0$])

Expectations formation. (Carvalho et al., 2023). Here simple extrapolation, for $j > 0$

$$\mathbb{E}_t\pi_{t+j} = \begin{cases} \pi^*_{t|t} \approx \pi^*_t = 0, & \text{Anchored} \\ \pi^*_{t|t} = \pi^*_{t|t-1} + \bar{g}\left(\pi_t - \pi^*_{t|t-1}\right), \quad \bar{g} >> 0 & \text{Unanchored} \end{cases}$$

$\Longrightarrow$ Shocks to inflation (e.g. from exchange rate movements) affect long-run expectations

De-Anchoring and Firm Pricing: Illustration

1. Pricing decision (individual firm). Optimal price under Calvo (ξ prob of not resetting price)

$$p_t = P_t + \mathbb{E}_t \sum_{j=0}^{\infty} (\xi\beta)^j \left[(1-\xi\beta)mc_{t+j} + \xi\beta\pi_{t+1+j}\right] \qquad [\beta : \text{discount rate}]$$

depends on expected real marginal costs and the expected path of prices

2. Inflation expectations. Depend only on *perceived* CB inflation target $\pi^*_{t|t}$ [$\mathbb{E}_t\left(\text{Shocks}_{t+1}\right) = 0$])

Pricing response to inflation shocks (ε_t) Given same path for expected real marginal cost

$$p_t^{Unc} - p_t^{Anc} = \frac{\xi\beta}{1-\xi\beta}\left(\pi_t - \pi^*_{t|t-1}\right) = \frac{\xi\beta}{1-\xi\beta}\bar{g} \times \varepsilon_t$$

$\Longrightarrow$ firms with unanchored expectation respond with a larger price change

$\Longrightarrow$ firms with higher gain ($\bar{g}$) and price duration (ξ) should respond more

De-Anchoring and Firm Pricing: Brazilian Data (July 2008 to Dec. 2020)

1. Long-run Inflation expectations: $\mathbb{E}_t \pi_{t+j}$. Focus Survey Details
   - High frequency (daily) survey: de-anchoring and re-anchoring of expectations (Bonomo et al, 2024)
   - Sample period alternates between "anchored" and "unanchored" regimes

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2. Firm prices: p_t. PPI microdata (IBRE-FGV) Details
   - Survey of firms from agriculture, mining, and manufacturing (310 "products" from 21 manf. "sectors"). Comprises 67.8% of PPI
   - Use microdata with prices for individual items
   - New BCB survey of firms' forecasts: $\approx 80\%$ of firms look at Focus Survey to form expectations...

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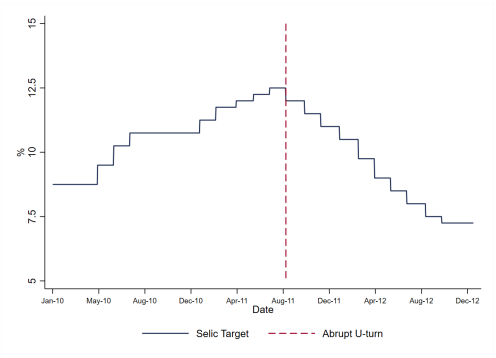
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3. The shock: ε_t. Exchange rate. Need *sizable* and *observable* "shock"
   - Follow international literature (Gopinath and Itskhoki, 2010)
   - Viewed as exogenous shifts to firms' costs: instrumental variable approach

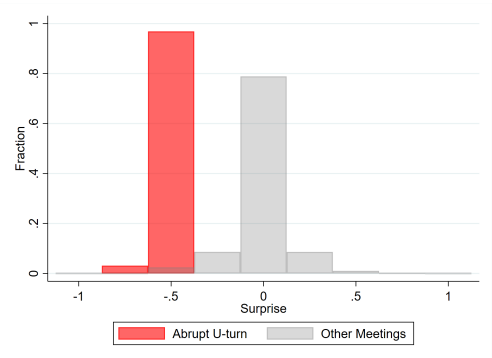
Monetary Policy U-Turn

Unexpected easing cycle: signal weaker central bank commitment to its inflation target

(a) *Policy reversal*



(b) *Large market surprise*



Bonomo et al (2024): $\Rightarrow$ de-anchoring of long-term inflation expectations Details

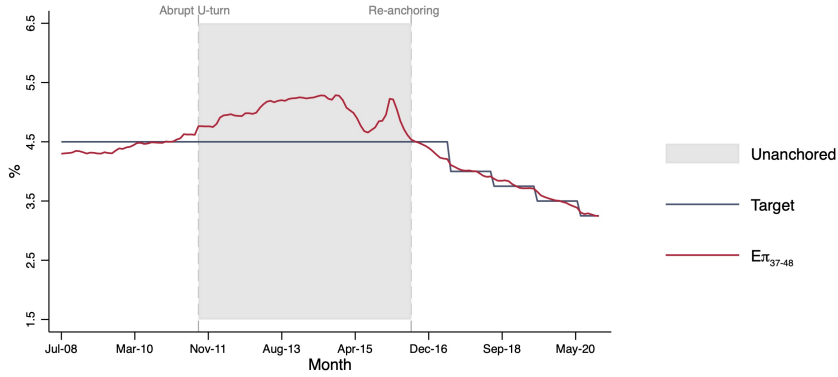
Long-Run Inflation Expectations in the Unanchored Regime

Bonomo et al (2024): Compared to "anchored" regime, long-run (4-yrs ahead) inflation expectations

1. Deviate significantly from *unchanged* inflation target Details
2. Twice as volatile Details
3. Significant pass-through from short-term expectations Details
4. Significant response to 'monetary surprises' Details

$\Longrightarrow$ Long-run inflation expectations respond to economic shocks: $\pi^*_{t|t} = \pi^*_{t|t-1} + \bar{g} \times \varepsilon_t, \quad \bar{g} >> 0$

The Regimes



Re-anchoring: President Rouseff removed from office in May 2016;

$\Rightarrow$ Re-anchoring process completed in August 2016 (Carvalho and Nechio, 2023)

De-Anchoring and Firm Pricing: Empirical Strategy

Baseline regression:

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

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

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

$\mathbb{1}_t^{Unanch}$: "Unanchored" regime indicator

x_{it}, $x_{\tau_i t}$: control variables: [see below]

ϵ_{it}: error term.

Exogenous Exchange Rate?

Empirical pass-through literature: changes in exchange rate represent a shock to firms' costs

- Orhtogonal to other shocks driving pricing decisions
- Not affected by firms' pricing

Do these assumptions hold here? Instrumental variable approach

First stage: $\Delta e_t = \theta_0 + \theta_1 \Delta S_t + \varepsilon_t$

where $\Delta S_t \equiv \frac{(\sum_{k=1}^{7} \Delta s_{k,t})}{7}$: monthly variation of emerging markets currency (s_k) basket comprising 7 countries (Colombia, Mexico, Peru, Chile, China, India, South Africa)

Second stage:

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

where $\Delta_{\tau_i} \hat{e}_t \equiv \hat{e}_t - \hat{e}_{t-\tau_{it}}$: change in instrumented exchange rate over the life of that price spell

De-Anchoring and Firm Pricing: Baseline Results

	$\Delta_{\tau_i} e_t$ - 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)
$\Delta_{\tau_i} p_{it-\tau_{it}}$			-0.122***			-0.123***
			(0.00521)			(0.00520)
τ_{it}			0.000359***			0.000244**
			(0.0000974)			(0.000101)
$\Delta_{\tau_i} ULC_t$			0.0289***			0.0160***
			(0.00608)			(0.00618)
$\Delta_{\tau_i} Sectoral\ cost_t$			0.0347***			0.0282***
			(0.0104)			(0.0103)
$Sectoral\ inventory_t$			-0.000177***			-0.000178***
			(0.0000184)			(0.0000184)
$Sectoral\ demand_t$			0.000325***			0.000327***
			(0.0000288)			(0.0000288)
$Constant$	0.0435***	0.0428***	0.00214	0.0445***	0.0441***	0.00428
	(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	0.0501	0.0502	0.0650
Individual Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time-Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Items/Sectors Controls	No	No	Yes	No	No	Yes

De-Anchoring and Firm Pricing: Robustness I (Exchange Rate)

Real rigidities (Gopinath et al., 2010)?

a. Lagged FX change Details

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

Different behavior across regimes? Exchange rate

b. Non-linear FX effect Details

$$\Delta_{\tau_i} p_{it} = \alpha_i + \gamma_t + \beta_1 \Delta_{\tau_i} e_t + \beta_2 \Delta_{\tau_i} e_t \times \mathbb{1}_t{}^{Unanch} + \beta_3 (\Delta_{\tau_i} e_t)^2 + \text{controls} + \epsilon_{it}$$

c. Asymmetric FX effect Details:

$$\Delta_{\tau_i} p_{it} = \alpha_i + \gamma_t + (\beta_1^+ \Delta_{\tau_i} e_t^+ + \beta_1^- \Delta_{\tau_i} e_t^-) + (\beta_2^+ \Delta_{\tau_i} e_t^+ + \beta_2^- \Delta_{\tau_i} e_t^-) \times \mathbb{1}_t{}^{Unanch} + \text{controls} + \epsilon_{it}$$

De-Anchoring and Firm Pricing: Robustness II (Inflation)

Larger price adjustments because inflation is higher?

d. Control for 12-months inflation Details

$$\Delta_{\tau_i} p_{it} = \alpha_i + \gamma_t + \beta_1 \Delta_{\tau_i} e_t + \beta_2 \Delta_{\tau_i} e_t \times \mathbb{1}_t^{Unanch} + \beta_3 \Delta_{\tau_i} e_t \times \pi_{t-1}^{12m} + \text{controls} + \epsilon_{it}$$

Alternative regime classification. $Unanch_t = \mathbb{E}_t[\pi_{t+s}] - \pi^T_{t+s}$ Degree of Anchoring

- $E_t[\pi_{t+s}]$: inflation expectation at time t for horizon $t+s$ (4 yrs)
- π^T_{t+s}: inflation target for $t+s$

e. Degree of anchoring Details

$$\Delta_{\tau_i} p_{it} \equiv p_{it} - p_{it-\tau_{it}} = \alpha_i + \gamma_t + \beta_1 \Delta_{\tau_i} e_t + \beta_2 \Delta_{\tau_i} e_t \times Unanch_t + \text{controls} + \epsilon_{it}$$

Model

- Standard new Keynesian model with imported inputs: source of exchange rate pass-through.
- Mechanism for unanchoring: inference about inflation target.
  - Agents' beliefs about target are more responsive to short-term monetary surprises $\Rightarrow$ long-term expectations become more sensitive to exchange rate shocks, leading to higher pass-through.
- We calibrate model to Brazilian economy, simulate artificial data and run pass-through regressions analogous to empirical specifications.
- Quantitative results in line with our empirical findings.

Firms' Pricing Decision

- Firm (i) resetting the price

$$p_{i,t} = P_t + \mathbb{E}_t \sum_{T=t}^{\infty} (\xi\beta)^{T-t} \left[(1-\xi\beta)\left(mc_T - a_{i,T}\right) + \xi\beta\pi_{T+1} \right]$$

where aggregate marginal cost Details

$$mc_T = \zeta \left[(1-\alpha) \underbrace{(e_t - P_t)}_{\text{real exch. rate: } P_t^* = 0} - a_t + \alpha\eta y_t \right] \quad [\zeta\text{: real rigidities.}]$$

- Exchange rate and pricing decisions:
  - Nominal exchange rate: $e_t = \rho_e e_{t-1} + \varepsilon_t^e \Rightarrow$ cost-push shock
  - Direct cost effect of exchange rate through imported inputs.
  - Equilibrium effects through expectations.

Central Bank and Expectation (Un)Anchoring

- Taylor rule:

$$R_t = \rho R_{t-1} + (1-\rho)\left[\phi_\pi\left(\pi_t - \pi_t^*\right) + \phi_y y_t\right] + \varepsilon_t^R$$

- Inflation target:

$$\pi_t^* = \rho_{\pi_*}\pi_{t-1}^* + \varepsilon_t^*.$$

- Learning about π_t^*:
  1. Agents cannot separately identify ε_t^R and π_t^*
  2. Signal extraction problem: Kalman filter
- Monetary policy shock: $\varepsilon_t^R = -\tau_e \varepsilon_t^e + \varepsilon_t^m$, τ "small" $\rightarrow$ accommodate exchange rate depreciation
- Bounded rationality: agents are 'know the model' but assume $\mathrm{Cov}(\varepsilon_t^R, \varepsilon_t^e) = 0$

Central Bank and Expectation (Un)Anchoring

- Monetary shocks and anchoring

$$\begin{aligned}\tilde{\pi}_t &= \pi_t^* - \frac{1}{(1-\rho_i)\phi_\pi}\varepsilon_{R,t}, \text{[Signal]} \\ \pi^*_{t+1|t} &= \rho_{\pi_*}\pi^*_{t|t-1} + \bar{g}\left(\tilde{\pi}_t - \pi^*_{t|t-1}\right) \text{[Update]}\end{aligned}$$

- Kalman gain: $\bar{g} > 0$
  1. $\bar{g}^{\text{Anchored}}$ (small): reflects correct signal-to-noise ratio from DGP of π_t^* and $\varepsilon_{R,t}$
  2. $\bar{g}^{\text{Unanchored}} >> \bar{g}^{\text{Anchored}}$: higher perceived volatility in the inflation target
- Exchange rate and anchoring: link between ε_t^e to long-run inflation expectations

$$\pi^*_{t+1|t} = \left(\rho_{\pi_*} - \bar{g}\right)\pi^*_{t|t-1} + \bar{g} \times \frac{1}{(1-\rho)\,\phi_\pi}\tau_e\varepsilon_t^e$$

Model Calibration

- Model calibrated to Brazilian economy. Details
  - Key target: *relative expectations' vol across regimes*.
  - Price response to exchange rate is untargeted
- We simulate the model, sample a panel of 5800 firms over 156 months (sample period)
- Assume windows of anchored/unanchored/anchored expectations as in the data, and run pass-through regressions analogous to empirical specifications.
- Monte Carlo experiment: perform 1000 replications and look at the mean regression outcomes.

Pass-Through Regressions with Model-Generated Data

	Model-generated data		PPI data	
Dependent variable: $\Delta_{\tau_i} p_{it}$	**(1)**	**(2)**	**(3)**	**(4)**
$\Delta_{\tau_i} e_t$	0.048	0.058	0.0586***	0.0653***
$\Delta_{\tau_i} e_t \times \mathbb{1}_t^{Unanch}$	0.021	0.022	0.0351***	0.0286***
$\Delta_{\tau_i} e_{t-\tau_{it}}$		0.012		0.0244***
$\Delta_{\tau_i} e_{t-\tau_{it}} \times \mathbb{1}_t^{Unanch}$		0.002		0.0386***
$\Delta_{\tau_i} p_{it-\tau_{it}}$	-0.138	-0.139	-0.109***	-0.112***
N	174,357	174,357	178,442	172,850
Individual Fixed Effects	No	No	Yes	Yes
Time-Fixed Effects	Yes	Yes	Yes	Yes
Items/Sectors Controls	No	No	No	No

Conclusions

- Present evidence that long-run inflation expectations matter for individual pricing decisions
- Passthrough from exchange rate shocks is considerably higher in the "Unanchored" regime
- We develop and calibrate a model in which expectations can become unanchored. Model provides structural interpretation for empirical findings

Focus Survey

- Professional forecasters covering many macroeconomic variables; commercial banks, asset managers, consulting firms and (a few) non-financial firms.
  - Unbalanced panel, approximately 300 participants over time.
  - Currently, 130-140 participants. Around 100 participants update their nowcasts and forecasts frequently (Gaglianone and Issler, 2021).
- System available daily for updates. BCB makes daily data available.
- We use inflation forecasts for various horizons and for the SELIC policy rate.
  - Both aggregate and individual forecasts data.
- Longer horizons: calendar years. Fixed horizons by simple interpolation.

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PPI Microdata

- Survey of firms from agriculture, mining, and manufacturing.
  - 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.
  - Item: most disaggregated level, individual prices; includes company, model, size, brand, packaging, city etc.
- Summary

	Total	**Monthly average**	
	Raw data*	Raw data*	Price changes
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		

*Raw data refers to the dataset treated for outliers and missing values. Unbalanced panel, some items are missing in any given month.

Daily Data: monetary policy caused unanchoring



Back

Expectations deviate meaningfully from target

Dependent variable	$E\left[\pi_{13-24} - \pi^T_{13-24}\right]$	$E\left[\pi_{25-36} - \pi^T_{25-36}\right]$	$E\left[\pi_{37-48} - \pi^T_{37-48}\right]$
$\mathbb{1}_t^{Unanch}$	1.033***	0.677***	0.532***
	(0.006)	(0.006)	(0.007)
$\left(1 - \mathbb{1}_t^{Unanch}\right)$	0.0356***	0.0156***	-0.0379***
	(0.003)	(0.002)	(0.003)
Observations	23,111	20,950	16,218
Adjusted R^2	0.709	0.536	0.387
p-value for H0: $\beta_{Unanch} = \beta_{Anch}$	0	0	0
Estimation method	Pooled OLS	Pooled OLS	Pooled OLS

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Expectations become more volatile

Dependent variable	$\sigma_{iJ}\left(E\pi_{1-12}-\pi^{T}_{1-12}\right)$	$\sigma_{iJ}\left(E\pi_{13-24}-\pi^{T}_{13-24}\right)$	$\sigma_{iJ}\left(E\pi_{25-36}-\pi^{T}_{25-36}\right)$	$\sigma_{iJ}\left(E\pi_{37-48}-\pi^{T}_{37-48}\right)$
$\mathbb{1}_t^{Unanch}$	0.533***	0.429***	0.398***	0.363***
	(0.0194)	(0.0187)	(0.0228)	(0.0241)
$\left(1-\mathbb{1}_t^{Unanch}\right)$	0.423***	0.190***	0.138***	0.155***
	(0.0129)	(0.00844)	(0.00771)	(0.00888)
Observations	276	287	277	265
Adjusted R^2	0.870	0.808	0.737	0.692
p-value for H0: $\beta_{Unanch}=\beta_{Anch}$	0	0	0	0
Estimation	Pooled OLS	Pooled OLS	Pooled OLS	Pooled OLS

Back

Sensitivity of long- to short-run expectations increases

Table: **Expectations passthrough regressions – between Focus "contest dates"**

Dependent variable	$\Delta E_i\left[\pi_{25-36} - \pi^T_{25-36}\right]$	$\Delta E_i\left[\pi_{37-48} - \pi^T_{37-48}\right]$
$\Delta E_i\left[\pi_{1-12} - \pi^T_{1-12}\right] \times \mathbb{1}_t{}^{Unanch}$	0.228***	0.175***
	(0.0399)	(0.0345)
$\Delta E_i\left[\pi_{1-12} - \pi^T_{1-12}\right] \times \left(1 - \mathbb{1}_t^{Unanch}\right)$	0.0214	0.0151
	(0.0169)	(0.0220)
Constant	-0.00172	-0.00215
	(0.00371)	(0.00370)
Observations	2,841	2,461
Adjusted R^2	0.0457	0.0242
Estimation method	Fixed effects	Fixed effects
Individual fixed effects	Yes	Yes
Time-fixed effects	No	No

Back

Sensitivity of inflation expectations to interest rate surprises

	One day after policy meetings		
Dependent variable	$\Delta E_i\left[\pi_{13-24} - \pi^T_{13-24}\right]$	$\Delta E_i\left[\pi_{25-36} - \pi^T_{25-36}\right]$	$\Delta E_i\left[\pi_{37-48} - \pi^T_{37-48}\right]$
Abrupt U-turn surprise	-0.939***	-0.852**	-0.637
	(0.184)	(0.363)	(0.498)
Other surprises $\times\ \mathbb{1}_t{}^{Unanch}$	-0.640***	-0.531***	-0.308*
	(0.161)	(0.152)	(0.173)
Other surprises $\times\ \left(1 - \mathbb{1}_t^{Unanch}\right)$	-0.0822	-0.0300	-0.0413
	(0.0547)	(0.0506)	(0.0955)
Constant	0.0203**	0.0155*	0.0120
	(0.00794)	(0.00812)	(0.0112)
Observations	509	471	333
Adjusted R^2	0.208	0.149	0.00974
Estimation method	Fixed effects	Fixed effects	Fixed effects
Individual fixed effects	Yes	Yes	Yes
Time-fixed effects	No	No	No

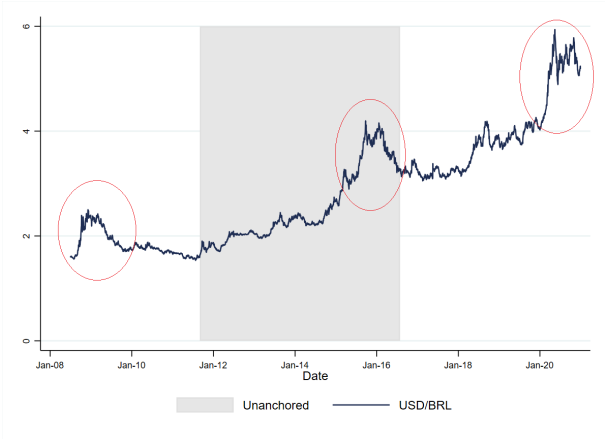
Pass-through regression with lagged FX change

	$\Delta_{\tau_i} e_t$ - Nominal Exchange Rate			$\Delta_{\tau_i} e_t$ - Instrumented FX		
Dependent variable: $\Delta_{\tau_i} p_{it}$	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta_{\tau_i} e_t$	0.0420***	0.0128**	0.00370	0.0865***	0.0561***	0.0507***
	(0.00430)	(0.00650)	(0.00667)	(0.00678)	(0.0102)	(0.0110)
$\Delta_{\tau_i} e_{t-\tau_{it}}$	0.0120***	-0.000287	0.00251	0.0223***	0.0110*	0.0202***
	(0.00348)	(0.00468)	(0.00467)	(0.00510)	(0.00657)	(0.00686)
$\Delta_{\tau_i} e_t \times \mathbb{1}_t^{Unanch}$		0.0618***	0.0513***		0.0623***	0.0513***
		(0.00896)	(0.00898)		(0.0131)	(0.0131)
$\Delta_{\tau_i} e_{t-\tau_{it}} \times \mathbb{1}_t^{Unanch}$		0.0277***	0.0375***		0.0276***	0.0357***
		(0.00676)	(0.00672)		(0.00954)	(0.00968)
N	178973	178973	172850	178973	178973	172850
Adjusted R^2	0.047	0.047	0.064	0.0471	0.0474	0.0642
Individual Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Items/Sectors Controls	No	No	Yes	No	No	Yes

Back

Exchange rate: Unanchoring or non-linearity?

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



Back

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	0.0855***	0.0684***	0.0787***	0.0659***	0.0592***
	(0.00393)	(0.00545)	(0.00495)	(0.00582)	(0.00602)	(0.00596)	(0.00812)	(0.00796)	(0.00919)	(0.00968)
$\Delta_{\tau_i} e_t \times \mathbb{1}_t^{Unanch}$		0.0460***		0.0425***	0.0337***		0.0431***		0.0417***	0.0252**
		(0.00805)		(0.00834)	(0.00853)		(0.0115)		(0.0117)	(0.0121)
$(\Delta_{\tau_i} e_t)^2$			0.0455***	0.0220	-0.0135			0.0400	0.0179	-0.0232
			(0.0163)	(0.0170)	(0.0188)			(0.0361)	(0.0370)	(0.0422)
N	192502	192502	192502	192502	178442	192502	192502	192502	192502	178442
Adjusted R^2	0.049	0.049	0.049	0.049	0.065	0.0501	0.0502	0.0501	0.0502	0.0650
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
Items/Sectors Controls	No	No	No	No	Yes	No	No	No	No	Yes

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Unanchoring or asymmetric response to FX?

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

	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta_{\tau_i} e_t$	0.0410***		0.0225***	0.00822		
	(0.00393)		(0.00545)	(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)
$\Delta_{\tau_i} e_t \times \mathbb{1}_t^{Unanch}$			0.0460***	0.0322***		
			(0.00805)	(0.00844)		
$\Delta_{\tau_i} e_t^{app} \times \mathbb{1}_t^{Unanch}$					0.0264	0.00626
					(0.0268)	(0.0274)
$\Delta_{\tau_i} e_t^{dep} \times \mathbb{1}_t^{Unanch}$					0.0423***	0.0357***
					(0.00948)	(0.00971)
N	192502	192502	192502	178442	192502	178442
Adjusted R^2	0.049	0.049	0.049	0.065	0.050	0.065
Individual Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time-Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Items/Sectors Controls	No	No	No	Yes	No	Yes

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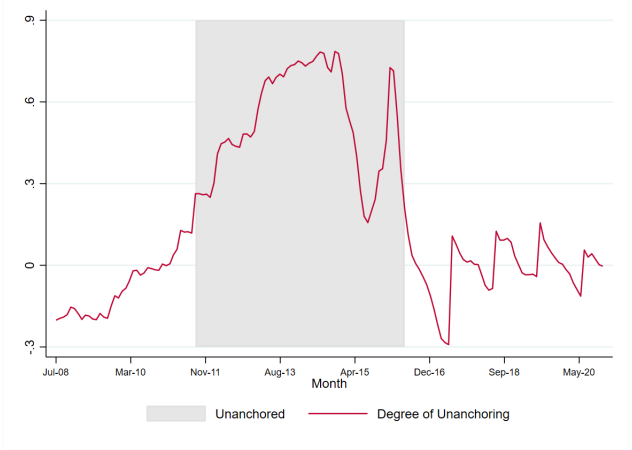
Unanchoring or higher 12m inflation?

	$\Delta_{\tau_i} e_t$ - **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***	-0.0142	-0.000444	-0.0284**	0.0855***	0.0684***	0.00945	0.0129	-0.0123
	(0.00393)	(0.00545)	(0.0105)	(0.0116)	(0.0122)	(0.00596)	(0.00812)	(0.0166)	(0.0179)	(0.0192)
$\Delta_{\tau_i} e_t \times \mathbb{1}_t^{Unanch}$		0.0460***		0.0283**	0.00358		0.0431***		0.00684	-0.0211
		(0.00805)		(0.0120)	(0.0128)		(0.0115)		(0.0157)	(0.0168)
$\Delta_{\tau_i} e_t \times \pi_{t-1}^{12m}$			0.00891***	0.00485**	0.00763***			0.0125***	0.0115***	0.0140***
			(0.00154)	(0.00230)	(0.00242)			(0.00255)	(0.00348)	(0.00371)
N	192502	192502	192502	192502	178442	192502	192502	192502	192502	178442
Adjusted R^2	0.0492	0.0495	0.0495	0.0495	0.0646	0.0501	0.0502	0.0502	0.0502	0.0651
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
Items/Sectors Controls	No	No	No	No	Yes	No	No	No	No	Yes

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A measure of the degree of unanchoring

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



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Pass-through 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***	0.0195***	0.00755	0.0855***	0.0637***	0.0541***
	(0.00393)	(0.00521)	(0.00542)	(0.00596)	(0.00775)	(0.00850)
$\Delta_{\tau_i} e_t \times Unanch_t$		0.109***	0.0700***		0.107***	0.0613***
		(0.0149)	(0.0157)		(0.0196)	(0.0204)
N	192502	192502	178442	192502	192502	178442
Adjusted R^2	0.0492	0.0496	0.0646	0.0501	0.0503	0.0650
Individual Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time-Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Items/Sectors Controls	No	No	Yes	No	No	Yes

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Firms' technology and pricing

- Firm i's output Y_{it}:

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

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

- Firm i's real marginal cost:

$$MC_{it} \propto A_{it}^{-1}\omega_t^{\alpha\eta} q_t^{1-\alpha},$$

ω_t: real wage
q_t: real exchange rate. [Partial equilibrium approach: constant foreign price level]

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Calibration Results

Parameters	Description		Parameters	Description	
$1-\alpha$	import elasticity	0.050	ρ_{π^*}	π_t^* shock	0.951
β	discount rate	0.995	σ_R	vol. mp shock	0.141
$1-\xi$	freq. Δp^i	0.200	ρ_e	persistence e_t	0.890
$1-\eta$	interm. inputs	0.200	ρ_a	persistence a_t	0.516
ϕ_π	TR: $\pi_t - \pi_t^*$	1.284	ρ_{a_i}	persistence a_{it}	0.950
ϕ_y	TR: y_t	0.005	σ_e	vol. e_t shock	3.893
ρ_i	TR: R_{t-1}	0.875	σ_a	vol. a_t shock	0.640
$\hat{g}^{\text{Unanchored}}$	Kalman gain	0.127	σ_{a_i}	vol. a_{it} shock	4.481
$\hat{g}^{\text{Anchored}}$	Kalman gain	0.008	$\text{Corr}(\varepsilon_t^R, \varepsilon_t^e)$	corr.	-0.097

Moments	Model	Data
$\sigma(\pi_t)$	0.421	0.300
$\sigma(R_t)$	0.203	0.260
$\sigma(e_t)$	8.603	8.720
$\sigma(\hat{y}_t)$	2.385	2.400
$\sigma(\mathbb{E}^{Anc}\pi)$:	0.162	0.160
$\sigma(\mathbb{E}^{Unanc}\pi)$:	0.367	0.360
$\rho(\pi_t, \pi_{t-1})$:	0.696	0.570
$\rho(R_t, R_{t-1})$:	0.810	0.950
$\rho(\hat{y}_t, \hat{y}_{t-1})$:	0.663	0.820
$\rho(e_t, e_{t-1})$:	0.867	0.867
$\mathbb{E}(\lvert\Delta p_t^i\rvert)$:	6.179	6.000

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