THE GRADUATE INSTITUTE GENEVA

INSTITUT DE HAUTES ÉTUDES INTERNATIONALES ET DU DÉVELOPPEMENT
GRADUATE INSTITUTE OF INTERNATIONAL AND DEVELOPMENT STUDIES

Graduate Institute of International and Development Studies

International Economics Department

Working Paper Series

Working Paper No. HEIDWP18-2022

Unravelling the Narratives Behind Macroeconomic Forecasts

Marcela De Castro-Valderrama
Central Bank of Colombia

Santiago Forero-Alvarado
Central Bank of Colombia

Nicolás Moreno-Arias
Central Bank of Colombia

Sara Naranjo-Saldarriaga
Central Bank of Colombia

August 2022

Chemin Eugène-Rigot 2
P.O. Box 136
CH - 1211 Geneva 21
Switzerland

©The Authors. All rights reserved. Working Papers describe research in progress by the author(s) and are published to elicit comments and to further debate. No part of this paper may be reproduced without the permission of the authors.

Unravelling the Narratives Behind Macroeconomic Forecasts

Marcela De Castro-Valderrama

Santiago Forero-Alvarado

Nicolás Moreno-Arias

Sara Naranjo-Saldarriaga

Central Bank of Colombia

Abstract

What are the main narratives among the public regarding the future course of the Colombian economy, and how do they compare to those of the Central Bank of Colombia? Macroeconomic forecasts collected through surveys mainly assess observable variables; therefore, they offer little understanding of underlying narratives. Our study used a semi-structural general equilibrium model as an interpreter to infer the shocks behind Colombian economic analysts' forecasts in the Monthly Expectations Survey (MES), and thus, unravel their implicit narratives. Those narratives were compared to those implicit in the Central Bank's forecasts for each MES release at our disposal, covering a sample from 2020 to 2022. Analysts' narratives were qualitatively similar to those of the Central Bank. In particular, analysts broadly agreed with the Central Bank's view that the 2020 economic recession was driven more by demand than supply factors, and that in 2021, inflationary pressure was explained by demand recovery and adverse cost shocks. We observed that, over time, there was a tendency for the narratives of the public to converge with those of the Central Bank, which appeared to be an 'early mover' in response to economic shocks.

Keywords: Macroeconomic expectations; Narratives; Central Bank; Monetary Policy; Professional forecasters; Survey.

JEL: C11, C32, C55, E47, E58, E37.

The authors thank Ph.D. **Michele Lenza** from the European Central Bank for the academic supervision of this paper. This research took place through the coaching program under the Bilateral Assistance and Capacity Building for Central Banks (BCC), financed by SECO, and the Graduate Institute in Geneva. The views expressed in this paper are solely those of the authors and do not necessarily reflect those of the Central Bank of Colombia.

1 Introduction

Central banks' monetary policy actions are based on their view about the structural forces driving the economic outlook. Thus, central banks routinely and carefully craft the *narrative* surrounding their economic projections. A fundamental element of the narrative for policy decision making is the discussion of the nature and persistence of shocks that trigger economic fluctuations,[1] given that different features of such shocks may require different policy responses (e.g. Clarida et al. (1999); Woodford (2010); Ravenna and Walsh (2006)). Moreover, central banks publicly communicate their views on the economic outlook along with the narrative surrounding them, aiming to anchor expectations, as the response of the economy to policy actions depends crucially on the expectations of economic agents, such as households and firms (Coibion et al., 2020).

Recently, economic literature has shown that communicating narratives is not only necessary to stabilise expectations[2] but also influences agents' decision-making (Coibion et al., 2022; Lamla and Vinogradov, 2019; Gürkaynak et al., 2004), as central banks convey information to the public.[3] Furthermore, recent papers (Shiller (2017); Andre et al. (2021a)) have highlighted how the economic agent's narratives are powerful drivers of their expectations and can thus greatly influence economic dynamics. Therefore, it is important for central banks to track economic agents' narratives and, potentially, assess how related they are to these banks' own narratives. Unfortunately, the economic agents' narratives (e.g. their views on the shocks expected to prevail in a certain economic environment) are rarely communicated and cannot be easily inferred from forecasts collected through surveys conducted with households, firms, researchers, or financial market analysts. Indeed, the bulk of macroeconomic expectations comes from surveys asking for endogenous aggregate macroeconomic variables, which offer little understanding of the narratives behind those expectations.

This paper sets up a framework to extract the underlying narratives from quantitative forecasts of central banks and economic agents, and applies it to the Colombian economy. We used a parsimonious small open economy (SOE) macroeconomic model capturing the core economic relationships characterising modern macroeconomic theory (Galí (2015); Woodford (2003)) to translate forecasts into narratives. More specifically, we applied the model to derive the shocks driving the economic projections of the Central Bank of Colombia (CBC) and a set of economic agents. These shocks and their magnitudes are our interpretation of the narratives behind said projections.

[1] Modern macroeconomics focuses on identifying primitive exogenous forces, or 'shocks' generating business cycles (Ramey, 2016).

[2] As Eusepi and Preston (2010) suggest, communication is as important as monetary policy actions. See Blinder et al. (2008) for a survey.

[3] Papers such as Jarociński and Karadi (2020) and Nakamura and Steinsson (2018) highlight that monetary policy surprises contain information about a central bank's economic outlook assessment.

The exact identity of the economic agents captured in macroeconomic models is still subject to debate in the literature (Coibion et al., 2018; Weber et al., 2022). For Colombia, owing data limitations, we used as a proxy for expectations of economic agents those of professional forecasters (hereafter we use professional forecasters and analysts interchangeably), which are collected quarterly and available for a short but interesting period that goes from January 2020 to the present.[4] The outcomes of our analysis span several dimensions, covering projections in different survey releases, various projection horizons, a cross-section of professional forecasters, and a set of economic shocks. To summarise our results, we examine the evolution across survey releases and over forecast horizons of (i) the CBC's narrative and (ii) a comparison of the latter with the cross-sectional distribution of professional forecasters' narratives.

Professional forecasters' mean narratives were qualitatively similar to those of the CBC, and, in general, quantitative differences were also relatively small. For example, professional forecasters and the CBC agreed that demand shocks were the main driver of the recession brought about by COVID-19 and of the early part of the recovery, while supply and foreign demand shocks were weighing down output growth the whole time. In addition, they also agreed that inflationary pressures in 2021 were both the result of less contractionary demand and significant adverse cost-push shocks, and that the latter were expected to persist through 2022.

In spite of this agreement between the CBC and the professional forecasters' mean narratives, the assessment of the cross-sectional distributions of professional forecasters' narratives shows dissent among analysts regarding shocks magnitudes. This quantitative disagreement came along, however, with a broad consensus about the general narrative (i.e. signs of shocks). Notably, the CBC appears to be an early mover in many cases. In fact, when the assessment of the Central Bank (both in terms of the outlook for observable variables and of the underlying shocks) lies at the tail of the analysts distribution; subsequently, we observed a clustering of the analysts' views towards those of the CBC. This may be interpreted as *suggestive* evidence that the CBC's narrative is at least one driver of analysts' narratives.

Notice that the cross-sectional dispersion in the analysts' narratives provides a measure of 'market uncertainty' prevailing in a specific economic environment. This is relevant because it has been recently highlighted how uncertainty is a potential amplifier of the effects of economic shocks (Bloom et al., 2018; Alessandri and Mumtaz, 2019) or, at times, by itself an exogenous trigger of economic dynamics (Basu and Bundick, 2017; Kozeniauskas et al., 2018) or shocks' persistences (Kozlowski et al., 2020).[5] For instance, Fernández-Villaverde et al. (2011) showed that uncertainty shocks can account

[4]The cut-off date for the exercises in our study was January 2022.

[5]See Fernández-Villaverde and Guerrón-Quintana (2020) for a review of the literature on uncertainty shocks and business cycle research or Castelnuovo et al. (2017) on the role uncertainty plays for a number of several countries' business cycle.

for a significant share of the aggregate role of uncertainty in several countries' business cycle fluctuations, and Carrière-Swallow and Céspedes (2013) found that downturns followed by uncertainty shocks are worst in emerging economies. Also, tracking market uncertainty is relevant, since recent studies have shown that the impact of policy actions differs when uncertainty is higher (Aastveit et al., 2017; Bekaert et al., 2013; Bloom et al., 2018). The sample available to us is relatively small; however, over time, the method we have devised will allow to study whether economic environments characterised by specific expected shocks are conducive to a greater economic uncertainty.

To the best of our knowledge, this is the first study to compare economic agents' narratives with that of a central bank. To achieve our aims, we employed quantitative survey data to obtain consistent narratives explaining macroeconomic expectations. Recent literature emphasises the importance of knowing agents' narratives regarding the sources of economic fluctuations (Andre et al., 2021b). Specifically, Shiller (2020) noted the need to collect a time-series on agents' narratives. However, obtaining such information is costly and entails some difficulties related to the methods for analysing qualitative survey answers (Pesaran and Weale, 2006; Shiller, 2020), or such analysis might even be inconsistent with quantitative projections (Batchelor, 2009; Stanisławska et al., 2021). Furthermore, how comparable even an *adequate* survey of narratives would be to a central bank's narrative is unclear in the current literature. Interpreting forecasts through the lenses of an invariant model not only exploits already collected surveys, to obtain narratives that are consistent with the reported forecast variables, but also makes narratives comparable across agents.

In addition, to show that our estimated semi-structural model, albeit relatively stylized, appropriately captures the properties of the data, we performed an empirical validation exercise comparing the model with a fully empirical benchmark. In particular, we compared the model's in-sample shock decomposition and its impulse responses to shocks (IRFs) to those of a state-of-the-art vector autoregression (VAR) model (Litterman, 1979; Doan et al., 1984; Bańbura et al., 2010; Giannone et al., 2015), estimated using Bayesian techniques[6] on data of Colombia and the US. We use the US data as an empirical proxy for the rest of the world. The similarity across shock decompositions and IRFs suggests that the parsimony of our macroeconomic New Keynesian model does not undermine its ability to adequately capture the empirical properties of the data.

Recent research has made an effort to collect data on economic agents' narratives. For instance, Andre et al. (2021a,b) surveyed households, firms, and economic experts to understand drivers of inflation. They find that experts often mention both demand- and supply-side factors, although their study is limited to a qualitative analysis of shocks on behalf of the survey respondents. Our approach is related to this work, as we aimed to obtain economic agent's narratives; however, our work also al-

[6]VAR was estimated using the BEAR Toolbox.

lows us to quantitatively compare shocks magnitudes. We also identified sources of discrepancy between narratives, the evolution through time of those narratives, and the disagreement regarding the contributions of different shocks in explaining the main macroeconomic variables such as inflation and GDP growth.

Our paper is also related to recent work trying to interpret the drivers of forecasts. For example, Gómez-Pineda (2020) used a univariate filter to gauge the depth and size of the COVID-19 recession by decomposing GDP into forecast's trend and cycle. In contrast, our study employs a general equilibrium model to extract shocks and latent variables from forecasts and compare them across agents and the central bank. Another example is provided by Yoko and Yoshihiko (2013), who constructed a model to decompose the total factor productivity into supply/productivity, demand and other shocks using the gap between the actual production and productive capacity. Nonetheless, they did not exactly extract narratives from projections, as we have done, nor is their model a general equilibrium model as ours.

The remainder of the paper is organised as follows. Section 2 presents a more detailed description of the procedure we used to filter forecasts from economic analysts and the CBC. This section also explains how the high-dimensional information set was organised to summarise the results. Section 3 briefly describes the model, explains its calibration and estimation process, and presents the estimation and comparison with a state-of-the-art VAR. Section 4 includes details of the MES and the CBC's forecast data, and the empirical results are presented in Section 5. Finally, Section 6 concludes the paper.

2 Interpreting Survey Expectations

The aim of our method was to elicit the narratives underlying the forecasts of policy-relevant variables. Specifically, we summarised such narratives by extracting the shocks driving these variables' outlooks. The shocks are the driving forces implied by an economic model ('the interpreter') for the macroeconomic variable forecasts of the public, and were derived by applying Kalman Smoothing techniques. The shocks and their transmission traced via the theoretical model helped us to unravel the implicit narrative underlying the macroeconomic forecasts. The methodological approach of filtering macroeconomic expectations could be considered a reverse engineering approach, because the model is used to interpret forecasts in terms of shocks, contrary to the more standard use of models to produce forecasts.

Notably, the stories are a function of a model selected to explain the economic outlook. Hence, the recovered narratives are not necessarily those that analysts considered, but rather those that conform to a specific, although economically rigorous,

framework. In our case, the interpreter used to unravel stories for the Colombian economy was the canonical SOE New Keynesian semi-structural model of the IMF, proposed by Carabenciov et al. (2008b), which we estimated for the Colombian economy.[7]

We selected this model as the interpreter because it is parsimonious and based on the standard core thinking in macroeconomics. The equations of our model are also embedded as the core economic relationships in the models of most policy institutions and most central banks (e.g. the CBC). In addition, a convenient feature of this model is that it allows for the estimation of relevant latent variables, such as the implicit output gap in each forecast, which is a valuable estimate of the balance between supply and demand shocks.

Furthermore, the fact that it is a semi-structural model and, in particular, that its parameters are not bounded by all the cross-equation restrictions of a fully micro-founded model, allows our parameter estimates enough flexibility to capture empirical relationships in the data. The generality and empirical flexibility of our framework slightly alleviate, although not completely dispel, the concern that our model is not necessarily the one used by analysts when considering the Colombian economy. Further demonstrating the empirical validity of our approach, we highlight that the estimated SOE model displays very similar IRFs and historical shock decompositions to those of a state-of-the-art Bayesian vector autoregression BVAR model for Colombia we estimated.[8] This resemblance suggests that our theoretical model may be a plausible characterisation of how the CBC and professional forecasters think about the Colombian economy.

As mentioned above, we used the model to filter a set of forecasts produced by the CBC and analysts. The latter was collected in the MES, conducted by the CBC. The MES collects forecasts reported by economic research departments of financial institutions participating in the local market.[9] This survey suits our purposes, given that these analysts report a sufficient number of variables to depict a very stylised macroeconomic equilibrium in an SOE: GDP growth, headline inflation, exchange rate, and monetary policy interest rate. These variables are also forecasted, and some published, by the CBC in its Monetary Policy Report. On top of that, MES respondents remain the same, providing a certain level of consistency in examining the market's macroeconomic perspectives and their implicit shocks over time.

Our analysis included a comparison of the narrative of the CBC with those of the analysts, which we performed in two steps. In the first step, the narrative of the CBC in a given release was captured by the shock decompositions of the main macroeconomic variables. We assessed the evolution of its narrative by filtering forecasts made at

[7]Note that we chose a standard New Keynesian model, but any other model could be used to interpret expectations.

[8]Details on the BVAR estimation are found in Section 3.

[9]More specific details about the MES are presented in Section 4.

different moments of the year (consistent with the MES releases and Monetary Policy Report publications), thereby obtaining the evolution of the CBC's macroeconomic narrative over time.

In the second step, we filtered the analyst forecasts through our economic model. This procedure led to a high-dimensional database. The results contained M variables, including the reported and latent variables yielded by the model, K forecast periods, ϑ shocks for each of the N survey respondents plus the CBC. We performed an intertemporal analysis of narratives and expectations and, thus, the information set $\{M, K, \vartheta, N\}$ repeats for Σ releases of the MES.

In should be noted that the mean or median narrative does not correspond to a specific analyst's set of forecasts. Instead, the resulting variables consistent with the median shocks will likely differ across all analysts' projections. To thoroughly assess the dispersion of the macroeconomic perspectives implied by all the forecasts reported in the survey, we compared the CBC to the analysts distributions. Furthermore, limiting the analysis to only the median macroeconomic outlook is especially problematic during the COVID-19 shock, given that uncertainty rose significantly during this period, as documented by Baker et al. (2020). Therefore, we assess market's uncertainty as the cross-section dissent among analysts' point forecasts. We first compared differences in analysts forecasts, both among them and with respect to the CBC. Afterwards, we compute the distributions of the cumulative contributions of each shock to each of the considered endogenous variables in every period.

Unravelling the implicit shocks in the forecasts produced by the CBC and the analysts has at least two benefits. Primarily, we were able to quantitatively compare narratives by comparing shock sizes. It was then possible to pinpoint the sources of disagreement in the market as the different types or magnitudes of the shocks featuring wider distributions. Accordingly, we could assess if all market agents shared the CBC's narrative and how similar their narratives are. Furthermore, the dispersion around the median shock contributions of the market to a given variable provides information about the shocks accounting for markets' uncertainty. This could provide suggestive messages of higher correlation of certain shocks and greater uncertainty, even if this cross-section measure of uncertainty underestimates true market's uncertainty. Finally, we were able to track the evolution of analysts' disagreements over time by assessing the dynamics of the distributions of shocks contributions across the different MES releases.

3 The Interpreter

3.1 Model Structure

As the interpreter of forecasts we used a semi-structural New-Keynesian model for an SOE based on the canonical model of the IMF (Carabenciov et al., 2008a), which features a similar and simpler structure than the CBC's official "4GM" model described in González et al. (2020). This more parsimonious set-up was sufficient to interpret the variables reported in the survey, and was in itself an additional contribution of this study, particularly to the literature on macroeconomic modelling in Colombia.

We divided our model into four blocks, broadly related to the four macroeconomic variables reported in the MES.[10] The first block consists of the IS curve and the potential output, the second consists of a hybrid Phillips curve for headline inflation, the third is an uncovered interest parity (UIP) between local and foreign interest rates, and the fourth describes the monetary policy rule.

IS curve and potential output

The output y_t is defined in terms of a cyclical component $\hat{y}_t$ (output gap) and a trend $\overline{y}_t$ (potential output). Therefore, output is defined as:

$$y_t = \overline{y}_t + \hat{y}_t \tag{1}$$

The annualised potential output growth and quarterly output level can be expressed, respectively, as:

$$\Delta\overline{y}_t = \rho_{\Delta\overline{y}}\Delta\overline{y}_{t-1} + (1-\rho_{\Delta\overline{y}})\Delta\overline{y}_{ss} + \epsilon_t^{\Delta\overline{y}} \tag{2}$$

$$\overline{y}_t = \overline{y}_{t-1} + \frac{\Delta\overline{y}_t}{4} + \epsilon_t^{\overline{y}} \tag{3}$$

Equation (2) describes the law of motion of potential growth, which depends on its past $\Delta\overline{y}_{t-1}$, the long-term growth rate $\Delta\overline{y}_{ss}$, and shocks to potential growth $\epsilon_t^{\Delta\overline{y}}$. Furthermore, equation (3) describes the level of potential output, contemplating an additional shock to the potential output level $\epsilon_t^{\overline{y}}$ that captures permanent effects on potential output. The latter is particularly relevant in times of crisis, when productive capacity might have a secular downfall. Henceforth, these two shocks will be referred to as supply shocks.

[10] The reported variables are GDP growth, annual inflation, monetary policy interest rate and exchange rate.

The cyclical component is modelled through an IS curve:

$$\hat{y}_t = \beta_1 \hat{y}_{t-1} - \beta_2 MCI_t + \beta_3 \hat{y}_t^* + \epsilon_t^{\hat{y}_t} \tag{4}$$

The output gap $\hat{y}_t$ is allowed to display inertia, captured by $\hat{y}_{t-1}$, and depends on a demand shock $\epsilon_t^{\hat{y}_t}$. It is also a function of the foreign output gap $\hat{y}_t^*$, that captures the dynamic of foreign demand, and of a real monetary condition index MCI_t. The MCI_t captures changes in the business cycle derived from both, the real interest rate gap $\hat{r}_t$, and the real exchange rate gap $\hat{z}_t$, according to the following equation:

$$MCI_t = \beta_4 \hat{r}_t + (1 - \beta_4)(-\hat{z}_t) \tag{5}$$

The real interest rate gap measures the effects of monetary policy on aggregate demand, while the real exchange rate gap captures the expenditure switching effects as a consequence of changes in the real exchange rate.

The output gap reflects the dynamic of the aggregate demand and it is an indicator of the business cycle. A negative gap indicates economic slack, while a positive one signals an overheating economy. Notably, when taken together, equations 1 and 4 imply that the output gap summarises the net balance between supply and demand shocks.

Hybrid Phillips curve

The short-term aggregate supply is modelled through a New Keynesian Phillips curve that links the inflation rate with the real marginal cost:

$$\pi_t = \alpha_1 \pi_{t-1} + (1 - \alpha_1)\mathbb{E}_t \pi_{t+1} + \alpha_2 RMC_t + \epsilon_t^{\pi}\,, \tag{6}$$

$$RMC_t = \alpha_3 \hat{y}_t + (1 - \alpha_3)\hat{z}_t\,. \tag{7}$$

The annualised quarterly inflation π_t depends on its lag π_{t-1}, expected inflation $E_t \pi_{t+1}$, the real marginal cost RMC_t, and a cost-push shock ϵ_t^{π}. The real marginal cost responds positively to the output gap and real exchange rate gap.

Determination of the Nominal and Real Exchange Rates

Nominal depreciation is modelled using the UIP condition:

$$\Delta s_t = (i_t^* - i_t + prem)\frac{1}{4} + \varepsilon_t^{ls} \tag{8}$$

where Δs_t is the nominal depreciation, i_t^* is the FED funds rate, i_t is the monetary policy interest rate, *prem* is a constant risk premium, and ε_t^{ls} is an idiosyncratic shock to the UIP condition.

Regarding the real exchange rate z_t one can identify a trend $\overline{z}_t$ and a cyclical component $\hat{z}_t$ following:

$$z_t = \overline{z}_t + \hat{z}_t \tag{9}$$

$$\Delta\overline{z}_t = \rho_{\Delta\bar{z}}\Delta\overline{z}_{t-1} + (1-\rho_{\Delta\bar{z}})\Delta\overline{z}_{ss} + \epsilon_t^{\Delta\overline{z}} \tag{10}$$

Finally, the nominal and real depreciation are related through:

$$\Delta z_t = \Delta s_t + \pi_t^* - \pi_t \tag{11}$$

Monetary Policy Rule and Interest Rates

The monetary policy rate depends on its lag i_{t-1}, the neutral nominal interest rate $\bar{i}_t$, the output gap, the one year ahead deviation of annual inflation expectations from its target $E_t\pi^A_{t+4} - E_t\overline{\pi}^A_{t+4}$, and a monetary policy shock ϵ_t^i. The parameter ρ_i is the smoothing coefficient, and ψ_π and $\psi_{\hat{y}}$ are the weights of the deviation of inflation expectations and of the output gap, respectively, on the monetary policy rate:

$$i_t = \rho_i i_{t-1} + (1-\rho_i)\left[\bar{i}_t + \psi_\pi(E_t\pi^A_{t+4} - E_t\overline{\pi}^A_{t+4}) + \psi_{\hat{y}}\ \hat{y}_t\right] + \epsilon_t^i\,. \tag{12}$$

The neutral nominal interest rate is defined by Fisher equation $\bar{i}_t = \overline{r} + 4 * E_t\pi_{t+1}$, where $\overline{r}$ is the neutral real interest rate and $E_t\pi_{t+1}$ are the inflation expectations one quarter ahead. Therefore, the long-run depreciation will be constant and provided by $\Delta\overline{z} = \overline{r} - \overline{r}^* + prem$, where $\overline{r}^*$ and $\Delta\overline{z}$ are the US neutral real interest rate, and the depreciation of the real exchange rate trend, respectively.

Foreign variables

The rest of the world is considered in the model through four macroeconomic US variables. These variables follow the exogenous processes below:

$$\hat{y}_t^\star = \rho_{\hat{y}^\star}\hat{y}^\star_{t-1} + \epsilon_t^{\hat{y}^\star} \tag{13}$$
$$\pi_t^\star = \rho_{\pi^\star}\pi^\star_{t-1} + (1-\rho_{\pi^\star})\overline{\pi}^\star + \epsilon_t^{\pi^\star} \tag{14}$$
$$i_t^\star = \rho_{i^\star}i^\star_{t-1} + (1-\rho_{i^\star})(\overline{r}^\star + 4 * E_t\pi^\star_{t+1}) + \epsilon_t^{i^\star} \tag{15}$$
$$r_t^\star = i_t^\star - 4 * E_t\pi^\star_{t+1} \tag{16}$$

where $\pi_t^\star$ is the US CPI headline inflation and $r_t^\star$ is the ex-post real interest rate.

3.2 Estimation

We adapted the model to the data following a two-step procedure. First, we calibrated the parameters describing the model's long-term equilibrium, the Taylor Rule coefficients, and the persistence coefficients of the AR(1) exogenous processes. This decision was made considering there is an official semi-structural model of the CBC described in González et al. (2020), which is common knowledge for the sample of analysts in our study. While that model has greater complexity, its core features are similar to our model because both are based on Carabenciov et al. (2008b). Accordingly, the set of parameters mentioned above should not be altered with the model's structure. For instance, the steady state of the inflation target or of the GDP growth are publicly and actively disclosed by the CBC. Similarly, the official model of the CBC also broadcasts the view of the CBC's technical staff on what could be the reasonable systematic monetary policy response to headline inflation and output gap in Colombia.

Despite these similarities between our model and that of the CBC, some relevant differences exist, which led to the second step followed to set the values of the remaining parameters. We estimated the coefficients of the IS and hybrid Phillips curves, as well as the standard deviations of the exogenous variables. It was necessary to estimate these parameters because the official model of the CBC does not have one equation for headline inflation, but rather several different equations for its sub-components, and it also features a different, richer structure of exogenous shocks than our model.

Specifically, we applied a Bayesian approach to estimate our model for this second group of parameters. For the estimation, we used quarterly data from 2003Q1 to 2019Q4 of GDP (constant prices, chained and seasonally adjusted), headline CPI, monetary policy rate, inflation target, nominal exchange rate (USD-COP), FED funds rate, US headline CPI, and an estimation of the US output gap. The last variable was calculated off-model using a Hodrick-Prescott filter (lambda = 1600) on the US GDP level (constant prices, chained and seasonally adjusted). Table 2 in Appendix 7.1 summarises the obtained posterior modes, as well as the prior distributions, means, and standard deviations used for the set of estimated parameters. These estimation results are broadly in line with those obtained by Carabenciov et al. (2008a), Andrle et al. (2013), and Charry et al. (2014).[11] The Appendix also provides graphs depicting the prior distribution and posterior mode for each estimated parameter, to more clearly

[11] In the estimation, we addressed the identification problem between potential output level and potential output growth shocks by using the former only during volatile periods. We defined 2008Q2-2008Q4 as volatile periods. Only the standard deviation for the potential output growth shock was estimated because there were too few volatile episodes to properly estimate shock to the potential output level. The standard deviation of the shock to potential output level was calibrated before the Bayesian estimation, such that the share of its standard deviation relative to the sum of the standard deviations of both shocks to potential output was inside the 0.175-0.75 range proposed by Gómez-Pineda (2020). Given that this estimation might change the initial calibration, the process needed to be repeated until it converged. We obtained a 0.2407 value that fitted inside the reference range.

present how informative both the data and the priors were.

3.3 Historical comparison to Bayesian VAR

The model used to interpret analysts' expectations features a very stylised macroeconomic structure to describe an SOE like Colombia. Although this structure stems from the standard core thinking in macroeconomics, it still imposes some restrictions on the data. These restrictions facilitate the translation of forecasts into economic narratives, given that they allow for interpretations of the exogenous forces driving the economy. However, some doubt may remain on the ability of the model equations to provide an appropriate empirical description of the Colombian economy. Thus, there is a trade-off between economic tractability and the weight of raw data on the results.

In this section, we compare our semi-structural model's empirical validity to a two-country BVAR for the US and Colombia estimated using the BEAR toolbox of Dieppe et al. (2016). After estimating the BVAR, we used a few, rather standard zero and sign restrictions to identify a set of shocks that is, in principle, broadly comparable to the shocks in the semi-structural model described above. These restrictions are summarised in Table 3 of Appendix 7.2. We compared the historical shock decompositions of GDP and inflation in Colombia from the BVAR and the semi-structural model to check if the less restrictive BVAR representation of the economy provides similar results to those of our theoretical model; if that were the case, it would suggest that the theoretical restrictions embedded in our model do not undermine its ability to explain the data.[12]

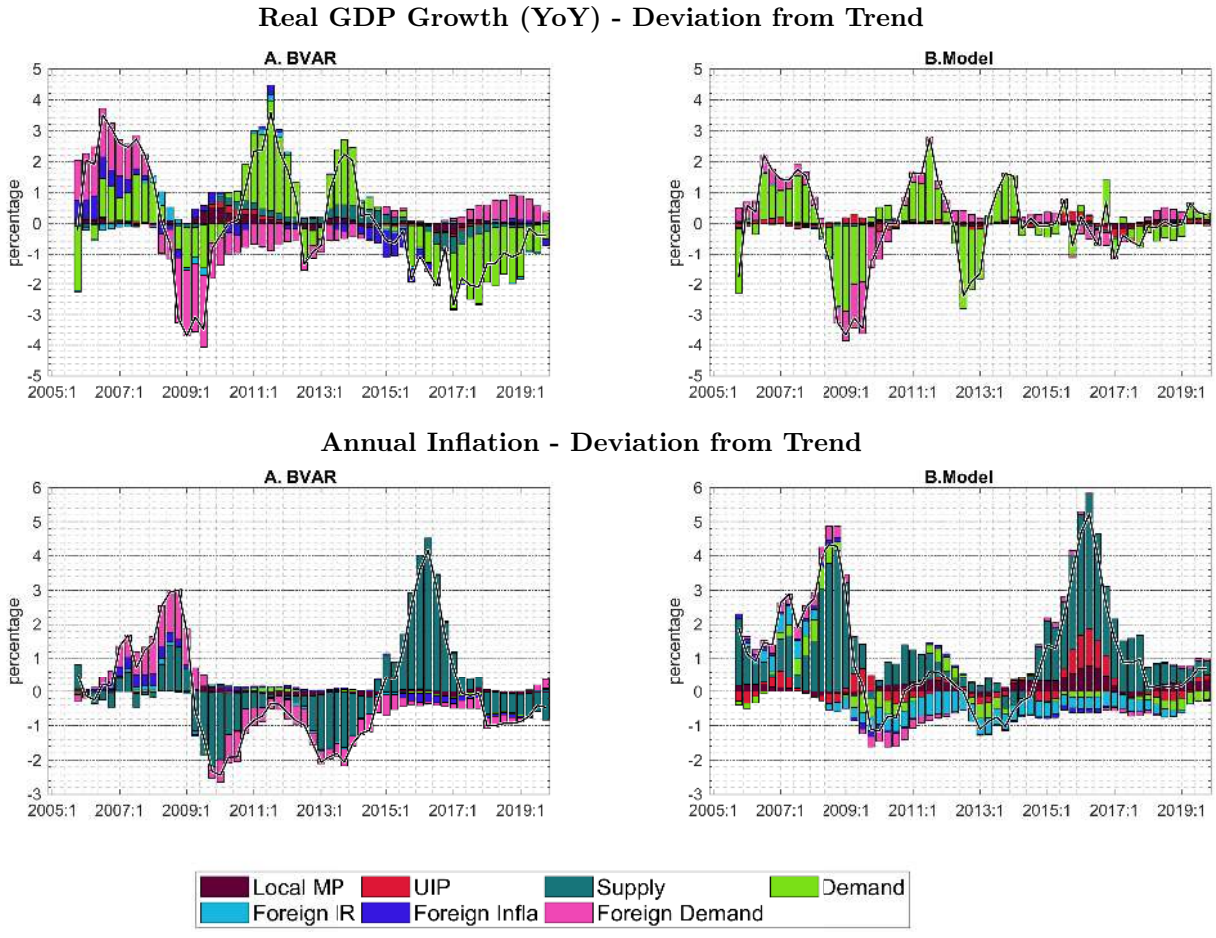
More specifically, we estimated the BVAR using US variables (FED Funds Rate, CPI, and GDP) and Colombian variables (Nominal Interest Rate, Nominal Exchange Rate (USD-COP), CPI, and GDP). We assumed block exogeneity to reflect the fact that Colombia is an SOE and its country-specific economic dynamics do not affect those of the US. We conducted the estimation with the same sample used for the semi-structural model: 2003Q3-2019Q4 with quarterly data. The estimation suffered from the curse of dimensionality since the sample was not very large and the BVAR included seven variables with five lags and admitting constants for each one. We addressed that issue using Bayesian shrinkage, as suggested in Bańbura et al. (2010). In particular, inspired by Litterman (1979), Doan et al. (1984), Kadiyala and Karlsson (1997), Giannone et al. (2017), Doan et al. (1984), Sims (1996), Sims (2000), Sims and Zha (1998), and Giannone et al. (2015) the prior distributions were taken from the Independent Normal-Wishart family, and we shrunk the coefficients on the BVAR lags towards those of the Random Walk model. As is customary, we also shrunk more the coefficients of

[12] We also compare the IRFs of both models but omitted those in the paper for brevity. However, they lead to the same conclusions as the historical decompositions.

more distant lags. The block exogeneity restrictions, according to which the lags of Colombian variables do not influence the US variables, were enforced by very strongly shrinking towards zero the coefficients of the Colombian variables lags in the US variable equations.[13] The hyperparameters of the estimation were set to the standard values from the literature just referenced, as shown in Table 4 of Appendix 7.2.

This state-of-the-art BVAR serves as a credible empirical benchmark for the semi-structural model for several reasons. First, it admits more general linear relationships among observed variables than the model. Second, the BVAR is estimated in levels to allow for potential common trends, in sharp contrast to the semi-structural model. Third, the block exogeneity for US variables in the BVAR is an imposition on the data, but a less stringent one than the assumed orthogonality in the model among these foreign variables. Fourth, the BVAR considers a large number of lags, which can capture correlations among variables further apart in time.

Figure 1: Historical Shock Decompositions: BVAR Versus the Model



[13] We then also put zero contemporaneous restrictions on US variables when we identified the Colombian shocks.

The comparison between the BVAR and the model is presented in Figure 1. Notably, the graphs show that, by and large, the stories regarding economic activity and prices were the same in the period considered. Foreign and local demand regularly explained the booms and busts in GDP, while supply shocks had a markedly predominant role in inflation. The BVAR features different trend components than the semi-structural model, explaining why cyclical annual inflation never reached the negative values of the BVAR, and cyclical real GDP growth was more volatile in the BVAR. Nonetheless, the qualitative behaviour and, more importantly, the main drivers explaining it, appear to be similar between models.

Although the semi-structural model tends to assign a smaller share of volatility to foreign shocks, this is a predictable result, given the assumption of orthogonality among them, and is in line with what Justiniano and Preston (2010) have documented. Finally, a very relevant by-product of this empirical validation is in itself the BVAR for the Colombian economy, which is, to our knowledge, the only VAR for this country with the state-of-the-art features we considered. It can surely be easily replicated going forward and employed as a useful benchmark for future macroeconomic empirical work in Colombia.

4 Forecast Data

This section provides specific information on the survey used to collect expectations of professional forecasters and the data of the CBC's forecasts to be interpreted using the model. For each quarter analysed, the data fed to the model included eight quarters of forecasts plus the historical data that is common for the CBC and all the professional forecasters, although the sources for their forecasts differ, as explained below.

For professional forecasters, the main source is the MES, which was designed by the CBC and surveys the research departments of financial institutions participating in the local market and economic research centres regarding their real GDP growth, headline inflation, nominal exchange rate, and monetary policy interest rate forecasts for a given horizon. Despite the frequency of the MES, the researchers report their real GDP growth forecast only at the end of each quarter. Therefore, the forecast set is complete only in the surveys conducted during the first month after each quarter ends. Thus, we selected these months for the analysis.

As explained in Section 3.1, the SOE model considered the US as a proxy for the rest of the world, but the MES does not ask analysts to report their forecasts for foreign variables. However, these are an important source of information for the model and need to be included to better identify the sources explaining the macroeconomic forecasts collected in the MES. Therefore, we assumed that the consensus of the daily

reported Bloomberg survey is common information for all professional forecasters.[14]

Regarding the main source of information on the CBC's projections, we used the Monetary Policy Reports published in the same months as the related MES releases.[15] However, to maintain the same data set between the CBC and the analysts (i.e. enter the same set of variable forecasts into the model), we used some non-public data on CBC projections. Table 5 in Appendix 7.3 outlines the information sources used for the forecasts of the analysts and the CBC.

To conduct a proper intertemporal analysis of the market's macroeconomic outlook and a proper general equilibrium assessment, we constructed a balanced panel in relation to analyst and release dimensions. This type of panel is desirable for two reasons. First, to conduct a general equilibrium analysis, it is necessary to have the complete set of variables that describe said equilibrium for an SOE. Therefore, to allow the model to properly identify the shocks behind a given forecast, we only considered analysts that fully reported the set of four domestic macroeconomic variables collected by the MES. Second, to perform a proper intertemporal analysis of the market's macroeconomic outlook it is necessary to keep the respondent sample constant. This prevents variations in macroeconomic outlooks between releases caused by new analysts being surveyed or old analysts that do not report all (or any) forecasts in a given release.

However, owing to attrition, we cannot maintain a constant set of analysts that report all variables for all the survey releases in the present sample (April 2020–January 2022). To address this issue, we divided the set of releases in two windows: the pandemic spanning from April 2020 to January 2021, and post-pandemic episode, assessing the evolution of expectations from April 2021 to January 2022. In each window, the set of analysts remains the same. The first window includes 22 analysts while the second includes 19 of them. Both windows include the CBC.

Given that we used the Kalman smoother, once data for 2020Q1 and beyond was included in the set of observable data, the output gap history changed radically, due to high volatility during the pandemic. The same was true for the foreign output gap estimated by the Hodrick-Prescott filter. To avoid a dramatic change in the historical estimations of these variables as the forecast horizon expanded, we conditioned the output gap to the values the model estimated with information up to 2019Q4. This implies that the historical data from the professional forecasters and the CBC also included the output gaps until the last quarter of 2019. Specifically, the same local and foreign output gap series (2003Q1–2019Q4) estimated by the model prior to the first MES release considered (April 20) were observed in every survey. Nonetheless, we

[14]We used the consensus forecasts reported in Bloomberg at the beginning of the month to assure that this external information could have been used to generate the forecasts of the MES.

[15]The MES is collected around the 10th of each month and the Monetary Policy Report is published approximately 20 days later. However, the latter projections are produced with data available up to the 15th.

updated the estimation of the output gaps using only the 2003Q1–2019Q4 sample with every GDP release, because historical economic activity data is frequently revised by Colombia's National Statistical Department.

5 Macroeconomic Narratives

In this section, we discuss our analysis of nine MES releases and break down the analysis into two parts. The first part examines the macroeconomic narratives implicit in the forecasts of the CBC and analysts as the COVID-19 pandemic unfolded throughout 2020 and the general public acquired more information about the sanitary and economic consequences of the virus. The second part explores macroeconomic stories of the CBC and professional forecasters during what we call the post-pandemic episode (2021–2022).

Both sections focus on the key takeaways of the analysis performed because, as stressed in Section 2, our procedure yielded a high-dimensional database containing copious information. Thus, the results are wide-ranging and can be far more comprehensive than what is shown here.[16] The output selected here is sufficient to depict a broad landscape of the macroeconomic stories conveyed in the MES releases and Monetary Policy Reports, as well as the disagreements about them among analysts and the CBC. It also allows keeping track of the evolution of these two dimensions of the analysis along the survey releases considered.

The analysis presented in this section first focuses on a discussion of the forecasts of inflation and GDP growth between the analysts and the CBC. Then, in the second step, we compare the underlying narratives in terms of shocks.

5.1 The Pandemic

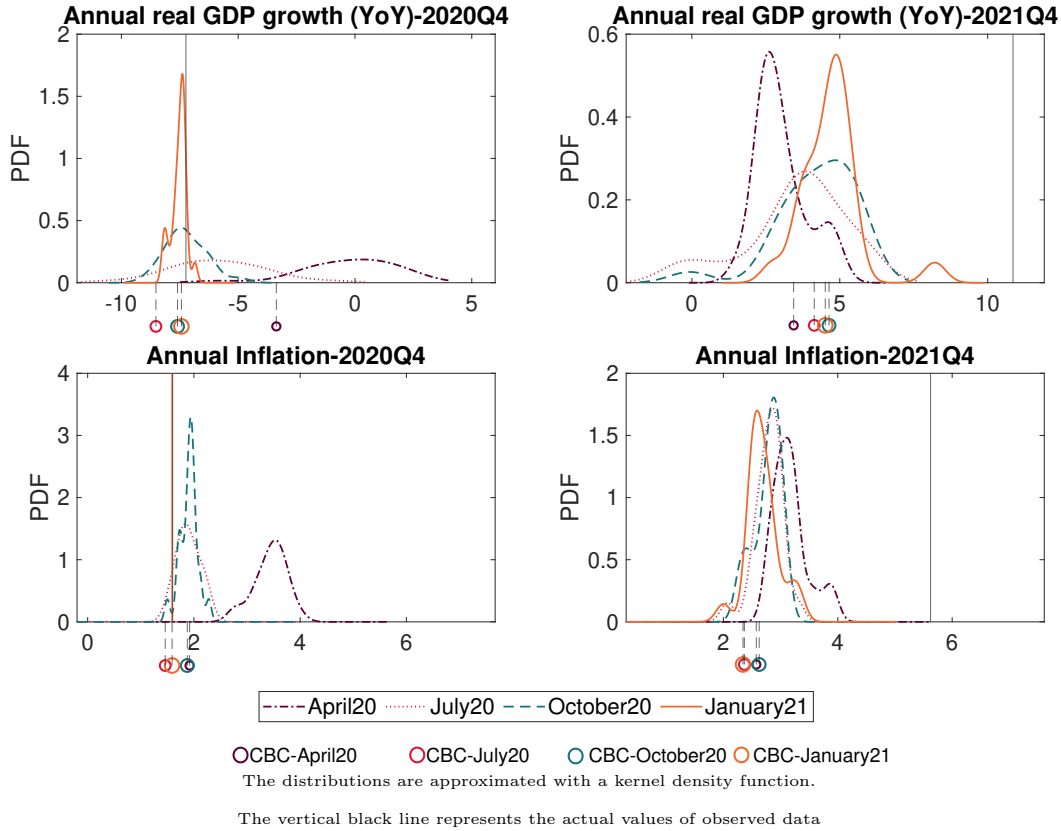
In Colombia, the first nationwide quarantine to slow the spread of the COVID-19 pandemic was declared near the end of 2020Q1. Consequently, the forecasts published in the January 20 Monetary Policy Report could not reflect the onset of the pandemic, and the CBC was not to distinctly change its macroeconomic outlook until April 2020.[17] The new macroeconomic view considered a dramatic fall into negative values of GDP growth projections for 2020, along with a modest fall in headline inflation. Initially, the CBC considered this recession to be driven by a shock to potential GDP and greater weakening of aggregate demand.

[16] For a full, more detailed account of the forecast narratives of the CBC and analysts, please refer to Appendix 7.4.

[17] Because the narratives in January20 are very different from the rest of the 2020, they are omitted for brevity. The details of the outbreak can be found in Appendix 7.4.

Throughout 2020, the CBC produced forecasts that qualitatively reaffirmed the view it adopted in the April20 release, even when it was clear that the magnitude of the recession had been underestimated. Figure 2 shows that professional forecasters as a group behaved similarly to the CBC, regardless of the great uncertainty in both GDP and inflation projections caused by the pandemic. Moreover, Figure 2 uncovers that the CBC was an early mover in 2020, considering that analysts' distributions gradually moved towards the point forecasts of the CBC. Disagreement among professional forecasters about the size of the GDP decline was greater in the first two releases, when the mean was far from that of the CBC, than in the last two, when it was closer. Notably, this early-mover pattern of the CBC also holds for the 2021 GDP forecasts, albeit less strongly, as well as for inflation in 2020, to a large extent.

Figure 2: Forecast Distributions for the CBC and Analysts



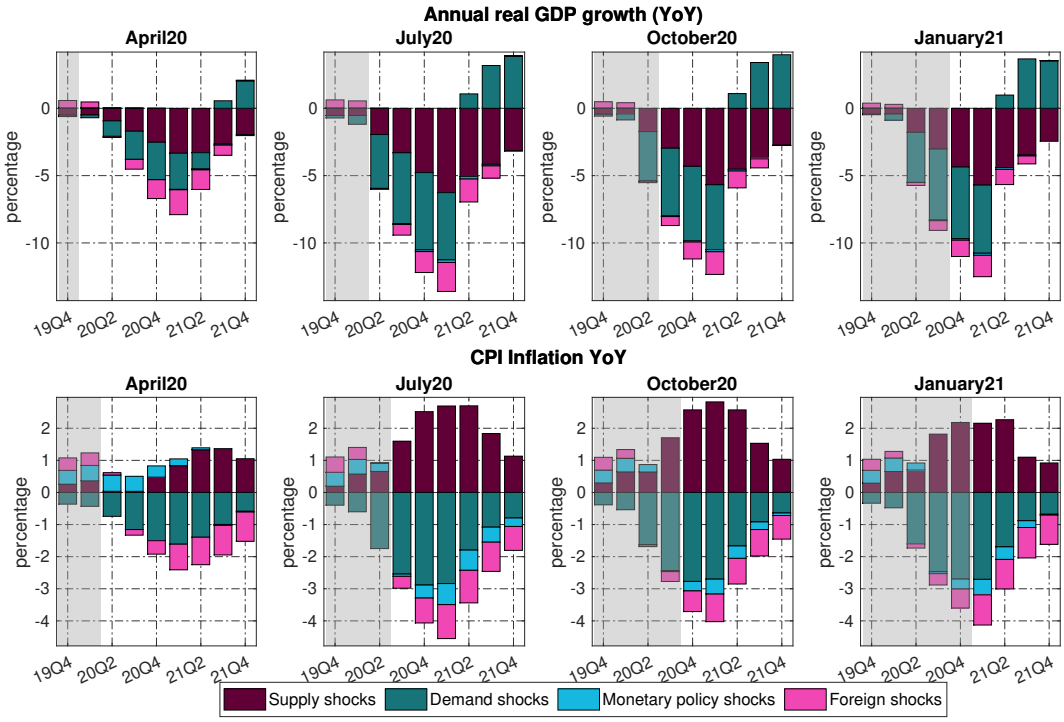
The distributions are approximated with a kernel density function.

The vertical black line represents the actual values of observed data

The analysts' forecasts differed considerably from those of the CBC at the outbreak of the pandemic, but ultimately clustered around the CBC's forecasts. Thus, the CBC's macroeconomic narrative behind their forecasts provides a general overview of the predominant account of the events of 2020. Figure 3 presents the shock decomposition for each of the CBC's forecasts. Qualitatively, the narrative of the CBC was always that the pandemic entailed contractionary demand shocks in 2020, but that this

shock would quickly bounce back in 2021 and be the only factor aiding the recovery. Quantitatively, the absolute value of demand shocks became larger over the course of the year, as the dimension of the crisis was gradually better assessed. Similarly, after the July20 release, potential GDP shocks were expected to be even more negative and persistent than in April20, weighing down GDP growth throughout 2020 and 2021. The absolute value of demand shocks being larger than that of supply shocks implies that the output gap had a negative variation in 2020, reflecting greater excess capacity in the economy compared to 2019.

Figure 3: Shock Decompositions of CBC's forecasts for 2020–2021



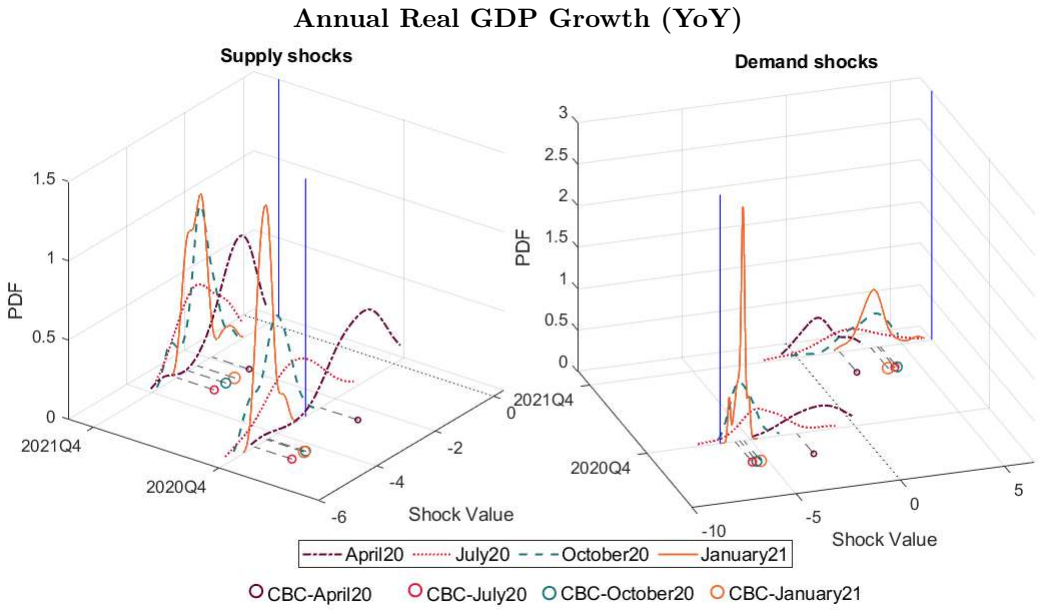
Reported values in the shock decompositions are deviations from their steady state.

Shaded areas indicate periods already observed in a given survey release.

Regarding inflation, the narratives of all CBC's forecasts suggested that, despite the positive demand shocks expected in 2021, the cumulative effects of a weak demand since 2020 would continue to create disinflationary pressures in 2021. As an opposing effect, the CBC also considered that adverse cost-push shocks would place positive pressures on inflation that were strong enough to partially counter local and foreign demand shocks and avoid inflation falling patently below 2%.

In its forecasts, the CBC exhibited the key aspects of the central macroeconomic narrrative about the pandemic. However, the disagreement surrounding the expected

Figure 4: Distributions of the CBC's Shocks Versus Analysts' Shocks



Shock value: Cumulative contribution of each shock to the deviation of the variable from its steady state

The vertical blue line represents the model's interpretation of the actual values of observed data.

path for the Colombian economy necessitates an examination of the shocks explaining said dissent. As shown above, dissent was particularly prevalent regarding GDP. To summarise the professional forecasters' narratives on real activity, Figure 4 plots the distributions of shocks driving GDP growth. Most importantly, the CBC's early-mover behaviour can be observed in the distributions for both supply and demand shocks in 2020 and 2021, given that the CBC forecasts values lied at the tails of the analysts shock distributions in the first two releases.

Then, these distributions modes grew closer each quarter to the CBC's projections and clustered around them. Remarkably, the pattern is even stronger than in GDP forecasts, highlighting the gains of the general equilibrium assessment enabled by our approach. Finally, it is also relevant to note that, with respect to the model's interpretation of actual data, for 2021, neither the CBC nor the analysts anticipated that supply would contribute positively to GDP growth nor the vigorous demand recovery that was eventually observed.

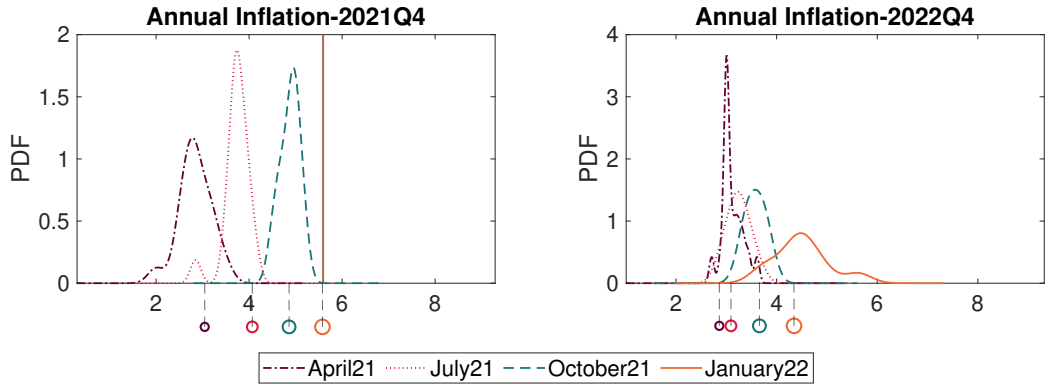
5.2 The Post-Pandemic Episode

Coming out of the pandemic-induced recession brought forecasting challenges for the CBC and analysts in some key aspects of their macroeconomic outlooks. In the previ-

ous analysis window, it became evident that they were all expecting strong economic recovery, but not as strong as it actually was. However, during this episode the positive inflation surprises caught analysts and the CBC off guard and forced them to revisit their macroeconomic stories.

The spike in inflation was both a global and local phenomenon. From the start of 2021, adverse cost-push shocks hit the economy at the expense of forecast accuracy, as a backlash of the pandemic. While the world suffered the burdens of global supply chain disruptions, goods shortages, and oil price increases, Colombia experienced a national strike in the second quarter of 2021 that engendered an upward inflation spiral for food prices that persisted for the remainder of the year.

Figure 5: Distributions of the Forecasts of the CBC and Analysts



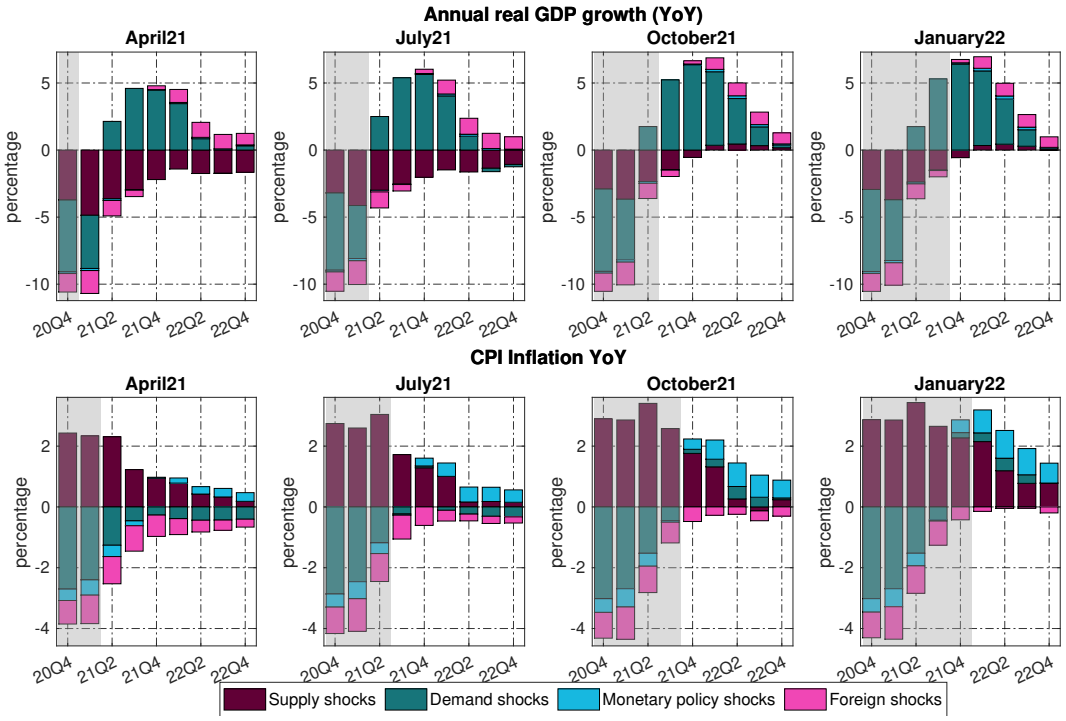
The distributions are approximated with a kernel density function.
The vertical black line represents the actual values of observed data

Figure 5 shows how inflation consistently surprised both the CBC and the analysts. During the post-pandemic episode, the CBC did not act as an early mover in inflation forecasts as it did for GDP growth during the pandemic. Additionally, in 2021, uncertainty decreased with each new release, indicating that the risks that materialised did not offset the marginal gains of information on realised inflation in each quarter. Strikingly, 2022 inflation forecasts in January22 did not consider a return of inflation to its 3% long-term target, showing that the market agreed that the inflationary shocks in 2021 were to persist. Besides, in the January22 release, the inflation expectations distribution shifted to the right, in line with the high inflation observed in 2021Q4, which surprised all the agents considered in this study. Although disagreement about inflation in 2022 increased across releases, the amplification in the last release might be related to uncertainty about inflation indexation, given the rise of inflation observed the entire year. A case in point was the historically unprecedented minimum wage adjustment decreed by the national government.

Consistent with its conservative behaviour revising its inflation forecasts across

releases, the CBC, in general, was never at the tail of the market distribution but rather close to the market's means. Then, assessing the narrative behind its forecasts serves as a benchmark for the analysts' general macroeconomic overview. As Figure 6 shows, to a large extent the CBC maintained the recovery narrative for GDP growth it told in the previous window releases. However, the systematically better outcomes across the 2021 releases generated growing optimism about supply shocks (i.e. potential GDP) and prolonged up to 2022 the view of demand as a growth booster.

Figure 6: Shock Decompositions of CBC's forecasts for 2021–2022



Reported values in the shock decompositions are deviations from their steady state.

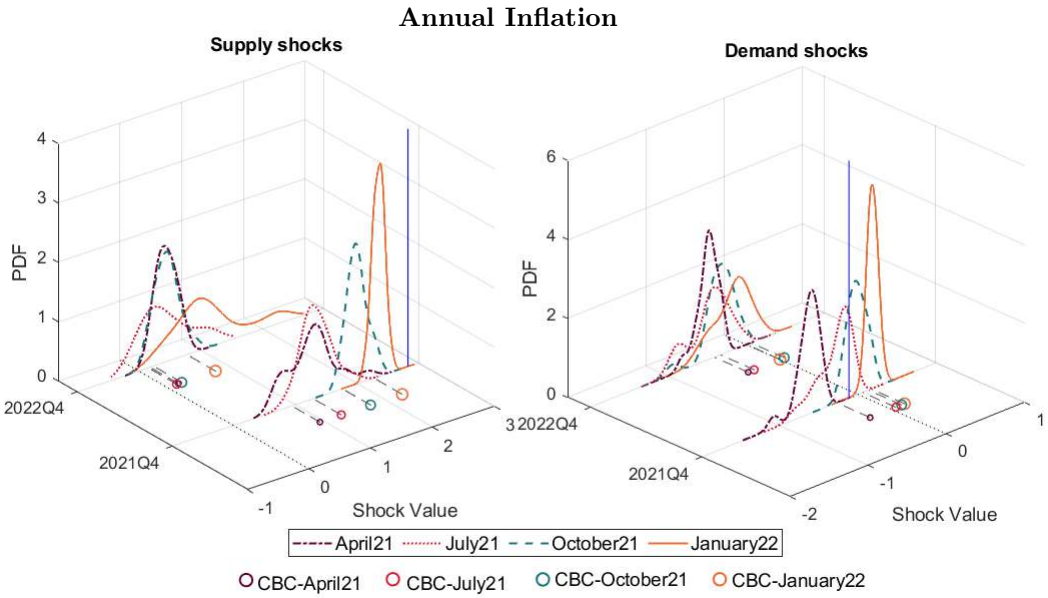
Shaded areas indicate periods already observed in a given survey release.

Contrary to the continuity in the GDP narrative, the forecasts for annual headline inflation for 2021 experienced qualitative and quantitative revisions across releases. As mentioned above, during the evolution of the pandemic, the CBC and professional forecasters expected low inflation rates for 2021. Despite the adverse cost-push shocks, inflation was expected to remain relatively low, first because of the negative downturn in demand during the pandemic, and second because of foreign and monetary policy disinflationary shocks. Post-pandemic, this changed drastically, as demand gradually stopped weighing down inflation, and the January22 release indicates that expansionary monetary policy shocks started pushing inflation upwards for the last quarter of 2021. For instance, in April21, the CBC expected demand to be a disinflationary pressure along the entire forecast horizon, whereas in October21 it already attributed a very small negative share to demand by the end of 2021 and believed that demand would

create inflationary pressure in 2022.

Figure 7 shows another dimension of the comparisons in inflation that is very relevant during the post-pandemic episode. It follows from those graphs that disagreement, both among analysts and with respect to the CBC, was more prominent in supply shocks than in demand shocks. The CBC incrementally updated its view on the size of cost-push shocks in 2021, with the risks materialising on the supply-side of inflation. However, the CBC did not change its view on the persistence of the shocks as much as the magnitude of the surprises it was observing. This helps explain why the CBC did not revise its 2022 inflation forecasts in the same magnitude as it increased the 2021 forecasts: it considered these higher costs as rather transitory. Nonetheless, in the January22 release, the disagreement among professional forecasters regarding the persistence of cost-push shocks increased.

Figure 7: Distributions of the CBC's Shocks Versus Analysts' Shocks



Shock value: Cumulative contribution of each shock to the deviation of the variable from its steady state.
The vertical blue line represents the model's interpretation of the actual values of observed data.

Finally, just as the CBC did not remain relatively anchored around a given value for supply shocks, neither did the professional forecasters.[18] Despite the noticeable shift to the right of the distributions of October21 and January22, the size of cost-push shocks interpreted by the model from the observed data was still higher, which indicates the

[18]In contrast, the CBC adopted a very stable view on demand shocks for 2021 following the July21 release, even when several professional forecasters were to the left of it (i.e. perceived more disinflationary pressures on the demand-side). This view was quite close to the model's interpretation of the observed data.

unusual magnitude of these surprises. In a way, this raised an important alert about inflation in 2022 and the large risks surrounding it.

6 Conclusion

Central banks explicitly communicate narratives explaining their macroeconomic outlooks, because narratives are an important determinant of agents' expectations and, therefore, of economic fluctuations. However, surveys conducted with economic agents usually assess observable variables without requesting the stories driving those expectations. By interpreting macroeconomic forecasts through a model, we elicited narratives in terms of a comparable measure, namely, shocks hitting the Colombian economy (e.g. demand, supply, monetary policy), across professional forecasters and the Central Bank of Colombia (CBC) between 2020-2022. To our best knowledge this is the first work to translate forecasts made by economic agents into narratives and compared them to those of a central bank.

Narratives throughout 2020 and 2021 were qualitatively similar between professional forecasters and the CBC, inasmuch as they agreed demand shocks were the main driver of the recession during the pandemic and the subsequent recovery, while supply and foreign demand would continue to weigh down output growth. Forecasts for 2021 were driven by expectations of a demand recovery and adverse cost-push shocks generating inflationary pressures, which were perceived as more persistent during 2021, to the extent that they were expected to last through 2022. Despite broad consensus regarding the central narrative among professional forecasters, dissent was observed in relation to shock magnitudes, which was higher at the beginning of the pandemic. Moreover, the CBC appeared to be an early mover, considering that it decreased its inflation forecast and assessment of excess capacity (output gap) before the market did in 2020.

Another reason why our study, and the method we developed, may be relevant for policy-makers is that a central bank's policy reaction should consider the different nature of the shocks characterising the economic outlook and the uncertainty about such assessment. Furthermore, with a larger sample of surveys than that to which we had access, it would also be possible to examine whether certain regularities appear, such as whether higher uncertainty is associated with the presence of specific shocks. Additionally, to improve the analysis of market's uncertainty, future research might attempt to gather each agent's predictive densities and use these instead of point forecasts.

References

Aastveit, K. A., Natvik, G. J., and Sola, S. (2017). Economic uncertainty and the influence of monetary policy. *Journal of International Money and Finance*, 76:50–67.

Alessandri, P. and Mumtaz, H. (2019). Financial regimes and uncertainty shocks. *Journal of Monetary Economics*, 101:31–46.

Andre, P., Haaland, I., Roth, C., and Wohlfart, J. (2021a). Inflation narratives. *CEPR Discussion Paper*, (DP16758).

Andre, P., Haaland, I., Roth, C., and Wohlfart, J. (2021b). Narratives about the Macroeconomy. ECONtribute Discussion Papers Series 127, University of Bonn and University of Cologne, Germany.

Andrle, M., Berg, A., Morales, R., Portillo, R., and Vlcek, J. (2013). Forecasting and monetary policy analysis in low-income countries: Food and non-food inflation in Kenya. *IMF Working Paper*, 13(61).

Baker, S., Bloom, N., Davis, S., and Terry, S. (2020). Covid-induced economic uncertainty. *IMF Working Paper*.

Bańbura, M., Giannone, D., and Reichlin, L. (2010). Large Bayesian vector auto regressions. *Journal of Applied Econometrics*, 25(1):71–92.

Basu, S. and Bundick, B. (2017). Uncertainty shocks in a model of effective demand. *Econometrica*, 85(3):937–958.

Batchelor, R. (2009). How robust are quantified survey data?: Evidence from the United States. In *Inflation Expectations*, pages 26–51. Routledge.

Bekaert, G., Hoerova, M., and Duca, M. L. (2013). Risk, uncertainty and monetary policy. *Journal of Monetary Economics*, 60(7):771–788.

Blinder, A. S., Ehrmann, M., Fratzscher, M., De Haan, J., and Jansen, D.-J. (2008). Central bank communication and monetary policy: A survey of theory and evidence. *Journal of Economic Literature*, 46(4):910–945.

Bloom, N., Floetotto, M., Jaimovich, N., Saporta-Eksten, I., and Terry, S. J. (2018). Really uncertain business cycles. *Econometrica*, 86(3):1031–1065.

Carabenciov, I., Ermolaev, I., Freedman, C., Juillard, M., Kamenik, O., Korshunov, D., Laxton, D., and Laxton, J. (2008a). A small multi-country global projection model. *IMF Working Paper*, 8(279).

Carabenciov, I., Ermolaev, I., Freedman, C., Juillard, M., Kamenik, O., Korsunmov, D., Laxton, D., and Laxton, J. (2008b). A small multi-country global projection model with financial-real linkages and oil prices. Technical report, IMF Working Paper.

Carrière-Swallow, Y. and Céspedes, L. F. (2013). The impact of uncertainty shocks in emerging economies. *Journal of International Economics*, 90(2):316–325.

Castelnuovo, E., Lim, G., and Pellegrino, G. (2017). A short review of the recent literature on uncertainty. *Australian Economic Review*, 50(1):68–78.

Charry, L., Gupta, P., and Thakoor, V. (2014). Introducing a semi-structural macroeconomic model for Rwanda. *IMF Working Paper*, 14(159).

Clarida, R., Gali, J., and Gertler, M. (1999). The science of monetary policy: a new Keynesian perspective. *Journal of economic literature*, 37(4):1661–1707.

Coibion, O., Gorodnichenko, Y., and Kamdar, R. (2018). The formation of expectations, inflation, and the Phillips curve. *Journal of Economic Literature*, 56(4):1447–1491.

Coibion, O., Gorodnichenko, Y., Kumar, S., and Pedemonte, M. (2020). Inflation expectations as a policy tool? *Journal of International Economics*, 124:103297.

Coibion, O., Gorodnichenko, Y., and Weber, M. (2022). Monetary policy communications and their effects on household inflation expectations. *Journal of Political Economy*, 130(6).

Dieppe, A., van Roye, B., and Legrand, R. (2016). The BEAR toolbox. Working Paper Series 1934, European Central Bank.

Doan, T., Litterman, R., and Sims, C. (1984). Forecasting and conditional projection using realistic prior distributions. *American Economic Journal: Macroeconomics*, 3:1–100.

Eusepi, S. and Preston, B. (2010). Central bank communication and expectations stabilization. *American Economic Journal: Macroeconomics*, 2(3):235–271.

Fernández-Villaverde, J., Guerrón-Quintana, P., Rubio-Ramirez, J. F., and Uribe, M. (2011). Risk matters: The real effects of volatility shocks. *American Economic Review*, 101(6):2530–2561.

Fernández-Villaverde, J. and Guerrón-Quintana, P. A. (2020). Uncertainty shocks and business cycle research. *Review of Economic Dynamics*, 37:S118–S146.

Galí, J. (2015). *Monetary policy, inflation, and the business cycle: an introduction to the new Keynesian framework and its applications*. Princeton University Press.

Giannone, D., Lenza, M., and Primiceri, G. E. (2015). Prior selection for vector autoregressions. *Review of Economics and Statistics*, 97(2):436–451.

Giannone, D., Lenza, M., and Primiceri, G. E. (2017). Priors for the long run. *Journal of the American Statistical Association*, 114:565–580.

González, A., Guarín, A., Rodríguez-Guzmán, D., and Vargas-Herrera, H. (2020). 4gm: A new model for the monetary policy analysis in Colombia. *Borradores de Economía. Banco de la República*, (1106).

Guerrieri, V., Lorenzoni, G., Straub, L., and Werning, I. (2022). Macroeconomic implications of covid-19: Can negative supply shocks cause demand shortages? *AMERICAN ECONOMIC REVIEW*, 112(5):1437–1474.

Gürkaynak, R. S., Sack, B. P., and Swanson, E. T. (2004). Do actions speak louder than words? The response of asset prices to monetary policy actions and statements. *The Response of Asset Prices to Monetary Policy Actions and Statements (November 2004)*.

Gómez-Pineda, J. G. (2020). The depth, length and shape of the covid-19 recession conveyed in 2020 growth forecasts. *Borradores de Economía. Banco de la República*, (1123).

Jarociński, M. and Karadi, P. (2020). Deconstructing monetary policy surprises—the role of information shocks. *American Economic Journal: Macroeconomics*, 12(2):1–43.

Justiniano, A. and Preston, B. (2010). Can structural small open-economy models account for the influence of foreign disturbances? *Journal of International Economics*, 81(1):61–74.

Kadiyala, K. R. and Karlsson, S. (1997). Numerical methods for estimation and inference in Bayesian VAR-models. *Journal of Applied Econometrics*, 12:99–132.

Kozeniauskas, N., Orlik, A., and Veldkamp, L. (2018). What are uncertainty shocks? *Journal of Monetary Economics*, 100:1–15.

Kozlowski, J., Veldkamp, L., and Venkateswaran, V. (2020). The tail that wags the economy: Beliefs and persistent stagnation. *Journal of Political Economy*, 128(8):2839–2879.

Lamla, M. J. and Vinogradov, D. V. (2019). Central bank announcements: Big news for little people? *Journal of Monetary Economics*, 108:21–38.

Litterman, R. B. (1979). Techniques of forecasting using vector autoregressions. *Working Papers*, 115.

Nakamura, E. and Steinsson, J. (2018). High-frequency identification of monetary non-neutrality: the information effect. *The Quarterly Journal of Economics*, 133(3):1283–1330.

Pesaran, M. H. and Weale, M. (2006). Survey expectations. *Handbook of Economic Forecasting*, 1:715–776.

Ramey, V. A. (2016). Macroeconomic shocks and their propagation. *Handbook of Macroeconomics*, 2:71–162.

Ravenna, F. and Walsh, C. E. (2006). Optimal monetary policy with the cost channel. *Journal of Monetary Economics*, 53(2):199–216.

Shiller, R. J. (2017). Narrative economics. *American Economic Review*, 107(4):967–1004.

Shiller, R. J. (2020). *Narrative economics: How stories go viral and drive major economic events*. Princeton University Press.

Sims, C. A. (1996). Inference for multivariate time series models with trend. *Princeton University*, Originally Presented at ASA meetings.

Sims, C. A. (2000). Using a likelihood perspective to sharpen econometric discourse: Three examples. *Journal of Econometrics*, 95:443–462.

Sims, C. A. and Zha, T. (1998). Bayesian methods for dynamic multivariate models. *International Economic Review*, 39(4):949–968.

Stanisławska, E., Paloviita, M., and Łyziak, T. (2021). Consumer inflation views: Micro-level inconsistencies and macro-level measures. *Economics Letters*, 206:110004.

Weber, M., D'Acunto, F., Gorodnichenko, Y., and Coibion, O. (2022). The subjective inflation expectations of households and firms: Measurement, determinants, and implications. *National Bureau of Economic Research*.

Woodford, M. (2003). Interest and prices. *Princeton University Press Princeton*.

Woodford, M. (2010). Optimal monetary stabilization policy. *Handbook of Monetary Economics*, 3:723–828.

Yoko, K. and Yoshihiko, N. (2013). Decomposition of Supply and Demand Shocks in the Production Function using the Current Survey of Production. *Research Institute of Economy, Trade and Industry (RIETI)*, (13003).

7 Appendix

7.1 Semi-structural Model - Parameters

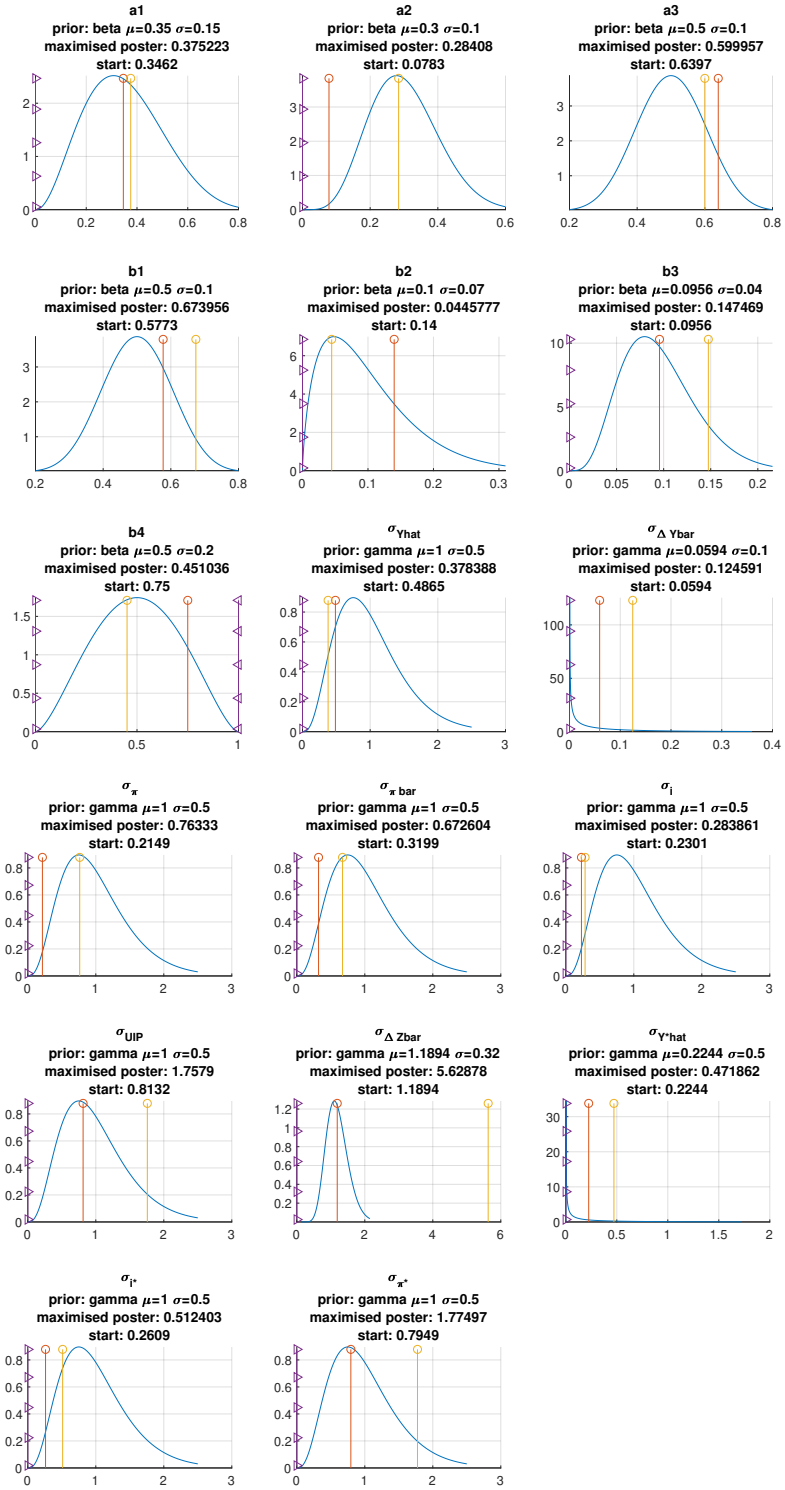
Table 1: Calibrated Parameters Values and Descriptions

Parameter	Value	Description
Steady State		
$\Delta\overline{y}$	3.3%	Long-term potential output growth
$\overline{\pi}$	3%	Inflation target
$\overline{r}$	2%	Long-term neutral real interest rate
$\overline{\pi}^{\star}$	2%	Long-term US inflation
$\overline{r}^{\star}$	0.5%	Long-term US neutral real interest rate
$\Delta\overline{z}$	0%	Long-term depreciation
$\overline{\omega}$	1.5%	Constant risk premium
Taylor Rule		
ρ_i	0.7	Backward component
ψ_{π}	1.5	Inflation weight
$\psi_{\hat{y}}$	0.3751	Output gap weight
Persistences		
$\rho_{\overline{z}}$	0.1	Persistence of the real exchange rate trend depreciation
$\rho_{\Delta\overline{y}}$	0.75	Persistence of trend real GDP growth
$\rho_{\hat{y}*}$	0.5	Persistence of foreign output gap
$\rho_{i^{\star}}$	0.6	Persistence of foreign interest rates
$\rho_{\pi^{\star}}$	0.5	Persistence of foreign inflation
Standard Deviation		
$\sigma\epsilon_t^{\overline{y}}$	0.2407	Standard Deviation of potential GDP shock level

Table 2: Prior and Posterior Distributions

Parameter	**Prior**			**Posterior**
	Distribution	**Mean**	**Std. Dev.**	**Mode**
a_1	β	0.35	0.15	0.3750
a_2	β	0.30	0.10	0.2840
a_3	β	0.50	0.10	0.6001
b_1	β	0.50	0.10	0.6739
b_2	β	0.10	0.07	0.0443
b_3	β	0.01	0.04	0.1480
b_4	β	0.50	0.20	0.4510
$\sigma_{\hat{y}}$	Γ	1	0.5	0.3792
$\sigma_{\overline{\Delta y}}$	Γ	0.06	0.1	0.1248
σ_{π}	Γ	1	0.5	0.7652
$\sigma_{\overline{\pi}}$	Γ	1	0.5	0.6740
σ_{i}	Γ	1	0.5	0.2843
σ_{UIP}	Γ	1	0.5	1.7627
$\sigma_{\overline{\Delta z}}$	Γ	1.19	0.3	5.6348
$\sigma_{\hat{y}^\star}$	Γ	0.22	0.5	0.4729
$\sigma_{i^\star}$	Γ	1	0.5	0.5140
$\sigma_{\pi^\star}$	Γ	1	0.5	1.7797

Prior Distributions and Posterior Modes



★ Blue line: Prior Distribution; Yellow line: Posterior mode; Purple line: Bound(s); Orange line: Initial Guess

7.2 Bayesian VAR - Estimation Details

Table 3: Structural Shocks - Identification Restrictions

(Impulses in columns and responses in rows)

	Local MP	**UIP**	**Cost-Push**	**Local Demand**	**FED rate**	**US Inflation**	**US GDP**
Interest Rate	+		+	+	+		
Exchange Rate		+					
CPI	-	0	+	+			
GDP	-	0	0	+	-		
FED Rate	0	0	0	0	+	+	
US CPI	0	0	0	0	-	+	
US GDP	0	0	0	0	-	-	+

Table 4: Hyperparameters Values

Hyperparameter	**Description**	**Value**
λ_1	Overall Tightness	0.2
λ_2	Cross-variable Weighting	0.5
λ_3	Lag Decay	2
λ_4	Constant	1000
λ_5	Block Exogeneity Shrinkage	0.001
λ_5	Sum of Coefficients	1

7.3 Forecasts Data Details

Table 5: Data Sources for Forecasts

Variable	Central Bank's Source	Analysts' Source
GDP growth	CBOF	MES
CPI headline inflation	CBOF	MES
Exchange rate	CBOF*	MES
Monetary policy interest rate	CBOF*	MES
USA GDP growth	CBOF*	CDBS
USA CPI inflation	CBOF*	CDBS
FED interest rate	CBOF	CDBS

CBOF: Central Bank's Official Forecast. *Non-public information. MES: Monthly Expectation Survey. CDBS: Consensus of the daily reported Bloomberg survey.

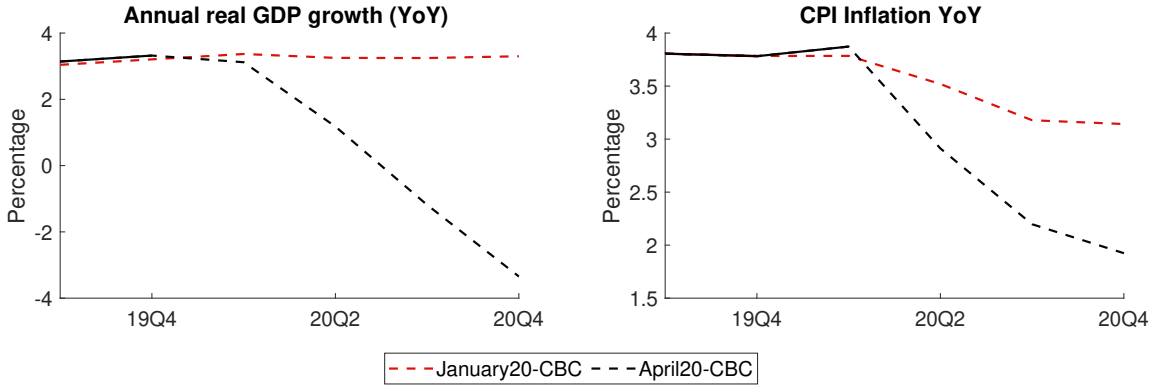
7.4 Full Account of Macroeconomic Narratives

7.4.1 The Outbreak

Colombia's first COVID-19 case was confirmed on March 6 2020; however, its first nationwide quarantine was declared 14 days later, with only one third of the month remaining. The virus continued to spread throughout the country in the following months, along with, policy actions to slow the pandemic. Thus, it was really during the second quarter of 2020 that the pandemic took root in Colombia. Moreover, this timeline implies that forecasts published in the CBC's January20 Monetary Policy Report could not have captured any domestic effects of the pandemic. Furthermore, by April20, the CBC could only have had a very incipient assessment of the size and nature of the pandemic's implications.

A comparison between forecasts made in January20 and April20, as shown in Figure 8, reveals how the CBC distinctly changed its macroeconomic outlook. The CBC's January20 forecasts of real annual GDP growth and headline inflation were close to the long-term values reported in Appendix 7.1. Subsequently, in April20, the CBC's projections of these variables underwent large revisions at the outbreak of the COVID-19 pandemic showcasing expectations that the economy was not operating at its fullest. This implied a change in GDP growth projections for 2020 from positive values to a significant economic downturn along with a fall in headline inflation.

Figure 8: Central Bank - Reported Variables, April20-January21

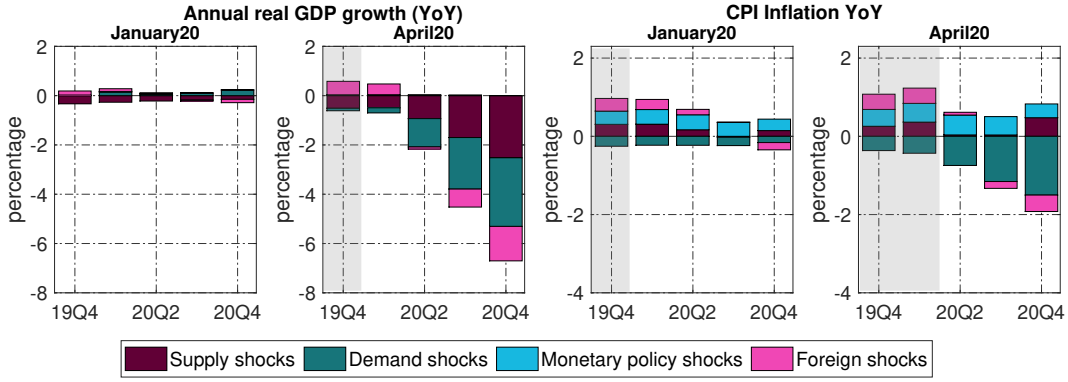


Furthermore, after filtering the CBC's set of forecasts from January20 through the model, macroeconomic narratives emerge in terms of shocks. In line with the GDP and inflation forecast revisions, Figure 9 shows that the CBC's narrative changed in terms of both shock signs and magnitudes. First, for the January20 projections the model interprets that expected GDP growth would be underpinned by a dynamic local demand, despite potential output and foreign shocks to be slightly negative. Second,

these shock decompositions also show that cost-push shocks were to push up inflation along with other monetary policy considerations, while the real exchange rate appreciations generated by favourable foreign shocks would constitute a disinflationary pressure at the end of the forecast horizon.

The increase in the magnitude of the CBC's implicit expected shocks between January20 and April20, shows the unprecedented nature of the crisis. After the pandemic began and lockdowns were imposed, the implicit narrative of the CBC is one of an economic recession predominantly induced by a negative demand shock. This narrative could speak to the CBC perceiving that the pandemic might hinder more strongly aggregated demand than supply, either because of Colombia's large informal sector or the presence of Keynesian supply shocks, as shown in Guerrieri et al. (2022). Nevertheless, the CBC's macroeconomic narrative also included adverse supply and foreign shocks, in that order of importance, which also played a negative role in GDP growth. Moreover, the depressed foreign and local demand were expected to exert disinflationary pressure, while cost and monetary policy shocks were to mitigate this.

Figure 9: Central Bank - Shock Decompositions April20-January21



Reported values in the shock decompositions are deviations from steady state.
Shaded areas indicate historic observed data.

In terms of magnitude, the CBC became more pessimistic about GDP growth in 2020, compared with its expectations for inflation, explaining the negative shocks to potential output seen in the shock decomposition. Accordingly, in the presence of wide and negative demand shocks with a more moderate decline in inflation, the model can only explain such stability through adverse inflationary cost-push shocks. Some plausible explanations for these costs shocks are biosafety costs, capacity restrictions, goods scarcity, disruptions in global value chains, and later-than-usual responses to weak demand.

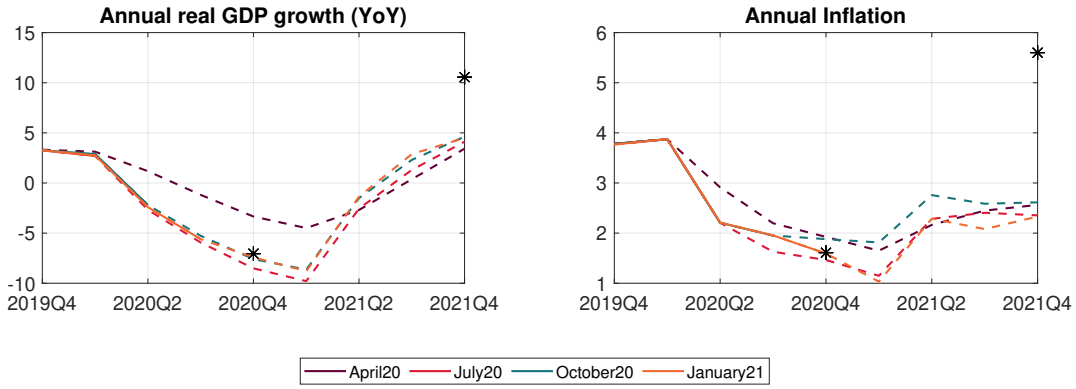
To a great extent, the narratives of April20 sharply contrasted the outlook implicit in the January20 release in terms of the direction and magnitude of macroeconomic shocks, markedly signaling the sudden entrance of the COVID-19 to Colombia. Overall, the narrative stemming from the model's interpretation of the April20 forecasts

portrays a very early macroeconomic assessment of the CBC, produced and published while still at the onset of an unknown shock. With most of the crisis yet to be experienced, the CBC was likely to revisit its view of the Colombian economy in future MES releases over the next two years.

7.4.2 Evolution of the Pandemic

The CBC's forecasts produced in 2020 reaffirmed the view it adopted in April20. As depicted in Figure 10, posterior forecasts after April20 show that the CBC projected an even worst depression for the Colombian economy in 2020, but induced by the same drivers. As more information became available, GDP forecasts for 2020 were even closer to the actual downturn observed in economic activity. Conversely, inflation forecasts for 2020 conveyed in the April20 release had smaller revisions in the subsequent projections made in 2020 and, despite that, ended up being quite close to actual data. However, this was not the case for the 2021 projections. Even at the beginning of 2021, GDP growth and inflation were underestimated in 2020 forecasts, with a higher deviation of inflation forecasts compared to the observed data. The CBC clearly did not expect inflation to reach levels even higher than the ones observed in 2019 after such an historic recession.

Figure 10: Central Bank - Reported Variables April20-January21

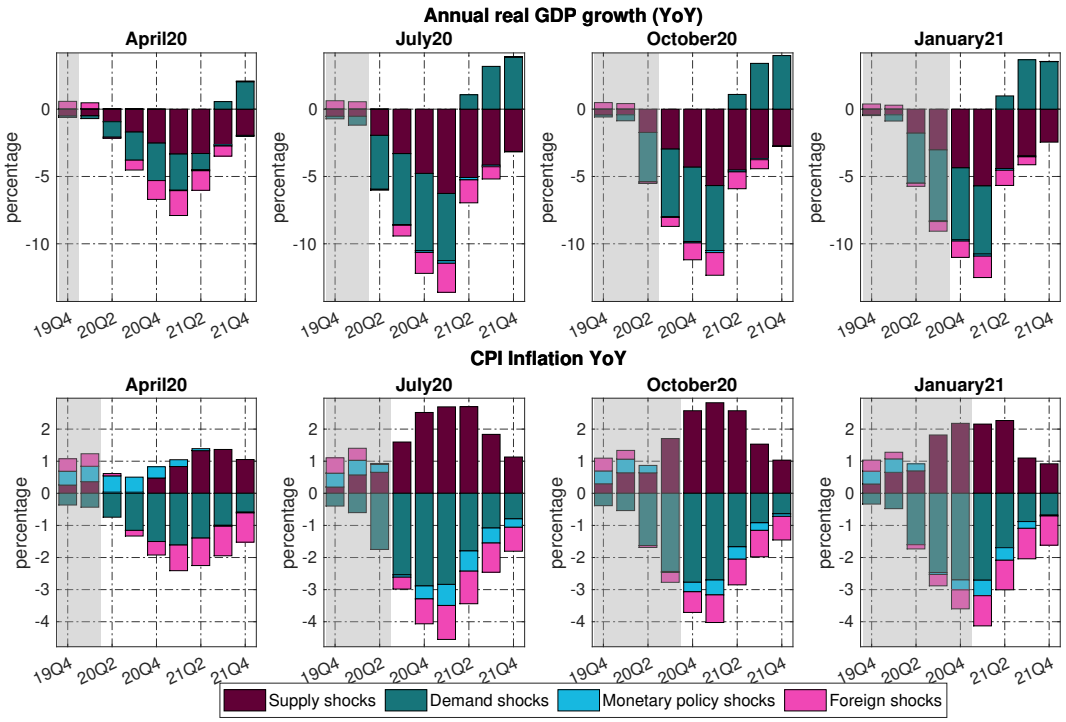


(*) Is the observed data. Dotted lines are forecast, continuum line shows observed data.

The narrative behind the expected paths for these variables, as presented in Figure 11, was always that the pandemic was driven chiefly by a negative demand shock in 2020, but which would quickly bounce back in 2021 and be the only factor aiding the recovery. In contrast, between April20 and July20 supply shocks were expected to be even more negative and persistent, weighing down GDP growth throughout 2021. Finally, foreign factors in the CBC's implicit narrative made a smaller contribution than local shocks to the recession, but would still be detrimental to Colombian growth.

Despite the expected demand recovery, the CBC's narrative suggested that the negative shock in 2020 would continue to place disinflationary pressure until 2021. However, inflationary cost-push shocks gained greater significance, causing positive pressure that countered local and foreign demand shocks, thus avoiding a great decline in inflation.

Figure 11: Shock Decompositions 2020-2021



Reported values in the shock decompositions are deviations from their steady state.

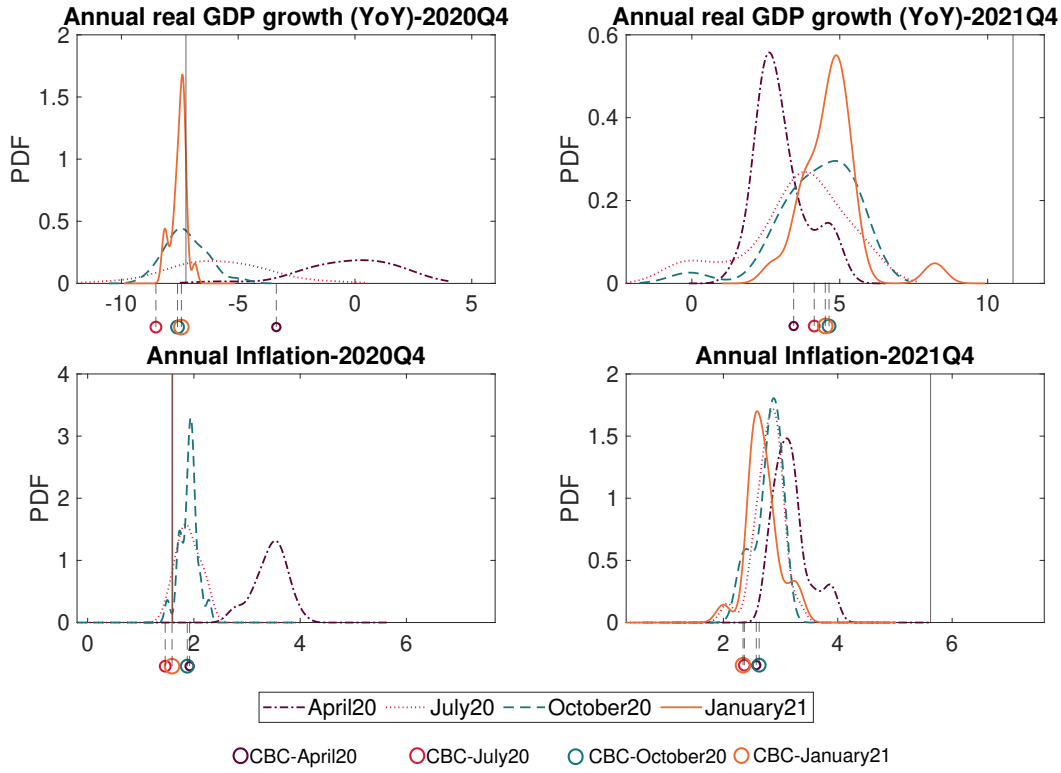
Shaded areas indicate periods already observed in a given survey release.

Although variables and shock magnitudes changed in each of the CBC's published forecasts throughout 2020, the overall narrative was broadly the same. However, the analysts' forecasts collected in the MES show the great uncertainty brought about by the pandemic, as illustrated in Figure 11. Indeed, there was more disagreement between professional forecasters in the first two releases of the MES regarding the magnitude of the GDP decline in 2020, compared with the last two forecasts reported in 2020. Since April20, the CBC had lower growth and inflation forecasts in comparison with most analysts. Afterwards, in the releases of October20 and January21, while uncertainty decreased, professional forecasters increasingly clustered around the CBC's projections for those two variables. Hence, the CBC was an early mover in 2020, considering that analysts' expectation distributions moved towards those reported by CBC's forecasts. However, disagreement between analysts regarding the 2021 forecasts persisted, especially when comparing real activity expectations. Even though, most analysts forecasted positive GDP growth while inflation expectations were broadly around

the long-term target's tolerance range (2-4%).

The analysis so far begs the question of whether the CBC's behavour was also true for other agents in the economy. How similar were the professional forecasters' narratives to that of the CBC? What were the sources of uncertainty between analysts? To answer these questions, the dispersion between forecasts of reported variables in the MES was assessed first, to determine if the market showed larger or smaller changes in forecasts over the course of the pandemic. Second, narratives between the CBC and analysts were compared by examining shock decompositions differences.[19]

Figure 12: Distributions of Forecast from the Central Bank and Analysts



The distributions are approximated with a kernel density function.

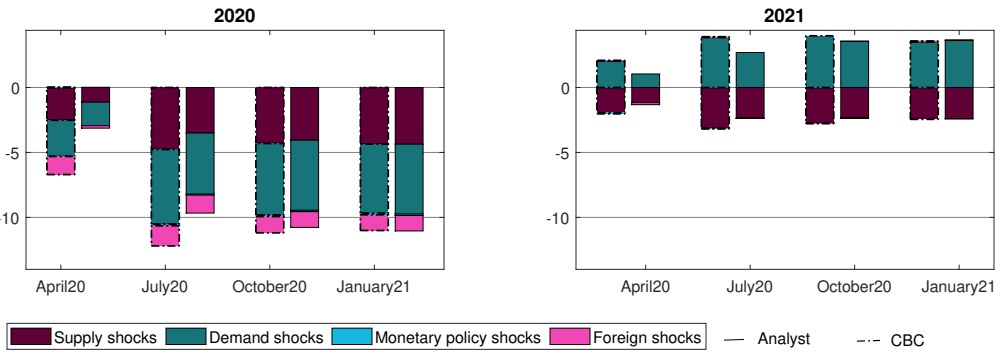
Regarding the narratives and shocks, the market's median narrrative coincided qualitatively with the CBC's narrative, as shown in Figure 13, despite disagreements over shock magnitudes. Consistent with its early-mover behavour in its forecasts, the CBC expected earlier, more negative supply and demand shocks explaining the GDP decline in 2020. In the October20 release, the quantitative differences decreased between the CBC and the median market's narrative. Both narratives agreed that demand was

[19]To summarise all information contained in the high-dimensional database obtained after interpreting all professional forecas, we present a few shock decompositions that clearly depict macroeconomic stories.

the main driver of GDP decline during the pandemic, having a participation rate near 49% as captured in the January21 release, while supply and foreign shocks were also harming real activity, with the latter being less influential.

Implicit stories about 2021 GDP recovery derived from the median market's reported expectations across 2020 were also aligned with those of the CBC. However, the CBC's forecasts exhibited a relatively better demand recovery albeit was more pessimistic about the persistence of negative supply shocks. Nonetheless, consensus about shock magnitudes also increased in the MES releases collected during the second semester of 2020.

Figure 13: Shock Decomposition for GDP Growth YoY

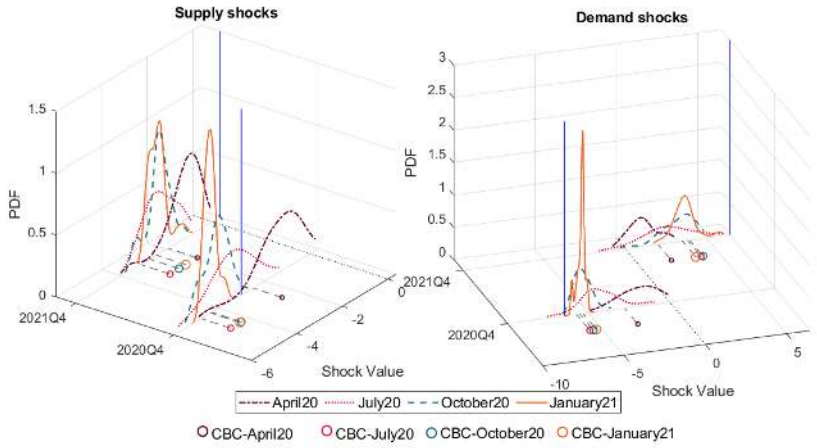


Once the general outlook was retrieved, the next step was to ascertain if there was relative agreement among professional forecasters regarding that narrative and if all market participants agreed with the CBC's narratives. To summarise the narratives' distributions for all professional forecasters considered in this analysis window, the distribution of shocks driving GDP growth is plotted in Figure 14. The first thing that stands out is that, since the July20 release, all analysts shared the CBC's narrative that the pandemic entailed negative demand and supply shocks during 2020. In fact, for 2020 domestic demand shocks were always and increasingly perceived as negative by analysts, and with each new survey, more professional forecasters expected larger positive demand shocks for 2021 boosting economic recovery. In addition, there was consensus regarding a more persistent harmed supply since supply shocks were consistently revised downwards (more negative) and all expected a negative contribution of supply to GDP growth for 2021.

Nonetheless, both supply and demand were sources of uncertainty explaining the market's disagreement. Notably, discrepancies among analysts regarding the magnitudes of the shocks explaining the 2020 GDP decline did not decrease until October20 and prevailed in forecasts made for 2021. Moreover, it is worth highlighting that the mean of the distributions for supply and demand shocks moved closer to the CBC's projection and clustered around it. The CBC was an early mover in its implicit projec-

tions of supply and demand shocks explaining 2020 forecasts. As shown in Figure 14, the CBC is found at the left tails of the distributions of April20 and July20 releases. Despite an uncertainty reduction about sizes of supply and demand shocks explaining 2020 GDP growth, all professional forecasters and the CBC were surprised by more negative demand shocks and less negative supply outcomes. Additionally, with respect to the observed data, neither the CBC nor the analysts expected for 2021 that supply would contribute positively to GDP growth, and they were also all surprised by a better demand recovery than expected.

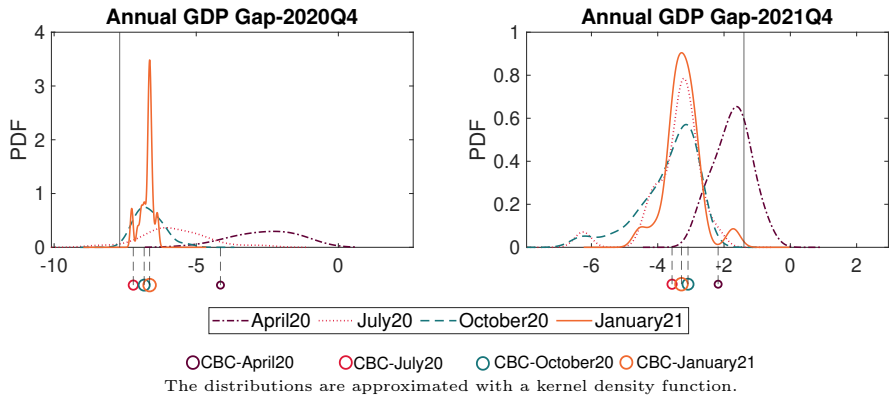
Figure 14: Annual Real GDP Growth (YoY) Shocks Distributions



Shock value: Cumulative contribution of each shock to the deviation of the variable from its steady state

In summary, monitoring the implicit output gap is a simple way to keep track of the final balance between aggregate demand and supply forces. This is exceptionally relevant in the context of the pandemic, since its unknown nature leads to questions about the relative importance of demand shortages and destruction of productive capacity during the crisis. Figure 15 shows that the market agreed with the CBC, in that the output gap would be negative in 2020. Even at the start of the crisis, these results indicate general agreement among professional forecasters on the COVID-19 shock being predominantly a negative demand shock. Although volatility surged in the first semester of the pandemic, one can again see that analysts continuously clustered around the CBC's implicit projection of an output gap and around an expected value of -6.5% for 2020 in the January20 release. In addition, the market analysts and the CBC agreed that excess capacity would remain in 2021, despite disagreement regarding the size of the negative output gap.

Figure 15: Distributions of the Central Bank and Analysts' of the Annual GDP Gap



The distributions are approximated with a kernel density function.

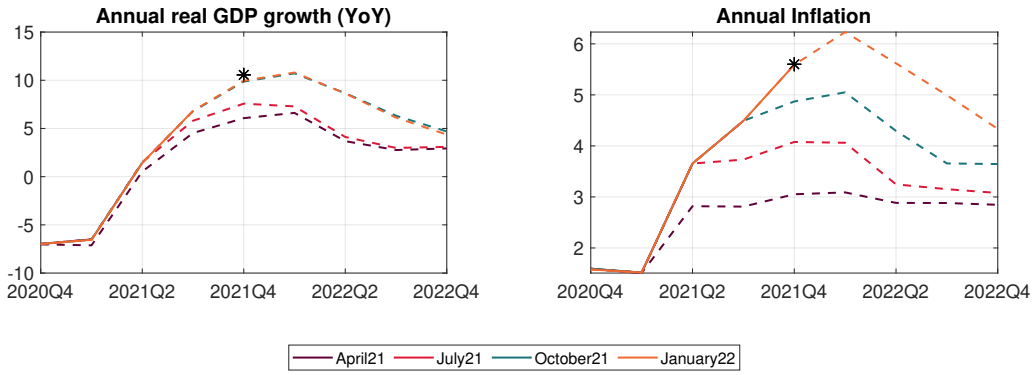
7.4.3 The Post-pandemic Episode

Coming out of the recession induced by the pandemic was challenging for the CBC and professional forecasters in some key aspects of their macroeconomic outlooks. In the previous analysis window, it became evident that they all expected strong economic recovery, but not as a strong as it actually was. However, this time inflation caught professional forecasters and the CBC off guard and forced them to revisit their macroeconomic narratives. By the end of the pandemic episode, there was some uncertainty regarding inflation in 2021; however, even the most pessimistic analyst still expected an inflation rate below 4%. The observed data was 5.66%, more than half of what this analyst forecasted and twice as much as the CBC's last reported projection.

Why were these forecasts so off-target? One thing that cannot be stressed enough is that the spike in inflation was both a global and local phenomenon. From the very beginning of 2021, adverse cost-push shocks hit the economy at the expense of forecasts accuracy as a backlash of the pandemic. While the world was experiencing the burdens of global supply chains disruptions, goods shortages, and oil prices increases, Colombia went through a national strike in the second quarter of 2021 that caused a food inflation upward spiral that did not die out over the remainder of the year.

During this post-pandemic episode, the CBC did not act as an early mover in inflation forecasts as it had for GDP growth during the pandemic. Nonetheless, in this case, it makes sense that the CBC remained more conservative in an effort to anchor inflation expectations. Figure 16 summarises how GDP and inflation consistently surprised the CBC.

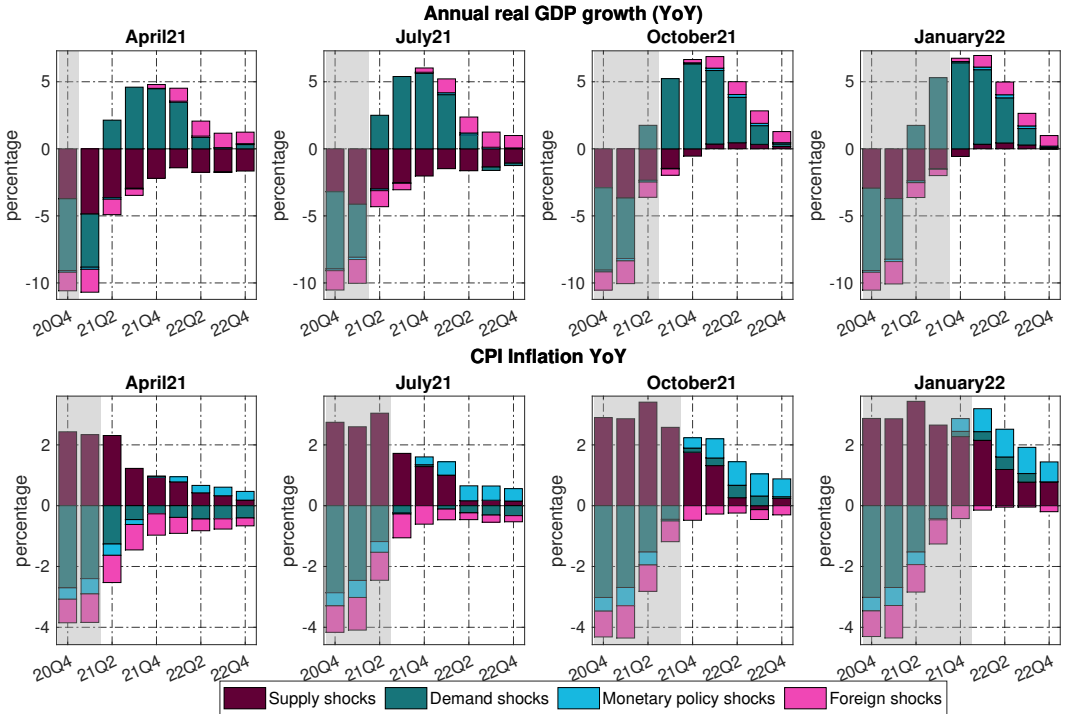
Figure 16: Central Bank - Reported Variables, April21-January22



(*) Is the observed data. Dotted lines are forecasts, the continuum line shows observed data

If the CBC was conservative in revising its inflation forecasts but not so much in terms of GDP growth, how can this be interpreted in the general equilibrium setup of our model? Notably by and large, the CBC maintained the recovery narrative for GDP growth that it had related in the previous window releases, as seen in Figure 17. Quantitatively shocks had to change to adjust the extraordinary rebound in economic activity. At least qualitatively, the CBC still foresaw demand as the main driver of GDP growth in 2021, and supply as dragging it down. However, the systematically better outcomes the 2021 releases generated growing optimism regarding supply shocks (i.e. potential GDP) and the view of demand as a growth booster stretched into 2022. Considering that the national strike meant a decline in GDP growth (QoQ) in 21Q2, which can be seen from the October21 release, it is still surprising how dynamic demand was in the second semester of 2021, and how this was expected to persist in 2022 along with a positive contribution of foreign shocks. This final point leads to the thought that the CBC considered that Colombian economic recovery was also going to be favoured by a global recovery.

Figure 17: Central Bank Shock Decomposition



-The reported values in the shock decompositions are deviations from their steady state.
-The shaded areas correspond to the observed data

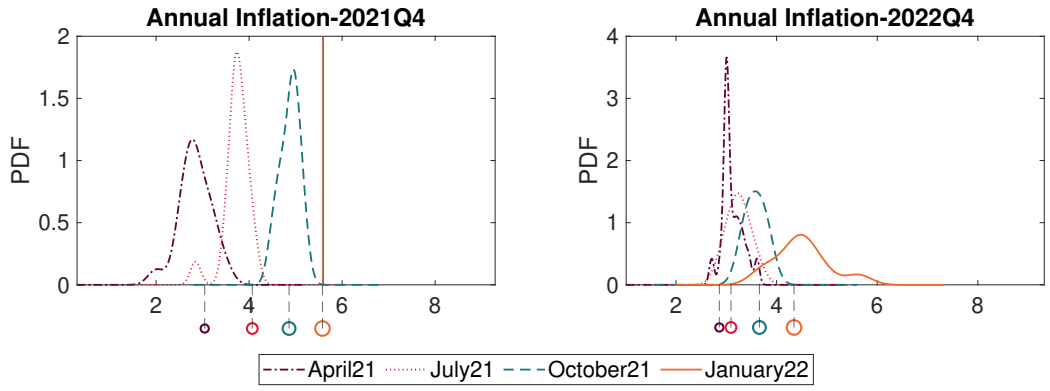
Contrary to the continuation of the GDP narrative, the forecasts for annual headline inflation for 2021 suffered qualitative and quantitative revisions across releases. As mentioned previously, during the evolution of the pandemic the CBC and professional forecasters expected low inflation rates for 2020 and 2021. Despite adverse cost-push shocks, inflation was expected to remain relatively low because of negative demand and foreign and monetary policy shocks, in that order of importance. During the post-pandemic episode, this changed drastically, as demand gradually stopped weighing down inflation; in the January22 release, monetary policy shocks start being even positive for the last quarter of 2021. For instance, in April21 the CBC expected demand to be a disinflationary pressure along the entire forecast horizon, whereas in October21, it already attributed a very small negative share to demand by the end of 2021 and believed that in 2022, this would create inflationary pressure.

These changes in the demand-side narrative of inflation are worth highlighting, since above we already mentioned all the unfavourable cost-push shocks affecting inflation that are clearly visible in the growing dark purple bars in the inflation shock decompositions of Figure 17. Although the CBC exhibited very interesting behaviour regarding the nature of these costs shocks, namely with each new release (and data surprise), the CBC did not change its forecast on the shocks' persistence as much as the magnitude of the data surprise. This helps explain why the CBC did not revise its 2022 inflation forecasts to the same magnitude as it increased its 2021 forecasts. This

was because it considered these higher costs to be rather transitory. The fact the CBC maintained this view in all the post-pandemic releases might have to do with an effort of anchoring expectations through conservative forecast revisions on inflation.

The shift described above in inflation's path for 2021 and 2022 rapidly became evident for not only the Central Bank but also all the professional forecasters. Figure 18 shows this fact in a compact fashion. Both graphs exhibit a general agreement between the CBC and the mean analyst inflation projections in every survey release, notwithstanding the increase in uncertainty about inflation for 2022, with each new cost-push shock observed. Strikingly, for 2021, uncertainty fell with each new release, indicaing that the risks that materialised did not offset the marginal gains from the information regarding realised inflation in each quarter. Another interesting point about 2022 inflation is that, in January22, no analyst expected inflation to return to its 3% long-term target, showing that the market agreed the inflationary shocks in 2021 would persist.

Figure 18: Distributions of Forecasts from Analysts and the Central Bank



The distributions are approximated with a kernel density function.

As can like be anticipated from the previous paragraph and the relative position of the CBC on the distributions of Figure 18, the median narrative of the professional forecasters was pretty much in line with that of the CBC. There were certainly some quantitative differences, especially in April21 because the CBC was at the right of the mode in 2021 and at the left in 2022, but not relevant qualitative ones. From July21 release, the median narrative of analysts and the CBC were very closed for 2021 and less so for 2022. However, Figure 19 highlights another dimension of the comparison that is very relevant when it comes to inflation during the post-pandemic episode. It follows from those graphs that disagreement, both among analysts and with respect to the CBC, was more prominent for supply shocks than for demand ones. In fact, the CBC adopted a very stable view on demand shocks for 2021 from the July21 release, even when several professional forecasters were to the left of it (i.e. perceived more disinflationary pressures on the demand-side). This view was quite close to the model's

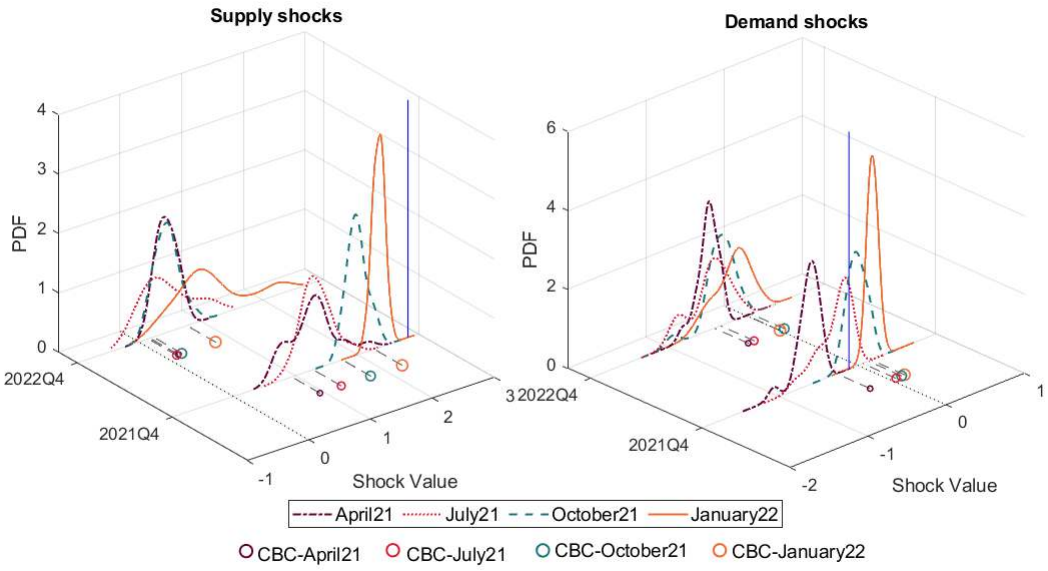
interpretation of the observed data.

Unlike demand, supply was a matter of debate for the CBC by itself and among analysts. The CBC incrementally updated its view on the size of cost-push shocks in 2021 with the risks materialising on the supply-side of inflation. Similar to how the CBC did not remain relatively anchored around a given value, neither did the professional forecasters. Analysts disagreed among themselves about these shocks, and markedly shifted to the right as a group in October21, after the national strike in 21Q2. The strike reduced disagreement among analysts for 2021, as they all expected that it would translate into inflationary pressure for the remainder of 2021. Despite the noticeable shift to the right of the distributions for October21 and January22, the interpretation of the model of the observed data was still higher, which speaks to the unusual magnitude of the data surprise.

Finally, the second semester of 2021 entailed costs shocks that moved the entire distribution of supply for 2022 to a positive ground, although with great uncertainty regarding the magnitude and with several analysts to the right of the CBC's view for that year. Moreover, that shift in supply shock distribution showed that, since October21, expectations regarding a higher persistence of cost push shocks increased for all professional forecasters. In a way, this raised an important alert regarding inflation in 2022 and the large risks looming over it. Moreover, this amplification of uncertainty for 2022 in the January22 release might have been reinforced by an historically unprecedented minimum wage adjustment of 10.07% on behalf of the government, given the rise of inflation in 2021.

Figure 19: Distribution of Central Bank Shocks Versus Analysts' Shocks

Annual Inflation



Shock value: Cumulative contribution of each shock to the deviation of the variable from its steady state