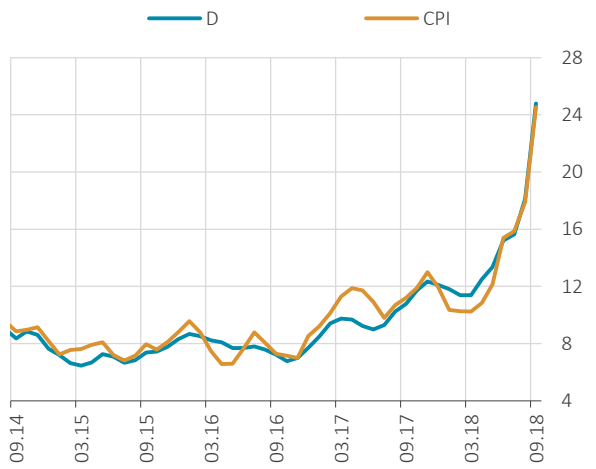
3. Inflation Developments

In the third quarter, consumer inflation surged by 9.13 points from the end of the previous quarter to 24.52 percent (Chart 3.1). Core goods, food and energy groups emerged as the main drivers of the hike in inflation, and annual inflation increased across subcategories (Chart 3.2). The Turkish lira depreciated by around 37 percent in the third quarter. Thus, the depreciation within the last one year exceeded 80 percent, emerging as the leading driver of the rise in inflation. In this period, elevated volatility in exchange rates weighed on inflation uncertainty, exchange rate pass-through to consumer inflation grew stronger, and the backward indexation behavior proved more widespread, all of which indicate a significant deterioration in pricing behavior[1]. In fact, this period was marked by notable price increases even in items with relatively low exchange rate pass-through, chiefly services.

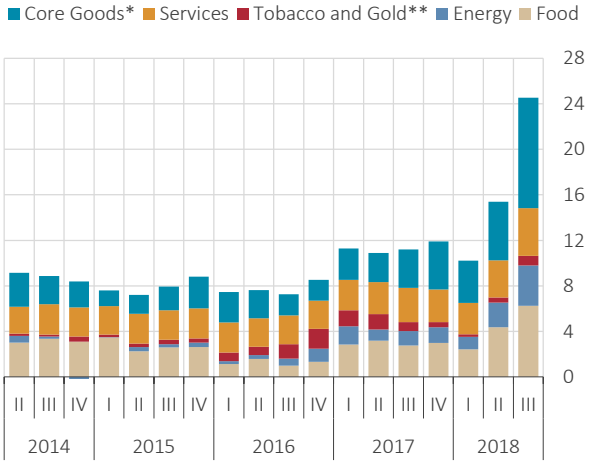
In the third quarter, oil prices trended upwards but the ongoing practice of sliding-scale tariffs in fuel oil prices curbed possible pressures. However, electricity and natural gas witnessed consecutive adjustments both for consumers and producers and energy-driven direct and indirect effects were evident in inflation. Economic activity, which was robust in the first quarter, slowed towards its underlying trend as of the second quarter, and the balancing trend has become more apparent recently. The slowdown in domestic demand intensified in the third quarter, while foreign demand remained strong. The ongoing brisk outlook in the tourism sector weighs on price increases in the items strongly affiliated to this sector. All in all, although aggregate demand conditions started to support disinflation in the second half of the year, the course of consumer inflation is shaped by cost pressures led by producer inflation, which climbed to 46.15 percent in September.

Chart 3.1: CPI and D Index (CPI Excluding Unprocessed Food and Alcohol-Tobacco, Annual % Change)



Source: TURKSTAT.

Chart 3.2: Contributions to Annual CPI (% Points)



Source: CBRT, TURKSTAT.

* Core goods excluding food, energy, alcoholic beverages, tobacco products and gold.
** Tobacco and Gold: alcoholic beverages, tobacco products and gold.

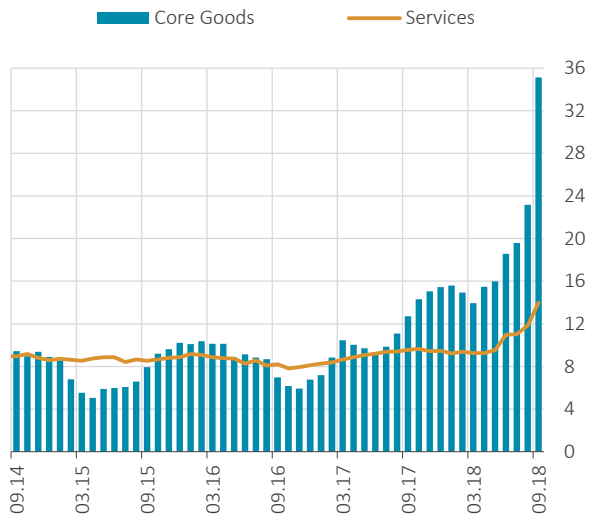
High levels of inflation and inflation expectations continue to pose risks to the pricing behavior. Thus, the weakening demand conditions notwithstanding, cumulative cost pressures and possible secondary effects may remain the determinants of the short-term inflation outlook for a while. In order for the economic slowdown to register a visible effect on inflation, backward-indexation mechanisms must be attenuated by anchoring inflation expectations and the exchange rate-inflation spiral must be broken. Accordingly, it is considered that strong policy coordination is required alongside a tight monetary policy.

[1] Analyses regarding the deterioration in the pricing behavior and the change in inflation dynamics are available in Box 3.1.

3.1 Core Inflation Outlook

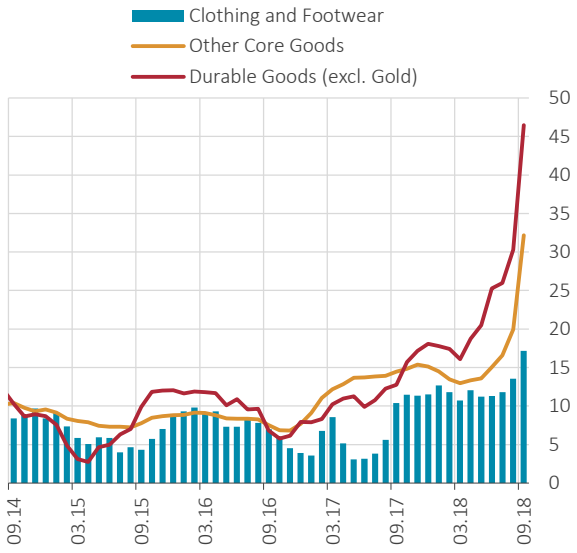
Annual inflation in the core goods group surged by 16.57 points to 35.12 percent in the third quarter (Chart 3.1.1). This was largely led by the considerable depreciation in the Turkish lira, while core goods with high imported content proved the most-afflicted items. This group witnessed an increase in inflation across subgroups, which proved more evident in durable goods and other core goods which have high exchange rate pass-through (Chart 3.1.2).

Chart 3.1.1: Prices of Core Goods and Services (Annual % Change)



Source: TURKSTAT.

Chart 3.1.2: Core Goods Prices (Annual % Change)



Source: TURKSTAT.

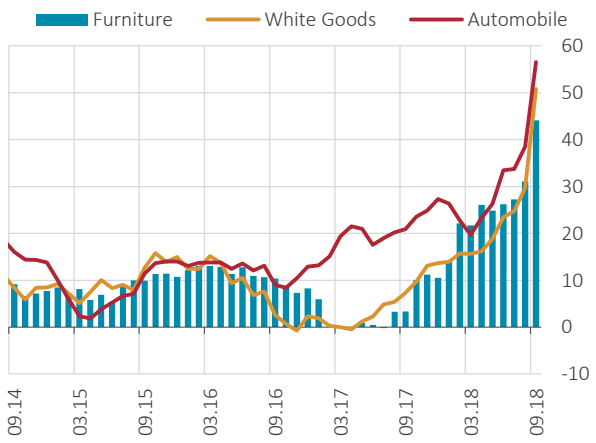
In the third quarter, the approximately 37-percent-depreciation in the Turkish lira against the exchange rate basket resulted in sharp increases in prices of durable goods with high imported content such as automobiles and white goods. Accordingly, durable goods recorded a price hike of 20.85 percent, and the group's annual inflation reached 46.45 percent (Charts 3.1.2 and 3.1.3). Annual clothing inflation rose by 5.85 points to 17.15 percent, which was to some extent driven by the depreciating Turkish lira coupled with the brisk course of exports and tourism. In the same period, prices in other core goods excluding durable goods and clothing surged by 17.30 percent. It was noticeable that exchange rate movements, the effects of which appear with a longer lag (from 6 to 9 months) in this group, compared to durable goods were reflected in prices in a much shorter time. As a result, the underlying trend of core goods inflation registered a sharp increase in this period (Chart 3.1.4).

Table 3.1.1: Prices of Goods and Services (3-Month and Annual % Change)

	2017			2018			
	III	IV	Annual	I	II	III	Annual
CPI	1.32	4.31	11.92	2.77	6.23	9.34	24.52
1.Goods	0.58	5.80	12.99	2.83	7.16	10.72	29.10
Energy	3.46	4.88	10.41	2.11	5.60	12.34	27.03
Food and Non-Alcoholic Beverages	-1.16	5.70	13.79	6.06	7.29	6.17	27.70
Unprocessed Food	-5.60	8.74	15.55	6.71	12.50	2.68	34.04
Processed Food	3.08	3.04	12.20	5.43	2.22	9.91	22.05
Core Goods	0.58	7.51	15.45	0.88	8.67	14.64	35.12
Clothing and Footwear	-5.90	13.17	11.51	-9.15	15.04	-0.95	17.15
Durable Goods (excl. gold prices)	3.37	7.58	18.08	4.09	8.22	20.84	46.45
Furniture	3.88	7.30	10.49	7.35	5.46	18.65	44.14
Electrical and Non-electrical Devices	1.65	4.72	10.24	1.39	4.87	20.52	34.20
Automobile	4.32	10.27	27.30	4.39	11.11	22.41	56.56
Other Durable Goods	2.58	0.90	12.77	3.76	5.98	14.45	26.99
Core goods excl. Clothing and Footwear	2.09	3.10	15.13	4.34	4.74	17.30	32.17
Alcoholic Beverages, Tobacco Products and Gold	0.82	1.18	5.96	1.37	3.15	6.76	12.95
2. Services	3.06	0.95	9.47	2.62	3.93	5.85	13.97
Rent	2.75	2.35	9.21	1.99	2.20	3.14	10.03
Restaurants and Hotels	3.84	1.65	11.47	2.81	4.40	9.15	19.09
Transport	4.20	0.44	12.46	1.18	4.48	7.52	14.17
Communication	0.54	0.12	1.87	-0.72	6.45	1.45	7.34
Other Services	2.93	0.17	9.39	4.45	3.51	5.55	14.30

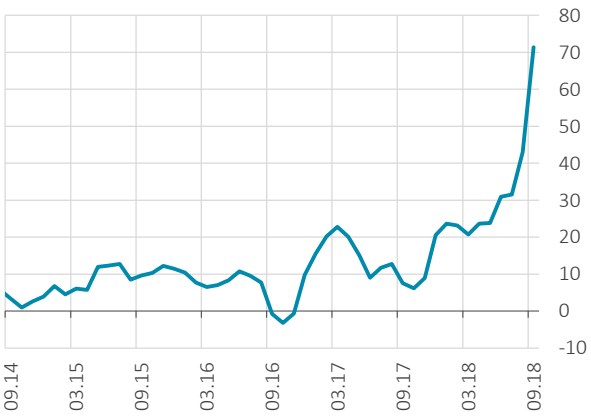
Source: CBRT, TURKSTAT.

Chart 3.1.3: Prices of Selected Durable Consumption Goods (Annual % Change)



Source: CBRT, TURKSTAT.

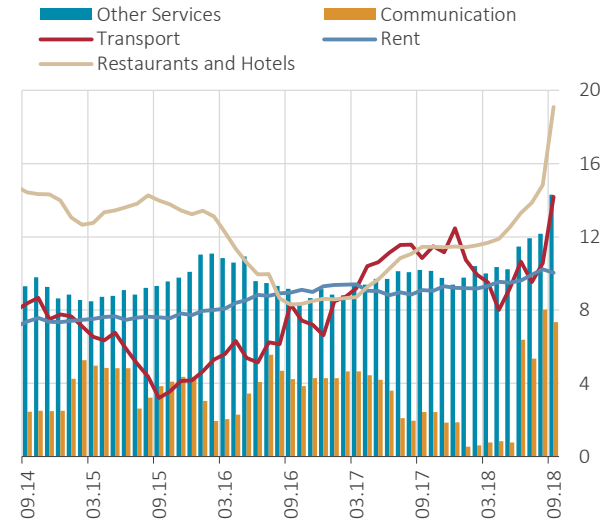
Chart 3.1.4: Core Goods Prices (Seasonally-Adjusted, Annualized Three-Month Average % Change)



Source: CBRT, TURKSTAT.

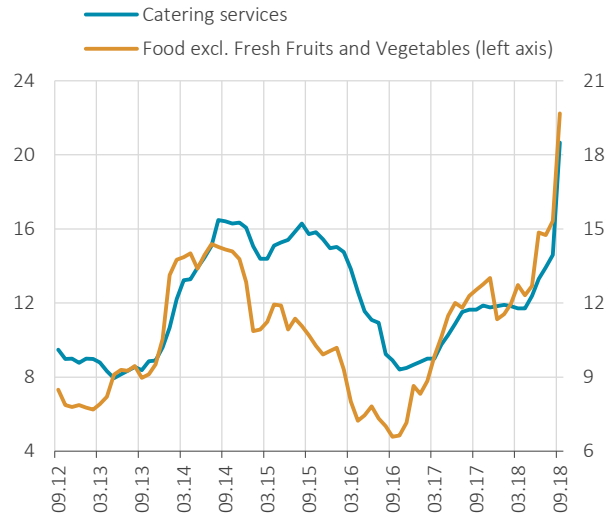
In the third quarter, prices of services rose by 5.85 percent, above past averages, and the group's annual inflation reached 13.97 percent (Chart 3.1.1). Annual inflation registered increases in all subgroups in this period (Chart 3.1.5).

Chart 3.1.5: Prices of Services by Sub-Categories
(Annual % Change)



Source: TURKSTAT.

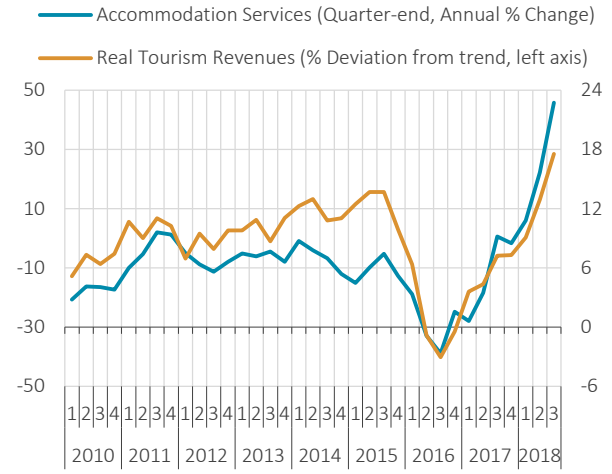
Chart 3.1.6: Prices of Catering Services and Food*
(Annual % Change)



Source: CBRT, TURKSTAT.
* Food excluding fresh fruits and vegetables.

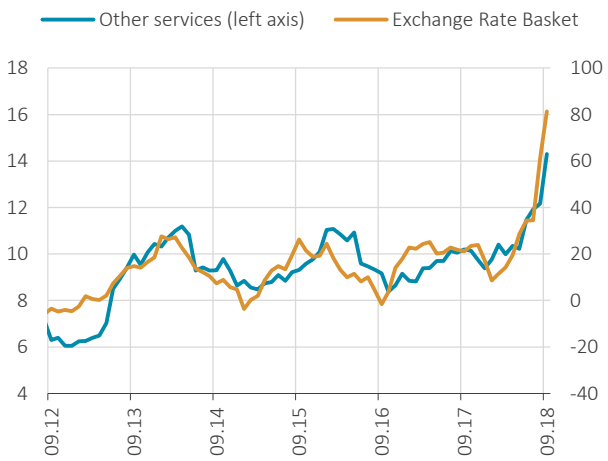
Among subcategories of services, the most remarkable hike was recorded in the restaurants-hotels group whose annual inflation reached 19.09 percent, increasing by 5.79 points compared to the previous quarter. Under the restaurants-hotels group, inflation in catering services trended further upwards due to food prices (Chart 3.1.6). Inflation in accommodation services, another subcategory, hit the highest level of the index history with 22.72 percent due to the brisk course of the tourism sector (Chart 3.1.7). Transport services inflation, which hit 14.17 percent in the third quarter, was shaped by the tourism-led demand-side effects as well as cost effects led by fuel oil prices. Annual inflation in other services rose by 2.83 percent on a quarterly basis due to the exchange rate effects (Chart 3.1.8). Communication services inflation, which has been low for a long time unlike the overall services group, trended upwards in the last couple of months in line with the worsening in the headline inflation outlook.

Chart 3.1.7: Accommodation Services and Tourism Revenues (Annual % Change and Deviation from Trend)



Source: CBRT, TURKSTAT.

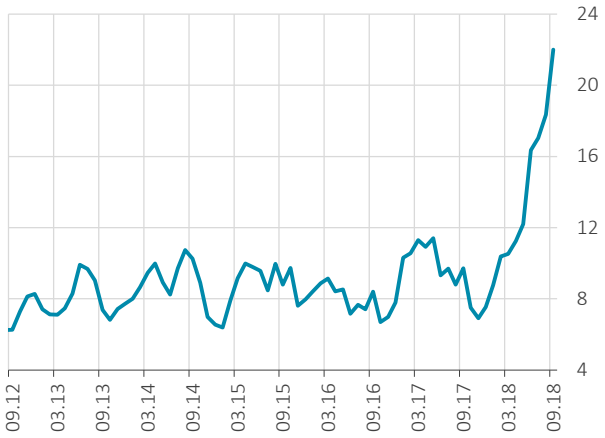
Chart 3.1.8: Other Services and Exchange Rate Basket
(Annual % Change)



Source: CBRT, TURKSTAT.

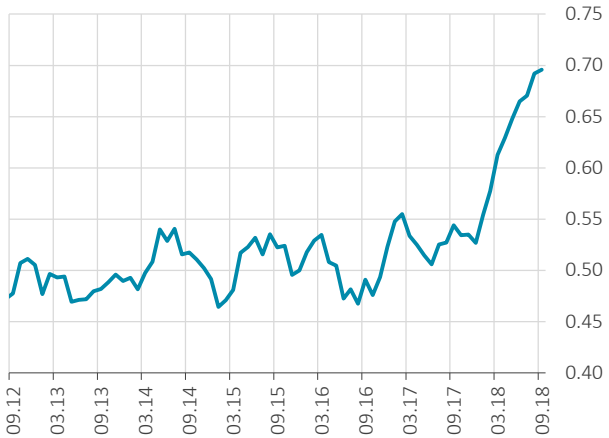
Against this background, both the three-month averages of seasonally-adjusted underlying services inflation and the price increasing tendency as captured by the diffusion index continued to increase in this quarter and signaled a notable deterioration in the pricing behavior (Charts 3.1.9 and 3.1.10).

Chart 3.1.9: Services Prices (Seasonally-Adjusted, Annualized 3 Three-Month Average % Change)



Source: CBRT, TURKSTAT.

Chart 3.1.10: Diffusion Index for Services Prices* (Seasonally-Adjusted, Three-Month Average)

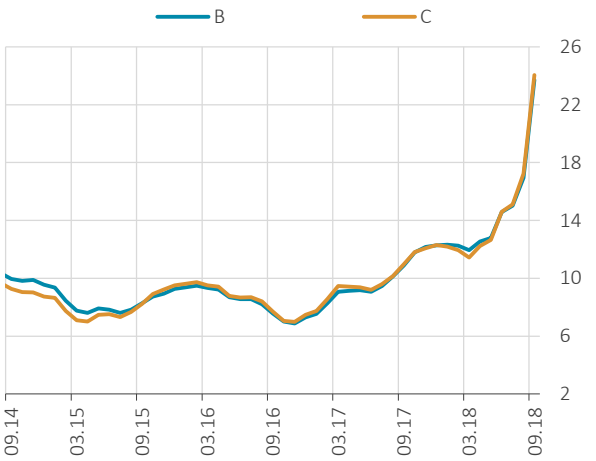


Source: CBRT, TURKSTAT.

* The diffusion index is calculated as the ratio of the number of items with increasing prices minus the number of items with decreasing prices to total number of items.

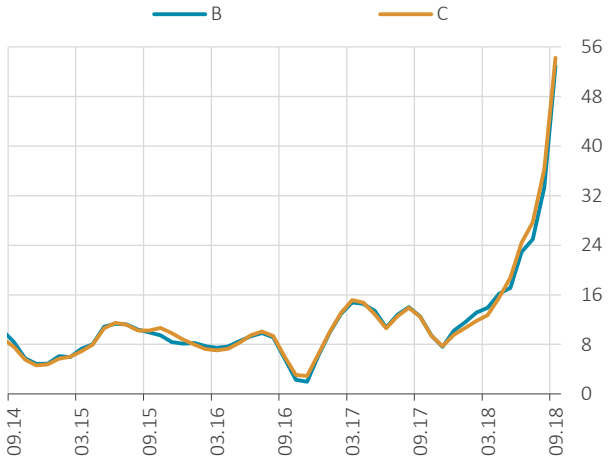
Among core inflation indicators, annual inflation in the B and C indices increased by 9 points each quarter-on-quarter to 23.71 and 24.05 percent, respectively (Chart 3.1.11). This period was marked by deterioration in the underlying trends of both the B and C indicators and Median and SATRIM, alternative indicators monitored by the CBRT (Charts 3.1.12 and 3.1.13).

Chart 3.1.11: B and C Index (Annual % Change)



Source: TURKSTAT.

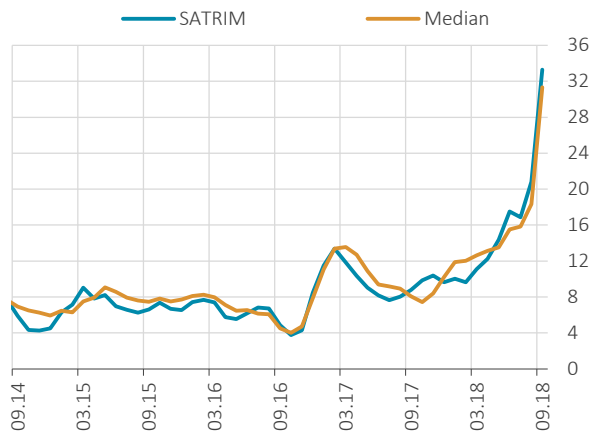
Chart 3.1.12: B and C Index (Seasonally-Adjusted, Annualized, Three-Month Average % Change)



Source: CBRT, TURKSTAT.

As suggested by the diffusion indices of the CPI and core indicators, the tendency to raise prices hit the highest level historically (Chart 3.1.14). In sum, indicators monitored for the tendency and pricing behavior suggest that the worsening in the underlying trend of inflation got considerably stronger.

Chart 3.1.13: Core Inflation Indicators SATRIM* and Median** (Annualized Three-Month Average, %)

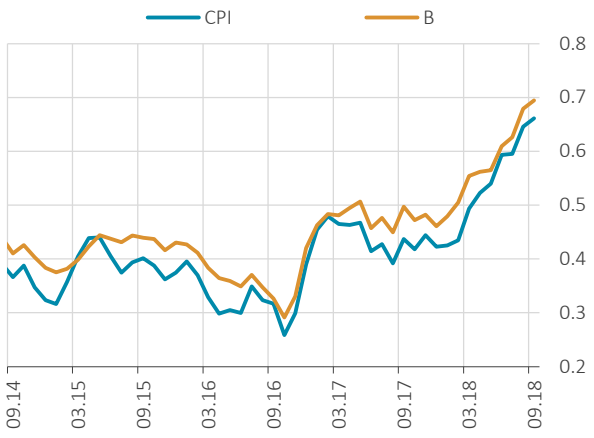


Source: CBRT, TURKSTAT.

* SATRIM: Seasonally-Adjusted, trimmed mean inflation.

** Median: Seasonally-Adjusted 5 median monthly inflation of sub-indices of 5 digits.

Chart 3.1.14: CPI and B Diffusion Indices (Seasonally-Adjusted Three-Month Average)

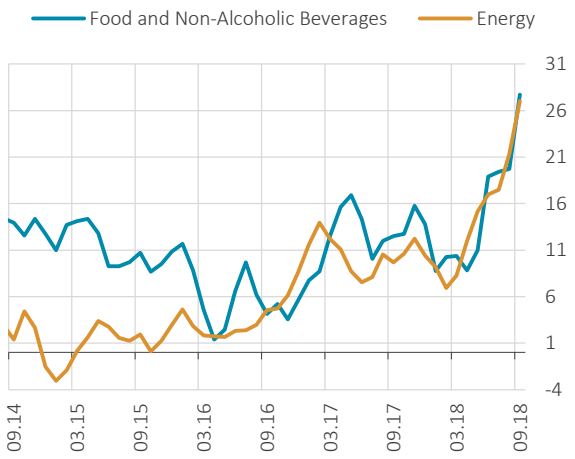


Source: CBRT, TURKSTAT.

3.2 Food, Energy and Alcohol-Tobacco Prices

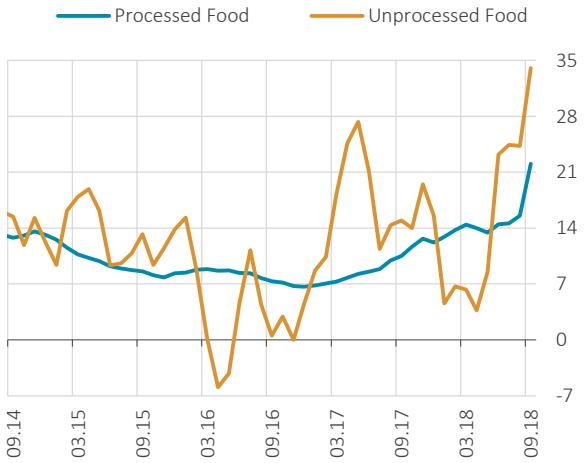
Annual inflation in food and non-alcoholic beverages rose by 8.81 points to 27.70 percent in the third quarter (Chart 3.2.1). Both the processed and unprocessed food groups registered a stronger tendency for price increases in this quarter (Chart 3.2.2). Cost factors led by the depreciation in the Turkish lira were held responsible for the deterioration in the outlook of food inflation.

Chart 3.2.1: Food and Energy Prices (Annual % Change)



Source: TURKSTAT.

Chart 3.2.2: Food Prices (Annual % Change)

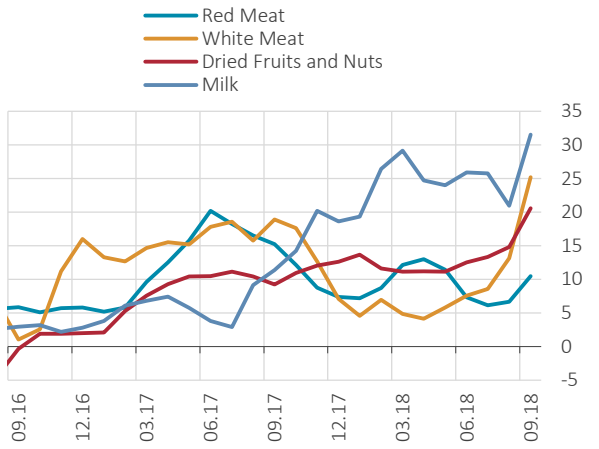


Source: TURKSTAT.

Annual unprocessed food inflation surged by 10.81 points quarter-on-quarter to 34.04 percent (Chart 3.2.2). The correction expected in July and August in fresh fruits and vegetables remained limited; whereas a sizeable price increase was registered in September. In the unprocessed food group excluding fresh fruits and vegetables, price increases in milk, white meat, rice, eggs, dried fruits-nuts and red meat stood out (Chart 3.2.3). Annual processed food inflation, which remained almost flat in the last two quarters, soared by 7.58 points to 22.05 percent in this quarter (Chart 3.2.2). This leap in this quarter is attributed to exchange rate developments as well as the prices of unprocessed food used as inputs (milk, red meat etc.). In line with the price hikes in raw milk, increases were recorded in cheese and other dairy products as well as fats (Chart 3.2.4). Annual inflation in bread-cereals recorded a notable increase also

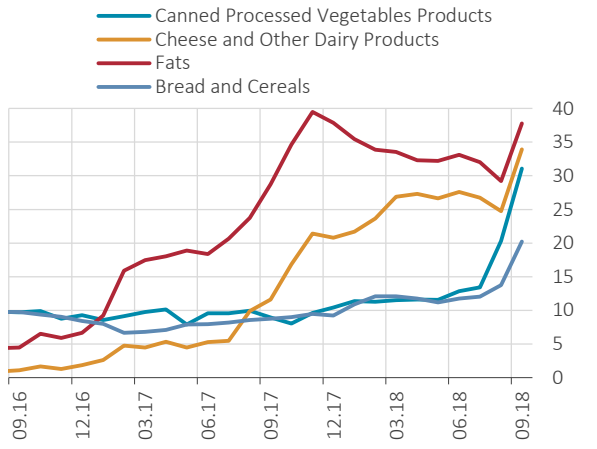
due to the raise in flour prices particularly in September. Cost pressures mounted on bread-cereals prices due to the price hikes in energy (electricity and natural gas) and flour in the upcoming period. Meanwhile, the main driver of the peak in annual inflation in canned processed vegetable products was the tomato paste item, which saw cumulative price hikes amounting almost to 70 percent in the last three months.

Chart 3.2.3: Selected Unprocessed Food Items (Annual % Change)



Source: CBRT, TURKSTAT.

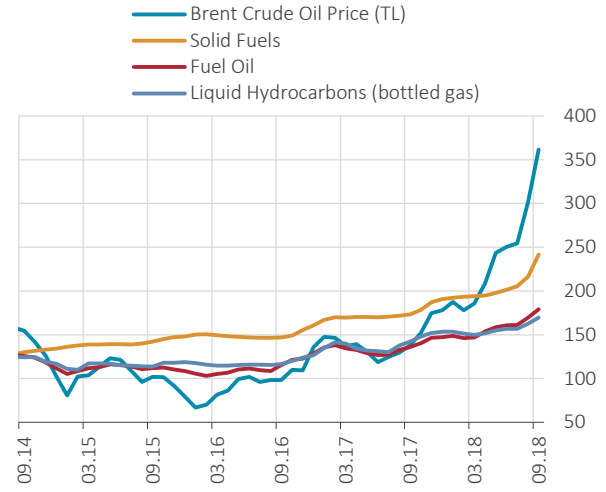
Chart 3.2.4: Selected Processed Food Items (Annual % Change)



Source: CBRT, TURKSTAT.

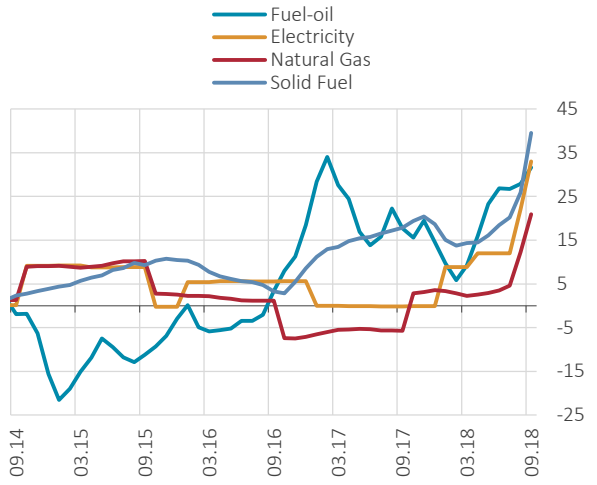
Energy prices soared by 12.34 percent in the third quarter (Table 3.1.1). After ending the previous quarter at 75 USD/bbl, Brent crude oil prices reached 79 USD in September. In this period, the depreciating Turkish lira pushed the TL-denominated oil prices significantly upwards, but the implementation of the sliding scale tariff on fuel oil prices curbed the upside effects (Chart 3.2.5). On the other hand, fuel oil prices surged by 11.21 percent in this quarter due to the SCT adjustment in August. Additionally, solid fuel prices recorded a noticeable hike of 19.93 percent on a quarterly basis. Among administered prices, electricity and natural gas soared by 18.80 and 16.98 percent, respectively, and the rise in water prices (3.19 percent) remained relatively limited (Chart 3.2.6). [2] As a result, annual energy inflation surged by 10.04 points to 27.03 percent in this period (Chart 3.2.1).

Chart 3.2.5: Oil and Selected Domestic Energy Prices (December 2010=100)



Source: Bloomberg, CBRT, TURKSTAT.

Chart 3.2.6: Domestic Energy Prices (Annual % Change)



Source: TURKSTAT.

[2] In August and September, consumer electricity and natural gas prices each saw a 9-percent-raise.

3.3 Domestic Producer Prices

Led by production and distribution of electricity and gas as well as the manufacturing industry, domestic producer prices (D-PPI) witnessed a sizeable increase of 20.29 percent in the third quarter (Table 3.3.1). Thus, annual producer prices inflation surged by 22.44 points to 46.15 compared to the previous quarter (Chart 3.3.1)[3]. This resulted from the evident depreciation in the Turkish lira and the rise in international oil prices worsened the course of prices in sectors affiliated to oil, particularly refined petroleum products.

Table 3.3.1: D-PPI and Sub-Categories (Three-Month and Annual % Change)

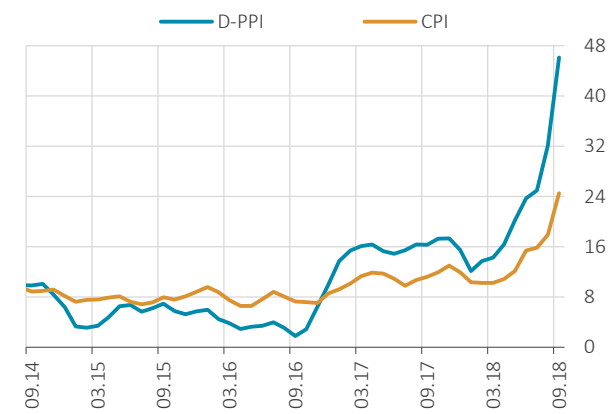
	2017			2018			
	III	IV	Annual	I	II	III	Annual
D-PPI	**1.82**	**5.18**	**15.47**	**5.29**	**9.72**	**20.29**	**46.15**
Mining	1.85	6.88	16.13	6.52	7.02	12.62	37.20
Manufacturing	2.13	5.52	16.64	4.98	9.68	19.15	44.77
Manufacturing excl. Petroleum Products	1.86	5.04	16.16	5.01	9.04	18.50	42.52
Manufacturing excl. Petroleum and Base Metal Products	1.08	4.21	14.04	4.88	8.58	17.41	39.33
Production and Distribution of Electricity and Gas	-2.37	-0.07	0.41	9.43	12.35	39.90	71.88
Water Supply	1.26	1.56	11.30	0.02	3.17	3.65	8.64
D-PPI by Main Industrial Groupings							
Intermediate Goods	3.15	7.21	20.75	5.38	10.24	22.02	51.96
Durable Consumption Goods	2.02	3.47	16.31	3.57	6.69	14.90	31.37
Durable Consumption Goods (excl. jewelry)	2.07	2.91	15.89	3.53	6.56	13.91	29.32
Non-Durable Consumption Goods	-0.88	1.00	7.69	4.32	7.61	12.56	27.63
Capital Goods	3.07	6.26	17.52	5.81	8.39	19.63	45.78
Energy	1.73	6.59	11.23	7.61	15.58	34.48	78.29

Source: CBRT, TURKSTAT.

In the third quarter, import prices remained relatively flat in USD terms, while they rose notably in TL terms due to exchange rate developments (Chart 3.3.2). This period was marked by producer price increases driven particularly by the energy sector (Chart 3.3.3). Production, transmission and distribution of electrical energy and gas manufacturing prices surged by around 40 percent on a quarterly basis and annual inflation in this group hit 71.88 percent (Table 3.3.1)[4]. Thus, in electricity and natural gas, in addition to the consumer price hikes, the increases in producer prices at higher rates, started to be reflected on CPI through cost channel. Accordingly, additional effects on consumer prices driven by energy prices may appear in the upcoming period.

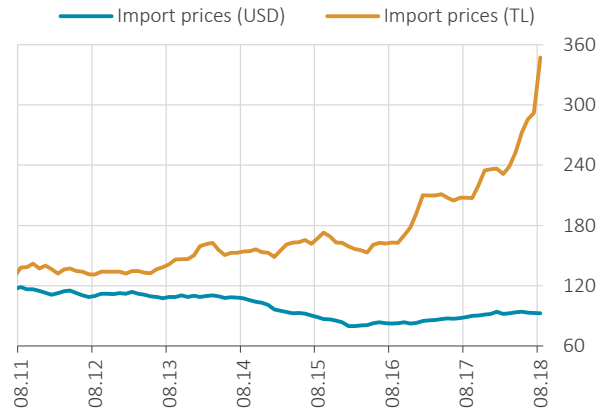
[3] The reasons for the differentiation between the producer and consumer prices and a brief evaluation regarding the pass-through from producer inflation to consumer inflation is available at the CBRT Blog post of 5 December 2017 "Are Producer Prices Running and Consumer Prices Chasing?"
[4] Industrial electricity and natural gas prices were raised by 14 percent each in August and September.

Chart 3.3.1: Domestic Producer and Consumer Prices (Annual % Change)



Source: TURKSTAT.

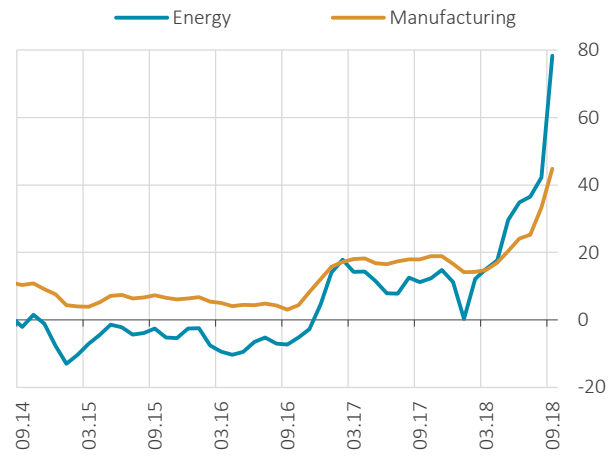
Chart 3.3.2: Import Prices in USD and TL (2010=100)



Source: CBRT, TURKSTAT.

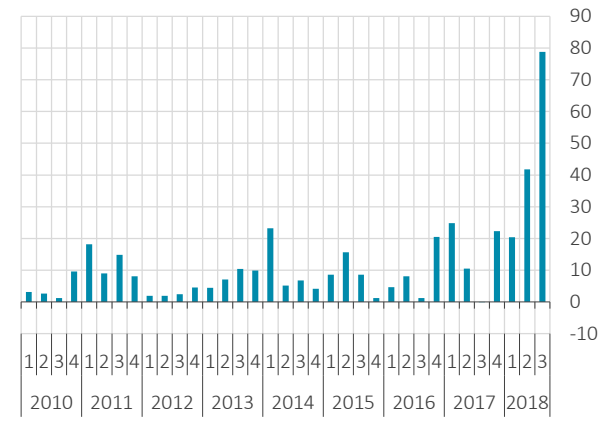
Main Industrial Groupings suggest that all subcategories witnessed soaring prices (Table 3.3.1). Price hikes in intermediate goods were mainly attributed to iron-steel and ferroalloys, plastics, textiles, threads and fibers, basic chemical products and paper products, while those in capital goods were led by motor vehicles and their accessories, metal construction materials and other machinery. On the other hand, prices of durable consumption goods were pushed up by furniture and household appliances, while those of nondurable consumption goods were driven higher by food and textile products. Against this background, the seasonally adjusted underlying trend of manufacturing prices excluding oil and base metals that entail information on the underlying trend of producer prices accelerated considerably. All in all, producer price developments pointed out that cost pressures grew stronger particularly through the energy and intermediate goods channels (Chart 3.3.4).

Chart 3.3.3: Energy and Manufacturing Prices (Annual % Change)



Source: TURKSTAT.

Chart 3.3.4: Manufacturing Prices Excluding Petroleum and Base Metal Products (Seasonally Adjusted, Annualized, Q-o-Q % Change)



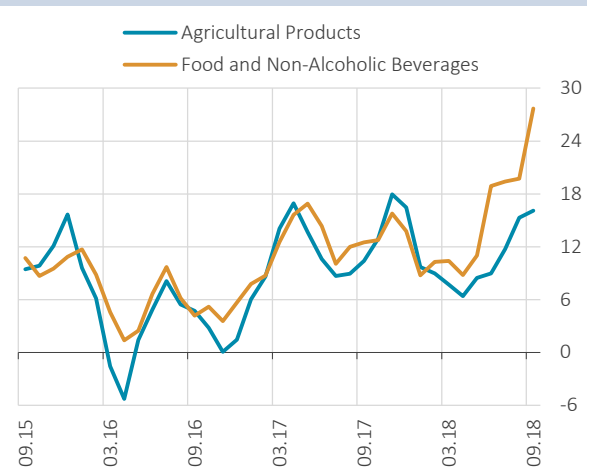
Source: CBRT, TURKSTAT.

3.4 Agricultural Producer Prices

Annual A-PPI inflation rose by 7.12 points to 16.09 percent in the third quarter (Chart 3.4.1). Annual inflation in cereals such as wheat, corn, barley as well as kidney beans and paddy rice recorded a quarterly uptick in this period. Moreover, some vegetables such as tomato and cucumber witnessed further price increases. Another subcategory that stood out in the third quarter was egg, the annual inflation of which hit 32.54 percent. Livestock prices recorded a quarterly rise, yet annual inflation in this

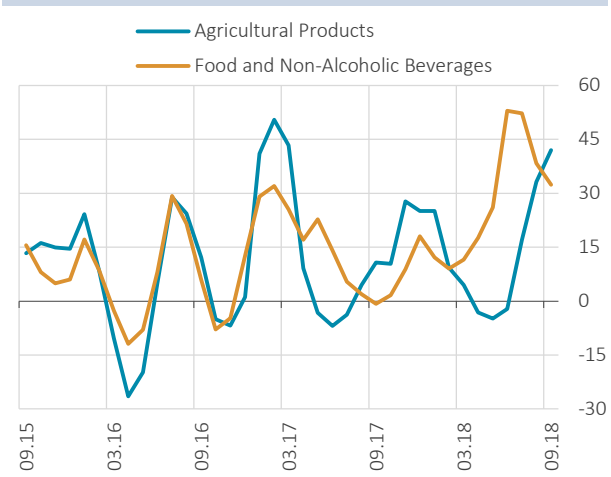
group remained relatively flat. Overall, seasonally-adjusted agricultural product prices trended upwards in the third quarter, which was also reflected in consumer food inflation (Charts 3.4.1 and 3.4.2).

Chart 3.4.1: Prices of Agricultural Products and Food
(Annual % Change)



Source: TURKSTAT.

Chart 3.4.2: Prices of Agricultural Products and Food
(Seasonally Adjusted, Annualized, Three-month Average % Change)

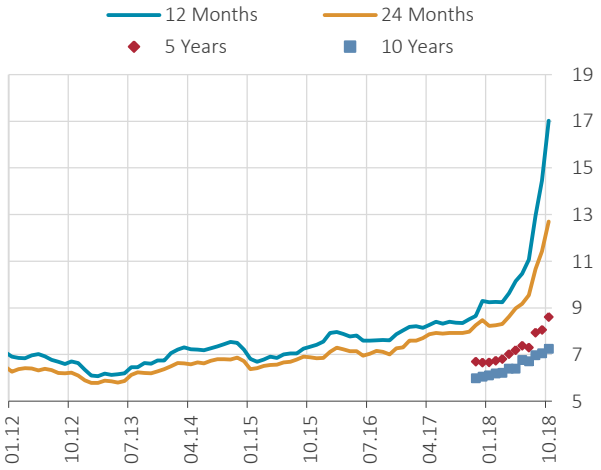


Source: CBRT, TURKSTAT.

3.5 Expectations

Following an upsurge in the second quarter of 2018, the uptrend in inflation expectations grew stronger in the third quarter amid the depreciation in the Turkish lira coupled with the deteriorated inflation outlook (Chart 3.5.1). In October, the year-end inflation expectation of the CBRT Expectations Survey respondents is 24.22 percent. Expectations for the next 12 and 24 months are 17.03 and 12.70 percent, respectively (Chart 3.5.1). Five-year and 10-year-ahead inflation expectations have also increased and continue to hover above the inflation target (Chart 3.5.1).

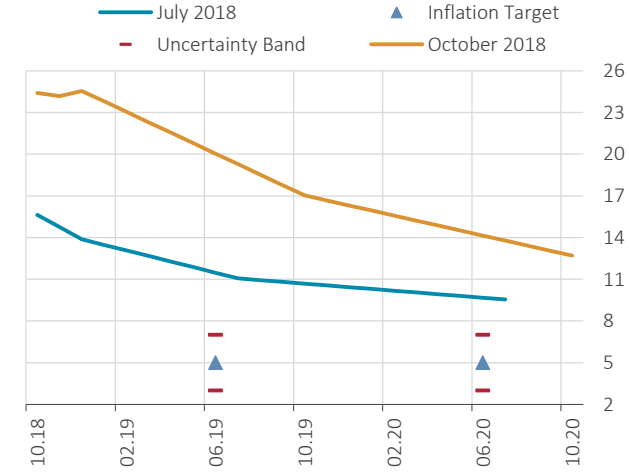
Chart 3.5.1: CPI Inflation Expectations* (%)



Source: CBRT.

* Second survey period results for the pre-2013 period using the CBRT Survey of Expectations, which polls representatives from the corporate sector, the financial sector and professionals.

Chart 3.5.2: Medium-Term Inflation Expectations Curve*
(%)

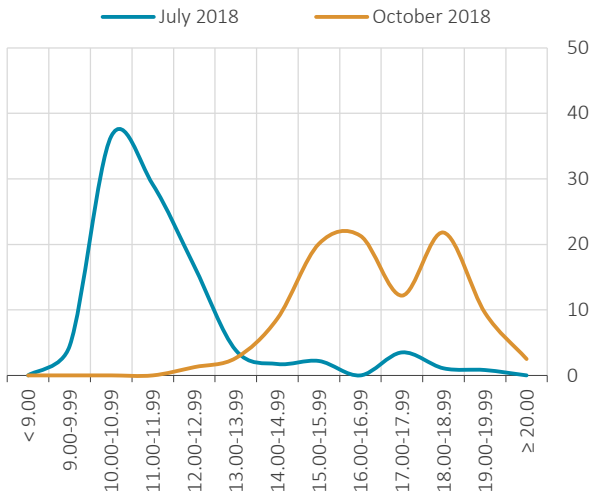


Source: CBRT.

* Calculated by linear interpolation of expectations for different time spans using the CBRT Survey of Expectations, which polls representatives from the corporate sector, the financial sector and professionals.

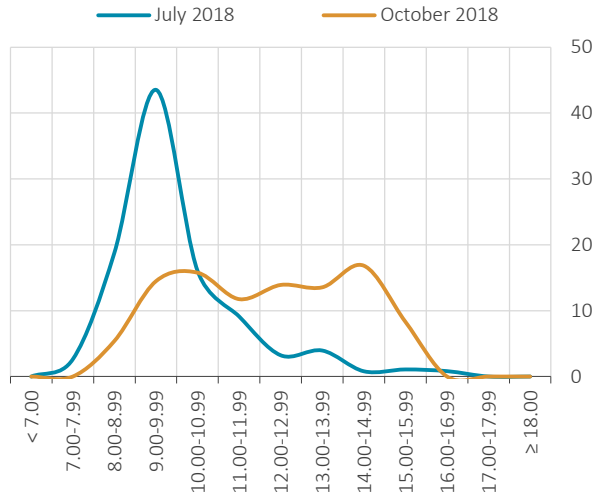
Inflation expectations were revised upwards quarter-on-quarter across all maturities, more markedly for the shorter term (Chart 3.5.2). Moreover, the probability distribution of inflation expectations also deteriorated compared to July (Charts 3.5.3 and 3.5.4). Probability distributions saw multiple peaks in this quarter, suggesting an increased uncertainty in the course of inflation as well. These factors pose upside risks to the inflation outlook through wage adjustments and pricing behavior.

Chart 3.5.3: Probability Distribution of 12-Month-Ahead Inflation Expectations* (%)



Source: CBRT.
* Horizontal axis denotes the expected inflation rate, while the vertical axis denotes the respective probability. For further details, see Statistics/Tendency Surveys/Survey of Expectations/Metadata at CBRT's website.

Chart 3.5.4: Probability Distribution of 24-Month-Ahead Inflation Expectations* (%)



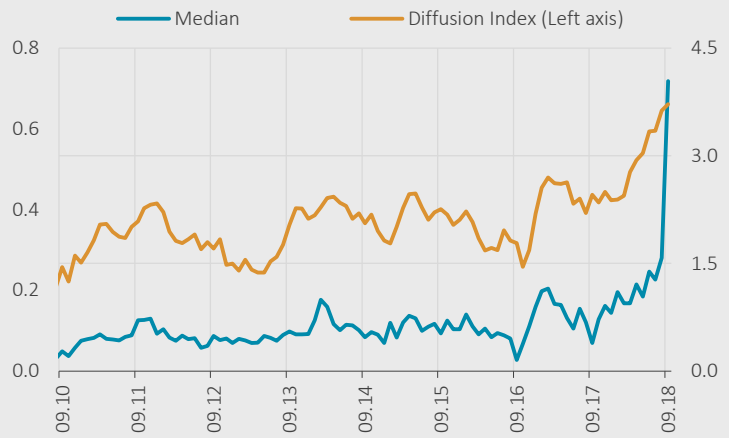
Source: CBRT.
* Horizontal axis denotes the expected inflation rate, while the vertical axis denotes the respective probability. For further details, see Statistics/Tendency Surveys/Survey of Expectations/Metadata at CBRT's website.

Box 3.1

A Model-Based Analysis of Recent Inflation Developments

In the third quarter of 2018, the deterioration in the inflation outlook grew more pronounced and the tendency for price hikes appeared strong across all subcategories. Hence, the diffusion index and median price increases registered the highest levels of the index history in September (Chart 1). This period differed from the past in terms of inflation dynamics, since inflation and medium-term inflation expectations have remained high for a long time, and backward-indexation in inflation has increased. Pricing behaviors have recently changed significantly, which in turn renders forecasting inflation more difficult. In this context, the change in inflation dynamics is analyzed through a simple reduced-form Phillips curve equation in this box.

Chart 1: CPI Diffusion Index and Median*



Source: TurkStat, CBRT.

(*)Median: Median monthly inflation rate of seasonally adjusted 5-digit sub-price indices.

Diffusion index: It is calculated as the ratio of the difference between the number of items whose price increases and the number of items whose price decreases to the total number of items. The chart is presented as a seasonally adjusted quarterly average.

Stability of the Phillips Curve

An approach frequently used in inflation estimations is the reduced-form Phillips curve (PC). In the equation below, the core inflation indicator CPIX (CPI excluding unprocessed food and alcohol-tobacco), is explained by the following variables:[1]

$$\pi_t^{CPIX} = \alpha_0 + \alpha_1 \pi_{t-1}^{CPIX} + \alpha_2 y_t + \sum_{i=0}^{2} \alpha_{i+3} \Delta e_{t-i}^{BASKET/TL} + \alpha_6 \Delta p_t^m + \alpha_7 \Delta w_{t-1} + \tau_t + u_t \qquad (1)$$

where π_t^{CPIX} is seasonally adjusted CPIX inflation in the end of quarter t; y_t is the output gap; $e_t^{BASKET/TL}$ is the quarterly average of currency basket and p_t^m is the quarterly average of import prices; $w_t$is the real unit wage and finally, τ_t is the contribution of tax adjustments to the CPIX inflation[2]. Constant parameter results for CPIX inflation of Model 1 are shown in Chart 2. This

[1] The model and methodology in this study is based on the study by Kara, Öğünç and Sarıkaya (2017). Also, you can look at the Koca and Yilmaz (2018) study which employs a similar approach for analyzing inflation dynamics differences between core goods and services.

[2] Two-quarter moving average of output gap and four-quarter moving average of real unit wage are used in this study.

model is estimated for the 2006Q2-2018Q1 period, and the second and third quarter of 2018 CPIX inflation is forecast with the coefficients obtained. An analysis of the actual and fitted values of Model 1 for 2006Q2-2018Q1reveals that residuals hover at reasonable levels fluctuating around zero. In this period, the absolute value of the highest residual is lower than 1 point. On the other hand, residuals steepened in the third quarter of 2018 (Chart 2). This model estimates CPIX inflation, which realized as 10.6 percent, to be 5.1 percent in the third quarter. In other words, pricing behaviors in the 2006Q2-2018Q1 are not sufficient to explain recent inflation developments and the constant parameter Phillips curve's forecast performance proved notably poor in third quarter.

Based on the Lucas critique, this observation indicates that during the periods of behavioral changes it is more appropriate to use a model in which the parameters are allowed to change. Accordingly, the time-varying parameter (TVP) Phillips curve is estimated again with the same variables (Model 2). This approach not only decreases residuals, but also enables us to interpret the change in inflation dynamics based on the course of time-varying coefficients.

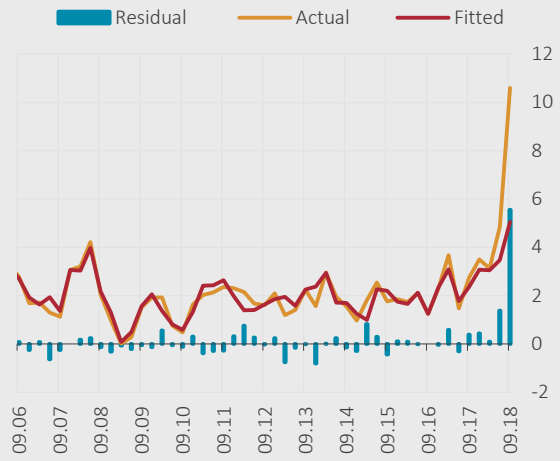
The results derived from Model 2 estimations can be summarized as follows:

(i) Backward-indexation in inflation: α_1 coefficient, which shows the impact of lagged inflation on the current inflation, has increased conspicuously (Chart 3). This movement indicates that backward indexation tendency became widespread and inflation inertia grew stronger.

(ii) Exchange rate pass-through: The model includes both the current and the lagged values of the exchange rate basket. Magnitudes of their coefficients entail information about the size and duration of the exchange pass-through to consumer inflation. Accordingly, the short-term pass-through (long-term pass-through) has hovered around 12 percent (17 percent) for a long time until 2018Q1 (Charts 4 and 5)[3]. Also, the current exchange rate pass-through (α_3) seems to be stronger than its lagged effect (α_4+α_5). The relative magnitudes of the current and the lagged coefficients indicate that approximately two-thirds of the short-term pass-through is completed within the same quarter. However, the exchange rate pass-through has recently changed significantly in terms of size and duration. In 2018Q3, the total exchange rate pass-through registered increases, especially the rise in the current period effect (α_3) is more evident. Although the sample is not yet sufficient to measure the change in lagged effects, the sharp increase in the current pass-through coefficient indicates that exchange rate effects are reflected on prices faster compared to the past. Moreover, stronger short-term exchange rate pass-through on the one hand, and higher inflation inertia (inflation becomes more affected by lagged inflation) on the other, aggravates the long-term effects of exchange rate shocks remarkably (Chart 5). However, this should not be interpreted as stating that long-term exchange rate pass-through in the upcoming period will be same as that in the third quarter. It should be noted that the pass-through will normalize again in the last quarter.

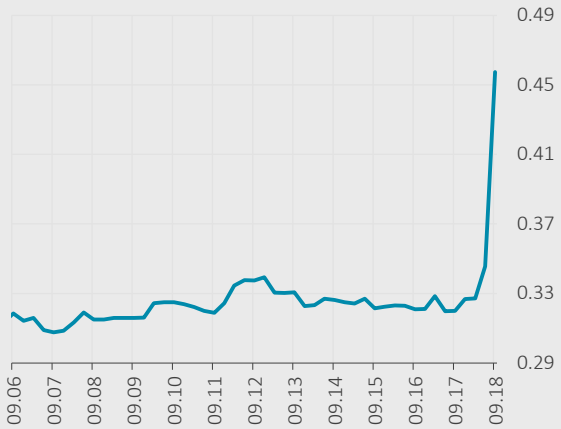
3 Long-term exchange rate pass-through is calculated as the sum of exchange rate coefficients (α_3+ α_{4+} α_5) divided by one minus lagged inflation coefficient (1- α_1).

Chart 2: Constant Parameter Phillips Curve Estimations



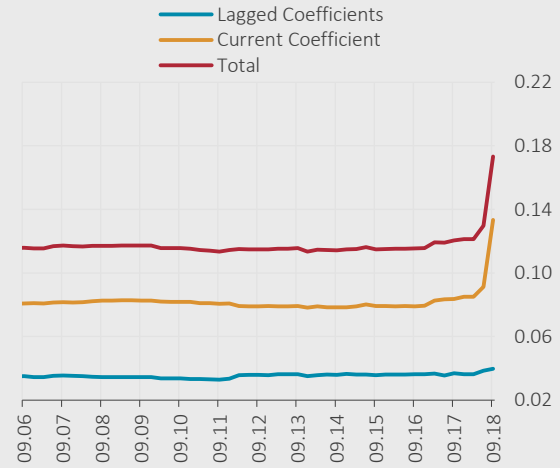
Source: Authors' calculations.

Chart 3: TVP Phillips Curve Lagged Inflation Coefficient



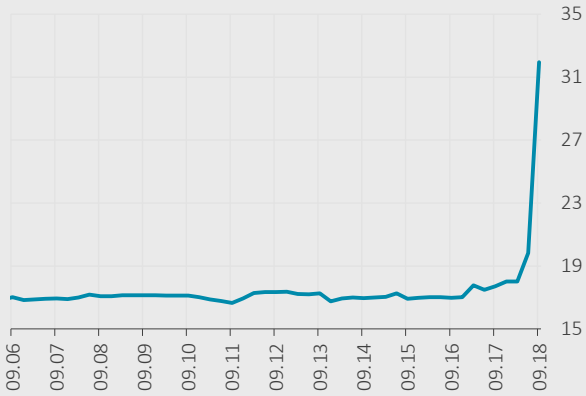
Source: Authors' calculations.

Chart 4: TVP Phillips Curve Exchange Rate Pass-Through Coefficients



Source: Authors' calculations.

Chart 5: TVP Phillips Curve Long-Term Exchange Rate Pass-Through Coefficient



Source: Authors' calculations.

In sum, it is seen that historical behavior patterns are insufficient to explain the recent developments in inflation, and pricing behaviors have deteriorated significantly. The change in Phillips curve coefficients indicates that the backward-indexation behavior has become widespread and the exchange rate pass-through has proved higher and faster. In the third quarter, agents followed a "front-loaded" pricing strategy, and the current pass-through to prices was quite high. Hence, lagged exchange rate effects in the upcoming period may turn out smaller compared to historical averages. Also, the exchange rate pass-through, which increased considerably in the third quarter, is expected to slow down in the last quarter. In addition, it is known that the exchange pass-through to prices decreases when demand conditions weaken (when the output gap is significantly negative) and increases when exchange rate expectations deteriorate (Kara et al., 2017). Therefore, the degree of pass-through in the upcoming period is likely to be determined by a tug of war between these two factors.

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Box 3.2

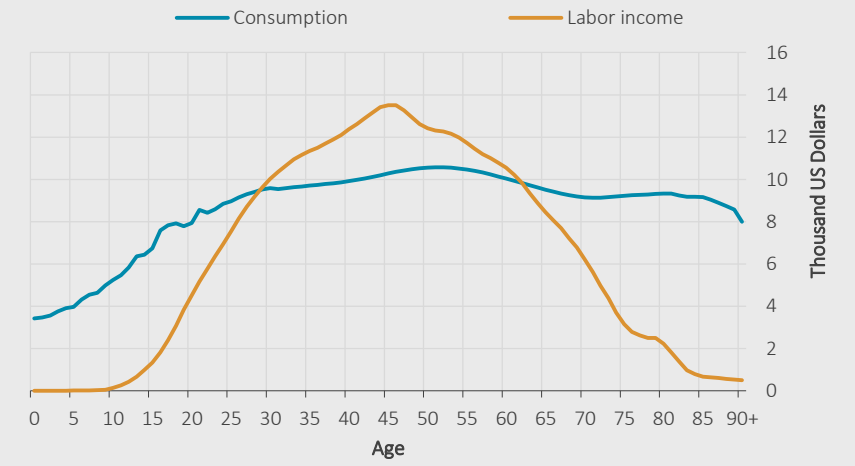
A Glance at the Structural Components of Inflation: Demography

While studies focusing on the sensitivity of inflation to business cycles shed light on short/medium term dynamics, the relation between inflation and structural factors such as demography, openness and productivity is key to understanding long-term tendencies. In this box, we aim to relate inflation and demography, one such structural factor, and to uncover the impact of demographic developments on the disinflation process Turkey experienced during the 2000s. Since demographic developments are highly predictable, we will also present projections of the likely impact of these developments on inflation over the upcoming period. [1]

National Transfer Accounts (NTA) Project

The life-cycle hypothesis suggests that individuals prefer consumption smoothing. Accordingly, in periods when the current labor income of individuals exceeds their consumption, individuals of working age save for the periods when their labor income will drop. The consumption of child dependents is met by private and public transfers, since they do not have any labor income. Whereas, consumption of senior dependents are either financed out of the savings they had accumulated during their working-age years or, depending on the functioning of the social security system in their country, by absorbing the savings of working age population with whom they concurrently live. The consumption and labor income profiles by age may vary across countries, depending on the differences based on the age of entry to labor market and retirement, average years of life expectancy and wage/pension levels. The NTA project[2] estimates consumption and labor income levels by age on the grounds of household income surveys and national accounts of countries (Chart 1). [3] Estimations for Turkey suggest that individuals' labor income exceeds their consumption between the ages of 29 and 62.

Chart 1: Labor Income and Consumption Level by Age in Turkey According to NTA Estimates



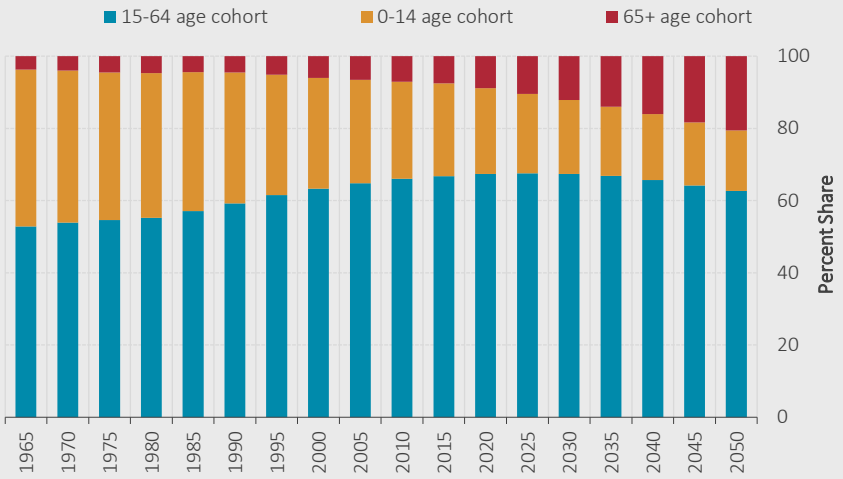
Source: http://www.ntaccounts.org/web/nta/show/Indicators

[1] This box comprises the initial findings of the ongoing study of Kalafatcılar, M.K. & Özmen, M.U. (2019).
[2] The NTA Project investigates the effects of demographic variables such as population growth rate and population age structure on macroeconomic aggregates on a global scale and sheds light on the intergenerational and intra-generational savings transfers. Interested readers may refer to the National Transfer Accounts Manual: Measuring and Analyzing the Generational Economy (2013).
[3] The data presented in Chart 1 are normalized with the labor income of the 30-49 age cohort and are converted into US dollars by the purchasing power parity. The date of access to data is 24/09/2018. Estimation for Turkey is provided by Prof. Aylin Seçkin of Istanbul Bilgi University, Department of Economics, based on 2006 data.

Demographic Structure in Turkey

As Turkey goes through demographic transition, sustained average life expectancy gains and the drop in the number of births per woman below the population replacement level bring about changes in the age structure of the population as well. For instance, in Turkey, while the share of the working age population (15-64 age cohorts) in total population stood at 52.9 percent in 1965 - the lowest record for the post-1950 period based on available data, the share reached 66.1 percent in 2010. The projection by the United Nations indicates that this share will increase moderately and reach its peak value at 67.5 per cent in 2025. This increase will be basically driven by the shift of child dependents to the working age cohorts (Chart 2).[4]

Chart 2: Age Structure of the Population in Turkey



Source: United Nations, Department of Economic and Social Affairs, Population Division. World Population Prospects – 2015 Revision.

Effects of Demographic Transition on Inflation: Model Estimations

As the share of age cohorts with different consumption/saving behaviors change, macroeconomic variables such as aggregate consumption, investment, real interest rate and inflation are affected by this transition even though the individual behavior remains unchanged. In this respect, a fixed effect panel data model for a set of 14 developing countries[5] is estimated in order to examine to what extent inflation is affected by age cohorts. In a similar vein, Juselius and Takats (2015) studied the subject for advanced countries. Due to high inflation experiences of emerging countries, the estimation period is restricted to 1996-2015. First, we computed the share of 17 age cohorts, each spanning five years, in the total population. Following Juselius and Takats (2015), these demographic variables are employed in the study after applying the polynomial transformation[6] suggested by Fair and Dominguez (1991). The transformation not only allows us to include all age cohorts without being exposed to the perfect collinearity problem, but also limits the differentiation of consecutive age cohorts' impacts. Accordingly, four age cohort variables representing the demography are included in the model, which aims to explain consumer inflation as the dependent variable. While the first model includes only demographic variables, economic variables that are fundamental determinants of inflation are also added to the following models. As explanatory variables, the base model employs the output

[4] Projections for 2025 suggest that there will be two workers corresponding to one dependent (either child or senior), however, there was approximately one worker corresponding to one dependent in 1965.
[5] Brazil, Chile, Hungary, India, Indonesia, Mexico, Peru, Philippines, Slovenia, Slovakia, South Africa, South Korea, Thailand and Turkey.
[6] In this study, transformation is made through a 4th degree polynomial. Readers may refer to Juselius and Takats (2015) for details.

gap and real interest rate; the following model includes real exchange rate as well, and additional controls of openness, labor cost indicator and import unit value indices are used in the last model. [7] Even though the sampling period excludes the high-inflation era of the emerging countries, a disinflation dummy used for three countries (Turkey, Mexico and Hungary) that shifted from a high inflation to a low inflation environment. [8]

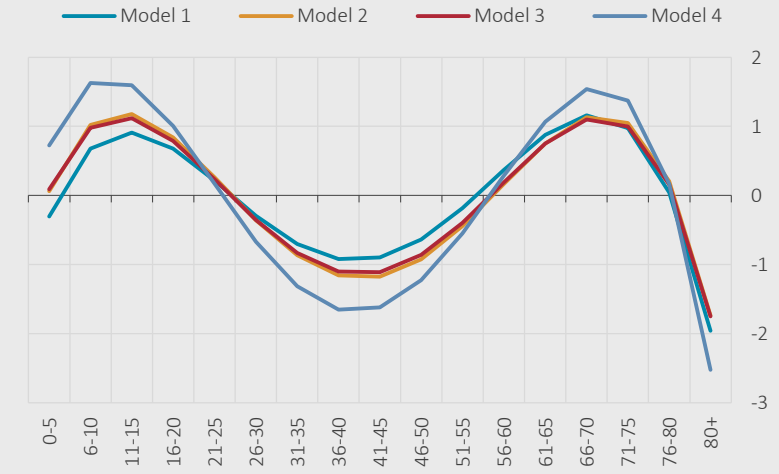
Table 1: Model Estimations

Dependent Variable : Annual CPI	Age Cohort 1	Age Cohort 2	Age Cohort 3	Age Cohort 4	Output Gap	Real Int. Rate	Real Exch. Rate	Open-ness	Labor Cost	Import Unit Value Index
Model 1	2.71**	-7.24***	6.65***	-1.95***						
Model 2	2.81**	-7.74***	7.12***	-2.08***	0.34**	-0.60***				
Model 3	2.66**	-7.36***	6.81***	-1.99***	0.44**	-0.57***	-0.07**			
Model 4	3.14**	-9.41***	8.98***	-2.68***	0.33**	-0.55***	-0.15***	-3.2**	0.42**	0.01***

Model is estimated over the 1996-2015 period. **, *** correspond to 5 percent and 1 percent significance levels, respectively.

Coefficient estimations obtained from the models are presented in Table 1. All coefficients for demographic variables have been found to be statistically and economically significant.

Chart 3: Effects of Age Cohorts on Inflation



Not: Coefficients presented in Table 1 are used to compute the curves.

[7] Data sources are as follows: United Nations - World Population Prospects (2015 revision) for demographic variables, BIS for real exchange rates, World Bank - World Development Indicators for remaining variables other than labor cost indicator. Labor share in GDP data, downloaded from Penn World tables, is adjusted by employment increases in order to acquire an indicator that reflects wage dynamics. Openness indicator is obtained after dividing trade volume in GDP data to commodity price index (energy excluded). Due to the fact that many emerging countries are commodity exporters, without such a correction, openness indicator would reflect revenue windfalls arising from commodity price movements. Since inflation expectations are not available for earlier periods, real interest rate is computed by deflating nominal rates with concurrent inflation rates.

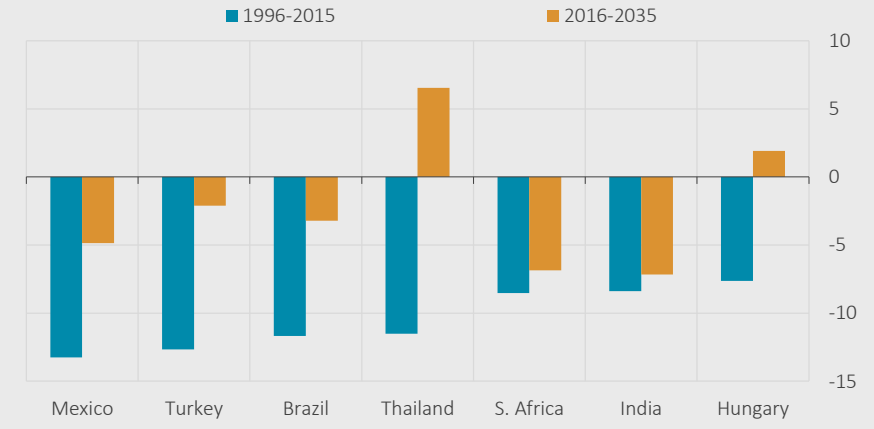
[8] Disinflation dummies assume "1" up to 2000 for Mexico and Hungary, up to 2004 for Turkey.

Chart 3 displays the impacts of age cohorts on inflation, which are computed by using the estimated coefficients and by back-casting the population polynomial. Accordingly, child dependents and employees at the early stages of the working age cohort are found to have an inflationary impact. It is observed that deflationary effects start with the 26-30 age cohort and continue until the 56-60 age cohort. Age cohorts in the middle of the working age, known as prime savers, are the most deflationary cohorts. Senior dependents constitute another inflationary cohort; however, it is interesting that the 80 and above age cohort turns deflationary. This can be explained by both the lower reliability of estimations due to the number of observations of that age cohort and decreased marginal propensity to consume coupled with the structure of the social security system. If the social security system mediates the transfer of intergenerational savings, then this mediation, considered together with low marginal propensity to consume, can help explain the deflationary impact of this age cohort.

The disinflationary impact arising from changes in the demographic structure has been calculated by employing the estimated coefficients and a historical accounting pertaining to these calculations and projections for the upcoming period have been presented in Chart 4.[9] All emerging countries that are covered in the study are found to have experienced disinflationary developments due to the demographic changes, and Turkey has benefited from this impact as well. However, as countries have been moving to the later stages of demographic transition, the growth rate of the share of the working age in total population decelerates, and even turns to negative in some countries. In this regard, we conclude that the disinflationary effect of demography will decrease in the upcoming period while it may even become inflationary for some countries.

Our findings suggest that demographic factors significantly contributed to the disinflation process in Turkey between 1996 and 2015. In the upcoming period, the distribution of age cohorts in total population will keep changing. Projections suggest that the share of the working age cohort, the deflationary group, in total population will decrease marginally after peaking in 2025. While the share of child dependents, one of the two inflationary cohorts, will continue to decline, that of senior-dependents will increase, particularly after 2020 (Chart 2). When the overall impact of all age cohorts is taken into account, it is projected that demographic factors will remain deflationary, albeit in a fading manner, over the second two-decade period under review. It should be noted that although demographic developments are projected to continue to restrict inflation in Turkey, the change in the age structure of population is only one of the many structural determinants of inflation.

Chart 4: A Historical Accounting and Projections



[9] Simple averages of the coefficients obtained from four models are used for projections.

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