Policy Performance and the Behavior of Inflation Expectations*

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This paper investigates the changing behavior of inflation expectations in response to the macroeconomic and policy environment. Using a panel of professional forecasters covering 13 years of inflation-targeting period in a major emerging economy, we present evidence on the behavioral shifts in the inflation expectations associated with evolving macroeconomic and policy performance. The rapidly changing nature of the policy setting and ample data variation in our data set constitute a suitable background to explore this question. We use a unique survey which includes matched policy rate and fixed-horizon inflation expectations at the individual level. Moreover, the paper employs a novel technique where direct feedback from the survey participants is used to determine the baseline empirical model governing expectations dynamics. Interpretation of the empirical findings jointly with the feedback from the survey respondents indicate that the anchoring power of inflation targets depend on the policy performance. The weights attached to inflation targets in forming expectations are strongly associated with the size of the inflation deviation from the targets. As the targets become less credible through time, the survey participants assign increasingly higher weight to past inflation and the relationship between exchange rates and inflation expectations becomes stronger. Overall, our results imply

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that expectations behavior might display significant and rapid shifts with the underlying economic and policy performance. Therefore, policymakers in advanced and emerging economies should not take the current stability of inflation expectations for granted.

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Another gap in our knowledge about the nature of the inflation process concerns expectations... Perhaps most importantly, we need to know more about the manner in which inflation expectations are formed and how monetary policy influences them.
– Janet Yellen (2016)

1. Introduction

Inflation expectations constitute an integral part of the monetary theory and policy (Blinder et al. 2008, Galí 2008). The behavior of inflation expectations is often the key input for forecasting and policy analysis models used by policymakers. Anchored longer-term inflation expectations is the hallmark of effective and credible monetary policy. Expectations drive a wide range of economic variables, which, in turn, affect real economic activity and inflation dynamics. Therefore, understanding inflation expectations and their interaction with monetary policy is important from an academic and policy perspective.

This paper seeks to understand how the behavior of inflation expectations shifts in response to policy performance. With the widespread adoption of price-stability-oriented policies during the past decades, inflation expectations have been increasingly anchored in many economies (Gürkaynak, Levin, and Swanson 2010). One important question is whether this success should be taken for granted in designing future monetary policy. Recently, this question is particularly of more relevance, given the excessive reliance on monetary expansion through unconventional tools and the tendency towards curbed central bank independence across the globe. Our study aims to shed some light on this question by utilizing a unique data set on inflation expectations. Using a panel of expectations covering 13 years of inflation-targeting period from Turkey, we investigate the changing behavior of inflation expectations in response to macroeconomic and policy environment. Turkish macroeconomic conditions and policy framework, which has been subject to frequent changes during the past decade, provides an ideal laboratory for the analysis of time-varying aspects of the expectations behavior.

Using a unique survey data set and rolling panel regressions, we explore several questions pertaining to the behavioral aspects of inflation expectations: How do agents form their inflation expectations in relation with the macroeconomic and policy environment? Do expectations dynamics change through time and across policy regimes? How do inflation expectations respond to shifts in the monetary policy framework and the policy performance? Answering these interrelated questions would not only yield insights into our main question of interest but also improve general understanding of the behavior of inflation expectations, which, in turn, may contribute to build more realistic models and formulate sound policy responses.

In order to conduct an analysis on inflation expectations, we need a quantitative measure of expectations. This paper employs the survey compiled by the Central Bank of the Republic of Turkey (CBRT), called "Survey of Expectations." The survey comprises one- and two-year-ahead fixed-horizon inflation expectations at the monthly frequency since 2006 along with some key macrovariable forecasts, incorporating a rich variety of responses at the individual level. A unique property of the survey is including policy rate expectations at the micro level, which allows us to extract forecaster-specific monetary policy surprises—a rare feature for such surveys.

Using individual-level survey data helps to identify the relationships through cross-sectional variation. Moreover, survey-based measures of inflation expectations reflect direct forecasts by economic agents, thus they have low sensitivity to varying market liquidity and do not require any adjustment or inflation risk compensation as opposed to market-based measures. These advantages may become more relevant in an emerging economy with relatively less developed financial markets and volatile risk premium. However, surveys may also have some weaknesses compared with market-based measures (Armantier et al. 2017). Because of the absence of direct financial consequences and limited ability to process information, survey responses may suffer from cheap-talk problems, weak incentives, herd behavior, strategic misreporting, as well as sticky information and/or inattention issues.[1] Notwithstanding these shortcomings, exploring the behavioral aspects of survey-based expectations on a micro basis and identifying the major shifts through time has the potential to provide important insights for the design and formulation of monetary policy (Coibon et al. 2020).

Determinants of inflation expectations and their interaction with the monetary policy have been studied extensively in the literature. A significant fraction of the previous work has concentrated on the variations of empirical closed-economy New Keynesian models across advanced economies (Mankiw, Reis, and Wolfers 2004; Coibon, Gorodnichenko, and Kamdar 2018), whereas our playground is an open emerging economy with rapidly evolving policy environment and imperfect credibility of institutions. Some related papers have explored the role of the policy framework in the behavior of inflation expectations, assessing the significance of the inflation-targeting regime in affecting expectations dynamics across countries (see, e.g., Brito and Bystedt 2010; Gürkaynak, Levin, and Swanson 2010). Another strand of the literature, closer to our work, has investigated the changing behavior of inflation expectations through time within a particular economy.[2]

Our paper's contribution to the literature can be summarized in four dimensions: First, we use a unique monthly data set including matched monetary policy and inflation expectations at the individual level, which is a valuable feature especially for estimating the impact of policy surprises on inflation expectations and their evolution through time. Availability of matched inflation and policy rate expectations at the micro level is a rare asset for expectation surveys. Second, we link the documented changes in the behavior of expectations to several aspects such as operational framework and credibility gap, showing that the role of nominal anchors may shift quickly depending on the policy performance. Third, we

[1] See e.g., Keane and Runkle (1990); Manski (2004); Pesaran and Weale (2006); Inoue, Kilian, and Kiraz (2009); and Marinovic, Ottaviani, and Sørensen (2013).

[2] Some examples are Celasun, Gelos, and Prati (2004), Carvalho and Minella (2012), and Cortes and Paiva (2017), for emerging economies; Blanchflower and MacCoille (2009), Strohsal, Melnick, and Nautz (2016), and Ciccarelli, Garcia, and Montes-Galdón (2017) for advanced economies. See also Köse et al. (2019) for a comprehensive literature survey on the dynamics of inflation expectations.

adopt a novel methodology where direct feedback from the survey participants is received regarding the construction of their inflation forecasts, where the results are used to build the base for the empirical model and to complement the main findings. Fourth, we use a macro data set with ample variation in variables of interest, which helps to identify key relationships. High volatility in inflation expectations and macroeconomic variables in Turkey provides substantial variation to explore the shifts in the dynamics of inflation expectations.

Overall, both the rich content of our data set and the rapidly changing nature of the Turkish economic context present a suitable background to study the behavior of inflation expectations and their interaction with the macroeconomic and the policy environment.

To our knowledge, this is the first study to employ individual-level direct policy surprises to investigate the response of inflation expectations to monetary policy surprises. The literature has used event studies (Bernanke and Kuttner 2005; Gürkaynak, Sack, and Swanson 2005), structural vector autoregressive (SVAR) models (Christiano, Eichenbaum, and Evans 1999), or a combination of both (Gertler and Karadi 2015) to identify the impact of monetary shocks on the inflation expectations. These papers, by nature, implicitly assume that monetary policy surprises are identical for each agent. Moreover, SVARs and other structural models often impose strong identifying assumptions. Using individual-level monetary policy surprises directly extracted from surveys might provide complementary evidence to the existing work on identifying the effect of monetary policy on inflation expectations.

More recently, some studies have explored the impact of monetary policy surprises using survey data. These papers have mostly focused on the effect of unconventional monetary policy (quantitative easing and forward guidance) on economic agents' expectations. However, none of these studies use *direct* monetary policy surprises at the *individual level*. For example, Boneva et al. (2016) explore the impact of asset purchase amounts on firms' inflation expectations, but they implicitly assume that the unexpected component of the quantitative easing is identical for all firms. Altavilla and Giannone (2017) extract the revision in agents' monetary policy expectations from their bond yield forecasts at the individual level, which provides a micro but *indirect* measure for policy effects at the individual level. Eminidou, Zachariadis, and Andreou (2020) utilize an estimated monetary policy reaction function to extract consumer-level monetary policy surprises; yet, their measure is *indirect and model dependent*. Our study, on the other hand, uses individual-level direct policy surprises, enabling us to assess the impact of monetary policy on the inflation expectations without imposing model-dependent identifying assumptions, which is a unique feature compared with the related work in the literature.

Given this background, we run full-sample and rolling panel regressions to explore the dynamics of inflation expectations and their interaction with the economic environment. Our estimates suggest that the inflation expectations are significantly related to macrovariables such as exchange rates, oil prices, inflation realizations, and inflation targets, as well as individual-level policy surprises, consistent with the previous literature on emerging economies.[3] More importantly, rolling regressions reveal that the parameters governing the expectations formation process change considerably through time, possibly responding to the shifting performance of the policy framework and sliding external conditions. Empirical results indicate that the weight attached to inflation targets by forecasters is inversely related to the size of the target breaches. Moreover, we document that the sensitivity of inflation expectations to monetary policy surprises varies significantly with the policy framework.

The findings are suggestive of a significant change in the expectation behavior, possibly associated with the policy performance. Despite the fairly anchored inflation expectations during the initial years of the inflation-targeting framework, expectations behavior changes rapidly through time with the persistent breaches of the targets on the upside. The relationship between exchange rates and inflation expectations becomes stronger and survey participants assign increasingly higher weight to past inflation through time. These findings are supported by the direct feedback survey we conducted among the participants, which indicates that, as of the end of the sample period, inflation target ceases to be a key parameter in

[3]See, for example, Carvalho and Minella (2012) for Brazil; Pedersen (2015) for Chile; and Kara and Küçük (2010), Çiçek, Akar, and Yücel (2011), and Başkaya, Gülşen, and Kara (2012) for Turkey.

driving medium-term expectations. Taken together, the results point to a significant weakening in the credibility and the anchoring power of inflation targets through time, associated with the underlying policy and economic performance.

Our findings imply that the existing stability of inflation expectations across the globe should not be taken for granted. The credibility and the ability to shape expectations around an inflation target may change rapidly depending on the policy performance. Recent overshoots of inflation targets in many economies and the tendency towards more discretionary policies in other jurisdictions warrant caution in this respect.

The remainder of the paper is organized as follows: The next section explains the main features of the expectation survey used in the paper and summarizes the evolution of inflation expectations throughout the sample period. The third section presents the empirical model and the changing behavior of inflation expectations along with some robustness analysis. The last section presents final remarks and some reflections.

2. An Overview of Inflation and Inflation Expectations in Turkey

Turkish economy and inflation dynamics have witnessed a comprehensive transition after 2001 with the adoption of a floating exchange regime along with an implicit inflation-targeting regime. Following a successful disinflation period between 2002 and 2005, which brought inflation down to single digits after many decades of high double-digit inflation, explicit inflation targets were adopted in 2006 to lock in the gains from disinflation. The period between 2006 and 2010 can be described as a standard inflation-targeting regime where the central bank used a single policy rate with a medium-term forecast horizon. The policy framework has evolved into a more flexible form of inflation targeting through time. Following the global financial crisis and the European debt crisis, multiple instruments were used to deal with the consequences of excessive global liquidity and the volatility in capital flows, with financial stability being adopted as a supplementary goal. To this end, the period between 2011 and 2015 involved unconventional interest rate corridor policies along with the active use of reserve requirement tools, where credit and exchange rate served as intermediate variables. Monetary policy operational framework reverted to a relatively more conventional setup after 2016 when leading central banks started implementing exit strategies from quantitative easing policies. These frequent shifts in the background policy framework provide ample variation to identify the changes in the expectation behavior associated with the monetary framework.

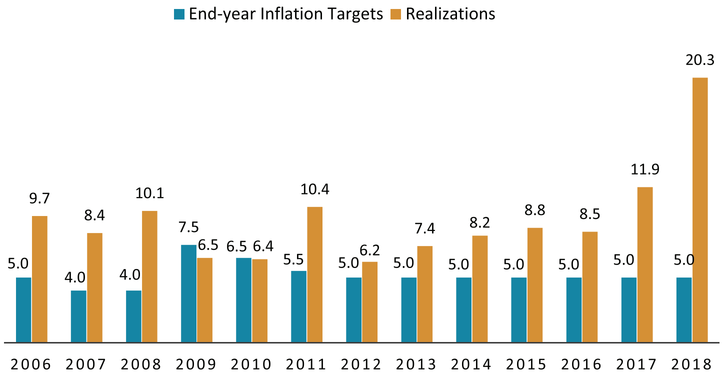
Another interesting feature of our data set is the variation in inflation targets, which is typically absent in many inflation-targeting countries. Since 2006, consumer price index (CPI) inflation targets have been announced by the CBRT in each December for a three-year horizon. During the initial years, the multi-year targets were set constant at 4 percent. However, targets were revised on the upside in June 2008, where 2009–11 inflation targets were set at 7.5, 6.5, and 5.5 percent, respectively. The inflation target has stayed at 5 percent thereafter (figure 1). Deviation of inflation from the targets has also showed considerable variation. The targets were breached consistently on the upside at varying degrees, except for the years 2009 and 2010. The size and the volatility of the deviation of inflation from the targets, coupled with the variation in the targets, allow us to explore whether and how the performance of the inflation-targeting framework has affected the anchoring role of the targets.

2.1 The Survey

The CBRT launched the "Survey of Expectations" in August 2001 to measure and monitor expectations for inflation and some key macroeconomic variables.[4] Expectations behavior analyzed in this paper pertains to the forecasts collected through this survey. The survey participants include commercial banks, asset management and investment banks, insurance and factoring companies, pension funds, large firms and conglomerates, economists, and other professionals. Financial institutions constitute a large fraction (around 80 percent) of the survey participants. The data governance and statistics department of the CBRT regularly monitors the quality of

[4]The most recent set of the survey questions can be found at the CBRT website.

Figure 1. End-Year Inflation Targets and Realization, 2006–18



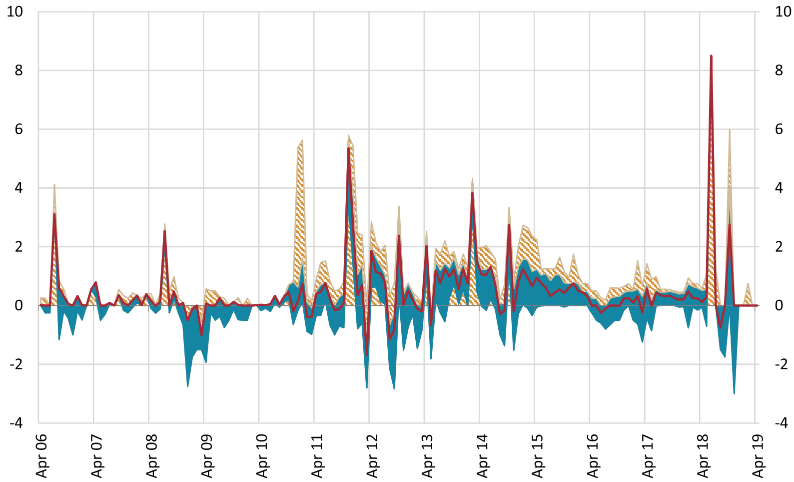
Source: CBRT, TurkStat.

the survey and contacts the participants to ensure a satisfactory participation rate. The survey is distributed to around 100 participants every month comprising professionals and institutions. The response rate has varied between 60 and 70 percent since 2006.[5] For the financial sector and large firms, the survey is sent directly to a representative of the institutions—typically the chief economist or the head of research. In a recent feedback study covering survey participants, around three-fourths of the respondents stated that their reported forecasts are institutional projections, implying that the responses largely reflect the institutions' official forecasts, possibly incorporating multiple cross-checks. Given this structure, the forecast production process should be less prone to the criticisms cited in the literature such as herd behavior, cheap-talk problems, and strategic misreporting.

Because forecasts are largely interpreted as institutions' views rather than individuals' own projections, changes in the specific survey representatives should have limited impact on the behavior of the institutions' forecasts. Still, the turnover may have some effect on the behavior of forecasts, as each individual is likely to add his/her

[5] Gülşen and Kara (2019) provide more detail on the survey response rates through time.

Figure 2. Distribution of Monetary Policy Surprises

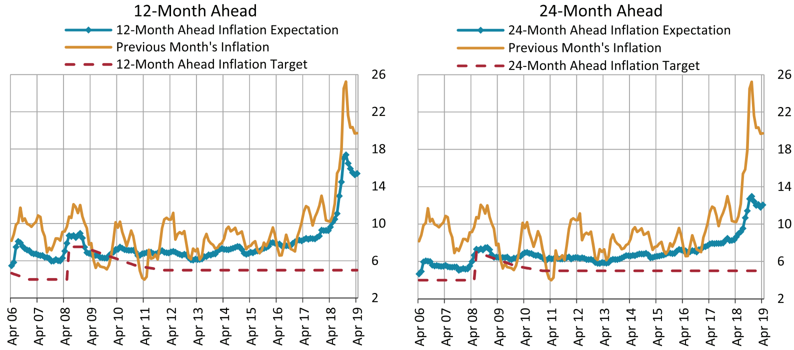


Source: CBRT.
Notes: The vertical axis reports the distribution of monetary policy surprises across survey respondents. For the April 2006–May 2018 period, individual-level monetary policy surprise is calculated as the difference between survey participants' end-of-month expectation and the realization for interbank market rate for the corresponding month. Since June 2018, survey expectations on one-week repo rate are used to calculate monetary policy surprises. A positive (negative) value for the surprise implies monetary policy is tighter (easier) than expected. The solid line is the median of the monetary policy surprise distribution for each month. The shaded areas comprise 50 percent and 90 percent of the cross-sectional distribution.

own judgment in forming expectations. Nonetheless, this effect is likely to be small on average, because in our sample only one-tenth of the survey respondents change institutions per year.

One of the strengths of the survey is that it has quantitative fixed-horizon inflation forecasts along with monetary policy expectations matched at the individual level. This unique feature enables us to explore the response of inflation expectations to the monetary policy surprises without imposing model-dependent identifying assumptions. As shown in figure 2, the distribution of the monetary policy surprises is quite dispersed across participants except for the periods of sharp and unpredicted movements in the policy rate during extreme market volatility. It is also interesting to observe

Figure 3. Inflation, Expectations, and Targets

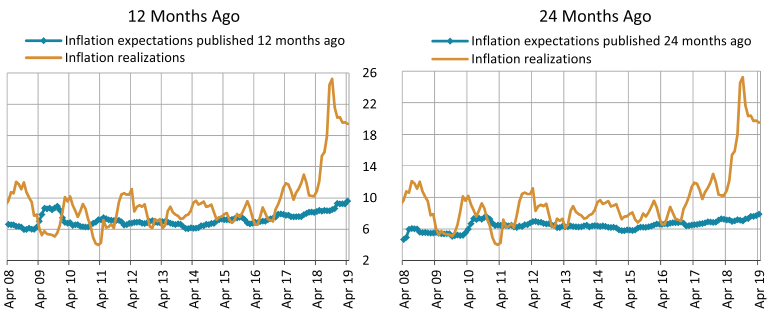


Source: CBRT, TurkStat.
Notes: All the inflation, target, and corresponding expectations series reflect annualized figures. The darker line (blue in color version of figure online) shows mean inflation forecasts by participants in the CBRT's Survey of Expectations. Until 2013, the survey was conducted twice a month. Starting from January 2013, participants are surveyed once a month. We use second-half-of-the-month results before January 2013. Monthly inflation target series are computed by linear interpolation of the year-end inflation targets.

that the cross-sectional dispersion increased considerably after 2010 with the implementation of the unconventional interest corridor policy. This picture suggests that exploiting the variation in surprises across forecasters may provide additional insights into the existing literature on estimating the impact of monetary policy surprises. Substantial variation in both cross-sectional and time-series dimensions facilitates the identification of the impact of policy shocks even in narrow moving-window estimates.

A cursory look at the historical plot of average inflation expectations reveals that expectations have been below the realized inflation but above the targets most of the time (figure 3). Moreover, inflation turned out to be consistently higher than expectations during the past decade (figure 4). The gap between inflation and the target has widened markedly at the end of the sample, which is likely to have affected the expectations formation process due to weaker anchoring role of the targets. In fact, inflation expectations have drifted upwards and moved closer to realized inflation after 2013, possibly related to persistent overshoots of the inflation targets. These observations suggest that anchoring power of the targets may

Figure 4. Forecast Performance of the Survey: Inflation Expectations and Realizations



Source: CBRT, TurkStat.

have waned through time—a recurrent theme that will be investigated throughout the paper.

3. Formation of Inflation Expectations

This section employs empirical specifications to explore the behavior of inflation expectations and their evolution through time. Deciding on the set of explanatory variables in an empirical model governing expectation dynamics is not a trivial task because inflation expectations of the professional agents may respond to a large array of variables affecting inflation outlook. Recent literature has suggested that, because of the reasons such as limited capacity for processing information, agents may choose a small set of variables to form their information set (Sims 2003). Existing studies on emerging economies typically adopt some version of an open-economy Phillips curve to explore the formation of inflation expectations, augmented by country-specific explanatory variables (Celasun, Gelos, and Prati 2004; Carvalho and Minella 2012). In this paper, we pursue a novel approach by utilizing the results of a direct "feedback survey" to determine the set of candidate explanatory variables, where the survey participants are asked to reveal the variables they use in constructing inflation forecasts. Doing so allows us to adopt a more tailored approach in choosing the variables of interest used in the main regressions, addressing possible endogeneity issues that may originate from omitted-variables and/or common factor problems.

3.1 A Survey of Survey Respondents: Which Variables Are Important in the Conduct of Inflation Forecasts?

Before turning to the empirical model, we summarize the results of the direct feedback from survey participants.[6] The feedback is collected by simply asking the survey participants to fill out the degree of importance they attach to certain variables when they forecast annual inflation at one- and two-year horizons. Specifically, we have provided the participants with a list of macrovariables and made the following request: "Please mark the variables you use when constructing your (one- and two-year) inflation forecasts and their degree of importance." The participants are asked to choose among four options: "high," "medium," "low," and "no" importance. Next, the feedback is quantified and aggregated for each variable by assigning grades to individual responses from 3 to 0, representing the range from high importance to no importance, respectively.

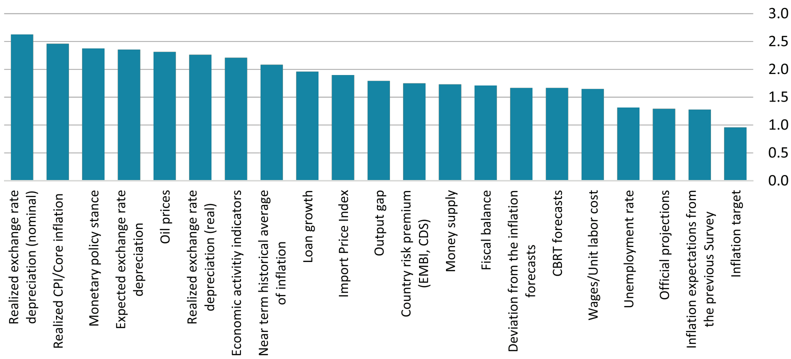
Figure 5 summarizes the results. The horizontal axis depicts the variables that appeared in the list provided to the participants as candidate variables having the potential to influence inflation forecasts. The vertical axis shows the score of each variable averaged across all participants. The quantitative scores provide a metric to assess the degree of relative importance of each variable in driving inflation forecasts.[7] The closer is the score to 3, the more important is the variable in shaping overall inflation expectations. For example, nominal exchange rate depreciation (USD/TL) makes the top among all variables with a value of 2.63 out of 3, whereas inflation target gets the lowest score with 0.96.[8]

[6]The survey was designed and conducted in June 2019 jointly with the data governance and statistics department of the CBRT. The questions were distributed to around 80 people, which constitutes the whole sample, and 50 of the respondents have provided direct feedback on the variables they use in forecasting inflation.

[7]We have tried different specifications in quantifying the feedback responses, but the ranking of the variables did not change in any meaningful way.

[8]Participants were also asked to state other relevant variables (not listed in the feedback forms) used in forecasting inflation, but they have not revealed any significantly important variable that would change the ranking in figure 5.

Figure 5. Importance of Variables Driving Inflation Forecasts: Survey Participants' Scores (out of 3)



Source: CBRT.
Notes: Values in the vertical axis show the average score of the corresponding variable in driving inflation forecasts across survey participants. The responses of survey participants are quantified by assigning grades from 3 to 0, for "high importance," "medium importance," "low importance," and "no importance," respectively.

Feedback results from the survey respondents show that the top six variables driving inflation forecasts of the professionals are exchange rates, inflation outturn, monetary policy stance, oil prices, economic activity, and near-term historical average of inflation. Each of these variables has an average score of more than 2 out of 3. These variables will constitute the base for the regressor set in our empirical models. Note that the participants attach high scores to various forms of exchange rate variables (nominal, real, and expected); but given the possible collinearity between these variables, we decided to use only one of the exchange rate variables, namely the nominal depreciation, which has the highest rank among the whole list.

Interestingly, the survey respondents seem to assign a very low weight to the inflation target when forming their inflation expectations. This observation suggests that the inflation target does not serve as an anchor among the survey respondents. We should note that the reported direct feedback is very recent, which represents the expectation formation process at the end of the sample period. Whether the targets had a low weight in shaping the expectations during the (relatively more successful) initial periods of the inflation-targeting period is an important question to be explored. Therefore, we will include the targets in our empirical specifications to assess the changing nature of expectations and their interaction with the background policy setting. The evolution of the estimated coefficients and the results of the feedback survey will be jointly used for cross-check purposes to support our main hypothesis.

3.2 The Empirical Model

Our aim is to explain the movements in inflation expectations at the individual level. The cross-sectional dimension of our data set captures around 70 participants per month, while the time dimension is about 150 months, which includes a rich panel of forecasters to identify some of the key factors driving inflation expectations. The empirical strategy will be running panel regressions of expectations on the relevant macroeconomic and policy variables and tracking the evolution of the key coefficients through rolling windows.

In light of the feedback from the survey participants and considering the related empirical literature, we construct the following model to explain inflation expectations:

$$\begin{aligned} \pi^e_{i,t|t+k} = {} & \beta_1 \pi_{t-1} + \beta_2 \pi^{MA12}_{t-1} + \beta_3 \pi^{target}_{t|t+k} + \beta_4 MP^{surprise}_{i,t-1} \\ & + \beta_5 \Delta basket_{t-1} + \beta_6 \Delta ipi_{t-2} + \beta_7 \Delta oil_{t-1} \\ & + \beta_8 D_{Target\ Revision} + \mu_i + \varepsilon_{it}. \end{aligned} \tag{1}$$

The dependent variable $\pi^e_{i,t|t+k}$ shows k-month-ahead inflation forecast (expectation) of participant i at time t.[9] The specific lag structure chosen for the explanatory variables reflects the information set available to the survey participants when constructing the forecasts.[10] The first two variables on the right-hand side pertain to

[9]During the initial years of the survey, the longest-term inflation forecast was one year. After the introduction of an explicit inflation-targeting regime in 2006, the survey questions were further expanded to include medium-term (two-year-ahead) inflation forecasts. In order to incorporate the two-year-ahead inflation forecasts, we start the sample at year 2006.

[10]Using lagged variables may also help to address potential endogeneity issues between expected inflation and other macrovariables as argued by Mehrotra and Yetman (2018).

observed levels of past inflation: π_{t-1} is the annual inflation rate of the previous month, which is the latest inflation figure observed by the time of the survey. π_{t-1}^{MA12} is the moving average of the annual inflation rate of the previous 12 months. Note that we use both previous month's inflation and last 12 months' average inflation to capture the sensitivity to past inflation components. The idea is that survey participants attach some weight to the most recent level of inflation, but they also consider the history of inflation in forming their forecasts.[11] Adding this latter variable to the set of regressors is also justified by the direct feedback from the survey respondents (see figure 5). $\pi_{t|t+k}^{target}$ represents the CBRT's k-month-ahead inflation targets known to the forecaster at time t, which is constructed by interpolating the end-year inflation targets.

$MP_{i,t-1}^{surprise}$ denotes the individual-level monetary policy surprise variable. This variable is constructed by taking into account the changes in the CBRT's operational framework. For the April 2006–May 2018 period, the policy surprise variable is calculated as the difference between participant i's end-of-month expectation and the realization for the interbank market rate. During this period, the overnight interbank rate is used to represent the monetary policy stance, rather than the official policy rates, because interbank rates have occasionally deviated from the official policy rates during the implementation of unconventional interest rate corridor policy. Related research shows that the de facto policy stance has been represented by the interbank rates during this period (Binici, Kara, and Özlü 2019). Since June 2018 the CBRT reverted to a relatively more conventional interest rate corridor system in which the one-week repo auction rate represents the policy rate. Therefore, after this period, we use survey expectations on the one-week repo rate to calculate monetary policy surprises. A positive (negative) value of $MP_{i,t-1}^{surprise}$ implies monetary policy surprise on the tightening (easing) side. The coefficient of this variable in the rolling regressions will be of particular interest, as part of our aim will be to track

[11]In fact, R^2 of a simple ordinary least squares (OLS) regression of actual 12-month-ahead inflation to one-month lagged and MA(12) inflation is 0.75, where most of the variation is explained by the MA(12) term. Therefore, past inflation variables we use in the regressions have strong predictive power for future inflation.

the interaction of monetary policy framework with the expectations behavior. Having an individual-level measure of the policy surprise is a valuable feature of the data set. To our knowledge, the CBRT survey is the only official broad-coverage survey asking the expectations of policy rates jointly with fixed-horizon inflation forecasts for a reasonably long period (13 years) at the monthly frequency.

$\Delta basket_{t-1}$ is the annual percentage change in the monthly average currency basket (representing euro and U.S. dollar in equal weights). A positive value in this variable indicates depreciation of Turkish lira. We use Δipi_{t-2} as a measure of economic activity, which is constructed using the three-month moving average of annual percentage change of the seasonally and calendar-adjusted industrial production index. This variable is lagged two months because industrial production data are publicly available with a two-month lag.[12] We apply three-month moving-average transformation to smooth excessive volatility in the monthly industrial production. Moreover, Δoil_{t-1} shows a six-month percentage change of monthly average crude oil price in U.S. dollars.[13]

$D_{Target\ Revision}$ is a dummy variable controlling for the announcement effect of the target revision in June 2008. The dummy variable takes the value of 1 for June 2008 and 0 otherwise. Finally, μ_i represents individual fixed effects, used to avoid any bias due to time-invariant individual characteristics that may be correlated with the independent variables. We use Driscoll and Kraay (1998) standard errors to account for cross-sectional and time correlation in the errors.

The use of forecaster-level microdata helps to address some of the endogeneity issues related to reverse causality problems in the empirical models using aggregate data, as discussed in Boneva et al. (2016). Individual expectations are affected by the inflation and other macrovariables but cannot significantly influence these variables. Therefore, employing a forecaster-level dependent variable eases the simultaneity problems inherent in macro relationships.

[12] We have also used one-month lagged or contemporaneous values of the industrial production for robustness purposes but the results remained intact.

[13] We use different data transformations for oil and exchange rates (six months and one year percentage change, respectively) in order to avoid possible collinearity between the U.S. dollar and oil prices.

While this addresses the reverse causality issue, expectations and the explanatory variables may still be driven by a common factor, which may be another source of endogeneity. Controlling for all the relevant variables on the right-hand side alleviates the common factor issue, but this is not a trivial task. Relative strength and the novel feature of our approach compared with similar studies is that we are able to relate the choice of explanatory variables to direct evidence, thanks to the availability of feedback from the survey respondents, which should minimize the omitted-variable problem.

Our particular focus when interpreting the empirical results will be on the role of inflation target, past inflation, exchange rates, and monetary policy in driving inflation expectations, as well as their changing nature through time. Table 1 shows panel regression results of the baseline empirical model for one-year and two-year inflation expectations. The high R^2 values, which are 0.8 for 12-month and 0.7 for 24-month expectations, suggest that the model is able to explain a sizable portion of the variations in inflation expectations. Moreover, both the sign and the magnitude of the coefficients on the explanatory variables are reasonable in economic terms. Inflation expectations have a positive and strongly significant relationship with the past inflation terms and the targets. The coefficients on the economic activity, exchange rates, and oil prices are positive and significant. The coefficient on the monetary policy surprise has a negative and significant sign, implying that tighter-than-expected monetary policy leads to lower inflation expectations.[14] However, these effects are not economically significant in the sense that the fit of the regression seems almost identical when we use the median surprise or altogether drop the individual-level surprises (not reported). Still, tracking the sign and statistical significance of the coefficients through time provides valuable information regarding the behavior of inflation expectations.

Although the coefficients on policy surprises seem to be in line with the textbook response, this may not reflect the expectations

[14] Note that, under a completely credible inflation target, expectations of inflation at long-enough horizons should not respond to shocks, including policy surprises. In our case, we use one- and two-year expectations due to data limitations for longer-term expectations. One- or two-year-ahead inflation may be within the horizon where policy is perceived to be effective, but not enough to fully offset the impact of shocks and bring inflation back to target at all times.

Table 1. Drivers of Survey-Based Inflation Expectations (April 2006–April 2019)

Dependent Variable: k-month-ahead annual inflation expectations of participant i at time t ($\pi^e_{i,t\|t+k}$)				
$k =$	**(1) 12-Month**	**(2) 24-Month**	**(3) 12-Month**	**(4) 24-Month**
CPI Inflation_{t-1}	0.335***	0.205***	0.366***	0.259***
	(0.029)	(0.042)	(0.037)	(0.035)
MA12 Inflation_{t-1}	0.371***	0.229***		
	(0.042)	(0.080)		
Inflation $\text{Target}_{t\|t+k}$	0.358***	0.665**	1.087***	1.482***
	(0.098)	(0.282)	(0.197)	(0.320)
Policy $\text{Surprise}_{i,t-1}$	−0.025*	−0.042**	−0.040***	−0.057***
	(0.014)	(0.021)	(0.009)	(0.020)
Nom. $\text{Depreciation}_{t-1}$	0.034***	0.025***	0.036***	0.025***
	(0.002)	(0.007)	(0.003)	(0.006)
IPI Growth_{t-2}	0.039***	0.030***	0.042***	0.024***
	(0.013)	(0.008)	(0.013)	(0.009)
Oil Price Growth_{t-1}	0.010***	0.008***	0.006***	0.005**
	(0.002)	(0.003)	(0.002)	(0.003)
$\text{Dummy}_{\text{Target Revision}}$	−0.087	−1.090*	−0.269**	−1.102**
	(0.177)	(0.606)	(0.112)	(0.428)
MA12 Target Deviation_{t-1}			1.229***	1.229**
			(0.328)	(0.478)
MA12 Target Dev._{t-1}* Inflation $\text{Target}_{t\|t+k}$			−0.186***	−0.222**
			(0.051)	(0.091)
Observations	8,182	7,943	8,182	7,943
R^2	0.799	0.688	0.803	0.695

Notes: MA12 Target Deviation_{t-1} shows the 12-month moving average of the deviation of annual inflation rate from the inflation target. *, **, and *** represent statistical significance at levels of 10, 5, and 1 percent, respectively. Driscoll and Kraay (1998) standard errors are given in parentheses.

behavior for all episodes, given that the interest-setting framework has shown considerable shifts during our sample period. In the next section, we will run moving-window estimates to understand if the response of the expectations to the interest rate decisions have shown behavioral shifts through time.

Empirical results in table 1 suggest that agents pay significant attention to past inflation terms, represented by the latest inflation print and the near history (as represented by the MA12 term). The coefficient on inflation targets may be interpreted as a measure of the degree of anchoring in inflation expectations. For one-year-ahead inflation expectations, the coefficient on the inflation target is smaller than the sum of the coefficients on the past inflation variables.[15] Regarding two-year-ahead expectations, the coefficient of the target is higher than the sum of the coefficients on past inflation terms. The finding that longer-term expectations are more sensitive to inflation targets makes sense, given the role of inflation targets in the policy regime. These findings are in line with Mehrotra and Yetman (2018) who argue that, as the forecast horizon shortens, newly arriving public information such as past inflation realizations become more relevant in driving inflation expectations. Overall, full-sample results suggest that inflation targets on average seem to have served at least as a partial anchor for medium-term expectations.

Recall that our direct evidence extracted from the feedback survey indicated that the survey participants do not rank the inflation target as a significant variable in forming their inflation forecasts as of the end of the sample period. On the other hand, the empirical results in table 1 suggest that agents attach a reasonable and highly significant weight to inflation targets for the whole sample period. Taken together, these observations suggest that the role of targets in anchoring expectations may have changed through time, which will be further explored in the upcoming sections.

One candidate explanation for the changing weight of the inflation targets may be related to the sizable and persistent deviations of inflation from the targets, which may have undermined the anchoring role of the targets. In order to further investigate this hypothesis, in the last two columns of table 1, we explore whether the anchoring degree of the targets depends on the past performance in meeting the targets. To this end, we ask the following question: Does the inflation-targeting performance—measured by the gap between inflation realizations and the target—affect the sensitivity of expectations to the targets? In order to test this hypothesis, we interact the inflation targets with the difference between realized inflation and the target in the baseline specification averaged over the past

[15] Although the inflation target has a relatively large coefficient in the baseline regression (especially for two-year expectations), its partial R^2 in explaining inflation expectations (reported in table A.1 of the appendix) is relatively small due to low variation of the targets.

year (table 1, columns 3 and 4). The answer is a clear yes, as depicted by the highly significant negative coefficient of the interaction terms shown at the last row. The results reveal that the higher is the gap between inflation and the target, the lower is the weight attached to targets. Sensitivity of expectations to the inflation-targeting performance seems to be higher for medium-term expectations (last column of table 1). These results support the view that persistent upside breaches of the inflation targets have weakened the anchoring power of the targets through time. This finding is also consistent with the direct evidence obtained from the survey participants, who have ranked the inflation target as the least important variable in driving their forecasts in a recent feedback survey (figure 5).

3.3 The Interaction between Exchange Rates and the Expectation Formation Process

We now turn to the interaction of inflation expectations behavior with the movements in exchange rates (table 2). Table 2 runs the baseline regressions by interacting key variables with an "exchange rate depreciation dummy," which takes the value of 1 for the periods where the exchange rate depreciated in the past 12 months and 0 otherwise. In total, we have 34 appreciation and 123 depreciation periods in our sample. Almost all the appreciation points take place before 2013, which was a period of relatively better performance in reaching the inflation targets.

The coefficient of the interaction term is significant and positive for the past inflation and negative for the inflation targets. In other words, during depreciation episodes, the weight attached to past inflation is higher and the weight on the inflation target is lower, compared with appreciation periods. These results reveal that the targets might be perceived as less of an anchor during depreciation episodes, possibly pointing to some interaction between the credibility of the inflation targets and the exchange rate depreciation. Expectations seem to be more sensitive to exchange rate movements during depreciation periods. These findings suggest that exchange rate depreciation periods coincide with weaker anchoring of inflation expectations. Overall, the behavior of inflation expectations seems to be sensitive to exchange rate movements, suggesting a strong

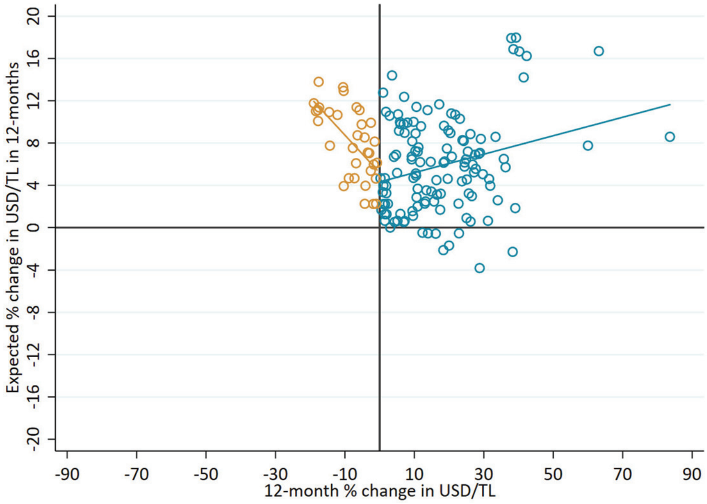
Table 2. Exchange Rate Movements and the Behavior of Expectations (April 2006–April 2019)

Dependent Variable: k-month-ahead annual inflation expectations of participant i at time t ($\pi^e_{i,t\|t+k}$)		
$k =$	**(1) 12-Month**	**(2) 24-Month**
CPI Inflation$_{t-1}$	0.047	−0.017
	(0.034)	(0.068)
CPI Inflation$_{t-1}$ * Depr. Dummy	0.272***	0.215***
	(0.056)	(0.078)
MA12 Inflation$_{t-1}$	0.405***	0.238***
	(0.038)	(0.051)
Inflation Target$_{t\|t+k}$	0.840***	1.080***
	(0.049)	(0.079)
Inflation Target$_{t\|t+k}$ * Depr. Dummy	−0.647***	−0.588***
	(0.146)	(0.161)
Policy Surprise$_{i,t-1}$	−0.026*	−0.043***
	(0.015)	(0.010)
Nom. Depreciation$_{t-1}$	0.012***	0.010*
	(0.005)	(0.006)
Nom. Depreciation$_{t-1}$ * Depr. Dummy	0.020***	0.017**
	(0.006)	(0.007)
IPI Growth$_{t-2}$	0.033**	0.026***
	(0.015)	(0.005)
Oil Price Growth$_{t-1}$	0.011***	0.008***
	(0.002)	(0.002)
Depr. Dummy	1.237	1.120
	(1.127)	(1.410)
Observations	8,182	7,943
R^2	0.809	0.695

Notes: Depr. Dummy is a dummy variable that takes 1 for the periods of Turkish lira depreciation, i.e., Nom. Depreciation$_t$ is positive. *, **, and *** represent statistical significance at levels of 10, 5, and 1 percent, respectively. Driscoll and Kraay (1998) standard errors are given in parentheses.

interaction between the exchange rates and the expectations formation process. This result may reflect that exchange rates play a more important role in driving inflation expectations, beyond the dimension of pass-through to domestic prices. In fact, Coibion and Gorodnichenko (2015) argue that in countries with high inflation, economic agents could routinely use exchange rates as a statistic summarizing the stance of monetary and fiscal policies as well as other macroeconomic conditions to infer the rate of inflation.

Figure 6. Realized vs. Expected Exchange Rate Movements (April 2006–April 2019)



Source: CBRT.

In order to further explore the behavioral asymmetry with respect to the exchange rate movements, we look at how the relation between realized and expected exchange rate changes differs during appreciation and depreciation episodes. Figure 6 depicts the scatter-plot of past 12-months' exchange rate (USD/TL) depreciation rate versus expected depreciation rate in the next 12 months by survey participants. The dots at the right side of the vertical axis indicate that weaker TL observed in the past year prompts expectations of further depreciation in the next 12 months, as most of the observations are in the first quadrant. On the other hand, as depicted by the dots at the left side of the vertical axis, survey respondents expect past appreciation periods to be somewhat reversed by future depreciation periods. In other words, appreciations are perceived as more temporary. These observations may help to explain why the linear relation between exchange rate movements and inflation expectations exhibit asymmetry. To the extent that the actual behavior of price setters mimics that of survey participants, such an asymmetric pattern in the expectation behavior may also lead to asymmetry in the realized exchange rate pass-through to inflation.

3.4 Formation of Expectations: Do the Financial and Real Sectors Differ?

Next, we investigate whether expectations formation differs between real- and financial-sector participants (table 3). This question is addressed by estimating the baseline empirical model with a binary dummy that takes the value of 0 or 1 denoting whether the participant is a representative of the financial or real sector, respectively.[16] We interact the dummy with each regressor and interpret the estimated coefficients. The results suggest that coefficients for both groups are of similar size, yet there are some statistically significant discrepancies. Financial-sector participants significantly put one-third more weight on inflation targets for the medium-term horizon than do real-sector participants. Response of the two-year-ahead financial-sector forecasts to the target revision in June 2008 is stronger and the difference is statistically significant. Regarding the sensitivity of expectations to the exchange rates and economic activity, there are also statistically significant differences across two groups, where financial participants seem to respond more strongly to the release of macrovariables, especially for the medium term. Overall, the results suggest that the financial sector's and the real sector's attentiveness to new information released by the central bank shows some heterogeneity, which echoes the point made by Blinder et al. (2008): Central banks, which largely focus on the financial markets in designing their communication strategy, need to develop alternative tools for communicating with the general public.

3.5 Has the Behavior of Inflation Expectations Changed through Time?

As explained in section 2, Turkish inflation dynamics and monetary policy framework has gone through significant changes during the past decade, especially after the global financial crisis, which might have significant implications for the inflation expectations formation process. We will seek to identify the changes in the behavior

[16]The real-sector participants are typically chief financial officers (CFOs) or chief economists of large conglomerates.

Table 3. Financial- and Real-Sector Expectations (April 2006–April 2019)

Dependent Variable: k-month-ahead inflation expectations of participant i at time t ($\pi^e_{i,t\|t+k}$)		
k =	**(1) 12-Month**	**(2) 24-Month**
CPI Inflation$_{t-1}$	0.336***	0.206***
	(0.028)	(0.029)
CPI Inflation$_{t-1}$ * Real-Sector Dummy	0.006	0.009
	(0.014)	(0.009)
MA12 Inflation$_{t-1}$	0.372***	0.235***
	(0.047)	(0.063)
MA12 Inflation$_{t-1}$ * Real-Sector Dummy	−0.007	−0.016
	(0.031)	(0.033)
Inflation Target$_{t\|t+k}$	0.364***	0.722***
	(0.108)	(0.185)
Inflation Target$_{t\|t+k}$ * Real-Sector Dummy	−0.017	−0.238*
	(0.052)	(0.122)
Policy Surprise$_{i,t-1}$	−0.021	−0.036**
	(0.019)	(0.015)
Policy Surprise$_{i,t-1}$ * Real-Sector Dummy	−0.009	−0.011
	(0.026)	(0.025)
Nom. Depreciation$_{t-1}$	0.034***	0.027***
	(0.003)	(0.005)
Nom. Depreciation$_{t-1}$ * Real-Sector Dummy	−0.006***	−0.007*
	(0.002)	(0.004)
IPI Growth$_{t-2}$	0.037***	0.031***
	(0.013)	(0.006)
IPI Growth$_{t-2}$ * Real-Sector Dummy	0.008***	−0.014***
	(0.002)	(0.004)
Oil Price Growth$_{t-1}$	0.010***	0.008***
	(0.003)	(0.003)
Oil Price Growth$_{t-1}$ * Real-Sector Dummy	−0.001	−0.001
	(0.001)	(0.001)
Dummy$_{\text{Target Revision}}$	−0.094	−1.336***
	(0.190)	(0.352)
Dummy$_{\text{Target Revision}}$ * Real-Sector Dummy	−0.060	0.816***
	(0.074)	(0.229)
Observations	7,712	7,473
R^2	0.797	0.682

Notes: This table shows the regression results of the baseline empirical model (equation (1)) for survey participants from financial and real sector. Real-Sector Dummy is a dummy variable that takes a value of 1 if the survey participant is from the real sector and takes 0 if it is from the financial sector. *, **, and *** represent statistical significance at levels of 10, 5, and 1 percent, respectively. Driscoll and Kraay (1998) standard errors are given in parentheses.

of inflation expectations by estimating moving-windows regressions and tracking the relevant coefficients in time.

We modify the baseline model (equation (1)) slightly to conduct the rolling regressions. The reason for using a different setup is the lack of variation in inflation targets since 2012. In other words, in our baseline model, one of the explanatory variables is constant during the last six years of the sample period. While this may not be a problem for the entire sample, it creates complications with short-horizon moving-window estimates. In order to circumvent this problem, we employ a modified version of the baseline model in equation (1), by simply replacing the *inflation-level* variables with the "gap" terms. Accordingly, our modified empirical model takes the following form:

$$\begin{aligned}\left(\pi_i^e - \pi^{target}\right)_{t|t+k} = \alpha_1 \left(\pi - \pi^{target}\right)_{t-1} + \alpha_2 \left(\pi - \pi^{target}\right)_{t-1}^{MA12} \\ + \alpha_3 MP_{i,t-1}^{surprise} + \alpha_4 \Delta basket_{t-1} + \alpha_5 \Delta ipi_{t-2} \\ + \alpha_6 \Delta oil_{t-1} + \mu_i + \varepsilon_{it}. \qquad (2)\end{aligned}$$

Our transformed dependent variable is now k-month-ahead inflation expectations minus the corresponding inflation target, which we denote as $((\pi_i^e - \pi^{target})_{t|t+k})$. We call this variable "the credibility gap," representing the gap between central bank's k-period-ahead inflation target and private agents' forecasts of inflation for the same horizon. Past inflation terms on the right-hand side are also transformed into the gap form. Instead of inflation levels, we use the gap between realized inflation and the target as explanatory variables. Accordingly, $(\pi - \pi^{target})_{t-1}$ shows the deviation of previous month's inflation rate from the corresponding target and $(\pi - \pi^{target})_{t-1}^{MA12}$ denotes past 12-month moving average of this deviation. Here, once again we assume that survey participants, when constructing their forecasts, not only consider the most recent inflation figures, but also take into account an average of near history performance (represented by the MA12 term). Other explanatory variables are exactly in the same form as in equation (1), except that we dropped the target change dummy, as the new form of the dependent variable makes it redundant. Table A.2 in the appendix shows the regression results for the credibility gap. As expected, the coefficients are almost identical to the results of the level specification.

In order to track the time-varying behavior of inflation expectations, we run five-year moving-window regressions. Figure 7 shows the evolution of coefficients on (i) the sum of past inflation terms (previous month's inflation and 12-month average inflation), (ii) exchange rate depreciation, and (iii) central bank policy surprises at the individual level.

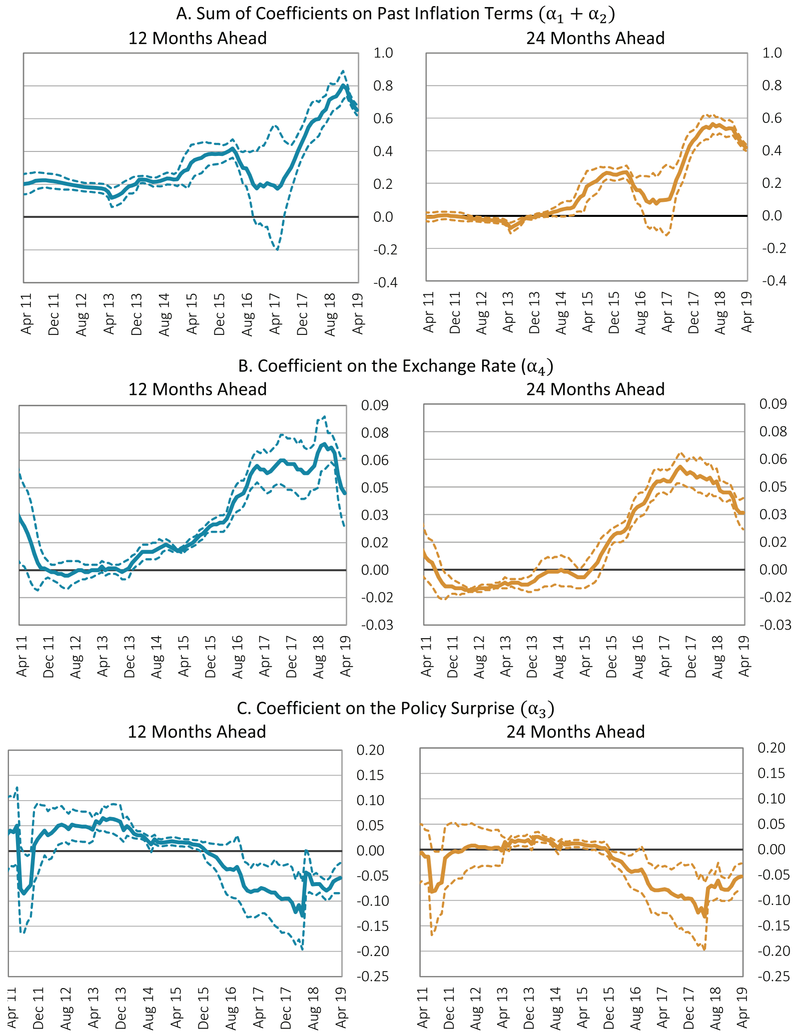
Several implications emerge from the rolling regression results. The sum of the coefficients on past inflation components exhibits a marked upward movement towards the end of the sample period (figure 7A). In other words, survey participants tend to attach increasingly higher weight to the previous inflation figures when forming expectations. Considering the significant upside breaches towards the end of the sample period, this finding is consistent with the negative sign of the interaction term in table 1. The anchoring role of inflation targets seems to have weakened as the gap between inflation and targets has widened.

Private forecasters attach higher weights to the past inflation in recent years, and the shift has become more noticeable after 2017—a period marked by persistent double-digit inflation. Given the sharp exchange rate depreciation of the Turkish lira towards the end of the sample period, these results are also consistent with the findings presented in table 2, which implies higher sensitivity of expectations to past inflation during depreciation periods.

The results depicted in figure 7B reveal that the relationship between exchange rate and inflation expectations has strengthened after 2013, which coincides with the persistent depreciation in the Turkish lira during this period. Higher inflation and inflation volatility, combined with the asymmetric pass-through effects may have altered the observed relationship between exchange rates and inflation expectations. Although the causality may run in both directions, this finding is notable, as it implies a stronger feedback between exchange rates and inflation expectations in driving the inflation process.

On the other hand, it is interesting to note that the upward trend in the sensitivity of expectations to past inflation and exchange rates seems to have partly reversed course towards the end of the sample period, as depicted by the decline in the coefficients in figure 7A and 7B during the recent period. These changes broadly coincide with a tighter monetary policy stance (the central bank increased

Figure 7. Five-Year Rolling Regressions for the Credibility Gap



Notes: Dates in the x-axis show the last month of the 60-month (five-year) rolling windows. Dashed lines show 90 percent confidence intervals with Driscoll and Kraay (1998) standard errors.

the base policy rate sharply in September 2018) and the adoption of a more conventional policy framework by mid-2018, although more observation is needed to make a firmer assessment on the drivers and significance of this behavioral shift.

Evolution of the coefficients on the monetary policy surprises across time provides useful insights regarding how monetary policy interacts with expectations under different policy frameworks. Under a conventional framework, a positive monetary policy shock would lower medium-term inflation expectations by signaling a tighter-than-expected policy stance. In fact, the full-sample estimations shown in table 1 and table A.2 reveal a negative and significant coefficient for the policy surprises. However, moving-window estimates depicted in figure 7C reveal that the coefficients showing the impact of monetary policy surprises on the inflation expectations vary across time, and these changes largely coincide with the shifts in the monetary policy framework. Adoption of an unconventional interest rate corridor policy in 2011 and the gradual exit from this framework after 2016 may explain some of the changing relationships. Between 2011 and 2015, the CBRT used a relatively complicated and high-frequency interest rate policy to smooth exchange rate fluctuations (Kara 2015). Moving-window regression coefficients suggest that, during this period, the response of the medium-term (two-year) inflation expectations to monetary policy surprises are insignificant and short-term (one-year) expectations respond with a wrong (positive) sign. This result makes sense because during this period, monetary policy surprises are likely to be perceived as short-term reactions to exchange rate volatility rather than a response to medium-term inflationary pressures. On the other hand, the sign of the policy surprise coefficient turns negative after 2016, following the attempts of gradually reverting to a more conventional monetary policy framework (figure 7C). With the normalization of monetary policy strategy towards the end of the sample period, a surprise tightening (easing) seems to be associated with a decrease (increase) in medium-term inflation expectations, as predicted by the conventional theory. Our unique data set including matched forecasts for inflation and the policy rate at the individual level, as well as the frequently changing nature of the background monetary policy framework, enables us to make these assessments with a reasonable precision.

The finding of an upside response of inflation expectations to tightening surprises in some occasions is not specific to our study. For example, Andrade and Ferroni (2018) argue that the “wrong sign” of the policy surprise coefficients in the case of the European Central Bank is due to the fact that policy surprises are perceived as news about future macroeconomic conditions, rather than a stronger or weaker commitment for the price stability objective. In our case, the economic agents may have perceived the high-frequency interest rate hikes as a signal of future exchange rate pressures during the period of unconventional interest rate corridor framework, which may have contaminated the relationship between policy surprises and inflation expectations.

Overall, the results suggest that the expectation dynamics have exhibited notable changes throughout the sample period, possibly associated with the underlying policy and economic performance.

One important question is whether the change in the actual inflation process mimicked the changes in the expectation dynamics. In order to contrast the pattern of changing expectation behavior with the inflation process itself, we have regressed actual inflation on lagged inflation and exchange rates along with similar control variables used in the empirical model for inflation expectations. The regression results are reported in figure 8 with five-year rolling windows. The coefficients on past inflation and the exchange rate depreciation in this regression rise sharply after 2017.[17] More interestingly, a comparison of figure 7B with figure 8B suggests that the sensitivity of inflation expectations to exchange rates started to increase before the rise in the estimated exchange rate pass-through.[18]

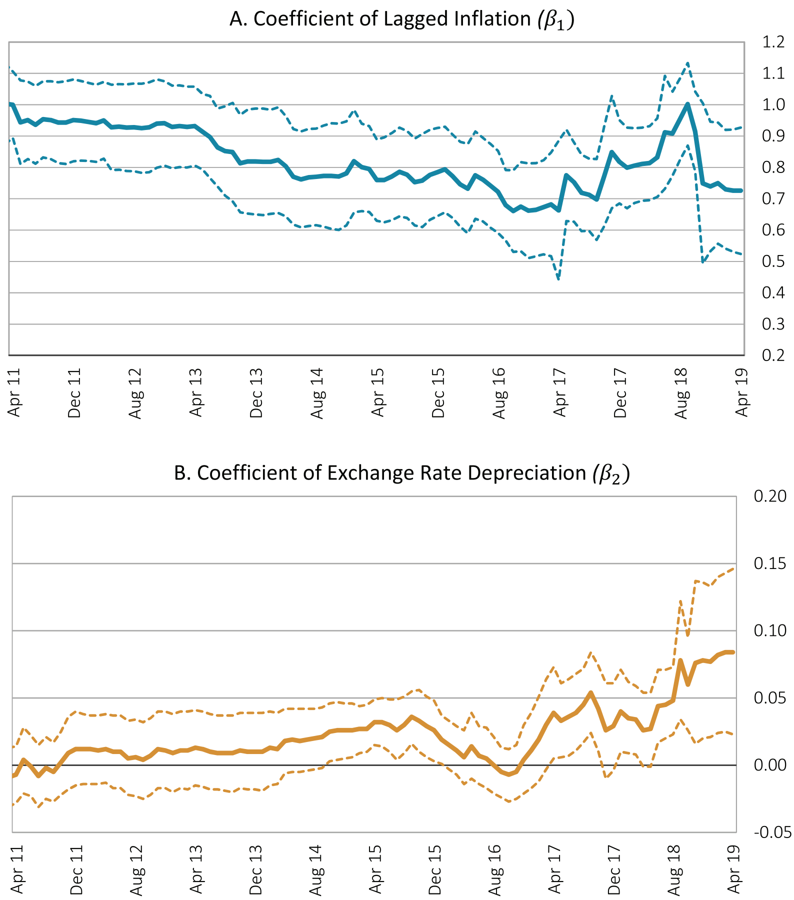
Our analysis so far suggests that the behavioral shift in inflation expectations might be attributed to the performance of achieving the inflation objectives. A complementary possible explanation for the increased prominence of past inflation and exchange rates in

[17]A recent CBRT Inflation Report box presents similar findings using a time-varying parameter model of the inflation process developed in Kara, Öğünç, and Sarıkaya (2017). For details, see CBRT (2019).

[18]The structural break dates based on supremum Wald and Lagrange multiplier tests suggest that a significant shift in inflation dynamics has materialized around June 2016.

Figure 8. Coefficient of Lagged Inflation and Exchange Rate Depreciation in Explaining Annual Inflation (five-year rolling regressions)

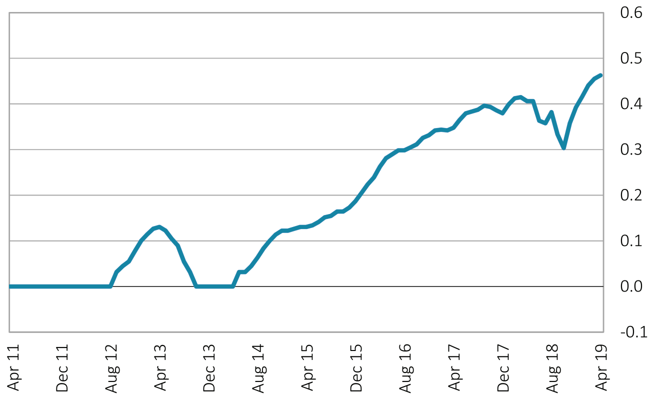
$$\pi_t = \beta_1\pi_{t-1} + \beta_2\Delta basket_{t-1} + \beta_3 ipi_{t-2} + \beta_4\Delta oil_{t-1} + \varepsilon_t$$



Notes: Dates in the x-axis show the last month of the 60-month (five-year) rolling windows. Dashed lines indicate 95 percent confidence intervals.

driving inflation expectations in recent years may be related to higher attentiveness of participants to these variables with the heightened volatility during the corresponding period (Coibion and Gorodnichenko 2015). In fact, figure 9 reveals that the individual-level correlation between expected exchange rate depreciation and

Figure 9. Co-movement of Individuals' 12-Month-Ahead Inflation Expectations and Expected TL Depreciation in 12 Months (five-year rolling correlation coefficients)



Source: CBRT.

expected inflation at the one-year horizon strengthened considerably towards the end of the sample period.

3.6 Robustness Analysis

In this subsection, we present some modifications and extensions to our baseline empirical model to see whether main findings remain robust against different specifications. To this end, we modify the main model in two dimensions: First, we use alternative definitions for key variables of interest, also considering the results of the direct feedback from participants. To this end, we add core inflation (instead of headline inflation), 24 months moving average of past inflation (instead of 12 months moving average), real effective exchange rate (instead of nominal exchange rate), and import prices (instead of oil prices). Second, we use additional explanatory variables that may be important in driving expectations dynamics implied by our feedback survey from respondents. Accordingly, we conduct alternative regressions by adding the following variables: (i) risk premium (monthly change in the Emerging Markets Bond Index (EMBI) spread), (ii) fiscal balance (primary budget balance to GDP ratio), (ii) money supply (rate of annual change in M1), and (iv) wage inflation (annual growth in hourly labor cost index).[19] Tables A.3 and A.4 in the appendix summarize the robustness results for one-year-ahead and two-year-ahead inflation expectations, respectively. Despite some minor discrepancies regarding the size of coefficients, our main conclusions are robust to all alternative specifications. The coefficients and the signs of the variables in the baseline model remain broadly the same. We also conduct moving-window estimates to see whether the main findings on the behavioral changes in expectations stay robust against alternative specifications. Moving-window estimates of the key parameters (past inflation, exchange rate, and policy surprise) are depicted in figures A.1 and A.2 in the appendix for the baseline and eight alternative models, with each column corresponding to a different specification. Although the size of the coefficients varies across models, their pattern and the evolution remain broadly robust. We still see parameters changing significantly through time associated with the background macroeconomic conditions and policy setting. The role of exchange rates and the past inflation terms seem to have strengthened through time. Policy rate surprises become insignificant during the implementation of the unconventional interest rate corridor between years 2011 and 2015, slightly gaining significance towards the end of the sample period.

Overall, our main results hold firmly across different specifications. Moreover, the robustness exercises show that direct feedback provided by the survey participants (summarized in figure 5) is highly consistent with the empirical results, confirming the usefulness of such feedback in supporting empirical research.

4. Concluding Remarks

We have investigated time-varying aspects of inflation expectation dynamics, seeking to explore how the behavior of expectations interacts with the policy setting and the macroeconomic performance. With its rapidly evolving macroeconomic and external conditions and highly volatile inflation process, the Turkish economy provides a

[19] Money supply series start from December 2006. Wage data are available at quarterly frequency and start from the first quarter of 2008, which is transformed into monthly series by assuming constant annual growth within the quarter.

genuine laboratory for exploring this question. Using individual-level data on a new survey of private forecasts, we document the changing dynamics of inflation expectations in response to the macroeconomic and policy environment. Our empirical model, which is built on direct feedback from survey participants, reflects a novel contribution to the related literature. The results imply that monitoring not only the *level* but also the *behavior* of inflation expectations may provide valuable insights for the formulation and the design of monetary policy.

The empirical evidence we provide on the expectations dynamics reveals that the behavior of inflation expectations may be highly sensitive to the underlying policy performance. Our results suggest that Turkish inflation expectations have been increasingly associated with the movements in exchange rates and past inflation through time, possibly associated with the changing macroeconomic landscape and the weakened anchoring power of the official targets through time. We support these findings by direct evidence from a recent feedback study conducted with the survey respondents, which reveals that towards the end of the sample period inflation target ceases to serve as an anchor in driving private inflation forecasts. These results indicate that the anchoring role of inflation targets can weaken considerably through time if the targets are breached for an extended period.

Overall, the Turkish experience offers important insights for other countries. The long-achieved credibility and strong anchoring of inflation targets across many emerging and advanced economies during the past decades should not be taken for granted. Credibility and the ability to shape expectations may shift quickly depending on the policy performance. The world experience and the literature so far has been on the benign examples where central banks gained credibility and inflation expectations became more anchored. Our study indicates that credibility may be gained yet lost quickly if promises are not delivered. The Turkish case, which shows that this may revert even after a period of successful inflation targeting, yields an important lesson for developing economies, which seem to be reverting to their previous ailments, and for developed economies, which face difficulties in raising inflation to their targets but have not suffered major credibility losses, yet.

Although our findings suggest that changes in the expectations formation process are related to the policy performance, we do not attempt to provide concrete evidence on why the performance of inflation targeting was far from stellar. Explaining the fundamental factors driving the inflation target overshoots or exchange rate depreciations during our sample period is beyond the scope of this paper. It should be noted that for the Turkish case, the significant changes in the behavior of inflation expectations coincided with a period of heightened concerns on central bank instrument independence, which may have accelerated the behavioral shift in inflation expectations. In that sense, deeper research is needed to unveil the specific underlying mechanisms leading to changes in the expectations behavior. It would be particularly an interesting extension for future work to explore to what extent the changes in the expectations dynamics are driven by the perceptions of sliding external outlook as opposed to domestic factors including macro policy setting and the role of strong institutions.

Appendix. Robustness Regressions

Table A.1. Partial R^2s for the Covariates in the Baseline Model of Table 1 (April 2006–April 2019)

	(1) $\pi^e_{i,t\|t+12}$	**(2)** $\pi^e_{i,t\|t+24}$
π_{t-1}	0.201	0.078
π^{MA12}_{t-1}	0.110	0.049
$\pi^{target}_{t\|t+k}$	0.043	0.071
$MP^{surprise}_{i,t-1}$	0.002	0.003
$\Delta basket_{t-1}$	0.106	0.070
Δipi_{t-2}	0.034	0.023
Δoil_{t-1}	0.040	0.026
No. of Observations	8,207	7,947

Notes: Values in column 1 and column 2 show the square of partial correlation coefficients of the corresponding variable with the 12-month-ahead and 24-month-ahead inflation expectations, respectively. Partial correlation coefficients measure the strength of a relationship between the corresponding variable and inflation expectations, while controlling for the effect of other variables. All the correlation coefficients are significant at the 1 percent significance level.

Table A.2. Drivers of Credibility Gap (expected deviation from the inflation targets) (April 2006–April 2019)

Dependent Variable: Credibility gap for participant i at time $t\,(\pi_i^e - \pi^{target})_{t\|t+k}$		
$\boldsymbol{k}$ **=**	**(1)** **12-Month**	**(2)** **24-Month**
Target Deviation$_{t-1}$	0.362***	0.217***
	(0.065)	(0.038)
MA12 Target Deviation$_{t-1}$	0.179***	0.078
	(0.068)	(0.075)
Policy Surprise$_{i,t-1}$	−0.064***	−0.077***
	(0.021)	(0.019)
Nom. Depreciation$_{t-1}$	0.037***	0.028***
	(0.008)	(0.008)
IPI Growth$_{t-2}$	0.040**	0.017*
	(0.019)	(0.010)
Oil Price Growth$_{t-1}$	0.013***	0.010***
	(0.003)	(0.002)
Observations	8,182	7,943
R^2	0.759	0.632

Notes: *, **, and *** represent statistical significance at levels of 10, 5, and 1 percent, respectively. Driscoll and Kraay (1998) standard errors are given in parentheses.

Table A.3. Robustness Analysis for 12-Month-Ahead Inflation Expectations (full-sample regressions)

Dependent Variable: 12-month-ahead annual inflation expectations of participant i at time t ($\pi^e_{i,t\|t+12}$)									
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
CPI Inflation$_{t-1}$	0.335***		0.293***	0.387***	0.306***	0.335***	0.336***	0.348***	0.331***
	(0.029)		(0.026)	(0.035)	(0.028)	(0.029)	(0.030)	(0.026)	(0.033)
Core Inflation$_{t-1}$		0.426***							
		(0.058)							
MA12 Inflation$_{t-1}$	0.371***	0.125**		0.350***	0.378***	0.370***	0.358***	0.377***	0.354***
	(0.042)	(0.055)		(0.039)	(0.033)	(0.041)	(0.034)	(0.033)	(0.032)
MA24 Inflation$_{t-1}$			0.675***						
			(0.063)						
Inflation Target$_{t\|t+12}$	0.358***	0.573***	0.274**	0.340***	0.373***	0.351***	0.217***	0.296***	0.289***
	(0.098)	(0.120)	(0.107)	(0.106)	(0.099)	(0.102)	(0.076)	(0.082)	(0.108)
Policy Surprise$_{i,t-1}$	−0.025*	−0.083***	−0.038**	−0.009	−0.026	−0.028	−0.024*	−0.030**	−0.021*
	(0.014)	(0.012)	(0.016)	(0.018)	(0.018)	(0.017)	(0.012)	(0.014)	(0.011)
Nom. Depreciation$_{t-1}$	0.034***	0.019***	0.035***		0.039***	0.033***	0.028***	0.027***	0.022***
	(0.002)	(0.006)	(0.004)		(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
Real Depreciation$_{t-1}$				−0.033***					
				(0.003)					

(*continued*)

Table A.3. (Continued)

Dependent Variable: 12-month-ahead annual inflation expectations of participant i at time t ($\pi^e_{i,t|t+12}$)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
IPI Growth$_{t-2}$	0.039***	0.022	0.047***	0.027**	0.029***	0.037**	0.030**	0.029***	0.051***
	(0.013)	(0.017)	(0.014)	(0.013)	(0.010)	(0.015)	(0.014)	(0.010)	(0.010)
Oil Price Growth$_{t-1}$	0.010***	0.016***	0.007***	0.009***		0.010***	0.008***	0.010***	0.011***
	(0.002)	(0.001)	(0.001)	(0.002)		(0.002)	(0.002)	(0.002)	(0.003)
Import Price Growth$_{t-1}$					0.037***				
					(0.008)				
Dummy$_{\text{Target Revision}}$	−0.087	−1.263***	−0.341***	−0.315**	−0.233	−0.060	0.518**	0.032	−0.438**
	(0.177)	(0.396)	(0.113)	(0.156)	(0.183)	(0.194)	(0.203)	(0.126)	(0.176)
ΔEMBI$_{t-1}$						0.001			
						(0.001)			
Prim. Balance (%GDP)$_{t-2}$							−0.212***		
							(0.016)		
Money Growth$_{t-1}$								0.024*	
								(0.012)	
Wage Growth$_{t-3}$									0.078***
									(0.015)
Observations	8,182	8,182	8,182	8,182	8,182	8,182	8,182	7,738	7,029
R^2	0.799	0.739	0.800	0.790	0.800	0.800	0.816	0.813	0.838

Notes: *, **, and *** represent statistical significance at levels of 10, 5, and 1 percent, respectively. Driscoll and Kraay (1998) standard errors are given in parentheses.

Table A.4. Robustness Analysis for 24-Month-Ahead Inflation Expectations (full-sample regressions)

Dependent Variable: 24-month-ahead annual inflation expectations of participant i at time t ($\pi^e_{i,t\|t+24}$)									
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
CPI Inflation$_{t-1}$	0.205***		0.181***	0.247***	0.184***	0.205***	0.205***	0.220***	0.210***
	(0.015)		(0.014)	(0.015)	(0.012)	(0.015)	(0.015)	(0.016)	(0.017)
Core Inflation$_{t-1}$		0.219***							
		(0.038)							
MA12 Inflation$_{t-1}$	0.229***	0.110		0.213***	0.232***	0.229***	0.207***	0.227***	0.216***
	(0.049)	(0.070)		(0.039)	(0.046)	(0.048)	(0.018)	(0.042)	(0.029)
MA24 Inflation$_{t-1}$			0.419***						
			(0.059)						
Inflation Target$_{t\|t+12}$	0.665***	0.659***	0.647***	0.672***	0.678***	0.666***	0.296***	0.503***	0.076
	(0.108)	(0.083)	(0.113)	(0.120)	(0.113)	(0.111)	(0.059)	(0.087)	(0.077)
Policy Surprise$_{i,t-1}$	−0.042***	−0.082***	−0.049***	−0.026***	−0.043***	−0.042***	−0.035***	−0.044***	−0.041***
	(0.008)	(0.009)	(0.009)	(0.010)	(0.010)	(0.009)	(0.006)	(0.008)	(0.006)
Nom. Depreciation$_{t-1}$	0.025***	0.021***	0.026***		0.029***	0.025***	0.020***	0.019***	0.016***
	(0.003)	(0.006)	(0.003)		(0.003)	(0.003)	(0.002)	(0.003)	(0.003)
Real Depreciation$_{t-1}$				−0.023***					
				(0.003)					
IPI Growth$_{t-2}$	0.030***	0.017**	0.037***	0.021***	0.022***	0.030***	0.015***	0.018***	0.021***
	(0.004)	(0.009)	(0.006)	(0.004)	(0.004)	(0.005)	(0.005)	(0.004)	(0.006)
Oil Price Growth$_{t-1}$	0.008***	0.011***	0.007***	0.008***		0.008***	0.006***	0.008***	0.008***
	(0.002)	(0.001)	(0.001)	(0.002)		(0.002)	(0.001)	(0.001)	(0.001)

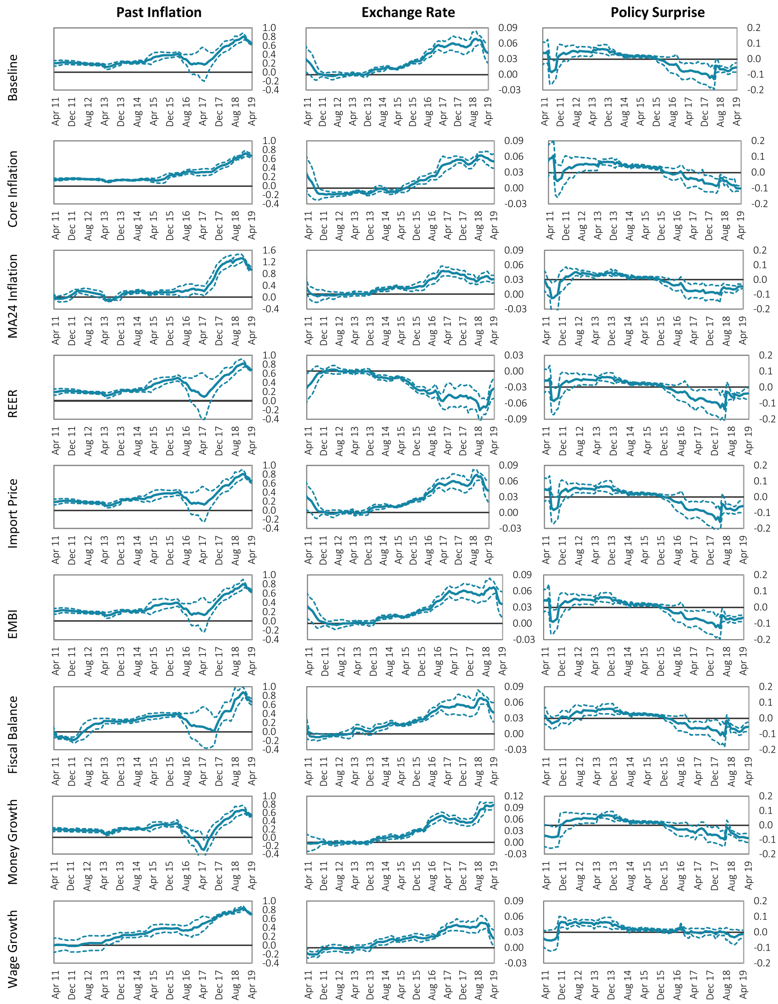
(continued)

Table A.4. (Continued)

Dependent Variable: 24-month-ahead annual inflation expectations of participant i at time t ($\pi^e_{i,t\|t+24}$)									
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
Import Price Growth$_{t-1}$					0.027***				
					(0.004)				
Dummy$_{\text{Target Revision}}$	−1.090***	−1.366***	−1.329***	−1.311***	−1.160***	−1.093***	0.076	−0.790***	−0.410***
	(0.197)	(0.248)	(0.227)	(0.221)	(0.227)	(0.201)	(0.182)	(0.153)	(0.125)
ΔEMBI$_{t-1}$						−0.000			
						(0.001)			
Prim. Balance (%GDP)$_{t-2}$							−0.287***		
							(0.018)		
Money Growth$_{t-1}$								0.024**	
								(0.011)	
Wage Growth$_{t-3}$									0.038***
									(0.012)
Observations	7,943	7,943	7,943	7,943	7,943	7,943	7,943	7,531	6,849
R^2	0.688	0.644	0.688	0.677	0.685	0.688	0.734	0.704	0.721

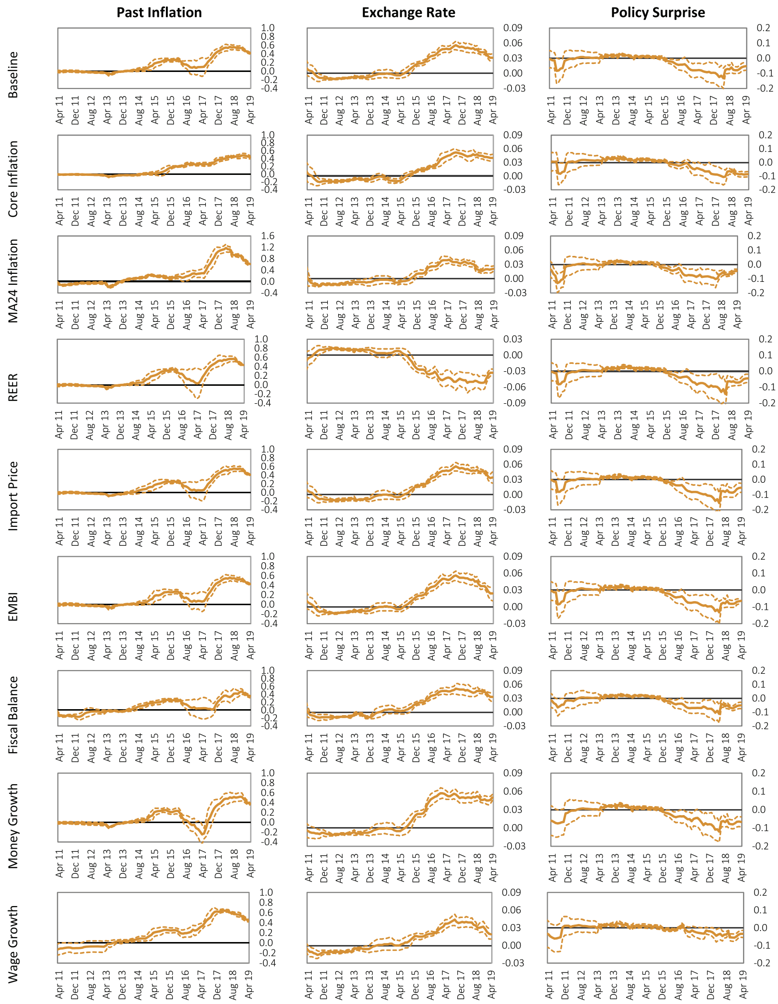
Notes: *, **, and *** represent statistical significance at levels of 10, 5, and 1 percent, respectively. Driscoll and Kraay (1998) standard errors are given in parentheses.

Figure A.1. Robustness Analysis for the Evolution of the Coefficients: 12-Month-Ahead Inflation Expectations



Notes: The graphs show five-year rolling window estimates of the coefficients on past inflation, exchange rate, and policy surprises for the baseline model in equation (2) and its modifications with additional variables listed in the first column. Dashed lines show 90 percent confidence intervals with Driscoll and Kraay (1998) standard errors.

Figure A.2. Robustness Analysis for the Evolution of the Coefficients: 24-Month-Ahead Inflation Expectations



Notes: The graphs show five-year rolling window estimates of the coefficients on past inflation, exchange rate, and policy surprises for the baseline model in equation (2) and its modifications with additional variables listed in the first column. Dashed lines show 90 percent confidence intervals with Driscoll and Kraay (1998) standard errors.

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