Box I
Macroeconomic Expectations: Analysis of the *Monthly Survey of Economic Analyst Expectations*

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Expectations related to inflation, the policy interest rate, GDP growth, and nominal depreciation constitute essential pieces of information for central banks, especially those pursuing inflation targeting strategies. Macroeconomic expectations help determine the present and future behavior of economic agents and, as a result, are fundamental to assess the current state and future outlook of an economy. Meanwhile, economic agents' macroeconomic expectations themselves can in turn serve as a reference point for central banks to gauge their forecasts and guide their communications and actions.

Expectations, though, are not an observable phenomenon, and as a result tracking and evaluating them is a complex task. In practice, market expectations are captured through surveys of specific population groups (e.g. analysts, firms, or consumers) or inferred from financial market instruments (e.g. breakeven inflation rates, swaps, or options).

Surveys are a useful way to compile economic agents' expectations, and allow for a direct estimate of their probability distributions. However, such resources are available infrequently (e.g. monthly or quarterly) and over limited time horizons (e.g. one or two years).

Beginning in September 2003, *Banco de la República* has captured economic agents' expectations for major macroeconomic variables with its *Monthly Survey of Economic Analyst Expectations* (EME in Spanish). The first iteration of the survey took responses from economic agents at 46 financial institutions on expected inflation and the expected exchange rate for the month in progress and at 12 months. The survey was later updated to include additional variables and time horizons.

The current survey of 42 financial market analysts asks, among other issues, for expectations regarding the policy interest rate path for the month in progress and the subsequent 24 months, annual headline inflation and inflation excluding foods, and the exchange rate at 12 and 24 months. In January, April, July, and October, the survey includes questions about expected annual GDP growth for the previous quarter, the quarter in progress, and the following six quarters. The analysts are also asked to weigh in on expected GDP growth at the end of the year in progress and the following year.

The information from the EME is an essential part of the technical staff's permanent analysis of the Colombian economy. The survey results published each month by the Bank[1] are also essential for users of the information included therein.

This supplement aims to analyze the information included in the EME in its entirety and evaluate the coherence and consistency in analysts' responses both within each survey and over time.

With this in mind, we analyze the distribution of expectations from the most recent EME (January 2021) and study their dynamics and dispersion using the available historical information. We also seek to establish the relationship between macroeconomic expectations in each survey and among surveys over time. In particular, we ask whether the EME questions reveal an empirical relationship between:

- The expected policy interest rate and expectations for inflation and GDP growth
- Expected inflation and the expectations for GDP growth and depreciation

1. Monthly Survey of Expectations (EME)

In this section we analyze the central tendency and the distribution of expectations for a set of variables in the EME from January 2021. We also examine the same set of expectations for the period 2003-2021, as well as the dispersion of answers from the analysts in each survey.

1.1 January 2021

Graph B1.1 shows the median (blue line) and the distribution (yellow shading) of analysts' expectations for annual inflation at 12 and 24 months, the policy interest rate, accumulated annual GDP growth for four quarters (4Q), and annual depreciation (calculated according to Annex B1.1) in the January 2021 survey.

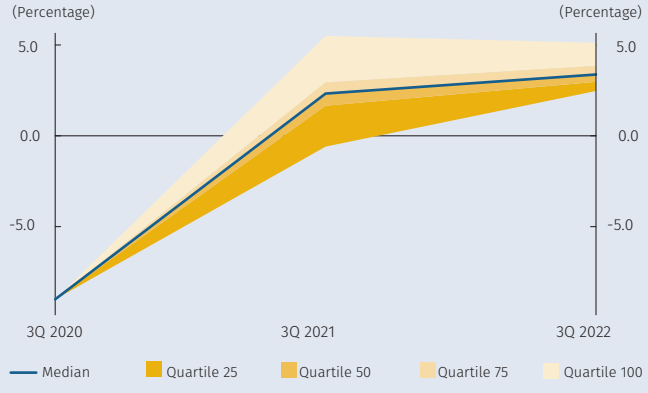
The median indicates that analysts expect inflation and GDP growth to increase over the next two years, and for the Colombian peso to appreciate. Although the analysts do not expect a change in the policy interest rate in 2021, they do expect an increase to come in 2022. Nevertheless, the distribution of the answers indicates a high degree of uncertainty for the period in question.

* The authors are members of the Office of the Deputy Technical Governor and the Department of Macroeconomic Modeling at *Banco de la República*; the opinions herein are their exclusive responsibility and do not necessarily reflect those of *Banco de la República* or its Board of Directors.

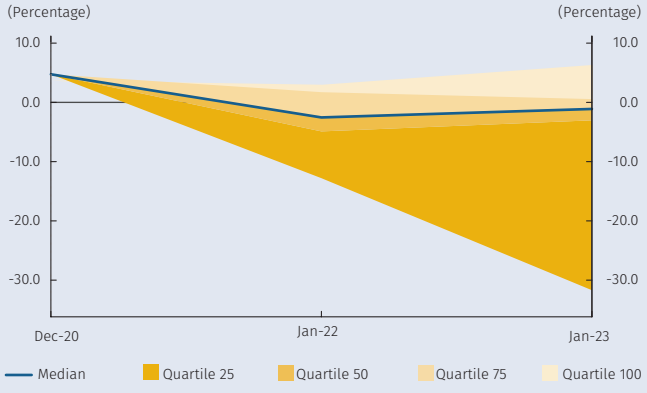
1 https://www.banrep.gov.co/resultados-mensuales-expectativas-analistas-economicos

Graph B.1
Distribution of Macroeconomic Expectations (January 2021 EME)

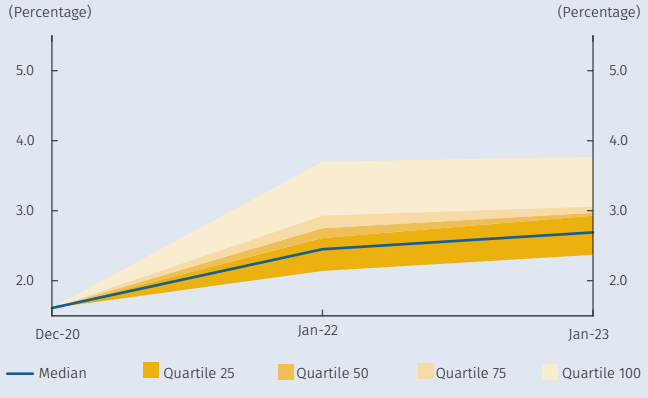
A. Annual GDP growth (4Q)



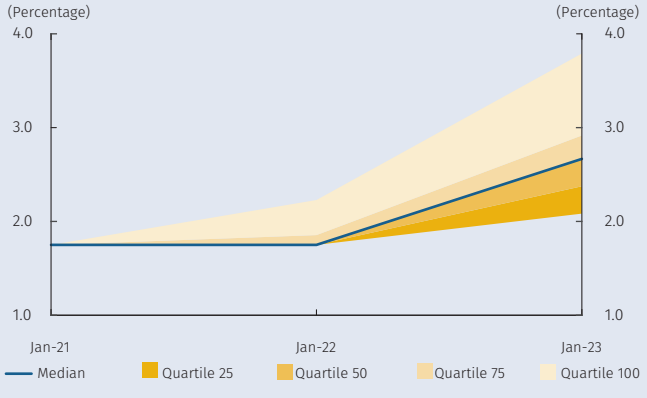
B. Annual depreciation



C. Annual inflation



D. Policy interest rate



Source: *Banco de la República*; calculations by the authors.

1.2 September 2003 to January 2021

Graph B1.2 shows the evolution of analysts' expectations for the same variables at 12 months over time (yellow dots) as well as the median of their answers from each survey (red dots). Graph B1.3 shows the dispersion[2] of the data.

The median expectations at 12 months for annual inflation, the policy interest rate, and annual GDP growth (4Q) follow the dynamic of the respective variables observed at the date of the survey. By contrast, the median of expected depreciation maintains a downward trend during the survey period. This figure is positive before 2010, and afterward is close to zero or negative. In this case the expectations differed from the observed values of the variable over this period.

Graphs B1.2 and B1.3 show that the dispersion of analysts' expectations changes over time and, in particular, increases in the presence of specific shocks to the economy. Nevertheless, this dispersion responds differently to shocks depending on the variable.

In general, the expected policy interest rate showed a lower degree of dispersion, followed by inflation expectations and expectations for GDP growth. That said, the dispersion of the latter figure reacted considerably to the COVID-19 shock.

The dispersion of expected inflation increased primarily in response to demand shocks, increases in oil prices and international food prices in 2007 and 2008, and the fall in oil prices and an *El Niño* weather pattern in 2015 and 2016. The degree of dispersion for expected depreciation is high during the sample period, increasing mainly in response to the global financial crisis and to significant movement in the price of oil.

2. Relationship between Macroeconomic Expectations

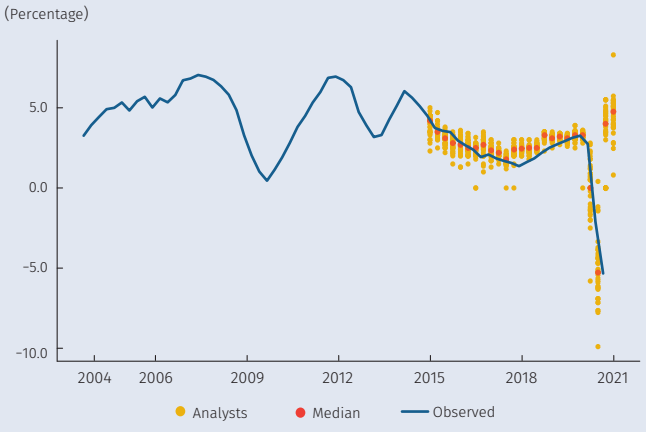
In this section we examine the relationship between macroeconomic expectations within each survey and between surveys over time. Cross-sectional regression exercises are employed in the first case, while a data pool for the sample period is used in the second.

In particular, we seek to answer the following questions:

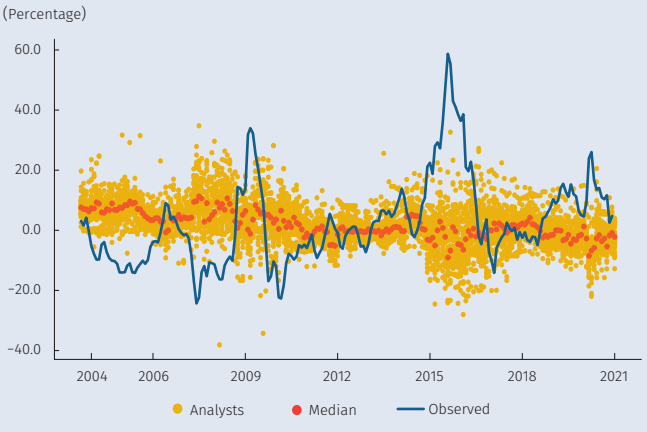
2 Measured as the standard deviation of analyst answers in each monthly survey.

Graph B.2
Analysts' Expectations at 12 Months (September 2003 – January 2021 EME)

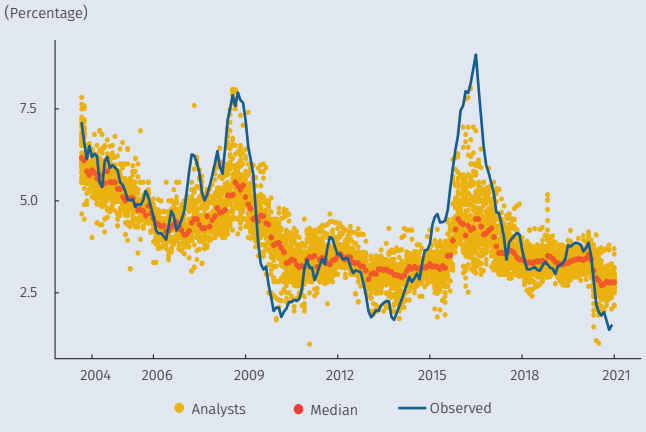
A. Annual GDP growth (4Q)



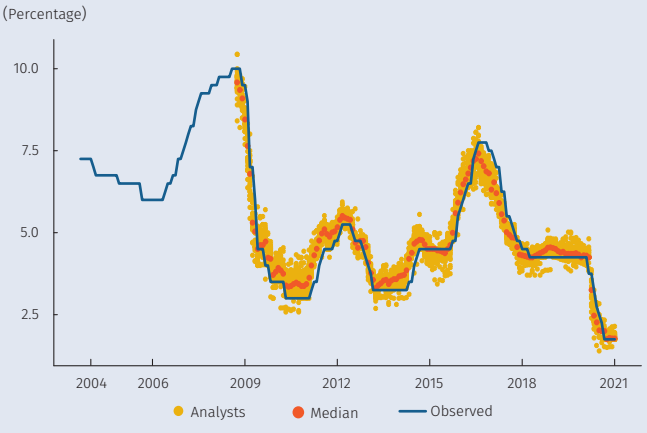
B. Annual depreciation



C. Annual inflation

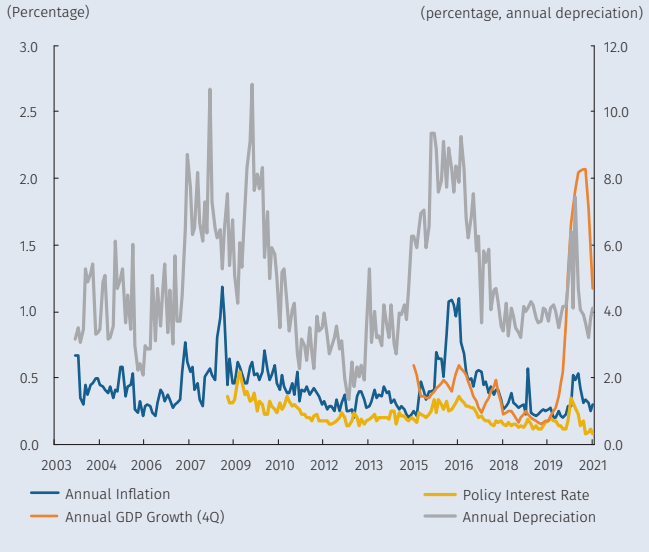


D. Policy interest rate



Source: DANE and *Banco de la República*; calculations by *Banco de la República*.

Graph B.3
Dispersion of analysts' expectations at 12 months
(September 2003 – January 2021 EME)



Source: *Banco de la República*; calculations by the authors.

A: Is there a relationship between the expected policy interest rate and expectations for inflation and GDP growth in the EME?

To respond to this question, we propose two empirical relationships:

$$i_j^{e,m} = \mu + \gamma \pi_j^{e,m} + \varepsilon_j, \quad (1)$$

$$i_j^{e,m} = \mu + \gamma \pi_j^{e,m} + \theta \Delta y_j^{e,m} + \varepsilon_j \quad (2)$$

where $i_j^{e,m}$, $\pi_j^{e,m}$ and $\Delta y_j^{e,m}$ represents expectations for the policy interest rate, annual inflation, and annual GDP growth (4Q) for the horizon m and each analyst $j = 1, \ldots, J$ (Annex B1.1).

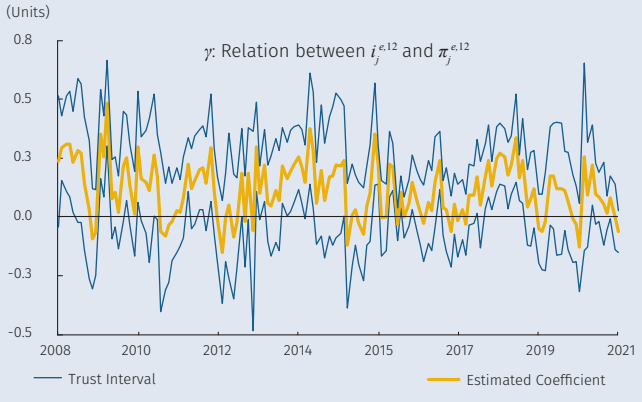
Equation 1 establishes the relationship between the expected policy interest rate and expected inflation, while equation (2) also controls for the effects of expected growth in GDP. Relationship estimate (1) uses monthly information starting in October 2008, while relationship estimate (2) includes quarterly data since 2015. Below we present and analyze several exercises related to EME expectations on an m=12 months horizon.
Using a cross-sectional approach, we estimate equations (1) and (2) by ordinary least squares (OLS) based on

expectations from each of the EMEs, and the statistical significance of the γ and θ parameters is evaluated using a 95% confidence interval. Each regression exercise includes an average of 40 observations, corresponding to the analysts' answers in the EME.

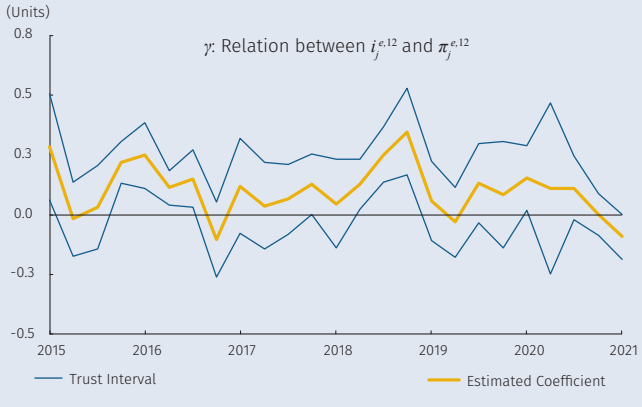
Graph B1.4 shows the estimated coefficient value for each relationship, as well as their corresponding confidence intervals. The results illustrate, in general, a positive relationship between the expectations of the policy rate and those for inflation, but it is neither stable nor statistically different from zero. Nor when controlling for expected GDP growth (Graph B1.4, Panels B and C) is there a stable and significant relationship between the variables. These results suggest that within each EME those analysts expecting higher inflation do not therefore systematically expect a higher policy interest rate.

Graph B.4
Estimated Relationship between Expectations at 12 Months for Policy Interest Rate, Inflation, and GDP Growth: Cross-Sectional Analysis

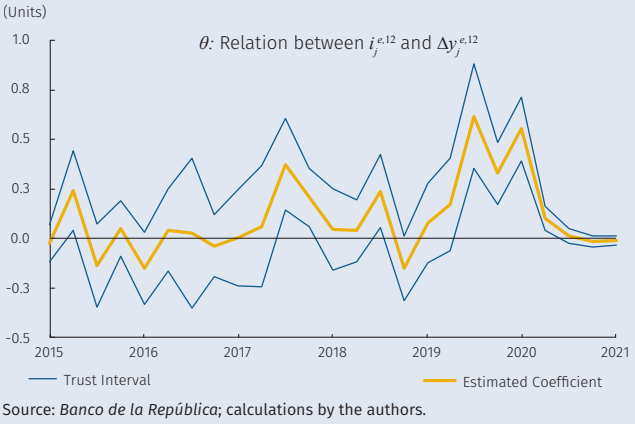
A. Relationship between the expected policy interest rate and expected inflation (equation 1)



B. Relationship between the expected policy interest rate and expected inflation (equation 2)



C. Relationship between the expected policy interest rate and expected growth (equation 2)



Source: *Banco de la República*; calculations by the authors.

In the regression exercises using the data pool, equations (1) and (2) are estimated by OLS and panel data with fixed effects (PD) using the set of expectations from the EME for the entire sample period. This allows us to consider the temporal dimension of the relationship between these variables.

Table B1.1 shows the results of estimate (1) and (2) by OLS and PD for the data pool. The results suggest evidence of a positive and significant relationship between the expected policy interest rate and inflation expectations.

Table B.1
OLS and Data Panel Regression for Equations (1) and (2) on EME Data Pool: Expectations at 12 Months

$i_j^{e,12}$	OLS	OLS	Panel Data	Panel Data
μ	0.000***	-0.005***	-0.002***	-0.009***
	(0.000)	(0.001)	(0.000)	(0.001)
$\pi_j^{e,12}$	1.325***	1.398***	1.387***	1.522***
	(0.019)	(0.048)	(0.019)	(0.051)
		0.107***		0.098***
$\Delta y_j^{e,12}$		(0.017)		(0.017)

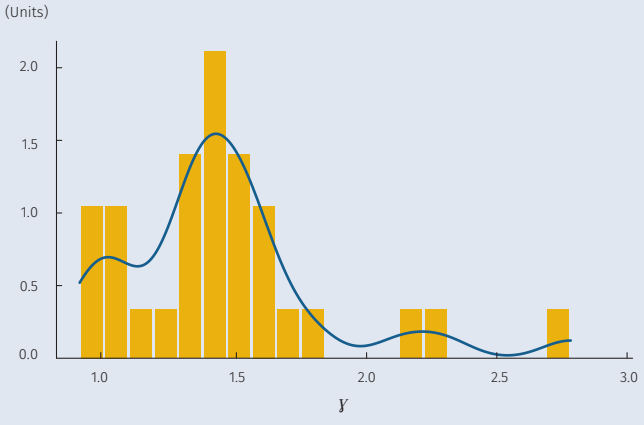
Note: *, **, *** equal significance of 10%, 5.0%, and 1.0%, respectively. Values in parenthesis correspond to standard deviations. Regression exercises for equation (1) consider a data pool from the EME that includes information since October 2008, while those for equation (2) cover data since the first quarter of 2015.
Source: *Banco de la República*, calculations by the authors.

In each of the exercises the estimated coefficient for γ is positive and greater than 1. This implies that the analysts who expect higher inflation over time also expect that *Banco de la República* will react by increasing the policy interest rate, and that this increase would be greater than that for expected inflation. In Table B1.1 we also show a positive and significant relationship between the expectation of the policy interest rate and expected GDP growth, though to a lesser extent.

Graph B1.5 shows the distribution of estimates for parameter γ for each of the analysts over time. This shows that the response of policy interest rate expectations to changes in expected inflation is positive and similar for a majority of those surveyed.

These exercises were replicated for expectations on a 24-month time horizon and the conclusions of the previous analysis held (Table B1.2). However, at this time frame the analysts expect a stronger response of the policy rate to changes in inflation expectations than on the 12-month horizon. This may reflect the perception that more persistent shocks on inflation would require a more significant policy reaction. In any case, it is important to note that, given the availability of data, the samples of each exercise differ.

Graph B.5
Density of Estimated Relationship between each Analyst's Expectations at 12 Months for the Policy Interest Rate and for Inflation (October 2008 – January 2021 EME)



Source: *Banco de la República*; calculations by the authors.

Table B.2
OLS and Data Panel Regression for Equation (1) on EME Data Pool: Expectations at 24 Months

$i_j^{e,24}$	OLS	Panel Data (FE)
μ	-0.029***	-0.046***
	(0.003)	(0.003)
$\pi_j^{e,24}$	1.988***	2.536***
	(0.117)	(0.124)

Note: *, **, *** significant at 10%, 5.0%, and 1.0%, respectively. Values in parenthesis correspond to standard deviations. Regression exercises consider a data pool from the EME that includes data since October 2019
Source: *Banco de la República*, calculations by the authors.

B: Is there a relationship between expected inflation and expected GDP growth and depreciation in the EME?

To answer this question the following relationships were proposed:

$$\pi_j^{e,m} = \alpha + \beta \Delta y_j^{e,m} + \varepsilon_j, \quad (3)$$

$$\pi_j^{e,m} = \alpha + \beta \Delta y_j^{e,m} + \delta \Delta s_j^{e,m} + \varepsilon_j, \quad (4)$$

where $\pi_j^{e,m}$, $\Delta y_j^{e,m}$ and $\Delta s_j^{e,m}$ represent annual inflation expectations, annual GDP growth (4Q), and annual depreciation for horizon m of analyst $j = 1, \ldots, J$ (Annex B1.1).

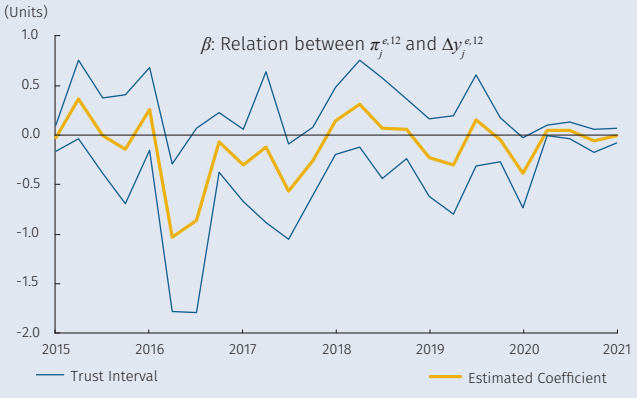
Equation (3) establishes the relationship between expected inflation and expected GDP growth while equation (4) controls for the effects of expected depreciation. The analysis of both relationships uses quarterly information since 2015. As with the empirical strategy from the previous section, these are analyzed through cross-sectional regression exercises and a data pool of EME expectations on an m=12 months horizon.

Equations (3) and (4) are estimated by OLS using expectations from each of the EMEs, and the statistical significance of the parameters β and δ is evaluated using a confidence interval of 95% (Graph 1.6). The same equations are estimated using a regression strategy with the data pool by OLS and PD using the set of expectations for the EME for the entire sample period (Table B1.3).

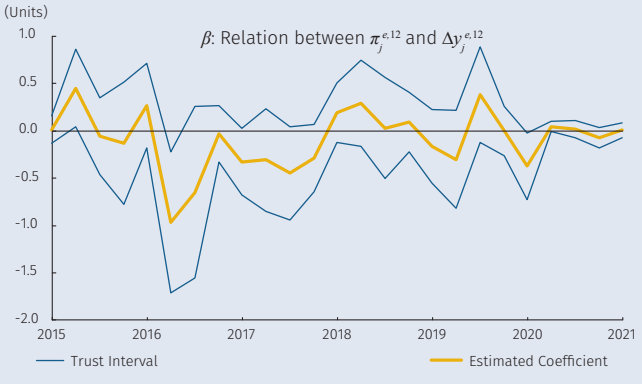
The results from Graph B1.6 do not show a stable or statistically distinct from zero relationship between expected inflation and GDP growth or depreciation expectations. As a result, there is no evidence that within each individual survey those analysts who expect higher growth or depreciation also systematically expect higher inflation.

Graph B.6
Estimated Relationship between Expectations at 12 Months for Inflation, GDP Growth, and Depreciation: Cross-Sectional Analysis

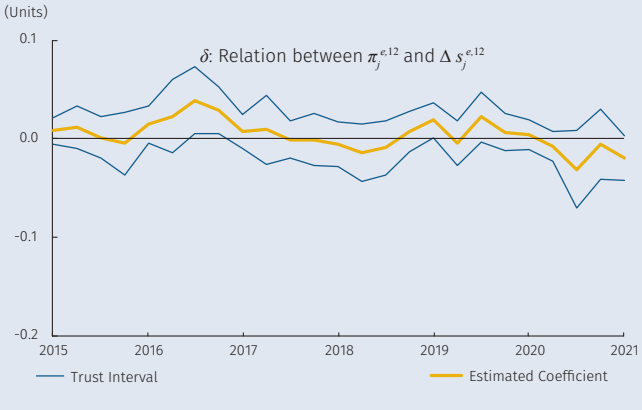
A. Relationship between expected inflation and expected GDP growth (equation 3)



B. Relationship between expected inflation and expected GDP growth (equation 4)



C. Relationship between expected inflation and expected depreciation (equation 4)



Source: *Banco de la República*; calculations by the authors.

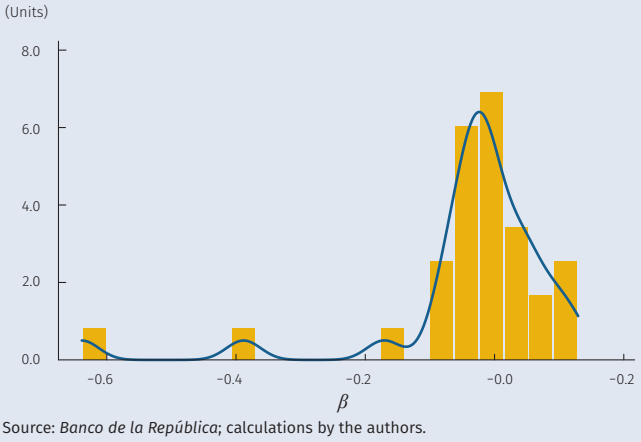
Nor is there evidence of a statistically distinct from zero relationship (significance varies) between expected inflation and the expectations for economic growth and depreciation in examining the same relationship in the data pool (Table B1.3). Additionally, the signs of the estimated relationship are not robust to marginal changes in the data set[3]. This suggests that analysts have not systematically associated expected movements in inflation with expected variations in aggregate demand or in the exchange rate over time.

Table B1.3
OLS and data panel regression for equations (3) and (4) on EME data pool: expectations at 12 months

$i_j^{e,12}$	OLS	OLS	Panel data	Panel data
μ	0.035***	0.035***	0.035***	0.035***
	(0.000)	(0.000)	(0.000)	(0.000)
$\Delta y_j^{e,12}$	0.019*	0.018	0.018	0.016
	(0.011)	(0.012)	(0.011)	(0.011)
$\Delta s_j^{e,12}$		0.009**		0.002
		(0.003)		(0.004)

Note: *, **, *** significant at 10%, 5.0%, and 1.0%, respectively. Values in parenthesis correspond to standard deviations. Regression exercises for equation (1) consider a data pool from the EME that includes information since the first quarter of 2015.
Source: *Banco de la República*, calculations by the authors.

Graph B.7
Density of Estimated Relationship Between each Analyst's Expectations at 12 Months for Inflation and GDP Growth (October 2008 – January 2021 EME)



Source: *Banco de la República*; calculations by the authors.

Graph B1.7 shows the distribution of the estimates for parameter β for each analyst over time. This suggests that the estimated response for inflation expectations to changes in expected GDP growth is dispersed among the analysts and is negative for some and positive for others. This graph corroborates the results presented in Table B1.3.

Annex 1

Table A1.1 shows information available from the EME for the variables considered in this supplement.

Averages at 12 and 24 months for expectations of annual inflation, the policy interest rate, annual GDP growth (4Q), and annual depreciation were used for graphs and regression exercises. For Graph B1.1, expectations for the same variables are displayed for the first and second year of the time horizon. Table A1.2 includes technical details for the transformations conducted for each expectation considered.

For accumulated GDP for four quarters (4Q), the survey does not include information on expected annual growth at 12 months. Between the first quarter of 2015 and the second quarter of 2020 we consider annual growth expected at year end for the year in progress from the January and April surveys as a proxy. From July 2020 annual expected GDP growth (4Q) at 12 months is approximated as the average of annual growth for each quarter over the course of four quarters for the path available in the EME.

3 A recursive estimate of these coefficients shows variation in the sign and significance for different data ranges.

Table A1.1
Information available from the Macroeconomic Expectations of the EME.

Expectation (e)		Horizon (h)	Available from
Annual inflation	$\mathbb{E}_t[\pi_{j,t+h}]$	12 months,	September 2003
		24 months	January 2015
Annual policy interest rate	$\mathbb{E}_t[i_{j,t+h}]$	Path 0-11 months forward	October 2008
		Path 12-23 months forward	October 2019
Annual GDP growth	$\mathbb{E}_t[\Delta y_{i,t+h}]$	End of year in progress End of following year	January 2015
		Previous quarter Current quarter Path 1-6 quarters forward	July 2020
Exchange rate	$\mathbb{E}_t[s_{i,t+h}]$	Month in progress 12 months	September 2003
		24 months	January 2015

Source: *Banco de la República*; calculations by the authors.

Table A1.1
Transformations of Macroeconomic Expectations from the EME

Expectativa (e)	Horizonte	Ecuación
Average annual inflation	m=12 months m= 24 months	$\pi_j^{e,m} = \prod_{h=12}^{m}(1+\mathbb{E}_t[\pi_{j,t+h}])^{12/m}, \quad h = 12, 24$
	a= second year	$\pi_j^{e,a} = \mathbb{E}_t[\pi_{j,t+h}], \quad h = 24$
Average annual policy interest rate	m=12 months m= 24 months	$i_{j,t}^{e,m} = \prod_{h=0}^{m-1}(1+\mathbb{E}_t[i_{j,t+h}])^{1/m} - 1, \quad h = 0, \dots, m-1$
	a= second year	$i_{j,t}^{e,a} = \frac{(1+i_{j,t}^{e,24m})}{(1+i_{j,t}^{e,12m})} - 1$
Average annual GDP growth (4Q)	m=12 months m= 24 months	$\Delta y_{j,t}^{e,m} = \prod_{h=0}^{\frac{m}{3}-1}(1+\mathbb{E}_t[\Delta y_{j,t+h}])^{3/m} - 1, \quad h = 0, \dots, m/3$
	a= second year	$\Delta y_{j,t}^{e,a} = \frac{(1+\Delta y_{j,t}^{e,24m})}{(1+\Delta y_{j,t}^{e,12m})} - 1$
Average nominal annual depreciation	m=12 months m= 24 months	$\Delta s_{j,t}^{e,m} = \frac{\mathbb{E}_t[s_{j,t+m}]}{\mathbb{E}_t[s_{j,t}]}^{12/m} - 1$
	a= second year	$\Delta s_{j,t}^{e,a} = \frac{\mathbb{E}_t[s_{j,t+24}]}{\mathbb{E}_t[s_{j,t+12}]} - 1$

Source: *Banco de la República*; Calculations by the authors.