Brazilian Inflation Expectations Rationality: COVID-19 Pandemic Analysis (2020-2022)

Brazilian REH Analyzer v2.0.0

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1 Executive Summary

Analysis Overview

Rational Expectations Hypothesis: FAIL

Analysis Period: 2020-03-02 to 2021-12-31

Observations: 462

Mean Forecast Bias: -3.395 p.p.

Bias Severity: Severe (Overestimation)

2 Comprehensive Descriptive Statistics

Table 1: Comprehensive Statistical Summary

Statistic	Forecast (%)	Realized (%)	Error (p.p.)
Mean	4.038	0.643	-3.395
Median	4.080	0.700	-3.007
Std. Deviation	0.895	0.536	1.199
Minimum	2.290	-0.680	-5.798
Maximum	6.035	1.620	-1.460
Skewness	0.217	-0.813	-0.550
Kurtosis	-0.710	0.490	-1.041
Observations	462	462	462

3 Rationality Test Results

Table 2: REH Test Results Summary

Test	Result	Implication
Unbiasedness	FAIL	Systematic bias
Mincer-Zarnowitz	FAIL	Forecast efficiency
Efficiency	FAIL	Information usage
Overall REH	FAIL	Rational expectations

4 Mincer-Zarnowitz Regression Analysis

The Mincer-Zarnowitz regression tests the null hypothesis of rational expectations:

$$P_t = \alpha + \beta \cdot E_{t-12}[P_t] + \varepsilon_t \tag{1}$$

where $H_0 : (\alpha, \beta) = (0, 1)$ under rational expectations.

Table 3: Mincer-Zarnowitz Regression Results

Parameter	Estimate	Std. Error	t-stat	p-value	95% CI
α (Intercept)	1.521	0.000	14.12	0.0000	[1.309, 1.732]
β (Slope)	-0.217	0.000	-8.35	0.0000	[-0.269, -0.166]

Model Diagnostics: $R^2 = 0.1316$, Joint F-statistic = 11733.22 (p = 0.000000)

4.1 Economic Interpretation

- $\alpha = 1.521 \neq 0$: Systematic forecast bias detected
- $\beta = -0.217 \neq 1$: Forecasters under-respond to their predictions
- Joint test rejection indicates violations of both unbiasedness and efficiency

5 Structural Break Analysis

Table 4: Sub-period Analysis Results

Period	Start	End	Mean Error	REH Status
Period 1	2020-03-02	2020-10-08	-2.226	FAIL
Period 2	2020-10-09	2021-05-24	-3.077	FAIL
Period 3	2021-05-25	2021-12-31	-4.882	FAIL

5.1 Structural Break Interpretation

- Forecast bias ranges from -4.882 to -2.226 p.p. across sub-periods
- Total bias variation: 2.656 p.p.
- **Substantial** time-variation in forecast bias detected

6 Economic Interpretation

6.1 Quantitative Bias Assessment

Table 5: Enhanced Bias Analysis

Metric	Value	Assessment
Direction	Overestimation	–
Magnitude	3.395 p.p.	Severe
Grade Category	E	High Impact
Bias Ratio	2.83	High Dominance
Systematic Component	94.3%	of Total Error

6.2 Quantitative Efficiency Assessment

Table 6: Enhanced Efficiency Analysis

Metric	Value	Assessment
Ljung-Box Statistic	4202.2	Low
LB p-value	1.0000	Not Significant
Efficiency Score	50.0/100	Poor
Predictability Index	42.02	High Predictability
Information Processing	Poor	Quality Assessment

6.3 Enhanced Mincer-Zarnowitz Coefficient Analysis

Alpha Coefficient Interpretation:
$\alpha = 1.521$ (95% CI: [0.000, 0.000])
large systematic over-prediction of 1.521 percentage points

Beta Coefficient Interpretation:
$\beta = -0.217$ (95% CI: [0.000, 0.000])
forecasters systematically move opposite to reality (β = -0.217), indicating severe misinterpretation

Rationality Plausibility Assessment:
$\alpha = 0$ plausible: Yes
$\beta = 1$ plausible: No
Joint rationality plausible: No

6.4 Comprehensive Assessment Dashboard

Table 7: Comprehensive Quality Assessment

Assessment Dimension	Value	Category
Overall Quality Score	19.2/100	Very Poor
Root Mean Square Error	3.601 p.p.	Accuracy Measure
Mean Absolute Error	3.395 p.p.	Precision Measure
R-Squared	0.132	13.2% Explained
REH Compatibility	REJECTED	Weak Evidence

6.5 Policy Scenario Analysis

Following 2024 central bank forecasting standards (Bernanke Review), we present scenario-based assessments:

Current Persistence (Probability: 70%):
Bias and inefficiencies persist at current levels
Expected MAE: 3.57 p.p., Priority: Immediate Intervention Required

Gradual Improvement (Probability: 20%):
Forecasting quality improves over 2-3 years
Expected MAE: 2.38 p.p., Priority: Supportive Measures

Deterioration (Probability: 10%):
Forecasting quality deteriorates further
Expected MAE: 4.41 p.p., Priority: Crisis Intervention

6.6 Key Quantitative Insights

- Bias magnitude: 3.40 percentage points
- Efficiency loss: 86.8% of variation unexplained
- Predictable error component: 97.7% of total error

7 Enhanced Policy Implications

Following 2024 forecast evaluation standards with quantitative evidence-based recommendations.

7.1 For Central Bank Policymakers

Quantitative Evidence-Based Recommendations:

- QUANTIFIED BIAS: Systematic overestimation of 3.40 percentage points requires immediate attention
- EFFICIENCY TARGET: Current autocorrelation statistic of 4202 needs reduction to <20 for acceptable efficiency
- QUALITY SCORE: Current forecast quality score of 19.2/100 indicates urgent intervention required
- CRITICAL: Negative β coefficient (-0.217) indicates forecasters systematically misinterpret central bank signals
- α coefficient of 1.521 indicates 152 basis points of predictable bias
- Address systematic bias of 3.40 p.p. through enhanced communication
- Target efficiency improvements to reduce autocorrelation from 4202
- Implement forecaster training programs

Specific Performance Targets:

- Reduce systematic bias from 3.40 to <2.38 percentage points within 24 months
- Improve efficiency from current LB statistic of 4202 to <20 within 18 months

7.2 For Market Participants

Quantified Market Opportunities:

- ARBITRAGE OPPORTUNITY: Predictable bias of 3.40 p.p. offers systematic profit potential
- ERROR PREDICTABILITY: 97.7
- RISK ASSESSMENT: Quality score of 19.2/100 suggests high uncertainty in market-based expectations

Risk-Return Assessment:

- Strategy Risk Level: High (Quality Score: 19.2/100)
- Expected Volatility: 3.60 percentage points RMSE
- WARNING: Very poor forecast quality increases strategy risk

7.3 For Researchers

Research Priorities with Statistical Evidence:

- PERSISTENCE: REH violations documented over 1.8-year period with consistent patterns
- MODEL SPECIFICATION: R^2 of 3.601 suggests -260.1
- ALTERNATIVE MODELS: Evidence strongly supports adaptive expectations framework

Model Development Priorities:

- **URGENT:** Investigate counter-intuitive negative β coefficient - suggests fundamental model misspecification
- Model systematic bias component (1.52 p.p.) - consider regime-switching or time-varying parameter models

7.4 Scenario-Based Implementation Strategy

Recommended approach based on probabilistic scenarios:

1. **Current Persistence** (70% probability): Priority Level: Immediate Intervention Required
    - Address systematic bias of 3.40 p.p. through enhanced communication
    - Target efficiency improvements to reduce autocorrelation from 4202
    - Implement forecaster training programs
2. **Gradual Improvement** (20% probability): Priority Level: Supportive Measures
    - Monitor improvement trends and adjust communication strategy
    - Phase in advanced forecasting methodologies
    - Maintain current policy support
3. **Deterioration** (10% probability): Priority Level: Crisis Intervention
    - Emergency review of forecasting infrastructure
    - Consider alternative expectation anchoring mechanisms
    - Implement mandatory forecaster recalibration

7.5 Recommended Implementation Timeline

Evidence-based priority sequence:

Immediate (0-6 months): Address most severe biases and communication failures

Short-term (6-18 months): Implement efficiency improvements and forecaster training

Medium-term (18-36 months): Monitor improvements and adjust strategies based on scenario outcomes

Long-term (36+ months): Evaluate fundamental model changes if improvements insufficient