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Decomposing supply- and demand-driven inflation in Turkey

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Abstract
We document the demand- and supply-driven components of inflation in Türkiye by following the decomposition method of Shapiro (J Money Credit Bank, 2024). The results suggest that the recent surge in inflation, which began with the COVID-19 pandemic and deviated significantly from global inflation rates, reaching as high as 80%, was initially driven by supply factors. As monetary policy loosened, demand-driven inflation also increased; however, throughout the post-COVID period, supply-driven inflation consistently exceeded the demand-driven component in this high-inflation environment. Consistent with theory, oil supply and exchange-rate shocks increased the supply-driven inflation, while monetary policy tightening reduced the demand-driven inflation. This decomposition can potentially serve as a useful real-time tracker for policymakers.

Keywords Inflation decomposition · Demand · Supply · Exchange rate pass-through

JEL Classification E12 · E24 · E31 · E52

1 Introduction

During the COVID-19 pandemic, nearly all countries experienced a significant surge in inflation, reaching levels unprecedented since the 1970s and 1980s. In response to the sharp and severe contraction caused by the onset of the COVID-19 pandemic and the subsequent lockdowns in early 2020, central banks worldwide implemented a range of conventional and unconventional monetary policy measures to support economic activity. As an emerging open economy, Türkiye faced an even higher and more volatile inflation surge compared to other countries, reaching a peak of 85%,

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making it crucial to understand the driving forces behind this increase for effective policymaking.[1]

At the beginning of the COVID-19 period, lockdowns led to supply chain disruptions and an increase in commodity and goods prices, consequently creating supply-driven inflation pressures. Subsequently, these supply shocks spilled over into negative demand shocks in some sectors (Guerrieri et al. 2022). However, with large fiscal stimulus packages and an accommodative monetary policy stance, demand quickly recovered and began to exert demand-driven inflationary pressures.[2] During this time period, discerning whether inflation is demand-driven or supply-driven is crucial for policymaking in real time. In this paper, we aim to document the extent to which supply and demand factors drive inflation in Türkiye.

We utilize sectoral CPI data to decompose inflation into supply- and demand-driven components, following the methodology of Shapiro (2024). For each sector in a given month, inflation is classified as demand-driven or supply-driven based on the residuals collected from separate sector-level price and quantity regressions. If, within a sector, residuals in both price and quantity regressions share the same sign, the sector likely experiences a net demand shock, categorizing sectoral inflation as demand-driven for that month. Conversely, if residuals exhibit opposite signs, sectoral inflation is categorized as supply-driven. The rationale is that supply shocks should move prices and quantities in opposite directions, while demand shocks should move them in the same direction. Subsequently, the total contribution of demand- and supply-driven components to aggregate inflation in a month is calculated as the weighted sums of sectoral inflation rates labeled as either demand- or supply-driven.

Turkish inflation has soared to levels not witnessed in decades, reaching its peak at 85 percent per annum in September 2022, before gradually subsiding to approximately 40 percent by spring 2023. In stark contrast, inflation stood below 10 percent before the onset of the 2020 COVID-19 pandemic. The decomposition reveals that the slight decline in inflation at the onset of the pandemic was driven by a reduction in demand-driven inflation. Subsequently, inflation began to rise, with increases observed in both demand- and supply-driven inflation toward the end of 2020. This moderate increase continued until the end of 2021, but afterward, there was a significant hike in inflation stemming from both demand- and supply-driven factors, coinciding with the re-loosening of interest rates in September 2021 and the depreciation of the Turkish lira aftermath. Supply-driven inflation weakened over time, consistent with the global recovery from supply chain disruptions. Nonetheless, supply-driven inflation still constitutes a large portion of aggregate inflation due to changes in exchange rates and unanchored inflation expectations. Demand-driven inflation remained robust due to accommodative monetary policy until the end of 2023. With the recent tightening

[1] Between September 2021 and May 2023, the Central Bank of the Republic of Türkiye (CBRT) pursued an expansionary monetary policy. Additionally, on top of the challenges posed by the COVID-19 pandemic, Türkiye was struck by a devastating earthquake in February 2023. This event exacerbated supply-side issues due to damage to production facilities, disruptions in supply chains, and power shortages.

[2] Additionally, a significant rise in supply-driven inflation occurred in early 2022, primarily due to economic disruptions stemming from the Russian invasion of Ukraine. These patterns observed during both the COVID-19 pandemic and its aftermath closely align with the conclusions drawn in studies conducted by Baqaee and Farhi (2022); Ferrante et al. (2023); Bernanke and Blanchard (2023); Lorenzoni and Werning (2023) and di Giovanni et al. (2023), all of which utilize structural methodologies.

cycle in monetary policy reaching its peak in March 2024, demand-driven inflation has started to decline.

To validate the methodology, we initially present narrative evidence to assess whether the decomposition aligns with key economic events in Türkiye. Then, we present Phillips Curve estimations utilizing supply- and demand-driven inflation and document the downward bias on the slope of the Phillips Curve stemming from supply shocks, further affirming the robustness of the methodological approach. Additionally, we empirically investigate the response of supply- and demand-driven inflation to various supply and demand shocks from the literature. We conduct local projections using high-frequency identified monetary policy shocks and global oil supply shocks. The results demonstrate that monetary policy surprises induce a significant decline in demand-driven inflation and do not impact supply-driven inflation, whereas oil supply shocks increase supply-driven inflation and do not affect demand-driven inflation. Thus, the empirical results are consistent with the theoretical understanding, which improves the validity of the approach.

This paper further contributes to the literature by examining the relationship between exchange rate and both supply- and demand-driven inflation. Taylor (2000) argues that in environments characterized by low and stable inflation, firms are less likely to adjust prices in response to exchange-rate fluctuations, leading to lower exchange rate pass-through. In contrast, in high-inflation environments, firms are more inclined to adjust prices to protect profit margins, resulting in a higher degree of pass-through.[3] Moreover, Gopinath and Itskhoki (2010) suggest that the extent of pass-through is influenced by market structures, pricing-to-market behavior, and the nature of the underlying shocks-whether they are supply- or demand-driven. Our findings indicate that both supply- and demand-driven inflation rates are responsive to exchange rate shocks. The stronger response observed in supply-driven inflation is due to the increased pressure on prices from higher import and marginal costs, while the relatively weaker yet significant response of demand-driven inflation can be explained by the wealth effect arising from the high dollarization rate in Türkiye.

Overall, the decomposition enables tracking the impact of policies in real-time, as it can be updated monthly and serves as an additional economic indicator. Section 2 describes the data and methodology, while Sect. 3 presents the inflation decomposition and the narrative evidence. Section 4 presents Phillips Curve estimation. Section 5 documents the response of demand- and supply-driven inflation to various exogenous shocks, and Sect. 6 concludes.

2 Data and methodology

The methodology requires price and quantity series at the sectoral level. This data is only available for limited number of sectors in Türkiye and the available data is based

[3] A related strand of literature focuses on the macroeconomic exchange-rate pass-through to aggregate price indices, as examined by Bacchetta and van Wincoop (2004); Gagnon and Ihrig (2004) and Campa and Goldberg (2005). Alvarez et al. (2018) empirically document that the frequency of price adjustment increases with higher inflation.

on retail sales.[4] The sectors covered include: (1) food, drinks, tobacco, (2) computers, software, telecommunication equipment, etc., (3) hardware, household appliances, furniture, etc., (4) textiles, clothing, and footwear, (5) pharmaceutical, medical, and orthopedic goods, cosmetic articles, (6) internet and mail orders, and (7) fuel. Ideally, more granular data would be preferable for the decomposition; however, price and quantity data at the 3-digit sector level are only available in a few countries (Firat and Hao 2023).[5] This data is available from 2010 onwards and covers nearly 60% of the CPI basket. The data series for sectoral prices and quantities can be found in the appendix (Fig. 17).

We closely follow the methodology from Shapiro (2024) to decompose inflation into supply- and demand-driven components.[6] The main assumption behind this methodology is that demand shocks move prices and quantities in the same direction, while supply shocks move them in opposite directions.[7] We first run the following price and quantity regressions for each available sector s:

$$q_{s,t} = \sum_{i=1}^{12} \beta^{qp} p_{s,t-i} + \sum_{i=1}^{12} \beta^{qq} q_{s,t-i} + c + \gamma_t + \gamma_t^2 + \varepsilon_{s,t}^q$$

$$p_{s,t} = \sum_{i=1}^{12} \beta^{pp} p_{s,t-i} + \sum_{i=1}^{12} \beta^{pq} q_{s,t-i} + c + \gamma_t + \gamma_t^2 + \varepsilon_{s,t}^p$$

where $q_{s,t}$ and $p_{s,t}$ are log quantity and log price index for sector s in time t. c is constant and γ_t, γ_t^2 are deterministic linear and quadratic time trends. The controls are 12 lags of price and quantity to account for existing trends and are not likely to capture a shift in demand or supply in time t. Effectively, residuals capture surprise increases (or decreases) in prices and quantities. Inflation in a sector is identified as demand-driven if both price growth (inflation) and output growth exceed or fall short of the expected levels based on their past values (12 lags).[8] If inflation and output growth move in opposite directions compared to expected levels, it is classified as supply-driven. Hence, the residuals $\varepsilon_{s,t}^q$ and $\varepsilon_{s,t}^p$ are basically used to label each sector

[4] TURKSTAT (Turkish Statistical Institute) publishes the data monthly. Retail price index is used for the analysis due to data restrictions, which is a common practice in the absence of full data (see Cloyne and Hürtgen (2016)). TURKSTAT provides the Central Bank of the Republic of Türkiye (CBRT) with the expenditure weight of each sector. These weights are meticulously mapped to correspond with the inflation weights.

[5] Firat and Hao (2023) conducts a cross-country analysis and uses only 4 sectors for most countries in the sample to decompose inflation into supply and demand-driven components.

[6] Sheremirov (2022) introduces a similar decomposition.

[7] The main caveat in this exercise is that although supply and demand shocks affect a sector simultaneously in a given month, we categorize the sector as either demand- or supply-driven based on the more prevalent shock in that month. So, the categorization is a noisy measure of underlying shocks and a more granular level of disaggregation would be better at attenuating this noise.

[8] Additionally, a time trend can be added to the regression, but the demand- and supply-driven inflation obtained from the baseline specification are robust to such alternative specifications.

s in each month t using the following restrictions:

$$\mathbb{1}_{s\in\text{Demand},t} = \begin{cases} 1 & \text{if } \varepsilon^q_{s,t}\varepsilon^p_{s,t} > 0 \\ 0 & \text{otherwise} \end{cases}$$

$$\mathbb{1}_{s\in\text{Supply},t} = \begin{cases} 1 & \text{if } \varepsilon^q_{s,t}\varepsilon^p_{s,t} < 0 \\ 0 & \text{otherwise} \end{cases}$$

In this way, inflation in each sector in each month is labeled as demand- or supply-driven. Subsequently, monthly aggregate inflation can be decomposed into supply- and demand-driven components as follows:

$$\pi_{t,t-1} = \underbrace{\sum_s \mathbb{1}_{s\in\text{Supply},t}\,\omega_{s,t}\pi_{s,t,t-1}}_{\text{Supply Driven, } \pi^{\text{Sup}}_{t,t-1}} + \underbrace{\sum_s \mathbb{1}_{s\in\text{Demand},t}\,\omega_{s,t}\pi_{s,t,t-1}}_{\text{Demand Driven, } \pi^{\text{Dem}}_{t,t-1}}$$

where $\omega_{s,t}$ is the weight of sector s and $\pi_{s,t,t-1}$ denotes the monthly inflation of sector s between time $t-1$ and t. Supply-driven inflation ($\pi^{\text{Sup}}_{t,t-1}$) is calculated as the weighted sum of sectoral inflation rates from sectors hit by supply shock. Similarly, demand-driven inflation ($\pi^{\text{Dem}}_{t,t-1}$) is derived as the weighted sum of sectoral inflation rates from sectors hit by demand shock. Finally, supply- and demand-driven contributions to year-over-year inflation are constructed as the running product of current and past inflation components:

$$\pi^{\text{Sup}}_{t,t-12} = \prod_{k=0}^{11}\left(1 + \pi^{\text{Sup}}_{t-k,t-k-1}\right) - 1 \quad \text{and} \quad \pi^{\text{Dem}}_{t,t-12} = \prod_{k=0}^{11}\left(1 + \pi^{\text{Dem}}_{t-k,t-k-1}\right) - 1$$

In this way, the methodology facilitates a comprehensive demand-driven and supply-driven decomposition of inflation, enabling a detailed examination of the distinct impacts of supply and demand shocks on price dynamics, thus offering crucial insights for policymakers.

3 Decomposing inflation and narrative evidence

Figure 1 displays the supply- and demand-driven contributions to year-over-year inflation rate in Türkiye.

Given the high and volatile inflation during this period, it is appropriate to provide narrative evidence to assess the consistency of the decomposition. Monetary tightening in the second quarter of 2018 reduced demand-driven inflation in subsequent months. However, in August 2018, political tensions with the USA triggered a more than 20% depreciation of the Turkish Lira in a single month, leading to a sudden surge in inflation as many sectors passed cost increases directly onto final goods prices, which rapidly increased supply-driven inflation. As the shock dissipated, inflation gradually declined

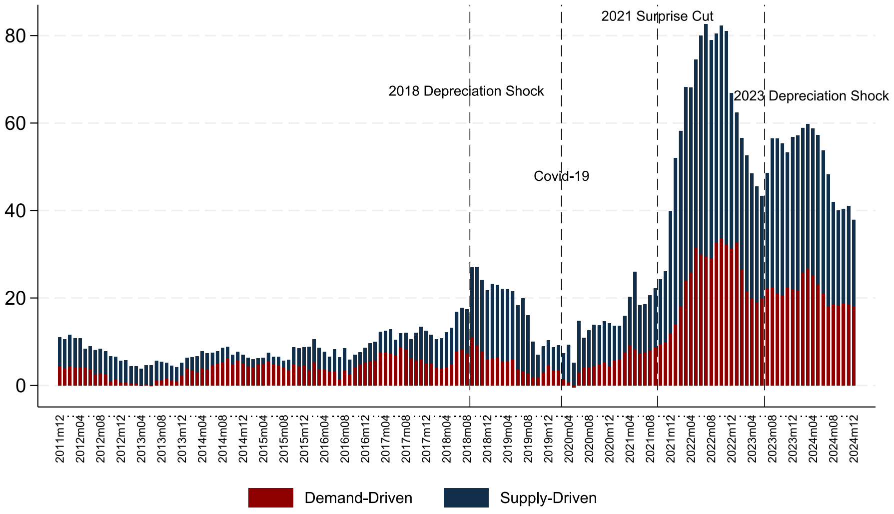


Fig. 1 Supply- and demand-driven inflation. The 12-month change in retail inflation is divided into contributions determined as supply-driven (blue) and demand-driven (red). Shapiro (2024) decomposition is used, and the results are driven by seven underlying sectors. The labeled events, in order, are as follows: a 21% depreciation of the Turkish Lira in August 2018 due to political tensions, the detection of the first COVID-19 case in March 2020, the start of an unexpected rate-cutting cycle in September 2021, and a 34% depreciation of the Turkish Lira in June 2023. The sample period covers 2011m12–2024m12

until the onset of the COVID-19 pandemic. Following the onset of the COVID-19 pandemic, demand-driven inflation even turned negative for a very brief period in 2020. During this period, supply-driven inflation surged due to supply chain disruptions and rising commodity prices, mirroring trends observed globally. With accommodative monetary policy and large fiscal support, demand-driven inflation quickly raised and with the rate cuts starting from September 2021, demand-driven inflation surged further due to large negative real rates. Indeed, supply-driven inflation reached its peak in the spring of 2022, primarily attributed to disruptions in food and energy supplies. These disruptions were further compounded by factors such as the invasion of Ukraine and the depreciation of the Turkish lira. From September 2021 to June 2022, the USD/TRY exchange rate nearly doubled, exerting substantial pressure on supply-driven inflation through increased import prices and unanchored inflation expectations, as both increasing short-term inflation expectations and import prices are inflationary (Fig. 2).[9] With the sudden depreciation and heightened volatility in nominal exchange rates, exchange-rate pass through has increased significantly during this period due to increasing attention within domestic market, which has become highly dollarized since the depreciation wave in 2018. Consistent with the standard New Keynesian Phillips Curve (NKPC) in an open market economy, increasing inflation expectations, markups, and import prices exerted upward pressure on firms' pricing dynamics.[10]

[9] See Ascari et al. (2023) and Blanchard and Gali (2007).

[10] We will control for expectations and import prices, but fluctuations in markups might matter for the variation in inflation as well. Markups will be in the error term, which basically includes any remaining

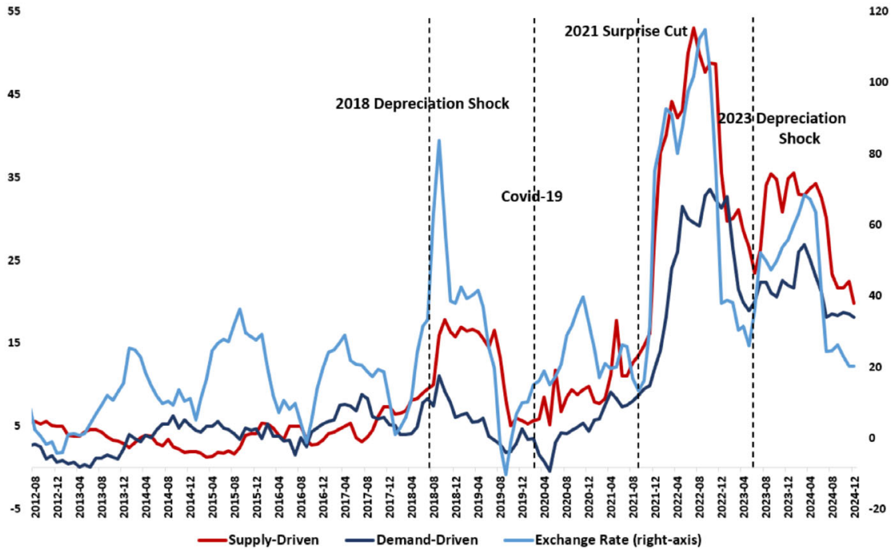


Fig. 2 Supply- and demand-driven inflation, and Δexchange rate. The 12-month change in retail inflation is divided into contributions determined as supply-driven (red) and demand-driven (blue). The 12-month percent change in the exchange rate (USD/TRY) is depicted on the right-axis

Nonetheless, 12-month inflation reached its 30-year high in October 2022. FX interventions stabilized the USD/TRY exchange rate between September 2022 and May 2023, resulting in a significant decline in supply-driven inflation, primarily driven by the stabilizing recovery in global supply chains, declining commodity prices, inflation expectations, and import price pressures, alongside diminishing household and firm attentiveness to exchange rates. Throughout this period, demand-driven inflation remained elevated due to large negative real interest rates and loose credit policies.

However, in May 2023, due to political uncertainty during the election period, the depreciation of the Turkish lira continued, compounded by the impact of the devastating earthquake.[11] In the summer of 2023, the Central Bank of the Republic of Türkiye, under its newly appointed governor, initiated a rate-hiking cycle, alongside fiscal tightening measures implemented by the newly appointed minister of finance.[12] These measures would likely mitigate demand-driven inflation in the subsequent months as the output gap declines, accompanied by a decrease in supply-driven inflation due to less volatile exchange rates and declining inflation expectations. Following the initiation of the rate hike cycle in June 2023, the interest rate reached 50% by March 2024, rising from 8.5%. Consequently, the exchange rate began to stabilize, and with tight-

cost-push shocks. Residual markup shocks might not be a problem if they include the impact of factors that are independent of monetary policy (Eser et al. 2020).

11 In February 2023, Türkiye was struck by an earthquake, unleashing significant economic repercussions alongside the humanitarian crisis. The seismic event disrupted both demand and supply dynamics, causing extensive damage to infrastructure, production facilities, and supply chains. This disruption led to a surge in demand for reconstruction materials and services, exacerbating inflationary pressures.

12 This led to an increase in supply-driven inflation for a few months due to higher taxes on various goods.

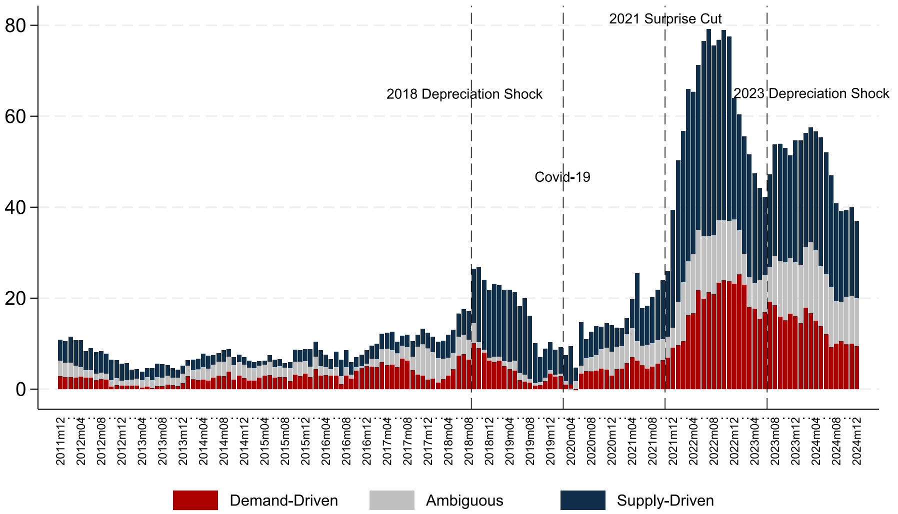


Fig. 3 Supply- and demand-driven inflation. The 12-month change in retail inflation is divided into contributions determined as supply-driven (blue), demand-driven (red), and ambiguous (gray). Shapiro (2024) decomposition is used and the results are driven by seven underlying sectors. The sample period covers 2011m12–2024m12

ening monetary and fiscal measures, demand started to cool, reflected in the decline in demand-driven inflation since early 2024. This narrative effectively validates the mentioned inflation decomposition, which aligns closely with nearly all developments in Türkiye's volatile economic environment over the past few years.

In this highly volatile environment, coupled with persistent high trend inflation, supply and demand shocks might simultaneously disrupt the markets. For this reason, if the residuals from the benchmark regression are too small, labeling an entire month as either supply–or demand-driven inflation might be misleading. Therefore, if the residuals are relatively small-specifically, lower than 0.1 standard deviations from zero-they are considered insignificant.[13] In such cases, we relabel them as ambiguous. This relabeling applies to less than 20% of sector-month observations. Figure 3 illustrates that ambiguity tends to be more prevalent during periods of lower turbulence. This occurs because structural shocks are not substantial enough to cause significant shifts in either demand or supply, or multiple shocks occur simultaneously, preventing the residuals from deviating significantly from zero. Since the beginning of 2024, as the economy has started to cool down, and the decline in demand-driven inflation is evident, indicating that the hawkish monetary stance is effectively suppressing demand.[14]

Lastly, we present additional evidence using alternative specifications as a robustness exercise. The results remain robust across different specifications (see Table 2), as the obtained inflation components exhibit high correlation. Figure 9 documents the

[13] The 0.1 cutoff is arbitrary; however, the results remain robust even when changing the cutoff to 0.2 standard deviations from zero.

[14] The ambiguous category has grown larger due to stabilization at the same time period.

results, where price and quantity indices are first filtered using the Hamilton (2018) filter to remove trends, and then, the same analysis is conducted both with and without ambiguity. The overall structure and consistency with narrative evidence remain intact. Using 24 lags instead of 12 lags, or removing time trends, does not significantly affect the decomposition (Fig. 10), although the change in demand-driven inflation during the post-COVID period appears slightly weaker in the former specification. Similarly, using retail weights instead of CPI basket weights does not substantially alter the results, as both approaches yield highly similar estimates (Fig. 11). Figure 12 demonstrates that the results remain consistent across different subsample periods. Figure 13 illustrates how supply- and demand-driven inflation evolve at the sectoral level. While computer, internet, and equipment were highly demand-driven at the onset of COVID-19, demand-driven inflation was negative for fuel and textile, as lockdowns restricted economic activity, further supporting the validity of the exercise. Lastly, Fig. 14 demonstrates that the results are not sensitive to a single sector, as removing sectors one by one does not significantly affect the decomposition. Overall, the movements in demand- and supply-driven inflation align with the narrative evidence. For the remainder of the paper, we use the decomposition obtained from the benchmark specification.

After providing narrative evidence, our validation exercises for the decomposition analysis also include a Phillips Curve estimation and a local projection estimation:

(i) For the Phillips Curve exercise, we employ monthly retail volume as a proxy for the output gap, computed using the Hamilton (2018) filter. This is coupled with 12-month ahead inflation expectations and import prices.[15] Then, we estimate the slope of the Phillips Curve for the demand and supply-driven components of inflation separately.

(ii) Using local projections, we utilize monthly monetary policy shock series from Bauer and Swanson (2023) and oil supply shocks from Känzig (2021) to estimate the impact of exogenous shocks on the demand and supply-driven components of inflation separately.

4 Phillips Curve estimation

The Phillips Curve plays a pivotal role in understanding the transmission of monetary policy. In a standard New Keynesian (NK) model, the Phillips Curve is driven by the pricing decisions of firms and essentially serves as the short-run aggregate supply curve, linking inflation to the output gap and cost-push (or markup) shocks.[16] The output gap, influenced by monetary policy, affects consumption, investment, and thus the marginal costs of firms. Consequently, slack is transmitted to inflation through the pricing mechanism of firms, as depicted by the equation:

$$\pi_t = E_t \pi_{t+1} + \kappa x_t + \varepsilon_t \tag{1}$$

[15] Inflation expectations are retrieved from the Central Bank of the Republic of Türkiye (CBRT) and import prices are retrieved from TURKSTAT.

[16] Residual cost-push shocks are not problematic as long as they remain independent of monetary policy. The residual term captures all relevant factors that may impact observed inflation.

In an open economy version of New Keynesian model, where there are imported goods[17] in intermediate goods production function (Blanchard and Gali 2007), there is an additional channel in firms' pricing decisions through import prices. A hybrid New Keynesian Phillips Curve (NKPC) can be expressed as follows[18]:

$$\pi_t = \lambda_b \pi_{t-1} + \lambda_f E_t \pi_{t+1} + \gamma \pi_t^m + \kappa x_t + \varepsilon_t \quad (2)$$

where x_t denotes the output gap as the deviation from the trend, $E_t \pi_{t+1}$ is 12-month ahead inflation expectations, and π_t^m stands for annual import price inflation. According to this structural relationship, λ_b and λ_f should be positive and sum to 1 if the discount rate β equals 1 (Gali and Gertler 1999). γ is expected to be positive since increasing import prices translate into higher marginal costs for firms.

Demand shocks influence the output gap and subsequently impact inflation in the same direction, proportional to the structural Phillips slope coefficient, κ. If only demand shocks were present, the structural coefficient could be derived from the reduced-form estimates. κ is expected to be positive as it represents the main mechanism for monetary policy transmission: a positive deviation of consumption and investment from the potential level due to loose monetary policy should be reflected in prices, driven by increasing marginal costs resulting from inefficient production levels to satisfy higher demand.[19]

Identification of this structural equation is challenging. The positive structural relationship between the output gap and inflation can be masked by monetary policy if it is successful at undoing all demand shocks. In fact, the relationship between the output gap and inflation might even be negative in response to cost-push shocks (Bullard 2018). So, improved monetary policy could flatten the reduced-form (empirical) Phillips Curve, as observed in many advanced countries over the past three decades. A successful monetary policy would eliminate any deviations caused by demand shocks, making it difficult to discern the underlying positive relationship between the output gap and inflation due to the lack of variation. In the case of cost-push shocks, optimal policy would tolerate output gaps from potential output to some extent, due to trade-off between stabilizing inflation and output gap. Consequently, cost-push shocks create negative relationship between the output gap and inflation. Thus, reduced-form regressions are unlikely to recover the structural relationship between the output gap and inflation if monetary policy is conducted optimally (McLeay and Tenreyro 2020). However, no monetary policy is set optimally in reality, and as a result, the Phillips Curve is likely to appear empirically with the correct methodological approach. We need to have either (i) exogenous demand shifter, such as monetary policy shocks, to identify the positive slope, or (ii) we need to control for supply shocks so that variation in aggregate demand can dominate and the structural Phillips Curve can be

[17] The import share in production is close to 20% in Türkiye (Erduman et al. 2020b). This number is close to 35% in manufacturing production.

[18] The backward-looking inflation component appears when there is indexation to past inflation in price-setting, capturing the adaptive component of inflation expectations.

[19] There is no rationing in standard models, although it could be relevant, especially during the COVID-19 period.

recovered.[20] In short, isolating the demand-driven variation in inflation is essential to capturing the positive slope of the Phillips Curve.

Opting for the first approach,[21] we will control for supply shocks by including import inflation in regressions.[22] However, in practice, there are numerous supply shocks that need to be controlled for. To mitigate a subset of these cost-push shocks, a mechanical approach is to focus on core inflation rather than headline inflation, as many papers do. We go a step further and decompose inflation into supply- and demand-driven components.

We utilize the deviation of monthly retail sales from the trend, obtained using the Hamilton (2018) filter, as our proxy for slack. Our inflation data here is retail price inflation, further decomposed into demand- and supply-driven inflation. Mechanically, for demand-driven inflation, cost-push shocks affecting the aggregate inflation rate are stripped out. So, a positive slope κ should be estimated, even without controlling for supply shocks. Similarly, for supply-driven inflation, since the variation in inflation stemming from demand is stripped out, the slope should be estimated as negative.

Shocks to inflation expectations, markups and import prices are both inflationary and recessionary (stagflation), so they are all considered as standard supply shocks.[23] So, it is expected to see a significant impact of inflation expectations and import prices on the supply-driven inflation. On the contrary, the impact on demand-driven should be much weaker.

Table 1 demonstrates that the estimated coefficients align with theoretical expectations. Inflation expectations and import price inflation both induce a significant increase in supply-driven inflation. When firms set their own prices, they incorporate their inflation expectations into pricing due to the staggered nature of price setting. Aware that they cannot frequently change prices, firms reflect these anticipated future increases in marginal costs in their pricing today.[24] This practice aligns with the principle that firm pricing equals the discounted sum of marginal costs, akin to Calvo-type price setting. Import price inflation contributes to higher marginal costs, given its substantial share in production costs.[25] Costlier production leads to higher supply-driven inflation. As originally targeted, the relationship between real activity and inflation is negative, meaning that supply-driven inflation captures supply-side factors affecting the economy, causing prices and the output gap to move in opposite directions. Estimating the model using supply-driven inflation yields a negative slope (− 0.046), which should mechanically hold if the decomposition is successful.

[20] If one can control for the effect of cost-push fully, then any remaining variation in the output gap and inflation must stem from the variation in aggregate demand (McLeay and Tenreyro, 2020). However, in practice, there are many supply shocks that need to be controlled for, and which of these are most important may be time varying as well.

[21] A monetary policy shock for Türkiye should be constructed to follow second approach and this is a work in progress.

[22] The correlation between exchange rate and import inflation is higher than 0.9, so the exchange rate is not included in regressions.

[23] See Ascari et al. (2023) for inflation expectations, Smets and Wouters (2003) for markups, and Blanchard and Gali (2007); de Walque et al. (2005) for import prices.

[24] Frequency of price changes is actually an increasing function of inflation, see Alvarez et al. (2018).

[25] Imports are not only used in final consumption, but also in production as intermediate inputs. The import share in production is close to 20% in Türkiye (Erduman et al. 2020b).

Table 1 Slope of the Phillips Curve: a comparison of demand- and supply-driven inflation

	(1) Inflation	(2) Supply-Inf	(3) Demand-Inf	(4) Inflation	(5) Supply-Inf	(6) Demand-Inf
$\sum_{j=1}^{11} \pi_{t-j}$	0.550***	0.485***	0.781***	0.561***	0.503***	0.808***
	(0.059)	(0.048)	(0.072)	(0.063)	(0.079)	(0.071)
$E_t \pi_{t+1}$	0.641***	0.424***	0.082	0.605***	0.402***	0.072
	(0.136)	(0.084)	(0.055)	(0.133)	(0.083)	(0.054)
π_t^m	0.133***	0.085***	0.030***	0.135***	0.078***	0.031***
	(0.018)	(0.011)	(0.007)	(0.018)	(0.011)	(0.006)
x_t	0.033	− 0.046***	0.047***			
	(0.030)	(0.017)	(0.012)			
Unemployment				− 0.190	0.168	− 0.150**
				(0.146)	(0.108)	(0.064)
Observations	133	133	133	144	144	144
R^2	0.98	0.98	0.98	0.98	0.98	0.98

Entries are coefficients and standard errors from estimating regression (2). Newey–West standard errors are in parentheses. ***$p<0.01$, **$p<0.05$, *$p<0.1$. x_t represents the output gap, obtained from retail sales data using the Hamilton filter. π_t^m denotes import inflation, and $E_t \pi_{t+1}$ represents 12-month ahead inflation expectations of professionals. "Supply-Inf" refers to the supply-driven component of inflation, while "Demand-Inf" refers to the demand-driven component. The sample period covers 2013m1–2024m12

In the case of demand-driven inflation, a steep positive Phillips curve (0.047) is estimated, whereas it becomes flatter and insignificant when aggregate inflation is used (0.033), indicating the downward bias created by supply shocks.[26] Changes in inflation expectations, import price inflation, and markup shocks alter the Phillips Curve, shifting the equilibrium output gap and inflation in opposite directions, thereby complicating their structural relationship. This actually represents the standard challenge in estimating structural, simultaneous relations. When these supply-side pressures are removed from the estimation, the Phillips Curve relationship appears to be much stronger. As can be seen from the coefficients, the bias is economically strong.

Inflation expectations exert differing impacts on demand- and supply-driven inflation rates. While expectations significantly influence supply-driven inflation, we do not observe a significant coefficient in the case of demand-driven inflation. A 1-percentage-point increase in inflation expectations transmits to supply-driven inflation as a 0.42-percentage point. The sum of estimated coefficients for lags of inflation is nearly 0.50, underscoring the importance of adaptive expectations (expectations based on lagged experience).[27] Import price inflation demonstrates a significant impact as a cost-push factor, with the contemporaneous pass-through rate to supply-driven inflation hovering around 8.5%.[28] However, this pass-through effect is considerably weaker on demand-driven inflation, since the demand for imports is lower and also indirectly for domestic goods due to lower purchasing power, as the currency depreciates. On the other hand, inflation expectations show no significant impact on demand-driven inflation.[29] This provides further evidence that a depreciation shock leads to a significant increase in supply-driven inflation, as observed in Fig. 2, by raising both inflation expectations and import prices.

Demand-driven inflation displays high autocorrelation, with the sum of coefficients for lagged inflation close to 0.80. According to the Euler equation (dynamic IS curve), higher inflation expectations and subsequently lower perceived real rates should lead to increased consumption by agents, thereby likely driving demand-driven inflation.[30] However, the front-loaded consumption, stockpiling channel in the case of higher inflation expectations, is not captured. One reason might be the fact that expectations data based on professional forecasters do not accurately reflect the expectations of households, which is documented to be higher and also more sensitive to gasoline and food prices (Coibion et al. 2020).[31] Another possibility is that since hand-to-mouth agents, who are myopic and consume what they earn, constitute a large share

[26] Downward bias is even stronger if we use firms' inflation expectations instead of professionals' in the model. See Table 3.

[27] Sum of the coefficients of the backward and forward-looking inflation terms is close to 1 in each specification.

[28] The results are robust to different number of lags as controls in supply-driven inflation regressions.

[29] Using firms' expectations, the coefficient becomes significant, though the magnitude remains small, as shown in Table 3.

[30] That is the main motivation behind forward guidance to raise inflation expectations. Through higher inflation expectations and being more optimistic about economic activity would lead to a higher aggregate demand today.

[31] Recently, the CBRT published households' and firms' inflation expectations data, and the data have been available since 2015. Using households' expectations instead does not make the coefficient significant.

of the population (Kaplan et al. 2014), we do not observe the impact of forward-looking behavior consequently. They are liquidity constrained or unabled to borrow such that intertemporal substitution effect from Euler equation cannot be observed for these agents. Moreover, since higher future inflation is effectively a tax on nominal assets, higher inflation expectations can capture negative wealth effect, which might create downward pressure on current consumption. From the perspective of debtors, inflation erodes the real value of the debt, which creates positive wealth effect. Also, households associate high expected inflation with a negative future economic growth and hold a stagflationary view of inflation (Kamdar 2019; Coibion et al. 2023; Binetti et al. 2024; Han 2024). So, consequently their income growth expectations are lower and they might even decrease their consumption as a response to higher inflation expectations.[32] Also, due to the stickier nature of wages, households might expect that in the short run, wages will not keep pace with rising prices, resulting in a negative income effect. However, as a result of nominal illusion, household might be inclined to increase their current consumption even if the expected income growth would not keep pace with inflation. Additionally, higher inflationary environment is associated with higher uncertainty (Binder 2017). This might induce a reduction in consumption due to precautionary savings motives. At the same time, higher inflation expectation might increase the cost of future borrowing, so households stock up on debt with fixed-rates and increase durable consumption today (Ryngaert 2022). All these channels related to inflation expectations might impact consumption decisions and there are conflicting empirical evidence in the literature. Therefore, the impact of inflation expectation on the aggregate demand-driven inflation is not clear.[33]

A flat Phillips Curve implies a higher sacrifice ratio, indicating the cost required to return inflation to its target, or a weak link between real activity and inflation. The latter interpretation suggets a lack of short-run policy trade-off between real activity and inflation; this might make policy makers overlook the natural rate hypothesis (Cogley and Sargent 2001).[34] However, this is not the case in Türkiye. The strength of the relationship between real activity and demand-driven inflation is significant: the slope of the Phillips Curve, κ, is -0.150 and comparable to the estimates with aggregate inflation in the literature (Gordon 2013; Coibion and Gorodnichenko 2015; McLeay and Tenreyro 2020). Nevertheless, the standard demand channel alone cannot fully explain the high inflation spikes observed in the data. Cost-push shocks and unanchored inflation expectations play significant roles. Additionally, the relationship between inflation and real activity may exhibit nonlinear characteristics (see Benigno and Eggertsson (2023)), which is beyond the scope of this paper. Overall, the Phillips Curve dynamics are highly consistent with the decomposition conducted in a high and volatile inflation environment, further enhancing the validity of the exercise.

[32] Hajdini et al. (2022) document that an increase in short-term inflation expectation does not fully transmit to expected income growth.

[33] A more granular data is required to test these different channels. For example, the intertemporal substitution might be more observable for durable goods compared to nondurables.

[34] Like in 1970 s in the U.S., the reason for inflation hike might be supply shocks leading to the unanchored inflation expectations and taming the expectations might induce a significant decline in inflation rate without needing a very high real contraction as "sacrifice ratio" suggests.

5 Dynamic response of supply- and demand-driven inflation to exogenous shocks

To see whether the demand-driven and supply-driven inflation are consistent with the theory, we estimate the response of constructed inflation rates to exogenous aggregate shocks, such as monetary policy shocks and oil supply shocks. A positive monetary policy shock should reduce inflation via a reduction in demand, and thus, we should observe a significant decrease in demand-driven component. A negative oil supply shock should increase the marginal cost of production; therefore, we should observe a significant increase in supply-driven component. If both externally constructed supply and demand shocks move components of inflation in anticipated directions, we can be more confident about the accuracy of the methodology used in the paper.

To assess these channels, we use the local projection method of Jorda (2005) and estimate the following specification:

$$\pi_{t+h}^{j} = c^{h} + \beta_{j}^{h}\mathrm{OilSS}_{t} + \gamma_{j}^{h}\sum_{k=1}^{6} Z_{t-k} + \epsilon_{t} \tag{3}$$

where OilSS_t stands for oil supply shocks from Känzig (2021). The dependent variable π_{t+h}^{j} is the cumulative growth in the supply-driven or demand-driven ($j \in \{\text{sup}, \text{dem}\}$) inflation between period t and $t+h$. The vector of controls Z_t includes the percent change in the exchange rate to account for exchange rate pass-through, the log VIX index to control for global financial conditions, lags of the dependent variable, as well as lags of shocks.[35]

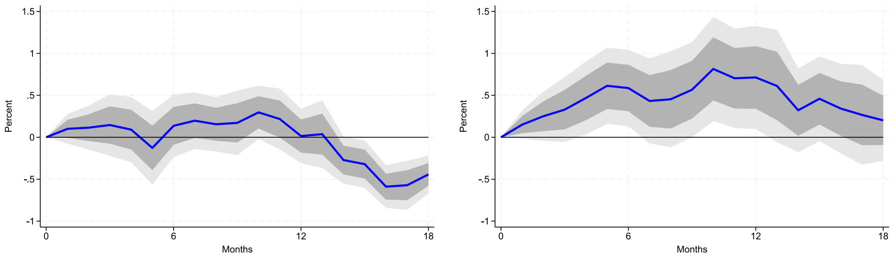
Figure 4 presents the response of demand-driven and supply-driven inflation to oil supply shock. A one-standard-deviation increase oil supply shock increases supply-driven inflation by a cumulative 0.8 percentage point over 9 months, the pass-through effect of oil prices is evident. The response of demand-driven inflation is insignificant over the short horizon and the same shock induces a slight decrease in demand-driven inflation in the long horizon, which is consistent with the fact that energy price increases leading to negative demand shock in a longer horizon (Edelstein and Kilian 2009).[36] The effect is significantly larger on supply-driven inflation, and therefore, oil supply shock has a positive impact on overall inflation (see Fig. 7).

The following specification is used to estimate the responses of inflation components to monetary policy shocks:

$$\pi_{t+h}^{j} = c^{h} + \beta_{j}^{h}\mathrm{MPS}_{t} + \gamma_{j}^{h}\sum_{k=1}^{6} Z_{t-k} + \epsilon_{t} \tag{4}$$

[35] Due to data limitations, we use six lags as controls; however, the results are robust to alternative lag specifications.

[36] This finding is similar to what Shapiro (2024) documented for the USA.



(a) Demand-driven Inflation **(b)** Supply-driven Inflation

Fig. 4 Response of inflation to oil supply shock. Light and dark gray areas are the 90th percentile and one-standard-deviation confidence bands. Newey–West standard errors are used. Oil supply shocks are retrieved from Känzig (2021). The sample period covers 2011m12–2019m12

where MPS_t stands for monetary policy shocks from Bauer and Swanson (2023).[37] Similar to above, the dependent variable π^j_{t+h} is the cumulative growth in the supply-driven or demand-driven ($j \in \{\text{sup}, \text{dem}\}$) inflation between period t and $t+h$. The vector of controls Z_t stays the same.

Figure 5 presents the response of demand-driven and supply-driven inflation to monetary policy shock. A one-standard-deviation increase U.S. monetary policy shock decreases demand-driven inflation by a cumulative 1.5 percentage point over 7 months, which is consistent with standard NK models, i.e., tightening leads to a reduction in demand-driven inflation via dampening of demand. The response of supply-driven inflation to monetary policy shock is insignificant and muted over 18 months.[38] These findings are consistent with the large literature on global financial cycles, which shows the spillover impact of US monetary shocks on both emerging and advanced economies (Miranda-Agrippino and Rey 2020; Bräuning and Ivashina 2020; Iacoviello and Navarro 2019; Dedola et al. 2017; Bruno and Shin 2015). Since the demand channel dominates, monetary policy shock has a negative impact on overall inflation as shown in Fig. 8.

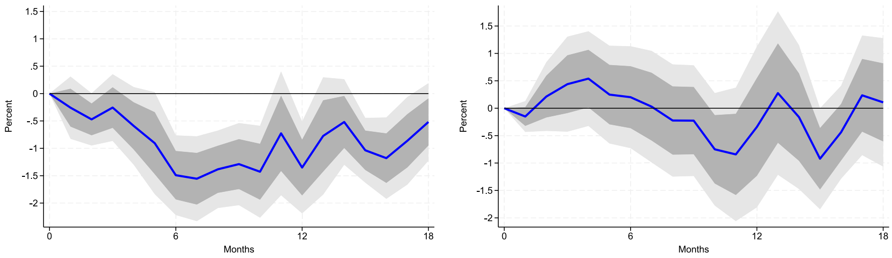
Both supply- and demand-driven inflation rates move in anticipated directions against exogenous oil supply and monetary policy shocks. This improves the validity of the decomposition approach used. The decomposition allows us to capture underlying supply and demand effects accurately. Overall, the evidence on dynamic responses of economic variables is consistent with the Phillips Curve estimation presented in the previous section. The findings are consistent with the economic theory.

Lastly, Taylor (2000) posits that the declines in pass-through to aggregate prices can be attributed to a low inflation environment.[39] Taylor's explanation hinges on a

37 See Fig. 15 for the shock series.

38 There might be some impact on supply-driven inflation if there is a pass-through from higher costs of capital to consumer prices, in case of monetary tightening. U.S. monetary shock increases funding cost of firms globally via rising corporate bond spreads (Miranda-Agrippino and Rey 2020). However, this is one cost-channel of monetary policy, and other cost-channels might be more important for Turkish firms. To capture cost-channel accurately, one needs to use monetary policy shocks created for Türkiye.

39 Most prior empirical research on the relationship between exchange rate pass-through and inflation, as demonstrated in studies by Calvo and Reinhart (2002a); Campa and Goldberg (2005); Choudhri and



(a) Demand-driven Inflation **(b)** Supply-driven Inflation

Fig. 5 Response of inflation to monetary policy shock. Light and dark gray areas are the 90th percentile and one-standard-deviation confidence bands. Newey–West standard errors are used. Monetary policy shocks are retrieved from Bauer and Swanson (2023). The sample period covers 2011m12–2019m12

model of firm behavior characterized by staggered price setting and monopolistic competition. According to this model, firms setting prices for several periods in advance are more likely to adjust prices in response to cost increases (such as those caused by exchange rate depreciation) if they perceive these cost changes to be persistent. Essentially, firms calculate the discounted sum of future marginal costs due to staggered price settings, as in Calvo pricing models, and if costs are persistent, the pass-through effect is likely to be particularly relevant for Türkiye, making it important to assess the impact of pass-through on supply- and demand-driven inflation separately.

We define an exchange rate shock in the spirit of uncertainty shocks of Bloom (2009), where shocks are defined as events when the peak of a series rises significantly above the mean. In this context, exchange-rate shocks are essentially monthly percentage changes in the exchange rate (USD/TRY) that deviate by more than one standard deviation from the series' mean.[40] So, the identification comes only from these large, and arguably unexpected, exchange rate shocks rather than from the smaller fluctuations.

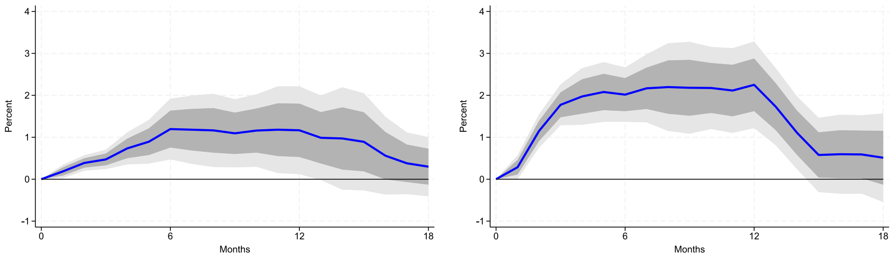
$$\pi^j_{t+h} = c^h_j + \beta^h_j \text{ExchRateShock}_t + \gamma^h_j \sum_{k=1}^{6} Z_{t-k} + \epsilon_t \tag{5}$$

where ExchRateShock_t stands for exchange rate shocks. Similar to above, the dependent variable π^j_{t+h} is the cumulative growth in the supply-driven or demand-driven ($j \in \{\text{sup}, \text{dem}\}$) inflation between period t and $t + h$. The vector of controls Z_t includes the log VIX index to control for global financial conditions, lags of the dependent variable, as well as lags of shocks.

Both supply- and demand-driven inflation rates respond to exchange rate shocks. The stronger response of supply-driven inflation reflects the increased pressure on

Hakura (2006a); Gagnon (2009); Devereux and Yetman (2010a); Auer and Schoenle (2016), and Hobijn et al. (2021), has explored this dynamic extensively.

[40] The threshold is one standard deviation above the mean, selected as the 16% one-tailed significance level, treating each month as an independent observation. According to this criterion, there are 18 months with positive exchange rate shocks within the 2010–2024 period.



(a) Demand-driven Inflation **(b)** Supply-driven Inflation

Fig. 6 Response of inflation to exchange-rate shock. Light and dark gray areas are the 90th percentile and one-standard-deviation confidence bands. Newey–West standard errors are used. Exchange rate shocks are defined as monthly percentage changes in the exchange rate (USD/TRY) that deviate by more than one standard deviation from the series' mean. The sample period covers 2011m12–2024m12

prices resulting from higher import costs, whereas the relatively weaker response of demand-driven inflation can be attributed to the wealth effect stemming from the high dollarization rate in Türkiye. Considering the large devaluation in the 2021 period due to policy rate cuts in the second half of 2021, we repeat our analysis for the pre-Covid subsample. As shown in Fig. 16, the response of supply-driven inflation remains stronger than that of demand-driven inflation, yet the overall impact of the shocks is somewhat smaller than in the full-sample analysis.

Moreover, the literature finds that exchange rate pass-through to prices is relatively high in emerging markets compared to advanced economies (Calvo and Reinhart 2002b), and is significantly higher for high-inflation economies (Choudhri and Hakura 2006b; Devereux and Yetman 2010b). Studies by (Hellerstein 2008) and (Forbes et al. 2018) show that exchange-rate-induced marginal cost shocks can be pivotal in firms' pricing decisions, effectively acting as cost-push shocks. This is especially relevant for Türkiye, given its high reliance on imports for domestic production (Erduman et al. 2020a). Consistent with these findings, our results indicate that exchange rate shocks lead to a pronounced increase in supply-driven inflation.

6 Conclusion

This paper offers a straightforward yet insightful decomposition of the inflation rate into supply- and demand-driven components, following the methodology of Shapiro (2024). While supply-driven inflation was initially predominant during the onset of the COVID-19 pandemic, demand-driven inflation began to rise due to an accommodative monetary policy stance and loose fiscal policies. Notably, after the rate cuts in the fourth quarter of 2021, supply-driven inflation surged due to a sharp depreciation of the currency and unanchored inflation expectations, accompanied by an increase in demand-driven inflation fueled by negative real interest rates and credit expansion. With the rate hike cycle that began in the summer of 2023 and peaked at 50% in March 2024, demand-driven inflation has started to decline as the economy slows with the hawkish stance.

This decomposition aligns with narrative evidence, empirical analysis, and theoretical understanding, providing a real-time indicator of the economy's performance. It enables the tracking of the impacts of monetary and fiscal policies and the different channels influencing demand- and supply-driven inflation. We hope this approach will serve as a valuable tool for policymakers and market participants.

Appendix A: Additional results

See Figs. 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18 and Tables 2, 3.

Figure 7 shows that oil supply shocks of Känzig (2021) induce anticipated impacts on oil quantity and prices in Türkiye. A negative oil supply shock leads to an increase in oil prices and a decrease in quantity consumed. This is an evidence for the validity of the oil supply shocks.

Figure 8 shows the response of retail inflation to supply- and demand-side shocks.

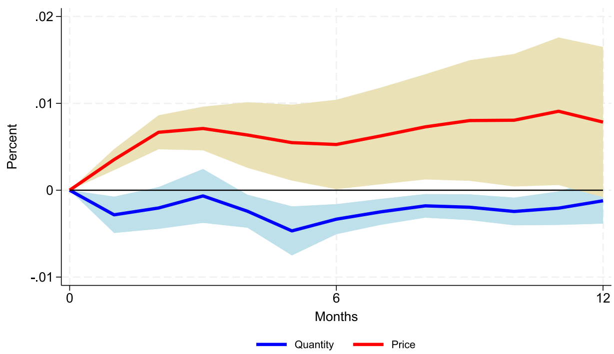
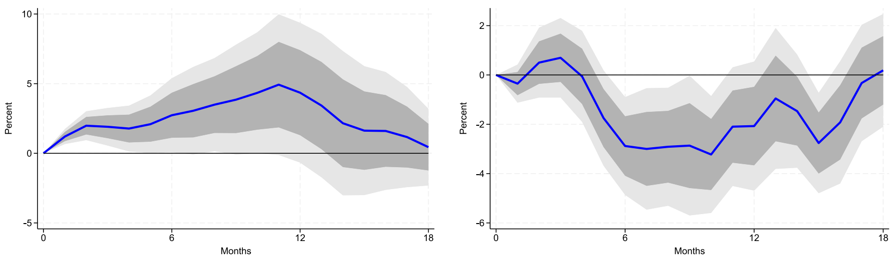
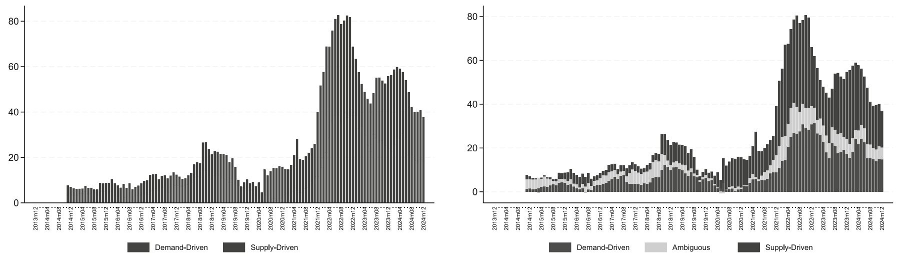


Fig. 7 Response of oil price and quantity to oil supply shock. Bold lines show the cumulative impulse responses of the log oil price index and log oil quantity index to the oil supply shock. Light areas are the 90th percentile confidence bands. Newey–West standard errors are used. The sample period covers 2011m12–2024m2



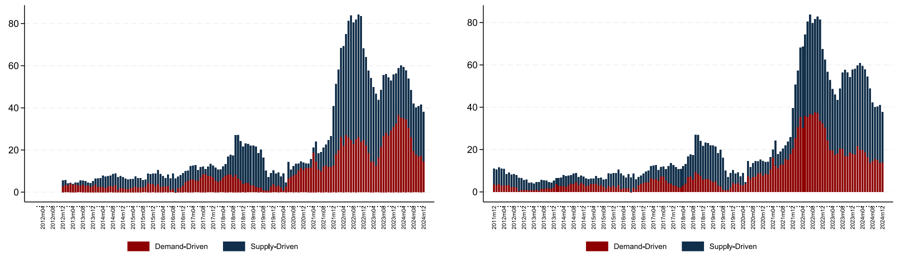
(a) Oil Supply Shock (b) Monetary Policy Shock

Fig. 8 Response of retail inflation to shocks. Bold lines show the cumulative impulse responses of the retail inflation to the oil supply and monetary policy shock. Light areas are the 90th percentile confidence bands. Newey–West standard errors are used. Estimation sample is 2011–2024 for oil supply shock and 2011–2019 for monetary policy shock



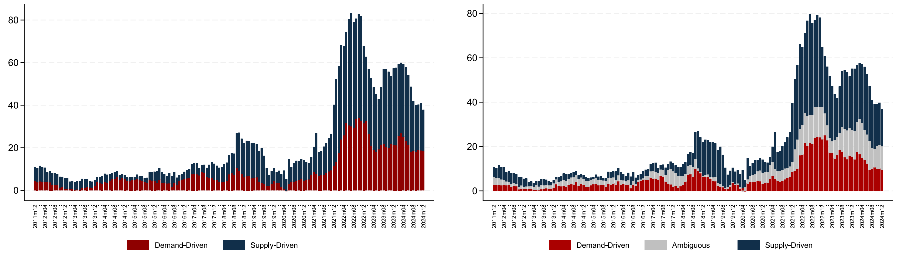
(a) Benchmark **(b)** Ambiguity version

Fig. 9 Supply- and demand-driven inflation (Hamilton filter). The 12-month change in retail inflation is divided into contributions determined as supply-driven (blue), demand-driven (red), and ambiguous (gray). The sample period covers 2011m12–2024m12. The price and quantity indexes are filtered using the Hamilton (2018) filter before running the main estimation



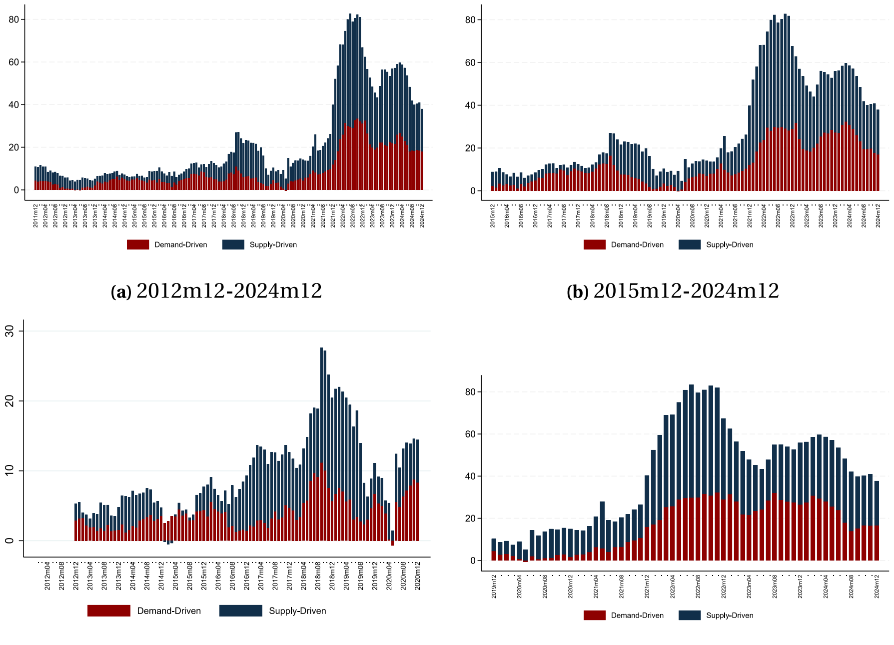
(a) 24 lags **(b)** No time trends

Fig. 10 Supply- and demand-driven Inflation (alternative specifications). The 12-month change in retail inflation is divided into contributions determined as supply-driven (blue) and demand-driven (red). The sample period covers 2011m12–2024m12. In panel-a, 24 lags of dependent variable is used instead of 12 lags. In panel-b, linear and quadratic time trends are not included in the main estimation



(a) Benchmark **(b)** Ambiguity version

Fig. 11 Supply- and demand-driven inflation (with retail weights). The 12-month change in retail inflation is divided into contributions determined as supply-driven (blue), demand-driven (red), and ambiguous (gray). The sample period covers 2011m12–2024m12. Instead of CPI weights, retail weights are used in this specification



(a) 2012m12-2024m12
(b) 2015m12-2024m12
(c) 2012m12-2020m12
(d) 2019m12-2024m12

Fig. 12 Supply- and demand-driven inflation for different subsamples. The 12-month change in retail inflation is divided into contributions determined as supply-driven (blue) and demand-driven (red), for different subsamples

Figure 18 compares the decomposition of inflation in Türkiye and the U.S. The U.S. demand-driven inflation series is relatively stable, though a noticeable drop around 2015 coincides with a sharp decline in crude oil prices. Since energy is a major input cost across many sectors, lower oil prices reduced production and transportation costs, thereby easing supply pressures on overall inflation. In Türkiye, a similar-though less pronounced-decline appears, reflecting some global spillover effects from cheaper oil.

However, beginning in 2018, Türkiye experienced a sharp depreciation shock, leading to a pronounced increase in supply-driven inflation, primarily due to higher import costs feeding into domestic prices. This cost-push pressure was further exacerbated during COVID-19, as both countries recorded steep increases in supply-driven inflation. Yet, following the Turkish interest rate cut in September 2021, another wave of lira depreciation triggered a significant surge in inflation expectations, accelerating the rise in supply-driven inflation.

After peaking in 2023, supply-side pressures weakened as supply chain disruptions eased, leading to a downward trend in supply-driven inflation in the USA. In Türkiye, supply-driven inflation also peaked around the same time before beginning to decline, suggesting that global supply chain pressures contributed to inflation dynamics in both countries. However, Türkiye's persistently higher inflation was largely driven by domestic policy choices and unanchored inflation expectations.

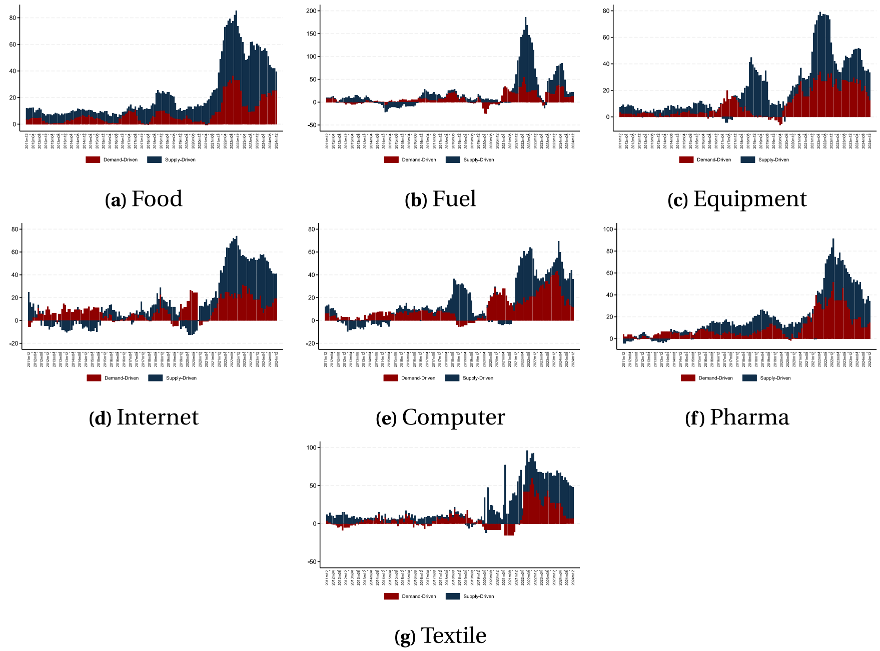
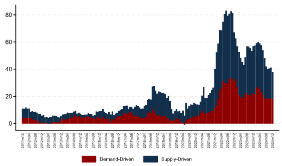
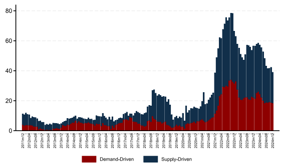


Fig. 13 Supply- and demand-driven Inflation (by sector). The 12-month change in retail inflation is divided into contributions determined as supply-driven (blue) and demand-driven (red). The sample period covers 2011m12–2024m12. The benchmark estimation is run for each sector separately

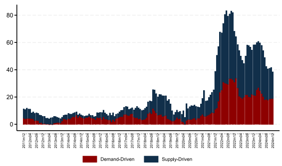
Additionally, the September 2021 rate cut accelerated demand-driven inflation in Türkiye by keeping real interest rates significantly negative. In contrast, by 2023, the USA had already reached the latter stages of its tightening cycle, effectively cooling demand-driven inflation. The peak in Türkiye's demand-driven inflation occurred later, as the country had only just begun its tightening cycle around mid-2023. Consequently, we observe a lagged peak in Turkish demand-driven inflation relative to the U.S., reflecting the different phases at which each country entered-and progressed through-its monetary tightening cycle.



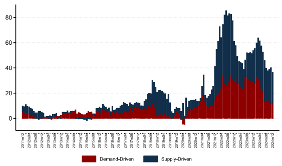
(a) Internet excluded



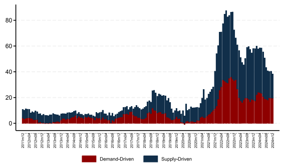
(b) Fuel excluded



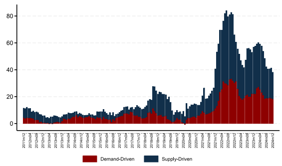
(c) Equipment excluded



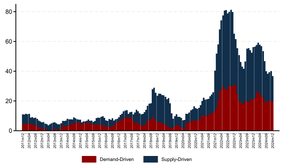
(d) Food excluded



(e) Computer excluded



(f) Pharma excluded



(g) Textile excluded

Fig. 14 Supply- and demand-driven inflation (excluding sectors one by one). In each panel, only the specified sector is excluded from the analysis. The 12-month change in retail inflation is decomposed into supply-driven (blue) and demand-driven (red) contributions. The sample period covers 2011m12–2024m12

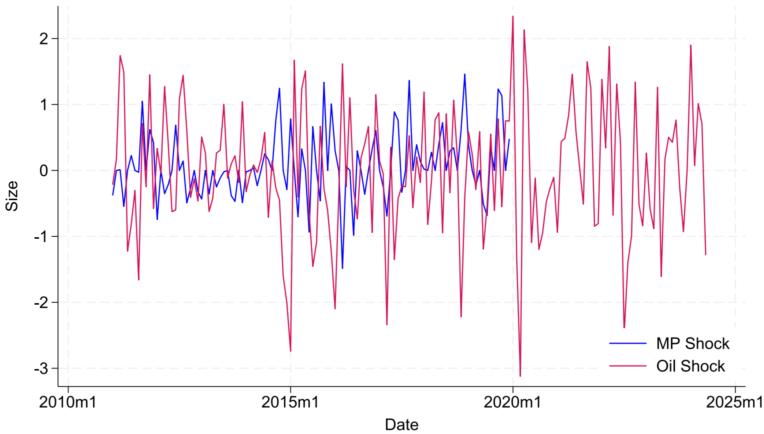


Fig. 15 Oil supply and monetary policy shock series. Oil supply shocks are obtained from Känzig (2021), and monetary policy shocks are obtained from Bauer and Swanson (2023). The sample period covers 2011m1–2024m6 for oil supply shocks and 2011m1–2019m12 for monetary policy shocks

Table 2 Cross-correlations between the alternative measures of supply- and demand-driven contributions

	Panel A: Supply-driven contributions							
	No ambiguity					Ambiguity		
	Benchmark	H.Filter	No time trend	24lags	Retail weights	Benchmark	H.Filter	Retail weights
Benchmark	1.000							
H.Filter	0.9624	1.000						
No time trend	0.9592	0.9387	1.000					
24lags	0.9782	0.9266	0.9243	1.000				
Retail weights	0.9837	0.9423	0.9180	0.9790	1.000			
Ambiguity (Benchmark)	0.9849	0.9209	0.9611	0.9689	0.9688	1.000		
Ambiguity (H.Filter)	0.9713	0.9830	0.9568	0.9510	0.9527	0.9502	1.000	
Ambiguity (Retail weights)	0.9670	0.9088	0.9151	0.9693	0.9881	0.9772	0.9362	1.000

Table 2 continued

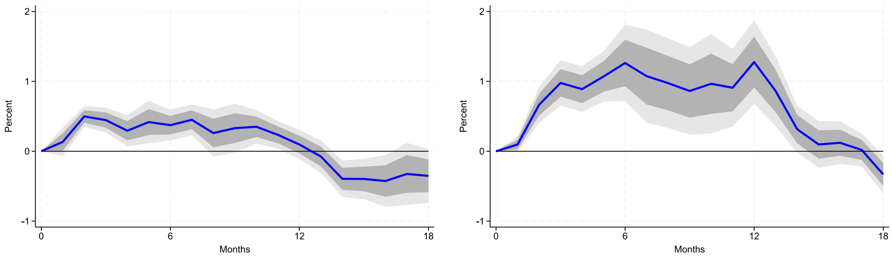
	Panel A: Supply-driven contributions							
	No ambiguity					Ambiguity		
	Benchmark	H.Filter	No time trend	24lags	Retail weights	Benchmark	H.Filter	Retail weights
	Panel B: Demand-driven contributions							
	No ambiguity					Ambiguity		
	Benchmark	H.Filter	No time trend	24lags	Retail weights	Benchmark	H.Filter	Retail weights
Benchmark	1.000							
H.Filter	0.9600	1.000						
No time trend	0.9426	0.9238	1.000					
24lags	0.9586	0.9034	0.8907	1.000				
Retail weights	0.9871	0.9268	0.9268	0.9691	1.000			
Ambiguity (Benchmark)	0.9733	0.9369	0.9691	0.9397	0.9598	1.000		
Ambiguity (H.Filter)	0.9196	0.9768	0.9214	0.8549	0.8807	0.9120	1.000	
Ambiguity (Retail weights)	0.9457	0.8748	0.9493	0.9395	0.9629	0.9780	0.8334	1.000

The displayed data showcases the contemporaneous correlations of contributions to 12-month inflation under the various specifications. Benchmark employs a benchmark specification incorporating 12 lags of price and quantity, alongside time trends. In contrast, H.Filter applies Hamilton (2018) filter to log price and log quantity prior to estimation, with a 24-month horizon. No time trend omits time trends from consideration. 24 lags extends the analysis by incorporating 24 lags of price and quantity. Retail weights adopt retail price index weights instead of inflation weights for the sector. The ambiguous component encompasses categories where the residual from either the price or quantity regression deviated by less than 0.1 sector-specific standard deviations from zero. Ambiguity(Benchmark), Ambiguity (H.Filter) and Ambiguity (Retail weights) utilize these ambiguity components by incorporating benchmark regression, Hamilton filter and retail weights, respectively. The sample period covers 2011m12–2024m4.

Table 3 Slope of the Phillips Curve: A comparison of demand- and supply-driven inflation

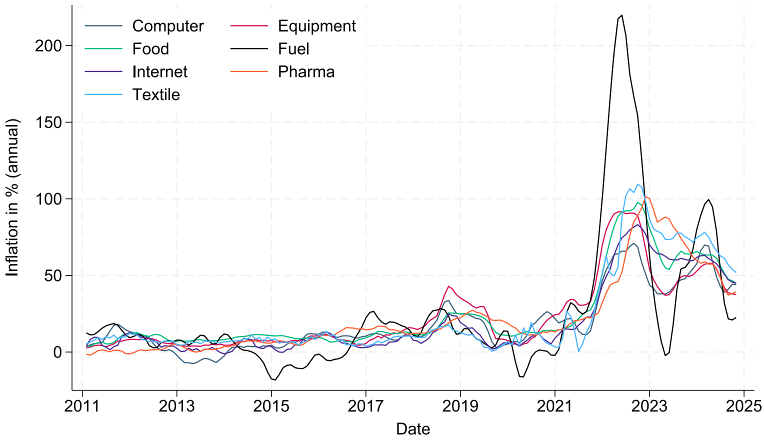
	(1) Inflation	(2) Supply-Inf	(3) Demand-Inf	(4) Inflation	(5) Supply-Inf	(6) Demand-Inf
$\sum_{j=1}^{11} \pi_{t-j}$	0.469***	0.470***	0.638***	0.470***	0.318***	0.606***
	(0.072)	(0.161)	(0.079)	(0.070)	(0.145)	(0.080)
$E_t \pi_{t+1}$	0.452***	0.250***	0.107**	0.452***	0.361***	0.119***
	(0.096)	(0.096)	(0.035)	(0.092)	(0.087)	(0.034)
π_t^m	0.144***	0.087***	0.027***	0.145***	0.081***	0.029***
	(0.016)	(0.019)	(0.004)	(0.015)	(0.018)	(0.004)
x_t	0.020	− 0.053**	0.057***			
	(0.041)	(0.027)	(0.016)			
Unemployment				− 0.042	0.526**	− 0.331***
				(0.226)	(0.218)	(0.123)
Observations	120	120	120	120	120	120
R^2	0.98	0.98	0.98	0.98	0.98	0.98

Entries are coefficients and standard errors from estimating regression (2). Newey–West standard errors are in parentheses. ***$p<0.01$, **$p<0.05$, *$p<0.1$. x_t represents the output gap, obtained from retail sales data using the Hamilton filter. π_t^m denotes import inflation, and $E_t \pi_{t+1}$ represents 12-month ahead inflation expectations of firms. “Supply-Inf” refers to the supply-driven component of inflation, while “Demand-Inf” refers to the demand-driven component. The sample period covers 2015m1–2024m12

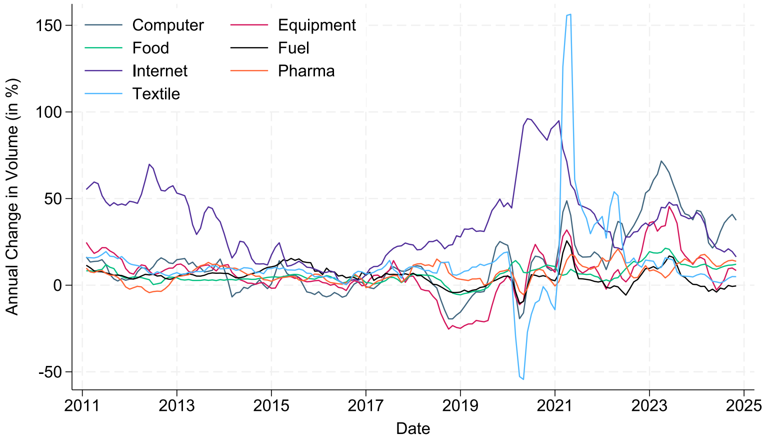


(a) Demand-driven Inflation **(b)** Supply-driven Inflation

Fig. 16 Response of inflation to exchange-rate shock (2011–2019 period). Light and dark gray areas are the 90th percentile and one-standard-deviation confidence bands. Newey–West standard errors are used. Exchange rate shocks are defined as monthly percentage changes in the exchange rate (USD/TRY) that deviate by more than one standard deviation from the series' mean. The sample period covers 2011m12–2019m12. For the full-sample analysis, please refer to Fig. 6

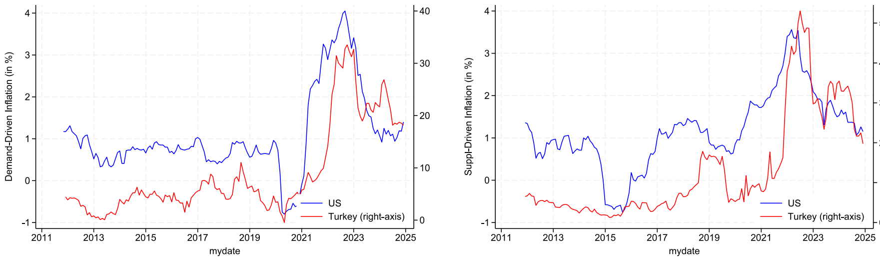


(a) Inflation Rate



(b) Quantity (annual growth)

Fig. 17 Sector level prices and quantities. Sectoral annual inflation rates and growth rates in volume are reported for each sector in the dataset. The sample period covers 2011m1–2024m12. The series are smoothed using a 3-month moving average



(a) Demand-driven Inflation **(b)** Supply-driven Inflation

Fig. 18 Decomposition of inflation in Türkiye and the U.S. The Türkiye results are based on our calculations, while the U.S. results are retrieved from Shapiro (2024). The sample period covers December 2011–December 2024

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