The Role of Expectations in the Inflation Process in Turkey: Have the Dynamics Changed Recently?

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Abstract

In this paper, we analyze the role of inflation expectations in inflation dynamics. The hike in inflation following the exchange rate shock in 2018 provides an interesting period to analyze whether the sensitivity of inflation to its main determinants, including expectations, has changed. To this end, we estimate a time-varying parameter Phillips curve model to focus on the changes in inflation dynamics. We also jointly study the formation of inflation expectations to further investigate how the setting of inflation expectations evolved over the course of the rapid rise and the following gradual decline in inflation observed since the second half of 2018. Our results reveal that inflation expectations play an important role in inflation dynamics; and that the sensitivity of inflation to expectations did not change much recently. Meanwhile, the sensitivity of inflation to the exchange rate has sharply risen and corrected only partially afterwards. However, the most notable change has been witnessed in the weight attached to the past inflation in forming expectations; agents pay higher attention to inflation realizations. Overall, our results reveal that inflation expectations and the exchange rate movements are the leading driving forces of inflation in Turkey, in which the interaction between them further amplifies the impact on inflation.

Keywords: Inflation, survey-based inflation expectations, state-space model, Turkey

JEL codes: E31, C32, C36

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Non-technical summary

In this study we analyze the role of inflation expectations in the inflation process. Although the medium-term inflation expectations hover above the medium-term inflation target in Turkey, changes in inflation expectations transmit into changes in inflation. The changes in inflation dynamics can be better understood if the role of inflation expectations and the formation of these expectations are well comprehended.

Following the exchange rate shock in 2018, inflation and inflation expectations increased noticeably. Analyzing the dynamics of inflation and inflation expectations in Turkey during a period covering the exchange rate shock, our results suggest that indeed inflation expectations have a sizeable and robust association with inflation, and that the sensitivity of inflation to expectations did not change much recently. We also find that the exchange rate pass-through has sharply risen and, despite gradually decelerating afterwards, is still above the historical averages. On the other hand, we document a slowdown in the extent of the import price pass-through. Meanwhile, the sensitivity of inflation to the output gap and real unit labor costs are found to be relatively stable.

Regarding the formation of inflation expectations, the most notable change has been witnessed in the weight attached to the past inflation as agents pay higher attention to inflation realizations. Overall, our results reveal that inflation expectations and the exchange rate movements are the leading driving forces of inflation in Turkey, in which the interaction between them further amplifies the impact on inflation.

1. Introduction

Following the exchange rate shock in 2018, inflation recorded a substantial increase in Turkey. Meanwhile, inflation expectations not only increased but also the dispersion of expectations around the mean expectation deteriorated considerably. Accordingly, 12-month ahead inflation expectations stood at 16.5 percent at the end of 2018 with a sizeable variation around the mean expectation (Figure 1).[1] Given the interplay between inflation and inflation expectations, a detailed analysis of the role of expectations in inflation dynamics is deemed necessary. Questions regarding the drivers of the rise in inflation expectations and the possibility of a change in the behavioral role of expectations in inflation dynamics, i.e. whether the economic agents put more weight on expectations, stand out.

Figure 1: Inflation, Expectations and Dispersion of Expectations

a) Inflation, Expectations and the Inflation Target   b) Dispersion of Inflation Expectations (12-month ahead)
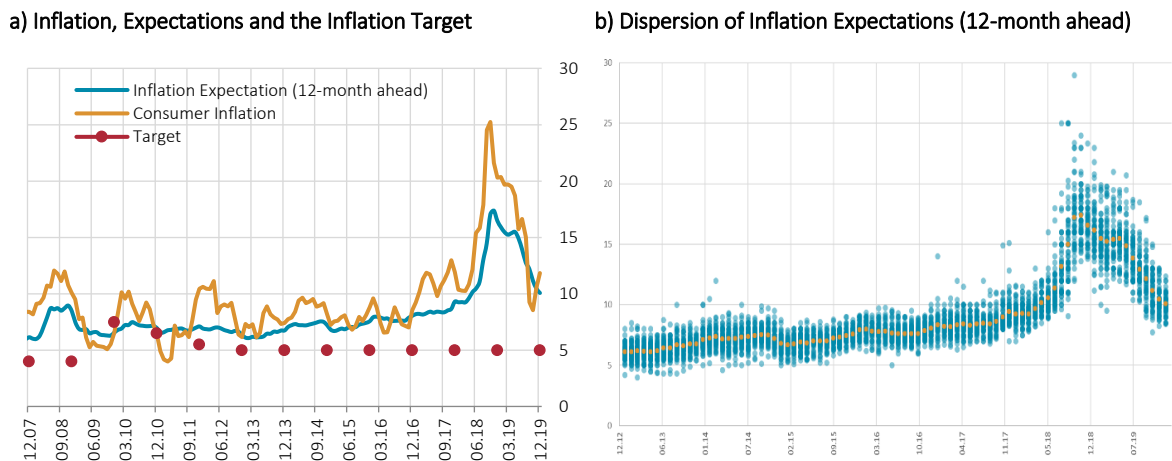
Source: CBRT.

Note: In the right panel, each blue dot represents an individual survey participant's inflation expectation, whereas the orange dot refers to the mean expectation at that period.

The workhorse theoretical framework for investigating above mentioned questions is the New Keynesian Phillips Curve.[2] The New Keynesian economists reconstructed the Phillips curve relation based on micro-foundations and forward-looking expectations since the expectations of economic agents are deemed to have an important effect on price setting. Fischer (1977) and Taylor (1979) were the first to work on the New Keynesian Phillips Curve (NKPC), while Gali and Gertler (1999) developed the hybrid version of the NKPC that relates inflation to future expected inflation, lagged inflation and the real marginal costs. In this setup, the monetary policy affects inflation also by

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[1] Note that actual inflation was 11.8 percent at the end of 2019.

[2] Phillips curve has been on the agenda of the economy for more than 60 years. Literature started with Phillips (1958), who investigated the relationship between unemployment and nominal wages; followed by Samuelson and Solow (1960), who characterized the negative relationship between inflation and unemployment. During this period, the Phillips curve has become one of the main arguments for conducting monetary policy. Phelps (1967) and Friedman (1968) also included expectations into the Phillips curve, where the expectations of economic agents were shaped according to the adaptive expectations hypothesis.

managing inflation expectations. Mishkin (2010) and Woodford (2003) suggest that the management of expectations and efforts of policymakers in this endeavor have become one of the pillars of the monetary policy setting, which has a catalyst role in achieving both economic growth and macroeconomic stability. Mishkin (2007) further argues that to evaluate changing inflation dynamics, it is vital to examine the possible changes in the formation of expectations as well. Recent studies enhance the open economy NKPC framework for investigating the inflation process with factors such as globalization, openness, exchange rates, import price index and oil prices (i.e. Auer, Borio and Filardo, 2017; Bianchi and Civelli, 2015; Blanchard, Cerutti and Summers 2015; Borio and Filardo, 2007; Ciccarelli and Mojon, 2010; Jorda and Nechio, 2018; Kamber, Mohanty and Morley, 2020).

It is widely argued that in the last 20 years, the Phillips curve has become flatter (Blanchard, 2016; Mavroeidis, Plagborg-Moller and Stock, 2014; Mishkin, 2007; Pfajfar and Roberts, 2018) especially in developed countries, where low inflation have been observed and recently inflation mostly remained below the inflation targets.[3] The response of wages and prices to economic activity continued to weaken. Despite sustainable economic growth, low unemployment, and historically low policy rates, inflation is persistently below the targets. The flattening of the Phillips curve is addressed to two issues: to the success of central banks in controlling inflation, and to structural changes in the economy.[4] The success of central banks has led to the anchoring of inflation expectations to the inflation targets.

Meanwhile, the level of anchoring of inflation expectations has also changed after the global financial crisis. Mazumder (2018) argues that while short and medium-term inflation expectations were tightly anchored until the end of 2008 in Euro area, this anchor has started to weaken since the global crisis, where the decline of inflation in the Euro-zone has been very sharp and inflation is persistently below the ECB's targets. Mazumder (2018) shows that short-term (one-year ahead) inflation expectations have become more significant than longer-term expectations in Europe. Similarly, Fuhrer (2012) finds that the impacts of short term expectations (four-quarter ahead) have become more relevant and more visible for US inflation. Guinigundo (2016) and Galati, Poelhekke

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[3] Pfajfar and Roberts (2018) suggest two reasons for flattening. The first one is that the prices are stickier at the micro-level, and thus they are adjusted less often. Second, the expectations of households and firms regarding future inflation do not include the information set about macroeconomic conditions. As expectations are important to determine current inflation, the sensitivity of inflation to macroeconomic conditions has decreased.

[4] Despite many studies disputing the validity of the Phillips curve, Blanchard (2016) argues that the relationship is still working. It is found out that inflation expectations have become more anchored, which leads to a relationship between unemployment and level inflation rather than the change in inflation. As a general view, the Phillips curve has become closer to its shape in the 1960s. Another finding is about the slope of the Phillips curve, which declined significantly. But the decline dates back to the 1980s, not the recent global crisis.

and Zhou (2011) also point to less anchoring of inflation expectations during and after the global financial crisis.

Expectations play a very important role in the inflation process. If well-anchored, inflation expectations can help stabilize inflation faster in case of supply and demand shocks. In Turkey, the medium-term inflation expectations hover above the medium-term inflation target. Nonetheless, changes in inflation expectations transmit into changes in inflation. The changes in inflation dynamics can be better understood if the role of inflation expectations and the formation of these expectations are well comprehended. In this perspective, we analyze the dynamics of inflation expectations as well as their impact on inflation in Turkey. Accordingly, in this paper, we estimate reduced-form Phillips curve models for consumer inflation based on the study of Kara, Öğünç and Sarıkaya (2017) to understand the role of expectations in inflation dynamics. We analyze both the fixed-parameter and time-varying parameter (TVP) models and extend their model in two dimensions. First, we utilize the direct survey measure of inflation expectations, similar to Roberts (1995), Adam and Padula (2011), Fuhrer (2012), Blanchard, Cerutti and Summers (2015) and Mazumder (2018), using the CBRT's Survey of Expectations data. In this regard, we allow for non-rational expectations. Second, we model the formation of survey expectations at a macro level based on the micro-level findings of Gülşen and Kara (2020) in a time-varying parameter setting.[5] Accordingly, the novelty of our approach is that we estimate the evolution of inflation and inflation expectations simultaneously in a time-varying framework for the Turkish case.

Our results suggest that indeed inflation expectations have a sizeable and robust relationship with inflation with a fairly stable coefficient; meanwhile some of the coefficients of other determinants of inflation are subject to considerable fluctuation. Our results also reveal that the sensitivity of inflation expectations to the exchange rate and inflation surprise grew stronger in 2018. More importantly, the sensitivity of expectations to past inflation substantially increased. In this respect, as the decline in headline inflation became evident throughout 2019, the improvement in inflation expectations in this period also accelerated.

The remainder of the paper is organized as follows. Section 2 examines the role of expectations in inflation dynamics with fixed-parameter Phillips curve models and attempts to model the survey expectation formation as well. Section 3 extends the models in the previous section to the time-varying parameter case and discusses main empirical findings. Section 4 concludes the study.

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[5] Note also that one of the strengths of our study is using data from an inflationary environment, which allows us to identify the changing relationships even with relatively small sample size.

2. The Role of Expectations in the Inflation Dynamics

In this section, we investigate the role of inflation expectations in explaining inflation dynamics through the lens of fixed-parameter Phillips curve models. To this end, we extend the previously estimated Phillips curve models for Turkey (such as Kara, Öğünç and Sarıkaya (2017), Koca and Yılmaz (2018)) by including the survey inflation expectations into the model. In the first part, we estimate the following specification for inflation:

$$\pi_t^{CPI} = c + \alpha\pi_{t-1}^{CPI} + \beta\pi_{t|t+4}^e + \delta(\sum_{i=0}^{1}\tilde{y}_{t-i})/2 + \sum_{i=0}^{2}\gamma_{i+1}\Delta e_{t-i}^{BASKET} + \varphi\Delta p_t^m + \theta(\sum_{i=1}^{4}\Delta rulc_{t-i})/4 + \tau_t + \omega_t\pi_t^{UnAT} + \varepsilon_t \tag{1}$$

Equation (1) models the inflation dynamics, where, π_t^{CPI} is the quarterly (seasonally adjusted) annualized CPI inflation, $\pi_{t|t+4}^e$ is (the CBRT Survey of Expectations) the 4-quarter-ahead annual consumer inflation expectation, $\tilde{y}$ is the output gap, Δe_t^{BASKET} is the quarterly percent change in the currency basket, Δp_t^m is the quarterly percent change in import prices in $ terms, $\Delta rulc_t$ is the quarterly percent change in real unit labor costs[6]. The two additional variables in the equation, which aim at capturing the impact of exogenous factors, refer to the contribution of tax adjustments to quarterly inflation, τ_t; and to the quarterly (seasonally adjusted) annualized unprocessed food and alcohol-tobacco inflation, π_t^{UnAT}. ω_t is calibrated according to the share of unprocessed food and alcohol-tobacco products in the consumer inflation basket over the years. Accordingly, the model reflects the dynamics of CPI inflation excluding the impact of unprocessed food and alcohol-tobacco prices, and that of tax adjustments. The sample covers 2007Q2:2019Q4.

The estimation results of Equation (1) are presented in Table 1. First, the model includes a forward-looking element, according to which current inflation is determined by expected future inflation. It is probable that the information set used to establish inflation expectations includes actual inflation developments, leading to a well-known endogeneity issue, which should be considered when using survey measures. Some studies have assumed predetermined survey expectations and exploited OLS in the estimations.[7] Given this background, we start with the assumption of exogenous inflation and the first column shows the OLS estimation results. Accordingly, the output gap, exchange rate, import prices, and the real unit labor cost have a positive impact on inflation. In addition, inflation expectations also have a sizeable coefficient. One

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[6] All monthly series are converted into quarterly frequency by taking quarter averages. The only exception are the inflation measures (π_t^{CPI} and π_t^{UnAT}), which are calculated from the end of quarter price indices.

[7] Rudebusch (2002) estimates the hybrid New Keynesian Phillips curve for the US by OLS using the Michigan Survey of inflation expectations. Adam and Padula (2011) resort to OLS as well but exploiting the Survey of Professional Forecasters' (SPF) inflation forecast as inflation expectation. Mazumder (2018) also presents the Euro area Phillips curve findings with SPF expectations by using OLS.

percent higher inflation expectation for the next 12 month is associated with 0.43 points higher annualized quarterly inflation.

Considering the possible endogeneity between inflation expectations and inflation argued above, in the next three columns of Table 1 we provide a set of instrumental variable regressions, where we employ different instrument sets for inflation expectations. The IV(1) column uses the lagged values of inflation expectations as instruments. The IV(2) column adds the inflation target, target revision, central bank's inflation forecast revision and lagged values of inflation surprise on top of the instruments in IV(1); and IV(3) adds the lagged inflation to the list of instruments in IV(2) for inflation expectations. The IV estimation results, as presented in Table 1, confirm the OLS results to a large extent, with inflation expectations still having a sizeable coefficient of 0.40.

Table 1: Determinants of Inflation – Reduced Form Phillips Curve Model

Dependent variable: CPI inflation (quarterly, seasonally adjusted, annualized)					
	OLS	IV(1)	IV(2)	IV(3)	SE
Lagged inflation	0.150**	0.152**	0.151**	0.151**	0.174***
	(0.0598)	(0.0599)	(0.0598)	(0.0598)	(0.0591)
Inflation expectations	0.431***	0.390***	0.405***	0.402***	0.478***
	(0.105)	(0.107)	(0.106)	(0.106)	(0.103)
Output gap	0.368***	0.365***	0.366***	0.366***	0.362***
	(0.0786)	(0.0788)	(0.0787)	(0.0787)	(0.0773)
Δ Exchange rate basket (t)	0.355***	0.357***	0.357***	0.357***	0.359***
	(0.0420)	(0.0421)	(0.0420)	(0.0420)	(0.0417)
Δ Exchange rate basket (t-1)	0.0509	0.0500	0.0503	0.0503	0.0527
	(0.0434)	(0.0435)	(0.0434)	(0.0434)	(0.0426)
Δ Exchange rate basket (t-2)	0.0974***	0.101***	0.0999***	0.100***	0.0947***
	(0.0362)	(0.0363)	(0.0362)	(0.0362)	(0.0357)
Δ Import prices	0.356***	0.356***	0.356***	0.356***	0.354***
	(0.0466)	(0.0467)	(0.0466)	(0.0466)	(0.0461)
Δ Real unit labor cost	0.456**	0.464**	0.461**	0.462**	0.431**
	(0.187)	(0.187)	(0.187)	(0.187)	(0.184)
Constant	0.747	1.034	0.929	0.949	0.183
	(0.912)	(0.926)	(0.920)	(0.920)	(0.895)
Observations	50	50	50	50	50
R-squared	0.93	0.93	0.93	0.93	0.93
Anderson can. corr. stat.		48.38	49.09	49.51	
p-value		0.000	0.000	0.000	
Sargan statistic		3.12	4.22	4.35	
p-value		0.08	0.52	0.63	

Notes: Robust standard errors are in parentheses. ***, ** and * refer to statistical significance at 1, 5 and 10 % level. Regressions include dummy variables for 2007Q4, 2016Q3, 2018Q3 and 2018Q4. IV(1) includes lagged values of inflation expectations; IV(2) includes IV(1) + inflation target, target revision, central bank's inflation forecast revision and lagged values of inflation surprise; IV(3) includes IV(2) + lagged value of inflation as instruments for inflation expectations. SE presents the estimates of the inflation equation where Equation (1) and (2) are simultaneously estimated. Δ refers to log-difference. SE results hinge on three-stage estimation for a system of simultaneous equations of Stata. For the Anderson canonical correlation test statistic, under the null hypothesis, the model is not identified (a test of under identification). For the Sargan test statistic, under the null hypothesis the instruments are valid (a test of over identification).

In addition to the OLS and IV estimations, we perform another modelling strategy as well, considering the possible simultaneous bidirectional relation between inflation and inflation expectations. To this aim, we also generate an equation to analyze the dynamics of inflation expectations formation (2) and simultaneously estimate equation (1) and (2) together.

$$\pi^e_{t|t+4} = \pi^e_{t-1|t+4} + b + \rho D\pi^{CPI,Y}_{t-1} + \mu D\pi^{target}_{t|t+4} + \lambda D\pi^{CBRTfore}_{t|t+4} + \vartheta \Delta e^{BASKET}_t +$$
$$\phi \Delta p^{Brent}_{t-1} + \psi Inf^{Surprise}_{t-2} + \varsigma D_{targetrev} + \epsilon_t \qquad (2)$$

We first describe equation (2), which models the change in one-year-ahead annual inflation expectations. The equation is motivated by the findings of the micro-level data study of Gülşen and Kara (2020), where the authors base their empirical model on a "feedback survey" conducted by the CBRT on the participants of the Survey of Expectations, in which the participants were asked to specify the degree of importance that they attach to certain variables while forming their inflation expectations.[8] $D\pi^{CPI,Y}_t$ is the difference of the annual CPI inflation, $D\pi^{target}_{t|t+4}$ is the change in the official inflation target, $D\pi^{CBRTfore}_{t|t+4}$ is the revision in the CBRT's inflation forecasts for four-quarter-ahead, Δp^{Brent}_t is the quarterly percent change in the Brent crude oil price ($), $Inf^{Surprise}_{t-2}$ is the inflation surprise variable (realization-inflation expectation of Survey participant; the quarterly average of monthly surprises) and lastly, $D_{targetrev}$ is the dummy variable which captures the impact of target revision in June 2008. Accordingly, in this specification, inflation expectations are affected by inflation realization, the inflation target, and the revisions to the central bank's forecast. Exchange rate developments, oil prices, and participants' inflation forecast errors are also expected to play a role in shaping inflation expectations.

The results for the inflation equation from the simultaneous estimation of equations (1) and (2) are presented in the last column of Table 1. We observe important changes in the coefficients of the inflation equation when the simultaneity between inflation and inflation expectations are controlled. Here, the coefficient of lagged inflation and that of inflation expectations are higher compared to OLS and IV estimates. The coefficient of inflation expectations becomes 0.48, about 20 percent higher than previous estimates. Meanwhile, the impact of real unit labor cost is slightly lower in the simultaneous equation case.

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[8] Although the presented model is based on the micro level analysis of Gülşen and Kara (2020), it has some differences regarding the findings. The effect of the micro-level monetary policy surprises, which is found significant by the authors and variables regarding economic activity (output gap, industrial production, etc.) on inflation expectations are not found statistically significant in the macro-level analysis.

When it comes to the dynamics of inflation expectation formation, the results of OLS and simultaneous equation models are presented in Table 2. In line with the priors, past inflation, inflation surprise, as well as exchange rate and oil prices, have a significant impact on inflation expectations. We see that both past inflation and inflation surprise have a sizeable impact on expectations, forming the backward portion of inflation formation. Besides, there is a positive association between the inflation expectations and the central bank's forecast revisions, which might be indicating to the potential role of forward-looking components in expectations.

Table 2: Inflation Expectation Formation

Dependent variable: Change in one-year-ahead annual inflation expectations		
	OLS	SE
D(Lagged annual inflation)	0.141***	0.143***
	(0.0312)	(0.0344)
Δ Exchange rate basket (t)	0.0404***	0.0402***
	(0.00823)	(0.00899)
D(Target)	0.106	0.116
	(0.136)	(0.151)
Δ Oil prices	0.00919***	0.00876***
	(0.00245)	(0.00270)
Inflation surprise	0.140***	0.141***
	(0.0399)	(0.0440)
Target revision	-0.510	-0.478
	(0.437)	(0.484)
Central Bank's forecast revision	0.435***	0.436***
	(0.0751)	(0.0826)
Constant	-0.276***	-0.277***
	(0.0624)	(0.0683)
Observations	50	50
R-squared	0.87	0.87

Notes: Robust standard errors are in parentheses. ***, ** and * refer to statistical significance at 1, 5 and 10 % level. SE presents the estimates of inflation expectations formation equation where Equation (1) and (2) are simultaneously estimated. Δ refers to log-difference. SE results hinge on three-stage estimation for the system of simultaneous equations of Stata.

In the case of inflation expectations, the OLS and simultaneous equation estimates provide similar results. Overall, bearing in mind the results for the inflation equation as well, we consider that the simultaneous estimation of equations (1) and (2) provides a more coherent framework. In this framework, in the next section, we will delve deeper into dynamics and analyze how the coefficients of these two equations evolve when they are allowed to vary over time.

3. Time-varying Parameter Model Estimations: Empirical Evidence

In this section, we re-estimate the Phillips curve equation (1) and expectation formation equation (2) analyzed in the previous section. However, we now estimate the time-varying parameter versions of (1) and (2) simultaneously, denoted by (1*) and (2*), where the definitions of variables are exactly as in the previous section.

$$\pi_t^{CPI} = c_t + \alpha_t \pi_{t-1}^{CPI} + \beta_t \pi_{t|t+4}^e + \delta_t (\textstyle\sum_{i=0}^1 \tilde{y}_{t-i})/2 + \sum_{i=0}^2 \gamma_{i+1,t} \Delta e_{t-i}^{BASKET} +$$
$$\varphi_t \Delta p_t^m + \theta_t (\textstyle\sum_{i=1}^4 \Delta rulc_{t-i})/4 + \tau_t + \omega_t \pi_t^{UnAT} + \varepsilon_t \tag{1*}$$

$$\pi_{t|t+4}^e = \pi_{t-1|t+4}^e + b_t + \rho_t D\pi_{t-1}^{CPI,Y} + \mu_t D\pi_{t|t+4}^{target} + \lambda_t D\pi_{t|t+4}^{CBRTfore} +$$
$$\vartheta_t \Delta e_t^{BASKET} + \phi_t \Delta p_{t-1}^{Brent} + \psi_t Inf_{t-2}^{Surprise} + \varsigma_t D_{targetrev} + \epsilon_t \tag{2*}$$

Based on the "Lucas critique", the model parameters are allowed to change in order to better track the possible behavioral changes. To this end, we treat each parameter of equation (1*) and (2*) to adjust smoothly over time and evolve as a random walk process. Assuming i.i.d. and normal error terms and zero correlation between state and measurement errors, we estimate the model with the Kalman filter.[9]

3.a Inflation Dynamics

The coefficient estimations presented in Figure 2 and Figure 3 indicate that there is variation in some of the model parameters. We start with the sensitivity of inflation to expectations as the main aim of this study is to provide an understanding of the role of inflation expectations. The β_t coefficient, which measures the sensitivity of inflation to inflation expectations, is fluctuating around 0.46, asserting the important role of expectations in inflation dynamics. Furthermore, no significant change has been recorded in the behavioral role of expectations recently (Figure 2a). Note that 4-quarter ahead annual inflation expectation, which was around 9.2 percent at the beginning of 2018, had reached to 17.0 percent in the last quarter of 2018. Since then inflation expectations improved particularly in the second half of 2019, and besides the growing consensus among survey participants has indicated decreasing uncertainties regarding the inflation outlook as of the end of 2019.

The coefficient indicating inertia in inflation appears to be decreasing over time. The α_t coefficient, which measures the impact of past inflation on current inflation, surged amid the exchange rate shock in the third quarter of 2018 (Figure 2b). The monetary tightening and the "fight against inflation program" may have contributed to the weakening of the inertia. However, this finding requires some caution and should not be directly read as the termination of indexation. Factors such as the fight against inflation, prolongation of certain administered price changes, and temporary tax cuts might cause a decline in inertia, but it is expected to normalize over time as the effects of these factors fade away. Overall, the reduced form model estimates point out that inertia weakened in 2019.
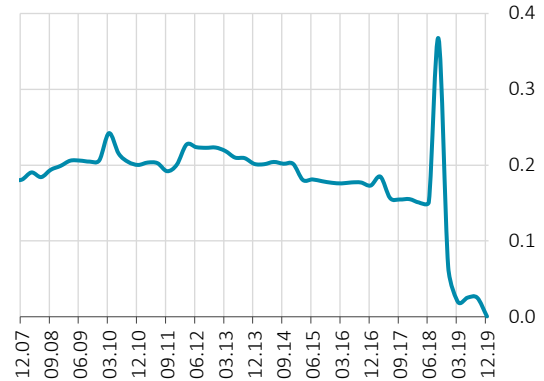
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[9] For further details, see Harvey (1990).

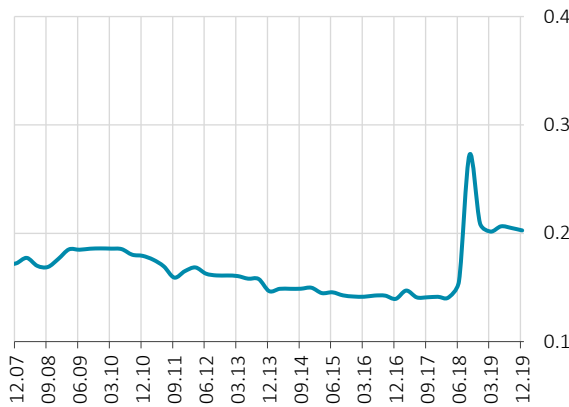**Figure 2: Phillips Curve – Time-Varying Parameter Estimates, Part (1)**
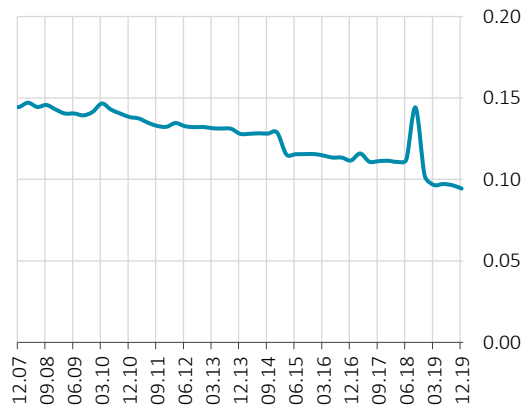
a) Coefficient of Inflation Expectations
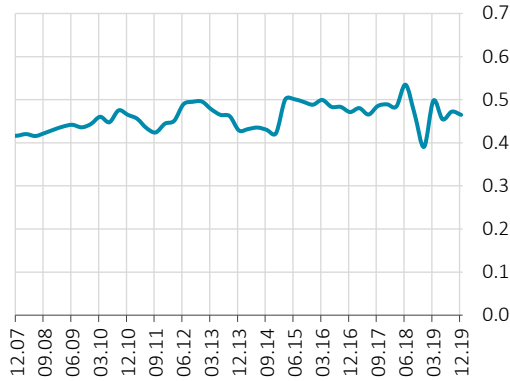
b) Coefficient of Lagged Inflation

c) Exchange Rate Pass-through (Long Run)

d) Import Price Pass-through (in $ terms, Long Run)

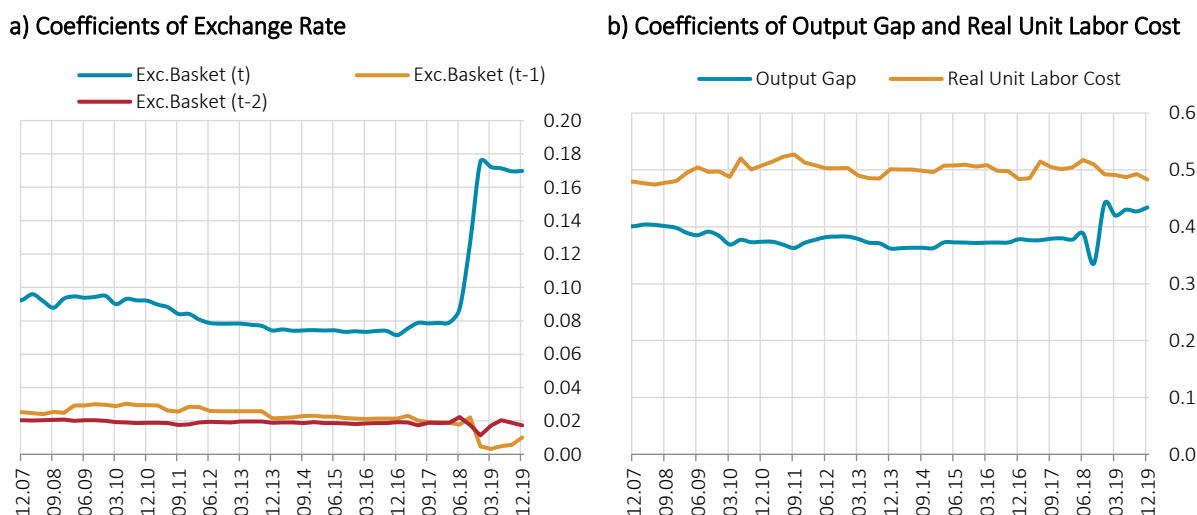Note: Filtered estimates are presented in the figures.

The exchange rate is widely recognized as one of the main determinants of inflation in Turkey, in this regard it will be useful to address the recent dynamics in this ground. The equation (1*) includes both simultaneous and lagged values of the exchange rate basket, the coefficients of which provide guidance on the size and duration of the exchange rate pass-through to domestic prices. Accordingly, estimations suggest that the long-run exchange rate pass-through surged substantially in the third quarter of 2018, possibly due to the "front-loaded" pricing strategy of the agents in the economy in response to the sharp depreciation of Turkish lira. Despite a slowdown afterward, the exchange rate pass-through currently hovers around 20 percent, above the historical average of 17-18 percent for the 2000s (Figure 2c).[10] A recent study by Ertuğ et al. (2020) for producer prices

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[10] Findings of Kara and Öğünç (2012) indicate that the pass-through for the exchange rate under different models for the period 2002-2011 is 15 percent on average in the one-year period and 17 percent in the two-year period. Estimates based on the Bayesian VAR approach by Öğünç et al. (2018) point at 18 percent pass-through for the exchange rate basket after two years. Özmen and Topaloğlu (2017) adopt a disaggregated approach examining pass-through for CPI sub-groups and document that pass-through for exchange rate is 17.4 percent for the aggregate CPI with a bottom-up approach. It should be noted that these studies concentrate on average estimates, yet the pass-though is affected by several factors and varies depending on the economic conjuncture, as discussed by Kara, Öğünç, Özmen and Sarıkaya (2017).

show that while the import price pass-through in Turkey is pretty much consistent with the share of imported input use, the exchange pass-through is usually higher than the share of imported inputs and additionally this excess pass-through became stronger lately. They also argue that the high share of foreign currency debt is associated with higher exchange rate pass-through for produces prices. This could be an explanation for the recent elevated pass-through levels for consumer prices. Despite being more of a structural issue, liability dollarization may have induced firms to set their prices with a higher margin due to debt repayment related concerns, especially in such a period of elevated uncertainty and sizeable exchange rate depreciation. Meanwhile, Gülşen and Kara (2020) suggest that such a rapid and sizeable exchange rate shock may have increased the responsiveness of firms to changes in the exchange rate when setting prices.

In addition, time-varying estimates reveal that simultaneous effect ($\gamma_{1,t}$) is quite strong compared to lagged ones ($\gamma_{2,t}$ and $\gamma_{3,t}$). While the simultaneous exchange rate effect maintains its relative importance, the first lagged effect is found to be somewhat weakened and whereas the second lagged one is relatively stable (Figure 3a). Overall these findings signal that the tendency of reflecting current exchange rate movements on prices more rapidly compared to the past episodes which become visible after the second quarter of 2018, has not fully normalized yet.

Figure 3: Phillips Curve – Time-Varying Parameter Estimates, Part (2)

a) Coefficients of Exchange Rate

b) Coefficients of Output Gap and Real Unit Labor Cost

Note: Filtered estimates and short-run values are reported in the figures. Exchange rate coefficients are divided by 4.

Another point to examine is the extent of the import price (in $ terms) pass-through. Time-varying estimation results indicate that the import price pass-through has been weakening, which is in line with the finding of Kara, Öğünç and Sarıkaya (2017). Recent coefficient estimates point to around 10 percent for the long-run pass-through of import prices to inflation, which was found to be around 15 percent earlier periods (Figure 2d). Estimates further imply that weakening starts

after the global financial crisis and proceeds at a moderate pace thereafter. At first glance, this result may contrast with the greater integration to global value chains and soaring imported input use. Yet, the more limited pass-through of falling oil prices on domestic electricity and natural gas prices after the global financial crisis (possibly due to the discontinuance of the automatic pricing mechanism) and the recent use of the sliding-scale tariff regime in fuel oil prices curbing the impact of international oil prices on inflation are some of the factors that explain the weakening the import price pass-through in Turkey's context.

The coefficient estimates for the output gap and the real unit labor cost are found to be relatively stable (Figure 3b). The short-run coefficient of the output gap has only recently increased slightly. When inflation inertia is taken into account, the coefficient of the output gap, in the long run, is estimated to be around 0.47, implying roughly 0.5 percentage point increase (decrease) in annual inflation when the output gap is one percentage point higher (lower), which is in agreement with the Bayesian VAR evidence of CBRT (2020). This estimate, at first glance, can be interpreted as the inflationary effect of aggregate demand conditions is not that high. However, we consider that the effect of growth on inflation is higher than estimated here when some indirect channels are considered. When the demand moves above the potential output, this may lead to larger current account deficit and further boost external financing needs of Turkey, which builds up into depreciation pressures though time. This situation, in the long term, manifests itself as the depreciation of the Turkish lira in an environment where capital flows to EMEs are volatile. The bottom line is that the above model structures measure the short-term effects of demand conditions, and the long-term inflationary effects of over-expansion periods might be eventually observed through the exchange rate channel. Lastly, the coefficient of the real unit labor cost suggests that 1 percentage point shock to this variable leads to a 0.61 percentage point increase in annual inflation in the long run.

3.b Dynamics of Inflation Expectations

Inflation is affected by expected future inflation, which implies that monetary policy can influence inflation by shaping expectations. In this regard, understanding what drives inflation expectations and whether there is any change in the current dynamics are crucial questions that will shed light on the monetary policy implementation. Empirical evidence suggests that past inflation, revisions to the central bank's forecasts, exchange rate fluctuations, supply shocks such as oil prices, changes in inflation targets, and the participants' own inflation forecast errors seem to key factors influential on survey-based inflation expectations in Turkey.

The results suggest that the agents pay considerable attention to past inflation, measured by (ρ_t). Moreover, time-varying estimates reveal that the most remarkable change has occurred in the sensitivity of inflation expectations to past inflation. Figure 4a displays that in the second half of 2018, economic agents increased the weight they assign to past inflation in their expectations. Along with the sharp depreciation of the Turkish lira and the accompanying high inflation, this sensitivity has increased noticeably.

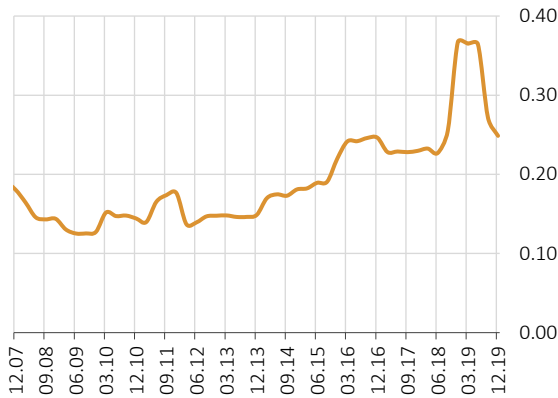**Figure 4: Inflation Expectations – Time-Varying Parameter Estimates**
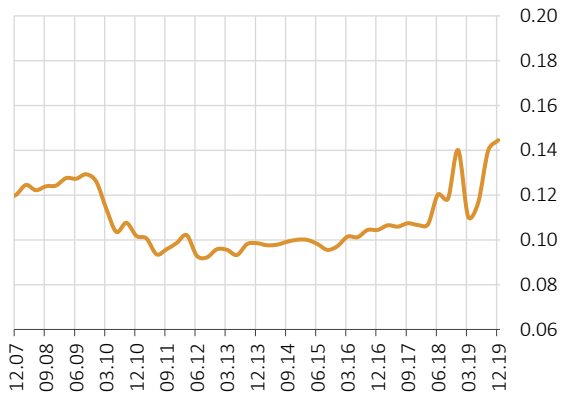
a) Coefficient of the Change in Annual Inflation
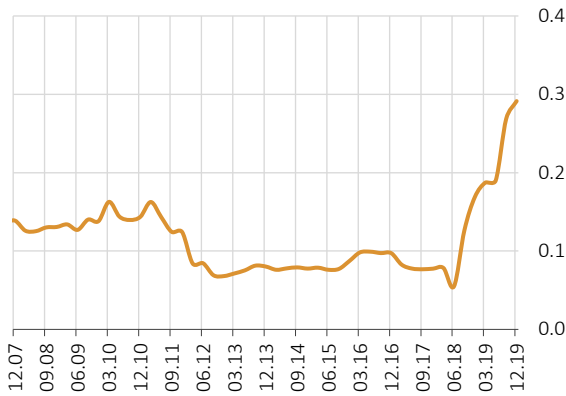
b) Coefficient of Change in Exchange Rate Basket
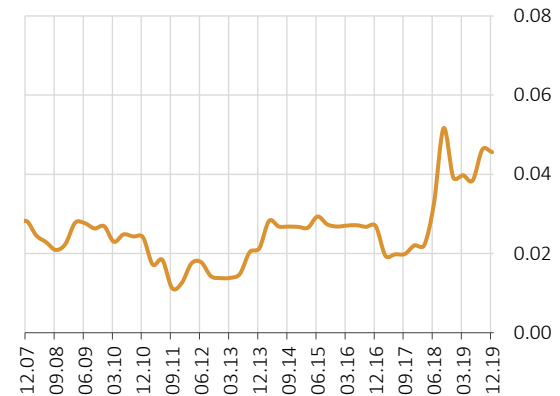
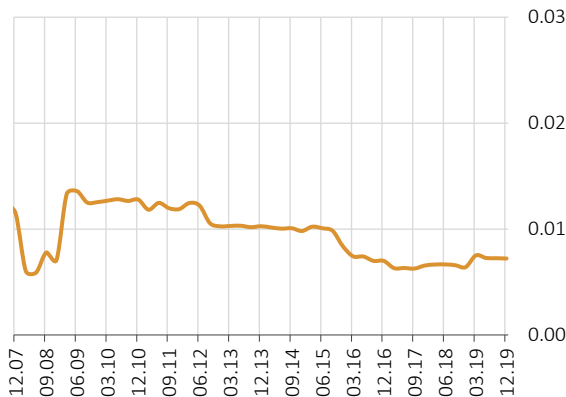c) Coefficient of the Revision in CBRT's Inflation Forecast for 12 Months Ahead

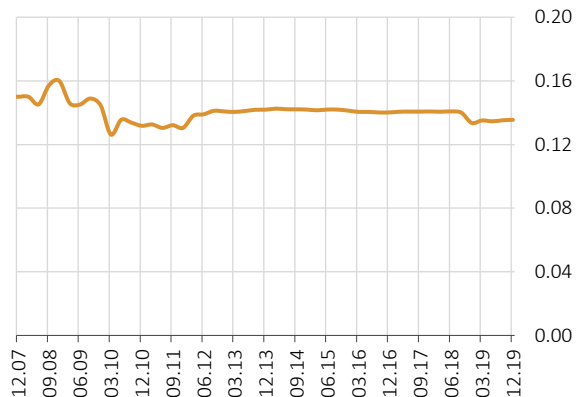d) Coefficient of Inflation Surprise

e) Coefficient of Oil Price

f) Coefficient of Change in Inflation Target

The impact of the exchange rate on inflation not only occurs through imports of consumption goods and the use of imported inputs (i.e. energy, intermediate goods) in production but also through the pricing behavior owing to the interactions with inflation expectations. Findings reveal that, despite being weaker than the cost channel, the impact of the exchange rate on inflation expectations gained strength in 2018 (Figure 4b). Increased weight of the past inflation, as well as the stronger impact of the exchange rate on expectations, are also parallel to the findings of Gülşen and Kara (2020).

The association between inflation expectations and the revisions in CBRT's 12-month-ahead inflation forecast has increased since 2013 and further strengthened in 2018Q4 before weakening to some extent in late 2019 (Figure 4c).[11] Another variable that we consider is inflation surprise, which refers to the difference between inflation expectations and the realized inflation (a positive surprise points to higher than expected inflation). The sensitivity of inflation expectations to surprises measured by (ψ_t) inched up over the last two years (Figure 4d). This implies that as inflation has been realized lower than expected in the recent period, economic agents reflect these negative surprises to inflation expectations with a higher weight. The estimates further reveal that the impact of oil prices in inflation expectations formation is relatively low and it has weakened over time, particularly after mid-2015 (Figure 4e). Finally, the weight attached to official inflation targets while forming expectations has not varied much throughout time, probably due to the fact that targets did not change much in the period studied.

4. Conclusion

Both inflation and inflation expectations surged noticeably after the severe exchange rate shock in 2018. Following that a group of economists argued that the role of inflation expectations in inflation dynamics strengthened. With this argument in mind, this paper examines the interaction between inflation and survey-based inflation expectations and questions whether there is any change in recent dynamics through the lens of both fixed and time-varying parameter Phillips curve models.

Inflation expectations play an important role in inflation dynamics in Turkey as suggested by the coefficient estimates of inflation expectation, which vary between 0.4 and 0.5 based on different estimation methods. However, it appears that there is no significant change in the behavioral role of expectations recently. On the other hand, time-varying parameter estimates point to significant fluctuations in other major determinants of inflation. Particularly, the coefficient

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[11] This finding differs from Gülşen and Kara (2020), where the authors find that this sensitivity diminished after 2013 and has only slightly picked up since 2018Q4.

indicating inertia in inflation seems to be decreasing over time, apart from acceleration amid the exchange rate shock in the third quarter of 2018. Factors such as the monetary tightening and the "fight against inflation program" might help explain such a weakening.

The results suggest that exchange rate pass-through to domestic prices elevated considerably in the third quarter of 2018. Furthermore, we observe a continuing tendency to pass current exchange rate changes on prices more promptly than before. Despite gradually decelerating afterwards, the exchange rate pass-through is still above the historical averages. On the other hand, we document a slowdown in the extent of the import price pass-through, possibly due to the discontinuance of the automatic pricing mechanism in electricity and natural gas and the recent use of the sliding-scale tariff regime in fuel oil prices. Meanwhile, the sensitivity of inflation to the output gap and real unit labor costs are found to be relatively stable.

When it comes to expectation formation, we spot a change in the recent expectation dynamics. Specifically, the sensitivity of inflation expectations to past inflation, exchange rate, participants' own inflation surprises grew stronger in 2018. However, the most remarkable change has been observed in the weight attached to the past inflation. It appears that agents pay higher attention to past inflation realizations. Accordingly, as the decline in inflation became evident especially in the second half of 2019, the improvement in inflation expectations also accelerated in 2019. Results also suggest that the association between forecast revisions' of the Central Bank and inflation expectations has strengthened in aftermath of monetary policy tightening. Another finding is the stronger impact of the exchange rate on expectations with 2018. Therefore, sudden and high exchange rate movements pose a risk on inflation not only through the cost channel, but also along with inflation expectations (by spreading to non-tradable goods), even though the latter channel is weaker than the mainstream cost channel.

Overall, our results reveal that inflation expectations and the exchange rate movements are the leading driving forces of inflation in Turkey. Besides, inflation expectations and the exchange rate interact with each other, creating a feedback mechanism, and thus amplifying the impact on inflation. Therefore, all kinds of policies taming inflation expectations and the expected depreciation are critical for successful inflation stabilization.

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