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# Lessons from survey-based inflation expectations in Brazil

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# Disclaimer

*"The views expressed in this presentation are those of the author and do not necessarily represent those of the Banco Central do Brasil or its members."*

# Presentation Outline

- Introduction
- Survey-based inflation forecasts
- Disagreement
- Rationality
- Bias-correction and forecast combination
- Conclusions

# Introduction

***"Expectations matter. [...] Yet how those expectations are formed, and how best to model this process, remains an open question."***

Coibion and Gorodnichenko (AER, 2015)

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***"Expectations matter. [...] Yet how those expectations are formed, and how best to model this process, remains an open question."***

Coibion and Gorodnichenko (AER, 2015)

- Wide variety of frameworks to model the expectations formation process;
- From the adaptive expectations to the full-information rational expectations;
- Different results for macroeconomic dynamics and policy implications.

# Introduction

**Some research on survey-based inflation expectations in Brazil:**

- Cerisola and Gelos (2005); Gouvea (2007); Bevilaqua, Mesquita and Minella (2008);
- Carvalho and Minella (2012); Campelo Jr *et al*. (2014); Guillén and Garcia (2014);
- Cordeiro, Gaglianone and Issler (2015); Areosa (2016); Correa and Picchetti (2016);
- Correa, Petrassi and Santos (2016); among others.

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Different measures of inflation expectations, such as:

***(i) Extracted from financial market data***

- Concerns due to the lack of market liquidity and risk premium issues.

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***(i) Extracted from financial market data***

- Concerns due to the lack of market liquidity and risk premium issues.

***(ii) Survey-based expectations***

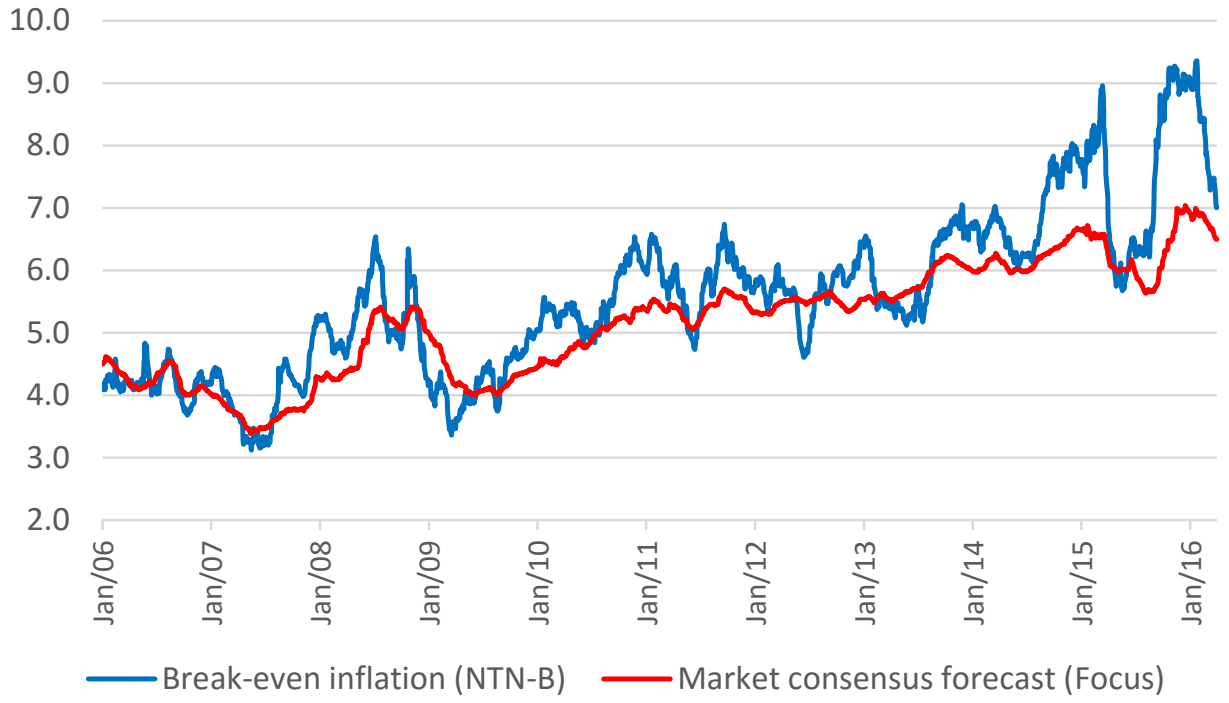
- Inflation forecasts from U.S. surveys of expectations outperform other forecasting methods.
  *(Ang, Bekaert and Wei, 2007)*

- Forecasters have access to econometric models, but add expert judgment to these models.
  *(Faust and Wright, 2012)*

# Introduction

**Figure 1** – Break-even inflation and market inflation forecasts

*(12 months ahead, % 12 months)*



# Survey-based inflation forecasts

## The Focus survey of professional forecasters (BCB)

- Since the implementation of *Inflation Targeting* regime in 1999.
- Daily survey with over 100 institutions.
- Forecasts for different horizons and a large number of economic variables.
- *Top 5 ranking* to improve forecasting expertise.
- *Certificate of Innovation Statistics* from the World Bank in 2010.

- See *Marques (2013)* for further details.

# Survey-based inflation forecasts

## The Consumer Survey (FGV)

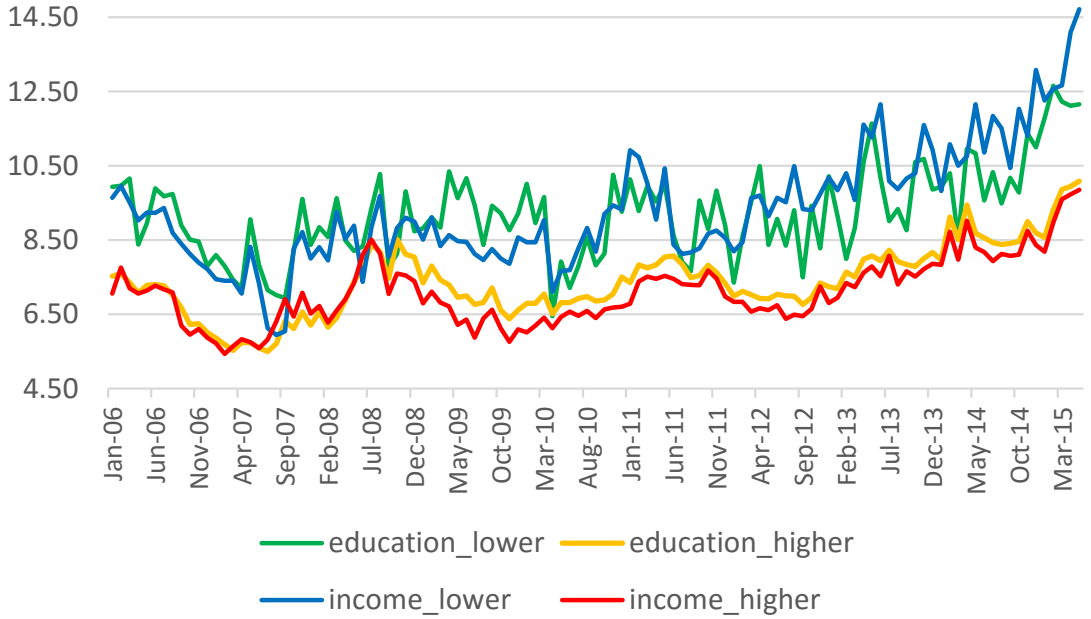
- Since September/2005 the FGV-IBRE conducts a monthly consumer survey.
- Qualitative information on household consumption, savings, employment, among others.
- Country-wide coverage (7 major state capitals) with approximately 2,000 consumers.
- Respondents are classified into 4 groups of household income level.
- Survey information can also be grouped by different education levels.

- See *Campelo Jr et al. (2014)* for further details.

# Survey-based inflation forecasts

## The Consumer Survey (FGV)

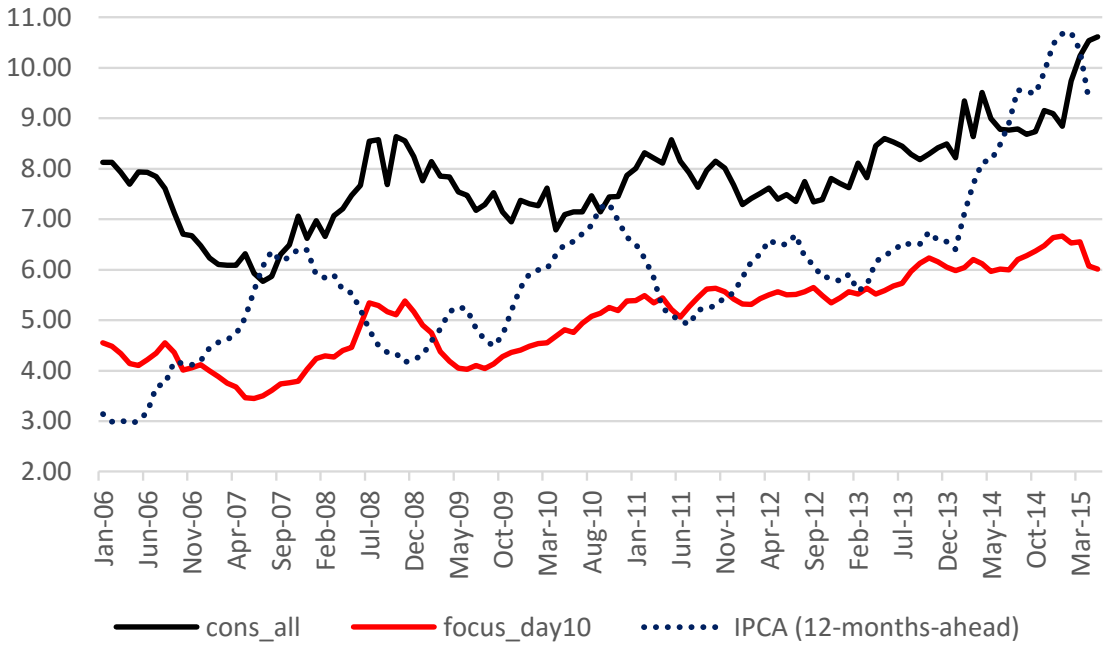
**Figure 2** – Consumer inflation forecasts for the next twelve months *(% 12 months)*




*Source: Gaglianone, Issler and Matos (2016)*

# Survey-based inflation forecasts

**Figure 3** - Consumer and market inflation forecasts compared to IPCA *(% 12 months)*



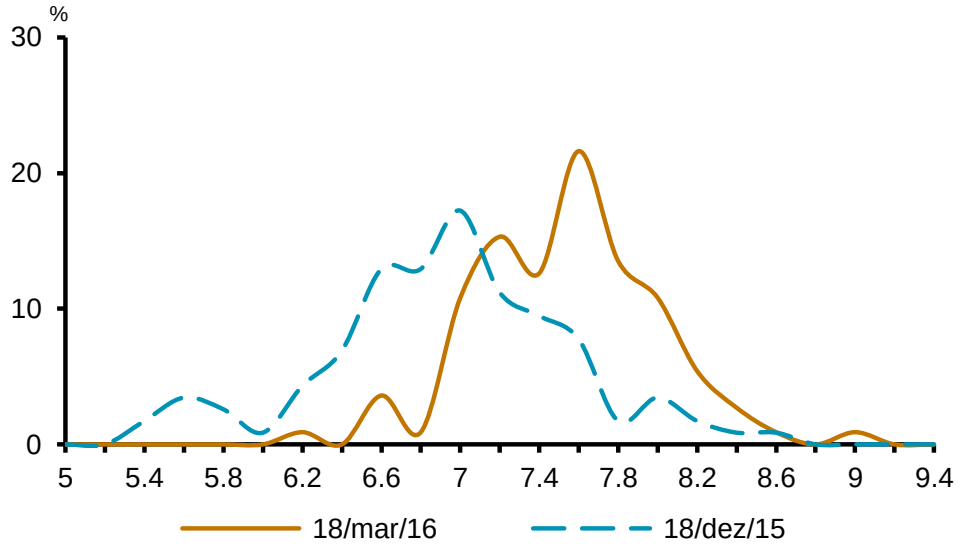

*Source: Gaglianone, Issler and Matos (2016)*

# Disagreement

Key indicator of inflation uncertainty *(Giordani and Soderlind, 2003)*

**Figure 4** – Dispersion of inflation expectations for 2016

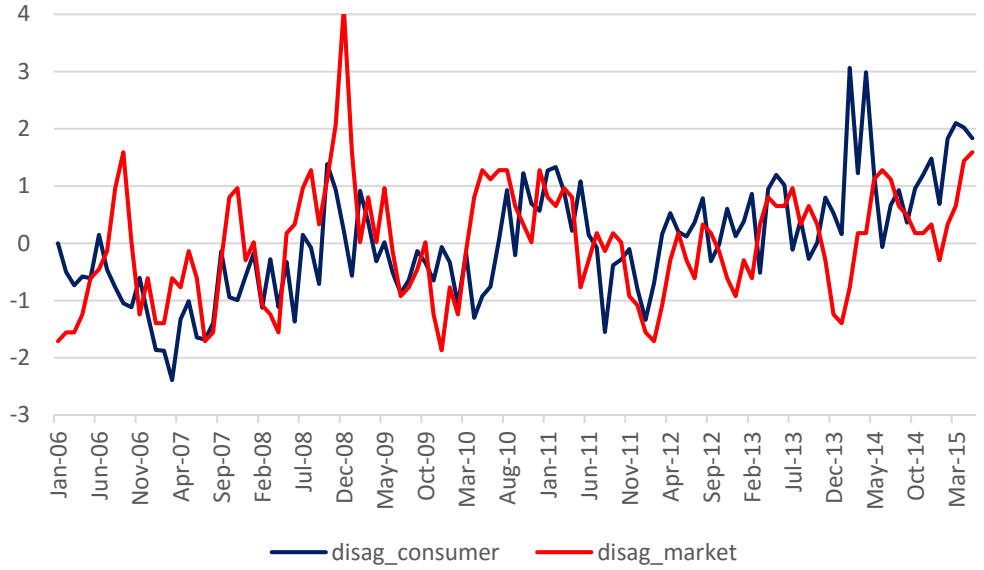
*(Focus, relative frequency)*




*Source: Inflation Report – March 2016.*

# Disagreement

**Figure 5** - Disagreement among consumers and market forecasters




Note: Cross-section standard deviation of the one-year-ahead inflation forecasts (standardized series).

- *Patton and Timmermann (2010)*: Disagreement is persistent and moves counter-cyclically.
- *Carvalho and Minella (2012)*: Country risk premium and change in inflation.

# Disagreement

**Table 1** - OLS regressions for Disagreement

| | Dependent Variable $(y_t)$ | |
|---|---|---|
| Regressor | $\sigma_t^{consum.}$ | $\sigma_t^{market}$ |
| $y_{t-1}$ | $0.451^{***}$ | $0.618^{***}$ |
| $\pi_{t-1}$ | $0.242^{**}$ | 0.065 |
| $\Delta\pi_{t-1}$ | 0.359 | $0.656^{**}$ |
| $\ln(Embi_{t-1})$ | 0.280 | 0.483 |
| $output\_gap_{t-3}$ | 0.434 | 3.654 |
| $\Delta \ln IBC_{t-3}$ | $-11.795^{*}$ | $-3.826$ |
| $intercept$ | $-2.787^{*}$ | $-2.943$ |
| Adjusted $R^2$ | 0.507 | 0.529 |

Note: Sample: January 2006 to May 2015. Newey-West HAC robust standard errors.
***, ** and * indicate significance at 1%, 5% and 10% levels, respectively.

# Disagreement

**Table 2** - OLS regressions for Disagreement

| | Dependent Variable $(y_t)$ | |
|---|---|---|
| Regressor | $\sigma_t^{consum.}$ | $\sigma_t^{market}$ |
| $y_{t-1}$ | – | – |
| $\pi_{t-1}$ | $0.508^{***}$ | – |
| $\Delta\pi_{t-1}$ | – | $0.716^{**}$ |
| $\ln(Embi_{t-1})$ | – | – |
| $\Delta \ln IBC_{t-3}$ | $-14.420^{**}$ | $-13.323^{**}$ |
| *intercept* | $-2.705^{***}$ | 0.059 |
| Adjusted $R^2$ | 0.388 | 0.030 |

Note: Sample: January 2006 to May 2015. Newey-West HAC robust standard errors.
***, ** and * indicate significance at 1%, 5% and 10% levels, respectively.

# Rationality

- Growing research on the implications of possible departures from rationality.

- **Coibion and Gorodnichenko (2015)**: *"If agents form their expectations rationally subject to information frictions, predictability in forecast errors will follow from the aggregation of forecasts across agents, even if no such predictability exists at the individual level."*

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- **Mincer-Zarnowitz test**

  - Consensus forecast: $\pi_t = \alpha + \beta F_{t|t-h} + \varepsilon_t$

    *Null hypothesis:* $[\ \alpha = 0\ ;\ \beta = 1\ ]$

  - Individual forecast: $\pi_t = \alpha_i + \beta_i f_{i,t|t-h} + \varepsilon_{i,t}$

    *Null hypothesis:* $[\ \alpha_i = 0\ ;\ \beta_i = 1\ ]$

# Rationality

**Table 3** - Rationality test for consumers

| Consensus | Individual Forecasts (% of rational) | Consensus Forecasts (MZ test, p-value) |
|---|---|---|
| cons_all | 35% | 0.000 |
| cons_educ_1_3 | 26% | 0.000 |
| cons_educ_4 | 31% | 0.000 |
| cons_educ_5_6 | 40% | 0.000 |
| cons_inc_1 | 22% | 0.000 |
| cons_inc_2 | 31% | 0.000 |
| cons_inc_3 | 35% | 0.000 |
| cons_inc_4 | 37% | 0.000 |

Notes: In the second column, the % of rational forecasters is based on p-value>0.05 in the MZ individual rationality test and on consumers with at least 20 observations in time dimension. Forecast sample: January 2006 to July 2014. IPCA sample: December 2006 to June 2015 (103 observations). Robust standard errors from a Newey-West covariance matrix.

*Source: Gaglianone, Issler and Matos (2016)*

# Rationality

**Table 4** - Rationality test for market forecasters

| (i) Individual Forecasts, OLS | $N$ | $NR$ | % Rational=$NR/N$ |
|---|---|---|---|
| All Days – daily frequency | 203 | 28 | 14% |
| Critical Days only – monthly frequency | 176 | 161 | 91% |
| (ii) Individual Forecasts, Panel | $\widehat{\alpha}$ | $\widehat{\beta}$ | p-value |
| All Days - daily (FE), $N \times T = 234,605$ | 0.02097 (0.00228) | 0.98264 (0.00515) | 0.0009 |
| All Days - daily (RE), $N \times T = 234,605$ | 0.02135 (0.00362) | 0.98261 (0.00514) | 0.0000 |
| Critical Days only - monthly (FE), $N \times T = 11,290$ | 0.01711 (0.00249) | 0.98414 (0.00557) | 0.0048 |
| Critical Days only - monthly (RE), $N \times T = 11,290$ | 0.01839 (0.00317) | 0.98269 (0.00557) | 0.0000 |
| (iii) Consensus Forecast, OLS | $\widehat{\alpha}$ | $\widehat{\beta}$ | p-value |
| All Days – daily, $T = 2,751$ | −0.04243 (0.00548) | 1.12749 (0.0114) | 0.0000 |
| Critical Days only – monthly, $T = 132$ | −0.04523 (0.02508) | 1.12517 (0.05308) | 0.0363 |

Note: Robust standard error in parenthesis. FE means fixed-effects and RE means random-effects. In the second column, N indicates the number of survey participants with at least 10 observations. In the third column, NR indicates the number of rational participants (p-value>0.05 in the rationality test). Sample: January 2nd, 2004 until January, 8th, 2015.

*Source: Gaglianone, Giacomini, Issler and Skreta (2016)*

# Bias-correction and forecast combination

➢ *Improve out-of-sample forecast performance*

- Granger (1969): **optimal forecast = conditional expectation**
- Palm and Zellner (1992); Davies and Lahiri (1995, 2013); Issler and Lima (2009)

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- Granger (1969): **optimal forecast = conditional expectation**
- Palm and Zellner (1992); Davies and Lahiri (1995, 2013); Issler and Lima (2009)
- Gaglianone and Issler (2015): Microfounded setup to model individual forecasts:

$$f_{i,t}^{h} = k_i^h + \beta_i^h \mathbb{E}_{t-h}(y_t) + \varepsilon_{i,t}^h$$

Combined forecast to deliver the conditional expectation:

$$\underset{(N,T\to\infty)_{\text{seq}}}{plim} \left( \frac{1}{N} \sum_{i=1}^{N} \frac{f_{i,t}^h - \widehat{k^h}}{\widehat{\beta^h}} \right) = \mathbb{E}_{t-h}\left(y_t\right)$$

# Bias-correction and forecast combination

- Bates and Granger (1969):
  - ✓ Increase the precision of prognostics benefitting of the complementarity of the information contained in each individual forecast.

- Granger and Ramanathan (1984):
  - ✓ Inflation as a linear combination of consumer and market aggregate forecasts:

$$\pi_{t+12} = \alpha + \beta_1 Consumer_{t+12;t} + \beta_2 Market_{t+12;t} + \varepsilon_{t+12}$$

# Bias-correction and forecast combination

**Table 5** – Mean Squared Forecast Error (MSFE)

| | AR(1) | GR | Average Forecast | BCAF | Extended BCAF |
|---|---|---|---|---|---|
| cons_all | 2.344 * | 0.921 | 3.406 * | 1.026 | 0.760 |
| focus_day10 | 2.344 * | 0.921 * | 1.295 | 0.624 | 0.590 |

Note: Forecast evaluation sample = July, 2010 through June, 2015. GR means the combined forecast of Granger and Ramanathan (1984), based on an OLS regression with intercept and "cons_all" and "focus_day10" forecasts as regressors. The second and third columns employs the equal variances' test of Diebold-Mariano (1995) between the AR(1) and GR, respectively, compared to the Extended BCAF of Gaglianone and Issler (2015) on each row. The fourth and fifth columns uses the equal-predictive accuracy test of Clark and West (2007), which compares the Average Forecast and the BCAF of Issler and Lima (2009), respectively, with the Extended BCAF (on each row). In all cases, * indicates a rejection of the null hypothesis at a 10% level.

*Source: Gaglianone, Issler and Matos (2016)*

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*Source: Gaglianone, Issler and Matos (2016)*

# Conclusions

- ✓ Consumer inflation forecasts are higher compared to market professional forecasts;

- ✓ Forecast bias is higher for consumers with lower education level (and lower income);

- ✓ Disagreement:
  - persistent
  - output growth (-)
  - inflation (consumers)
  - change in inflation (market)

# Conclusions

- ✓ Rationality hypothesis (MZ test) rejected for the *consensuses* of consumer and market professional forecasts;

- ✓ Micro data support rationality for:
  - 35% of consumers
  - 91% of market forecasters

- ✓ Bias-correction and forecast combination are useful tools to improve inflation forecasting.