Central Bank of the Republic of Uzbekistan

Statistics and Research Department

N. Omonov, J. Mamasalaev, A. Toshnazarov

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Tashkent 2025

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Prepared by the Statistics and Research Department.
You may send your comments and suggestions to the following address:
E-mail: nurbekomonov@cbu.uz; j.mamasalaev@cbu.uz

DECOMPOSING DEMAND AND SUPPLY DRIVEN INFLATION

Authors: Nurbek Omonov, Jamshid Mamasalaev, Azizjon Toshnazarov

Introduction

The COVID-19 pandemic, combined with the worsening global geopolitical situation, has resulted in a sharp rise in inflation across both advanced and developing economies. This, in turn, further reinforces the necessity of conducting a comprehensive analysis of the factors driving inflation and developing an effective monetary policy framework aimed at containing it.

By decomposing inflation into demand-side and supply-side factors, policymakers can more accurately evaluate the effectiveness of implemented measures, better manage inflation expectations, and mitigate the risks associated with rising consumer prices.

On the demand side, factors such as personal income, investment, and government spending put upward pressure on inflation by influencing aggregate demand. By monitoring these indicators, policymakers can better gauge the level of economic activity and identify potential positive demand gaps that may contribute to inflationary pressures.

Conversely, increases in energy prices, production costs, natural disasters, and supply chain disruptions place upward pressure on inflation through their effects on aggregate supply. Analyzing these supply-side factors enables policymakers to design appropriate monetary policy responses by helping them determine whether inflationary pressures stem from temporary supply shocks or from more persistent structural forces.

Literature review

In the aftermath of the pandemic, many central banks and independent economists began analyzing the supply- and demand-side factors influencing inflation.

In particular, Shapiro (2022) carried out a comprehensive analysis of the U.S. Personal Consumption Expenditure (PCE) Index using data spanning from 1990 to 2022. His research examined both the prices and volumes of goods and services, disaggregated into more than 100 distinct categories.

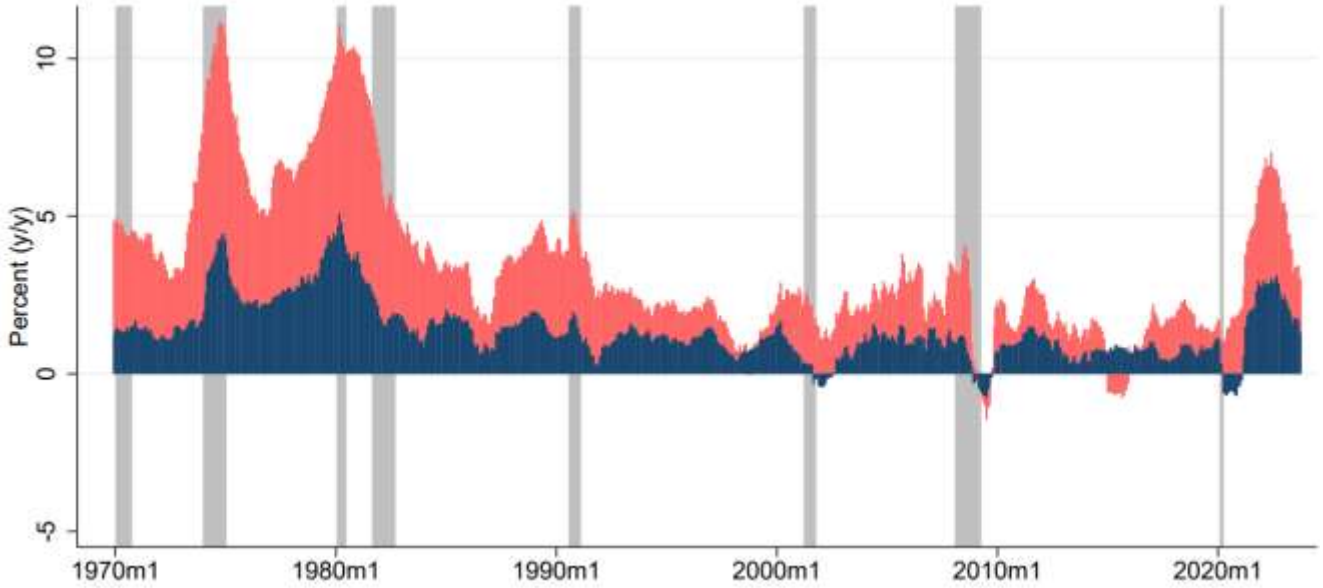
The residuals obtained from the VAR model of weighted average prices across each product group were utilized to decompose total production within the framework of a production state model. This model differentiates between production driven by demand-side fluctuations and production influenced by supply-side factors.

The research findings suggest that during the 2007-2009 financial crisis, the inflation rate declined due to a confluence of demand and supply factors. Notably, the drastic easing of monetary

policy during this period led to a temporary increase in the supply of financial services, further contributing to the disinflationary trend.

Furthermore, the sharp decline in air travel in 2001 influenced inflation from the demand side, whereas the decrease in prices of energy, metal, and agricultural products in 2014-2016 was influenced by supply-side factors (for reference: the price of crude oil for 1 barrel from 106 dollars in June 2014 to 30 dollars in February 2016 down to the dollar).

Figure 1. Personal Consumer Expenditure Index change in the US between 1990-2022, %



Source: Shapiro, (2022). Decomposing supply and demand driven inflation. Federal Reserve Bank of San Francisco. p.14.

Moreover, *Furman (2022)* states that demand-side pressure on inflation has increased due to stimulative monetary and fiscal policies, especially increased fiscal spending during the pandemic. Whereas *Giovanni et al. (2022)* and *Carriere-Swallow et al. (2023)* note that disruptions and a sharp increase in raw material prices were the main factors affecting inflation.

During his speech in May 2022, Federal Reserve Chairman, Jerome Powell stated that the Federal Reserve can only influence demand, and supply factors cannot be influenced through monetary policy. Therefore, the return of high inflation to the target level also depends on supply factors.[1]

Besides, other economists have pointed out that in situations where the impact of supply factors on inflation is higher than demand factors, monetary and fiscal policies might not have the expected effect on inflation *(Boissay et al. (2021)* and *Ghassibe and Zanetti (2022)).*

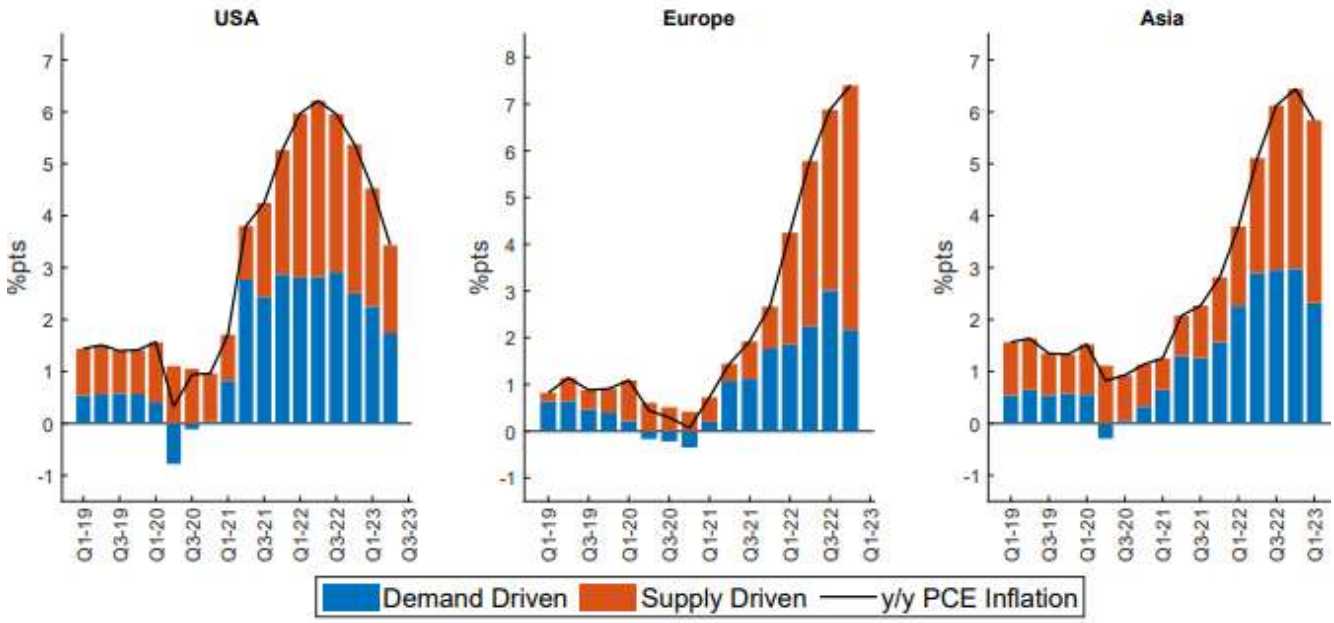
[1] https://www.marketplace.org/2022/05/12/fed-chair-jerome-powell-controlling-inflation-will-include-some-pain/

According to *Giovanni et al. (2022)* , in 2020-2021, the impact of external shocks and global supply chain disruptions on the formation of inflation was higher than domestic aggregate demand shocks, the policies aimed at stimulating aggregate demand.

Sheremirov (2022) claims that temporary supply shocks in the US economy were a major factor in the development of inflation in 2021–2022.

In addition, demand and supply factors of inflation have been studied by several economists across countries. In particular, according to the results of the research conducted by *Melih* and *Hao (2023)* based on the data of 32 developed and developing countries for the period 1990-2023, starting from 2021, the influence of not only supply factors but also demand factors on inflation has increased.

Figure 2. Decomposition of inflation in 2019-2023, *in annual percentage*



Source: Firat, M. and Hao, O. (2023). Demand vs. Supply Decomposition of Inflation: Cross-Country Evidence with Applications. IMF Working Papers. WP/23/205. p.11.

In particular, in the USA, the pressure of supply factors on inflation increased during the pandemic until mid-2022, while the pressure decreased in the following periods. At the same time, the influence of these factors remained dominant in European and Asian countries during that period.

The share of supply factor in the inflation decomposition decreased from an average of 3.2% in 2022 to 2.7% in 2023 in the United States, while it increased from an average of 2.3% to 2.7% in European countries, and an average of 3.2% to 3.5% in Asian countries.

Methodology

In this study, we aim to decompose the the change in the consumer price index in Uzbekistan between 2018 and 2024 into demand and supply sides. The calculations were carried out following the methodology developed by Adam Shapiro (2022), the Federal Reserve Bank of San Francisco.

The study employs the quarterly and yearly consumer price index and household's personal monthly expenditure data in aggregated as well as disaggregated forms. We decompose the inflation data in 3 different sub-categories, food (1), non-food (2) and service (3).

In particular, the vector autoregressive (VAR) model is used for empirical analysis:

$$q_{i,t} = \sum_{j=1}^{N} [\gamma_{i,j} p_{i,t-j} + \delta_{i,j} q_{i,t-j}] + v_{i,t}^{q}$$

$$p_{i,t} = \sum_{j=1}^{N} [\alpha_{i,j} p_{i,t-j} + \beta_{i,j} q_{i,t-j}] + v_{i,t}^{p}$$

Where,

- $q_{i,t}$– *log (average monthly personal consumption expenditure);*
- $p_{i,t}$ – *log (consumer price index);*
- $v_{i,t}^{q}, v_{i,t}^{p}$ - *shocks.*

The presence of shocks in the form of $v_{i,t}^{q} > 0$, $v_{i,t}^{p} > 0$ or $v_{i,t}^{q} < 0$, $v_{i,t}^{p} < 0$ indicates that the change in the prices of certain goods or services is formed due to demand factors, on the contrary, in cases where $v_{i,t}^{q} > 0$, $v_{i,t}^{p} < 0$ or $v_{i,t}^{q} < 0$, $v_{i,t}^{p} > 0$ indicate that the change is due to supply factors.

In other words, demand-side shocks serve to simultaneously increase or decrease the quantity and price level of goods and services, while supply factors cause the two indicators to move inversely.

Such as rise in lending within the economy causes an increase in the consumption of goods and services and raises prices. Conversely, disruptions in the supply chain lead to a rise in prices and a decrease in consumption.

Considering that, the decomposition of changes in consumer prices can be calculated by dividing them into two groups as follows.

$$\pi_{i,t} = \sum_{i} (supply)\ w_{i,t}\pi_{i,t} + \sum_{i} (demand)\ w_{i,t}\pi_{i,t}$$

In which,

- $\pi_{i,t}$ *– Price change of i good or service;*

- $w_{i,t}$ – *Weight of type i good or services in consumers basket.*

We used quarterly the consumer price index and personal consumption expenditure data of Uzbekistan for the period of 2018Q1-2024Q4.

Products and services in the consumer basket were classified into 32 groups: food products into 11 groups, non-food products into 13 groups, and services into 8 groups.

Analysis of empirical results

Calculations made for Uzbekistan showed that although the impact of demand factors on the change of consumer prices in the pre-pandemic and post-pandemic periods was substantial, during the pandemic, due to disruptions in global supply chains, the increase in prices was mainly due to supply factors. In particular, due to the increase of utility tariffs[2] in the third quarter of 2019, the inflation of services in this quarter was formed mainly by supply-side factors.

Figure 3. Decomposition of inflation in Uzbekistan in 2020-2024, *in percent (QoQ)*

Source: Central Bank's calculations

[2]*For residents: 1 м³ natural gas: from 320 to 380 soums; 1 square meter of electricity: from 250 soums to 295 soums; 1 l. A-80 gasoline: from 4000 soums to 4500 soums.*

Moreover, the 1.8% increase in consumer prices during the second quarter of 2020 was mainly due to supply factors. There was an increase in the prices of cereals (12.7%), flour and flour-based products (6.9%), meat and meat products (3.3%), and dairy products (3.8%), mainly as a result of a decrease in the supply of food products. This situation is explained by the disruptions in supply chains caused by the global pandemic and the partial limitation of production processes in enterprises for a certain period.

In the second quarter of 2022, demand was the main driver of the increase in consumer prices. This could be explained by the transition of conventional wheat purchasing process to market-based mechanism, doubling the prices of wheat, which in turn resulted in an average increase in the price of bread from 1400-1600 sums to 2800 sums.

It is noteworthy that starting from the fourth quarter of 2022 the predominance of supply side factors emerged. In particular, in the second half of 2023, supply-side factors played a dominant role in driving inflation, contributing to approximately 70% of the overall inflation rate. This was primarily influenced by several key developments within the economy. One of the most significant factors was the seasonal increase in fruit prices, which naturally fluctuated due to production cycles and other seasonal variables. In addition to this, there was a noticeable reduction in the supply of meat and meat products, which further impacted prices, as lower availability typically leads to higher costs for consumers.

Moreover, during the fourth quarter of 2023, there was a substantial increase in the price of essential utilities. The cost of drinking water and wastewater services surged by an extraordinary 3.5 times, placing additional financial pressure on households and contributing to overall inflationary pressures. Another important development was the rise in public transportation fares in Tashkent. The hike in transportation costs added to the burden on residents, further intensifying the inflationary trend.

In the fourth quarter of 2024, the observed inflation rate (about 3%) was primarily driven by aggregate demand factors (2.1%). The contribution of supply-side factors (0.8%) exerted relatively weaker inflationary pressure compared to previous quarters.

Overall, the dominance of demand-side factors was observed, on the one hand, due to a 10% increase in public sector wages and a 15% rise in nominal pensions and allowances in October 2024, and, on the other hand, as a result of higher food prices. The surge in food prices was mainly driven by increases in the prices of vegetable oil, eggs, and vegetables.

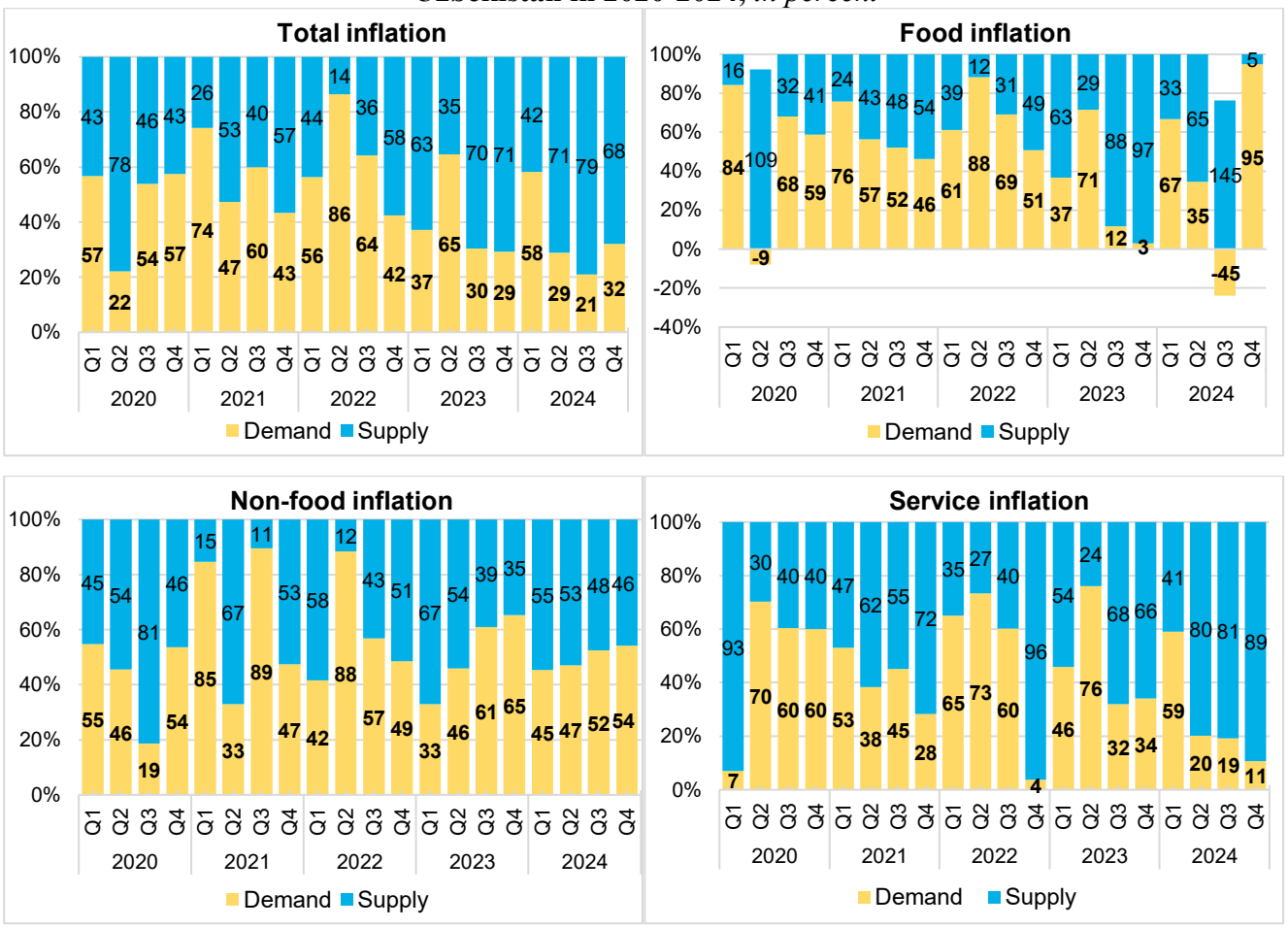
In the analysis of inflation for the above years, demand factors accounted for 49.3% of the total annual inflation, while supply factors contributed slightly more at 50.7%. When disaggregated further,

the influence of demand and supply factors on specific categories of inflation reveals some notable trends.

In food inflation, demand factors made up 49.7% of the increase, while supply-side factors were responsible for 50.3%. Looking at the non-inflation specifically, demand factors contributed 51.5%, slightly outweighing the supply-side factors, which accounted for 48.5%. In contrast, when examining inflation in services, demand factors accounted for 44.7%, while supply-side factors played a more dominant role, contributing 55.3% to the inflation in this category.

According to the analysis, the annual inflation rate in 2024 (approximately 10%) was predominantly shaped by supply-side factors, which accounted for 6.7 percentage point. The fact that 68% of annual inflation in 2024 was driven by supply-side influences is mainly associated with the strong impact of supply factors on services inflation. In contrast, demand-side factors played a more significant role in the inflation of both food and non-food goods.

Figure 4. Changes in the share of demand and supply factors in annual inflation in Uzbekistan in 2020-2024, *in percent*



Source: Central Bank's calculations

As a result of the easing of anti-pandemic restrictions and the increase in fiscal spending, the dominance of demand factors in the formation of general inflation remained from the first quarter of

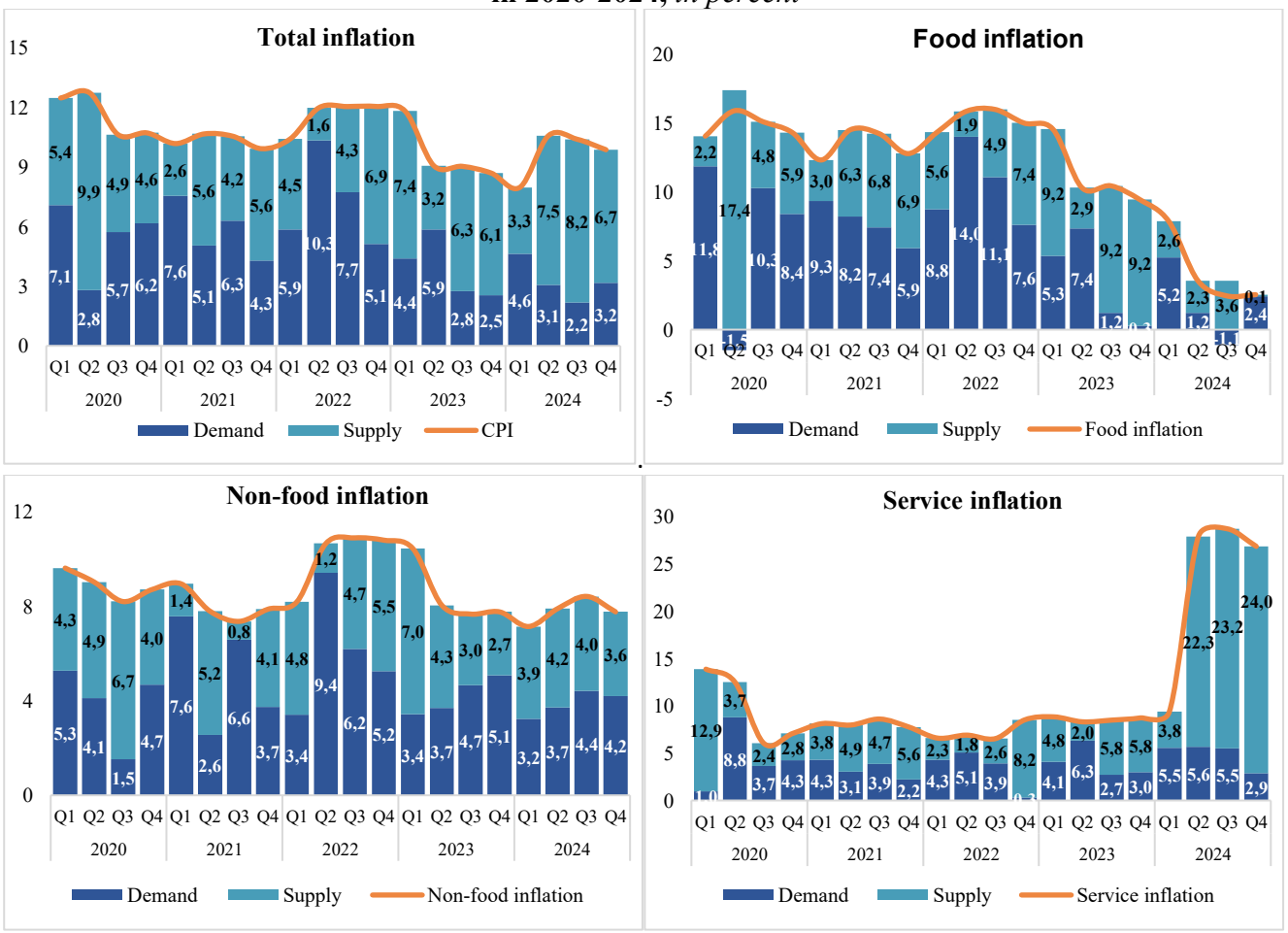
2021 to the third quarter of 2022. In particular, in the first quarter of 2021, annual inflation was 10.2%, of which 7.6 percentage point was contributed by demand factors.

At the same time, since the second half of 2022, there has been a noticeable decrease in the share of demand factors in overall inflation. Specifically, in the second of 2022, 10.3% of the 12.0% annual inflation was attributed to demand factors, while at the end of 2023, 2.5% of the 8.8% inflation was influenced by demand factors. In this context, the 10.3% inflation shaped by demand factors at the end of June 2022 was primarily caused by the increase in the prices of meat, bread, and confectionery products from food items, as well as household appliances and fuel prices from non-food items.

Additionally, at the end of 2023, the dominance of supply factors in shaping inflation can be explained by the seasonal increase in fruit prices, as well as the rise in tariffs for medical services, public transportation, and communication services.

In 2024, the increase in services inflation was primarily driven by the liberalization of energy prices. The liberalization of energy prices amplified services inflation through supply-side channels.

Figure 5. Decomposition of inflation (YoY) in Uzbekistan in 2020-2024, *in percent*



Source: Central Bank's calculations

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