

Inflation Expectations Collected by the Central Bank of Brazil

Inflation expectations play a fundamental role in the inflation formation process. However, since these variables cannot be directly observed, some proxies are usually adopted by central banks, such as: (i) expectations extracted from financial market data; and (ii) survey-based expectations. In 1999, the Central Bank of Brazil implemented a daily survey as part of the transition to the inflation targeting system. Nowadays, the Market Expectations System collects information – on several variables, among which inflation rate – from roughly one hundred financial and non-financial institutions. Because of the importance of the subject for monetary policy, this Box aims to identify the main features of survey-based inflation expectations collected by the Central Bank of Brazil, as well as to map the driving forces behind the expectation formation process.

Overall, by comparing the time series of short and medium-term expectations (Table 1), and of long-term expectations (Table 2) with the respective monthly percentage change of the National Consumer Price Index – extended (IPCA), it can be noticed that the average and median values of the expectations approach the observed inflation rate as long as the

Table 1 – Descriptive Statistics (series in % month)

	IPCA (% p.m.)	Top5 Short h=1 month	Median h=1 month	Top5 Average h=3 months	Median h=3 months	Top5Average h=6 months	Median h=6 months
mean	0.55	0.50	0.48	0.44	0.43	0.43	0.43
median	0.46	0.45	0.45	0.4	0.4	0.4	0.4
maximum	3.02	1.88	1.49	1.72	1.4	1.3	1.4
minimum	-0.21	0.10	0.10	0.15	0.16	0.2	0.21
standard deviation	0.48	0.29	0.22	0.20	0.17	0.17	0.17
correl (IPCA , .)	1.0	0.78	0.69	0.18	0.2	(0.08)	(0.08)

Nota: Top5 expectations refer to median series of Top 5 (short or medium term), while expectations denominated Median represent the medians of all surveyed institutions in a certain time period. The Sample is from 2002m05 to 2008m12 (80 observations).

Table 2 – Descriptive Statistics (series in % 12 months)

	IPCA (% 12 months)	Median (h=12 months)
mean	7.1	5.57
median	6.1	4.92
maximum	17.2	13.18
minimum	3.0	3.37
standard deviation	3.9	2.01
correl (IPCA, .)	1.0	0.17

Note: sample from 200m1 to 2008m12 (74 observations)

forecast horizon diminishes, whereas the correlation between the inflation rate and the expectations increases, approaching the unit value.

A relevant issue to be investigated regarding any inflation expectations series is the existence of bias. To do so, first consider the following regression:

$$\pi_t = C_1 + C_2 \pi_{t-h}^e + \varepsilon_t, \quad (1)$$

where π_t represents the observed inflation rate; π_{t-h}^e is the respective inflation expectation, formed with a forecast horizon of h periods; and ε_t is a random residual. According to Grant & Thomas (1999), the existence of bias, or a “weak” form of rationality¹, can be verified through the following joint null hypothesis $H_0: (c_1; c_2) = (0; 1)^2$. Tables 3 and 4 show the bias test results for the survey-based inflation expectations in Brazil.

Table 3 – Bias Test $H_0: (C_1; C_2) = (0; 1)$

Sample	Top5 Short h=1 month	Median h=1 month	Top5 mean h=3 month	Median h=3 month	Top5 mean h=6 month	Median h=6 months	Median h=12 months
2002m05 – 2008m12							
C_1	(0.11)	(0.15)	0.37	0.32	0.66	0.65	5.22
standard deviation	0.07	0.13	0.21	0.24	0.22	0.22	1.88
C_2	1.31	1.47	0.41	0.55	(0.23)	(0.21)	0.34
standard deviation	0.17	0.35	0.51	0.61	0.35	0.35	0.24
P Value	0.19	0.36	0.09	0.15	0.00	0.00	0.02

Nota: o teste de hipótese utilizou a correção de Newey & West (1987). Para a regressão da Mediana (h=12 meses), adota-se como variável dependente IPCA (%12 meses), com uma amostra de 2002m11 até 2008m12.

Table 4 – Bias Test $H_0: (C_1; C_2) = (0; 1)$

Sample	Top5 Short h=1 month	Median h=1 month	Top5 mean h=3 month	Median h=3 month	Top5 mean h=6 month	Median h=6 months	Median h=12 months
2002m05 – 2008m12							
C_1	0.04	0.04	0.16	0.10	0.16	0.18	1.74
standard deviation	0.09	0.09	0.12	0.15	0.17	0.19	1.80
C_2	0.94	0.95	0.70	0.86	0.70	0.65	0.70
standard deviation	0.16	0.17	0.25	0.35	0.39	0.48	0.35
P Value	0.91	0.77	0.36	0.48	0.55	0.47	0.56

Notes: the hypothesis test used Newey & West (1987). For the regression of the median (h=12 months), we adopt as dependent variable IPCA (%12 months). In this case, for a sample from 2005m01 até 2008m12, we obtain a p-value of 0.56

- 1/ According to the authors, the “strong” form of rationality requires the forecast errors to be uncorrelated to any relevant available economic information.
- 2/ Obstfeld and Rogoff (1996, p. 79) argue that rational expectation is a mathematical expectation conditional on the available information set. In other words, the rational expectations hypothesis does not require the forecasts to be strictly correct in all periods but, instead, requires the forecast errors to be unbiased and uncorrelated with any information in which the forecast is conditioned. See also Clements (2005, p 5) for further details.

Notice from Table 3 that the null hypothesis is rejected at a 5% confidence level only for longer forecast horizons (6 and 12 months), whereas for 1 and 3 months the results suggest the inexistence of a forecast bias. However, the results based on more recent samples suggest the inexistence of bias for all the considered forecast horizons (Table 4). Such results support the “weak” form of rationality of market agents researched by the Central Bank’s survey, reflecting in some way the degree of sophistication of the models used in the expectations formation process³.

A more in-depth investigation reveals some factors that help explaining the dynamics of inflation expectations in Brazil. Tables 5 and 6 show some specifications for the inflation expectations, based on the following regressors: autoregressive term, inflation target (for the next 12 months), inflation and Selic rates (both in percentage over 12 months), nominal exchange rate, industrial production, the Emerging Markets Bond Index Plus Brazil (Embi+Br) and industrial capacity utilization(UCI)⁴.

Table 5 – Estimation of inflation expectations for the next 12 months

Regressors	I	II	III	IV
expectation (t+11,t-1)	0.723 (0.000)	0.720 (0,000)	0.684 (0,000)	0.709 (0,000)
Inflation target (t+12,t)	0.207 (0.000)	0.210 (0,001)	(0.005) (0,977)	(-4.1) (0,229)
IPCA (t)	0.155 (0.000)	0.161 (0,000)	0.133 (0,004)	0.142 (0,002)
selic (t)	(0.071) (0.000)	(0.074) (0,000)	(0.068) (0,000)	(0.051) (0,045)
exchange rate (t)	0.007 (0.043)	0.007 (0,032)	0.004 (0,173)	0.008 (0,033)
Δ (industrial production)(t)		0.014 (0,130)		
embi+Br (t)			0.002 (0,211)	
capacity utilization (t)				0.043 (0,208)
R ²	0.936	0.939	0.936	0.938
Adjusted R ²	0.931	0.933	0.933	0.932
LM Test (p-value)	0.117	0.094	0.172	0.116

3/ The formation of expectations of some US surveys is analyzed by Mankiw et al (2003), in which the authors investigate the hypotheses of adaptive, rational or “sticky-information” expectations.

4/ All variables are in log terms, excepting IPCA, Selic, inflation target and expectation, which are used in $\log(1 + \text{rate}/100)$. None of the regressions has intercept, since inflation target is constant in the adopted sample period.

According to Table 5, the autoregressive coefficient (around 0.70) indicates quite a significant persistence of inflation expectations. In addition, as expected, the expectations are positively related to the inflation target, as well as to the current inflation and nominal exchange rates. On the other hand, the results also suggest a negative coefficient for the Selic short-term interest rate, revealing the due reaction of the long-term inflation expectations *vis-à-vis* the changes in monetary policy, also reflecting the credibility of monetary authority, according to market agents.

Table 6 – Estimation of inflation expectations for the next 3 months

Regressores	I	II	III	IV
expectation (t+11,t-1)	0.535 (0.000)	0.534 (0.000)	0.499 (0.000)	0.547 (0.000)
Inflation target (t+12,t)	0.033 (0.361)	0.033 (0.366)	(0.059) (0.554)	(-3.41) (0.397)
IPCA (t)	0.071 (0.015)	0.071 (0.016)	0.058 (0.093)	0.053 (0,133)
selic (t)	0.001 (0.939)	0.001 (0.939)	(0.002) (0.853)	0.019 (0.446)
exchange rate (t)	0.166 (0001)	0.165 (0.028)	0.132 (0.003)	0.223 (0.016)
$\Delta(\text{industrial production})(t)$		0.000 (0.987)		
embi+Br (t)			0.001 (0.317)	
capacity utilization (t)				0.031 (0.392)
R^2	0.654	0.654	0.660	0.660
Adjusted R^2	0.629	0.622	0.629	0.629
LM Test (p value)	0.901	0.904	0.514	0.806

Notes: all specifications use Newey & West (1987). Sample from 2004m01 to 2008m12 (60 observations). The significant coefficients at 5% are marked in black, with respective p-values below the estimated coefficients in the parenthesis. In Table 5, inflation expectations (median of expectations of all economic agents surveyed) are measured in 12 months, with forecast horizon of h=12 meses. In Table 6, inflation expectations (median of medium term forecasts of *Top5*) are measured quarterly, with forecast horizon of h=3 meses. The exchange rate volatility refers to the average (of the last 3 months) of the volatility of the monthly nominal exchange rate.

Table 6 presents the behavior of inflation expectations, in quarterly rates, with a three-month forecast horizon. First, a lower persistence of expectations is obtained in comparison to the results of Table 5, probably due to the higher frequency of the inflation expectation rate. In addition, the coefficient for inflation is again positive, but the responses to the inflation target and Selic seem to be not significant. These results are not surprising, taking into account the short-term horizon of the considered expectations.

On the other hand, the results of Table 6 suggest that the past exchange rate volatility has a positive impact on inflation expectations.

In summary, these exercises suggest that the factors explaining the formation of inflation expectations vary with the considered forecast horizon. In particular, the analysis presented herein corroborates the notion that both the inflation target and Selic interest rate play an important role on the formation of inflationary expectations in the relevant horizon for the monetary policy.

References

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