

Supply and demand factors driving rising inflation in Italy.*

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Abstract

In this work, we wonder whether initial inflationary shocks linked to imported input and input production costs remained the main drivers of the inflation phenomenon or whether there has been a mix of demand, supply and uncertainty factors during the last part of 2021 and 2022 due, for example, to the reopening after the pandemic phase. To this aim, following the recent literature on the topic, we have performed an exercise that breaks down Italy HICP core inflation into supply-driven, demand-driven factors, and ambiguous shocks. We use the HICP monthly series from 2001 to 2022 matched with the quarterly National Accounts chain-linked data on household consumption expenditures classified by 33 Coicop consumption functions. Shocks in a given quarter are identified by running a two-equation VAR of prices and quantities. The equations are estimated over a 10-year rolling window for the period 2010Q1-2022Q4. Differently from the ECB, we estimate for the first time, the contribution of the overall HICP index in 2022, and its components by forecasting gas and energy consumption. Preliminary results tell us that both demand and supply factors have played an important role in determining the rise in HICP and core inflation in Italy, particularly in the recent period. Finally, the sharp acceleration in food from the end of 2021, has also been driven by both supply and demand factors. In the last quarter of 2022, the decline in domestic demand together with the ECB's tightening monetary policy led to a reduction in demand-driven factors. Overall, the inflation rate remains high mainly driven by supply shocks.

Keywords: Inflation, National Accounts Consumption Data, Supply shock, Demand shock.

JEL classification codes: C53, E31, E37

*The views expressed are those of the authors and do not necessarily reflect those of the Italian Statistical Institute. This paper has benefited from valuable and helpful discussions with Stefano Costa (Istat-PSS) and Claudio Vicarelli (Istat-PSS). We also are grateful to Sara Basso (Istat-DCCN) for providing NA Consumption data.

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1 Introduction

In Italy and in the euro area inflation has experienced a growing dynamics starting from the second quarter of 2021, triggered by the sharp acceleration in the prices of raw materials, oil, and gas, and by the shortage of supplies of gas following the outbreak of the conflict in Ukraine. As a result, the increasing dynamics of import prices and domestic market producer prices in 2021 and 2022, that is the upstream stages of price formation, spread rapidly up to consumer prices (the annual change rate of the import prices is 9.2 in 2021 and 18.5 in 2022; domestic market producer prices of consumer goods is 2.2% and 9.3%; HICP is to 1.9% and 8.7%, respectively).

The energy aggregate is the HICP component that has experienced the greatest increases since spring 2021, in comparison to other countries of the euro area (on average it goes from 14.3% in 2021 to 52.3% in 2022 while in the euro area, is equal to 13% and 37%, respectively). However, starting from the last months of 2021 and during 2022, the inflationary phenomenon feeds into the other price components. While the prices of other non-energy industrial goods and services have undergone gradual increases following the post-pandemic re-openings, the food prices, processed and unprocessed, have accelerated the most driven by the increase in commodity prices in agriculture but also by the recovery of domestic and foreign demand. Furthermore, together with the impact of the re-openings, the accommodative monetary policy works mainly via the demand channel. Therefore, not only cost-pushed inflation but also demand factors seemed to be the main drivers of raising inflation in Italy. So it is important to assess to what extent developments in underlying inflation can be attributed to either supply or demand factors.

To this aim, we wondered whether the initial inflationary shocks due to persistent supply bottlenecks for industrial goods and input shortages and therefore the costs of production inputs remained the main drivers of the inflation phenomenon during 2021 and 2022 or whether there was a mix of factors also linked to demand factors and uncertainty due, for example, to the persistence of the conflict, the costs of the energy transition, the costs of supply of raw materials in new markets, etc. That question cannot be answered with a high degree of certainty, but some econometrics exist for estimating the contributions of demand and supply factors.

Drawing inspiration from the work already proposed by [Shapiro \(2022\)](#) and [Shapiro et al. \(2022\)](#), [Gonçalves et al. \(2022\)](#) published in the ECB Economic Bulletin (July, 2022) and "If it's not one thing it's another: supply and demand factors driving rising inflation" published in OECD Economic Outlook (Volume 2022 Issue 2), we repeated for Italy the exercise that breaks down inflation calculated with the HICP index into supply shock, demand shock and ambiguous.

Preliminary results tell us that both demand and supply factors have played an important role in determining the rise in headline and core inflation in Italy, particularly in the recent period. The recovery of activities after the pandemic period has also contributed to the current high rates of inflation, in particular in the services sector and other non-energy

industrial goods which have seen their inflation rate accelerate especially since the end of 2021. Finally, the sharp acceleration in food from the end of 2021, both processed and unprocessed, has also been driven by both supply and demand factors. In the last quarter of 2022, the decline in domestic demand together with the ECB’s tightening monetary policy led to a reduction in demand-driven factors. However, the inflation rate remains high mainly driven by supply shocks.

The paper is structured as follows. Section 2 describes data collection and the matching methodology between price categories and consumption volumes by purpose. Section 3 illustrates how is the rule we follow to disentangle supply shocks from demand ones and how we obtain demand and supply contributions to inflation. Section 4 presents preliminary results on how underlying and core inflation and its sup-components can be attributed to either supply or demand factors. 5 Concludes.

2 Data and Methodology

The estimate is inspired by similar exercises carried out for the United States (Shapiro, 2022), the Euro area (ECB, 2022) and some OECD countries (OECD (2022)).

Differently from the US exercise, we follow an alternative approach using detailed quarterly national accounts data for total household consumption expenditure by consumption purpose (COICOP) since monthly personal consumption expenditures (PCE) data are not available for Italy.

For the Italian case, the breakdown combines the 88 monthly series of HICP price components from 2001 to 2022 classified by the Classification of Individual Consumption by Purpose (Coicop) 4-digit with the Quarterly National Accounts (QNA) volume data on household consumption classified by 33 Coicop consumption functions starting from 1996q1 up to 2022q4¹. (of which 30 combined) supplemented by the quarterly series on the turnover in transport services relating to passengers, goods by road, air, and sea at the quarterly level. The services turnover indices were used as a detailed proxy for consumption of transport services, after deflating and adjusting them seasonally. Based on this matching exercise, it was possible to derive price-quantity pairs for all 88 HICP sub-components. Since the household consumption items are less than the price breakdown, one price component has been matched with more than one consumption item according to the nearer products rule. Based on this matching exercise, price-activity pairs for all 88 HICPX sub-components can be derived.

Prices and activity developments are affected by many factors, of which some have led to unexpected changes in supply and some have shifted demand. To assign a pair price-quantity to supply or demand in a binary way, we follow the economic theory according

¹QNA Household Consumption data, classified by 33 Coicop consumption functions, are available on request at a quarterly level, chain-linked, and seasonally adjusted.

to which a shift in demand leads to a shock in the same direction of price and quantity along the supply curve, while a shift in supply defines a shock in which price and quantity move in opposite directions along the demand curve.

To define whether the price change of that commodity is driven by supply or demand factors, our approach follows [Shapiro \(2022\)](#) decomposition. Given this definition of the supply and demand curve for each sector i :

$$\text{Supply Curve: } q_i = \sigma^i p_i + \alpha_q^i$$

$$\text{Demand Curve: } p_i = -\delta^i p_i + \alpha_p^i$$

where the dependent variable q_i and p_i are respectively quantity and price level, σ^i and δ^i are the slope, α_q^i and α_p^i the intercept. Then as in [Shapiro \(2022\)](#) the supply shock $\epsilon_{i,t}^s = \Delta\alpha_q^i$ and the demand shock $\epsilon_{i,t}^d = \Delta\alpha_p^i$ can be represented as:

$$\epsilon_{i,t}^s = (q_{i,t} - \sigma^i p_{i,t}) + (q_{i,t-1} - \sigma^i p_{i,t-1})$$

$$\epsilon_{i,t}^d = (\delta^i q_{i,t} - p_{i,t}) + (\delta^i q_{i,t-1} - p_{i,t-1})$$

and can be estimated using a structural VAR, where the reduced form for each of the 88 HICP sub-components i will be:

$$q_{i,t} = \sum_{k=1}^4 (\beta_k^p p_{i,t-k} + \beta_k^q q_{i,t-k}) + u_{i,t}^q$$

$$p_{i,t} = \sum_{k=1}^4 (\lambda_k^q q_{i,t-k} + \lambda_k^p p_{i,t-k}) + u_{i,t}^p.$$

In our exercise, the two-equation VAR, of order 4 given the quarterly nature of the data, are estimated with a rolling window of ten years starting from the first quarter of 2001, and the reduced form residuals $u_{i,t}^q$ and $u_{i,t}^p$ are used to identify the sign of the structural demand and supply shocks.

3 Decomposing inflation

The underlying hypothesis is that residuals of prices and quantities with the same sign reflect a demand shock (increased demand pushes prices and quantities up and vice versa) while residuals with opposite signs correspond to a change in supply (a lower supply translates into a reduction in quantities and an increase in prices).

$$+ \text{ Demand shock: } u_{i,t}^p > 0, u_{i,t}^q > 0$$

- Demand shock: $u_{i,t}^p < 0, u_{i,t}^q < 0$
- + Supply shock: $u_{i,t}^p < 0, u_{i,t}^q > 0$
- Supply shock: $u_{i,t}^p > 0, u_{i,t}^q < 0$

Only components whose errors are statistically significant – i.e. those which, in absolute value, are more significant than 5 percent of the standard deviation of the respective distribution are classified in this way; the components whose unexpected changes in prices and quantities are not significantly different from the model’s predictions are classified as ambiguous.

As shown in [Jump and Kohler \(2022\)](#), the signs of the residuals can be used to identify the signs of the structural shocks. Based on this approach, for each quarter each HICP category can then be labeled as predominantly demand-driven (unforeseen changes in prices and activity move in the same direction), as predominantly supply-driven (unforeseen changes in prices and activity activities move in opposite directions), or as ambiguous.

If the residuals for quantities and prices in the final months of each window of the VAR estimation have the same sign, that component is labeled as “demand-driven”, whereas, if they have opposite signs, it is identified as “supply-driven”. If the residual for either the price or the quantity series is statistically indistinguishable from zero, the category is labeled as “ambiguous” for that month.

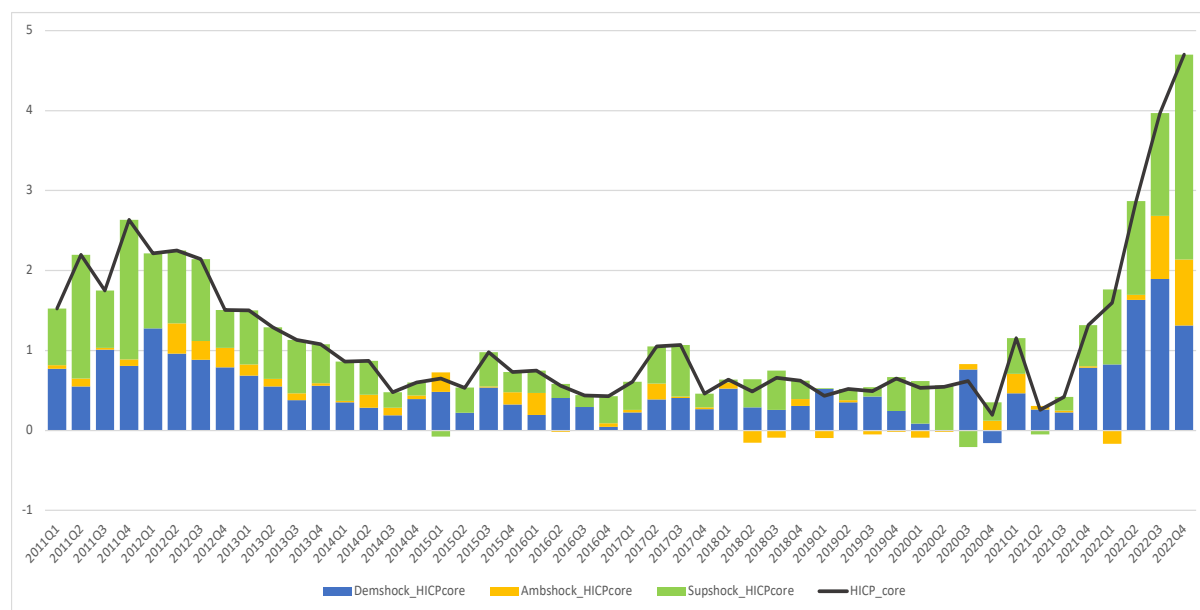
After performing this classification, the HICP indices were disaggregated into individual contributions (using their consumption weights) to derive the impact of the demand-driven, supply-driven, and ambiguous components for each quarter. Specifically, the demand-driven (supply-driven) contribution to inflation in a given quarter is then constructed as the expenditure-weighted average of the inflation rates of those categories labeled as demand-driven (supply-driven) in that quarter. The contributions of the three categories demand-driven, supply-driven, and ambiguous sum to total core or headline HICP inflation.

4 Preliminary Results

As a first estimation, we consider demand and supply contribution to “core” inflation (HICP), defined as excluding food (including tobacco) and energy (It was equal to 0.8% in 2021 and 3.3% in 2022). The breakdown suggests that the increase in “core” inflation in Italy has been driven by a mix of supply and demand shocks since the third quarter of 2021. However, the importance of demand factors has gradually increased in 2022, particularly in the middle quarters of the year. In the final months of 2022, supply and demand factors played substantially similar roles except for the last quarter in which supply factors returned to prevail, influenced, among others, by the ECB’s tightening

monetary policy which is holding back demand (figure 1). Therefore, excluding the more volatile components, such as energy and food prices, it emerges that above all during 2022 demand factors also drive the diffusion of inflation in Italy. In detail, the price growth is mainly driven by clothing, furniture, and home furnishings items, catering, and air transport as well.

Figure 1: HICP core inflation rate. Contributions of demand shocks, supply shocks, and ambiguous (Hicp index: percentage values; contributions: percentage points).

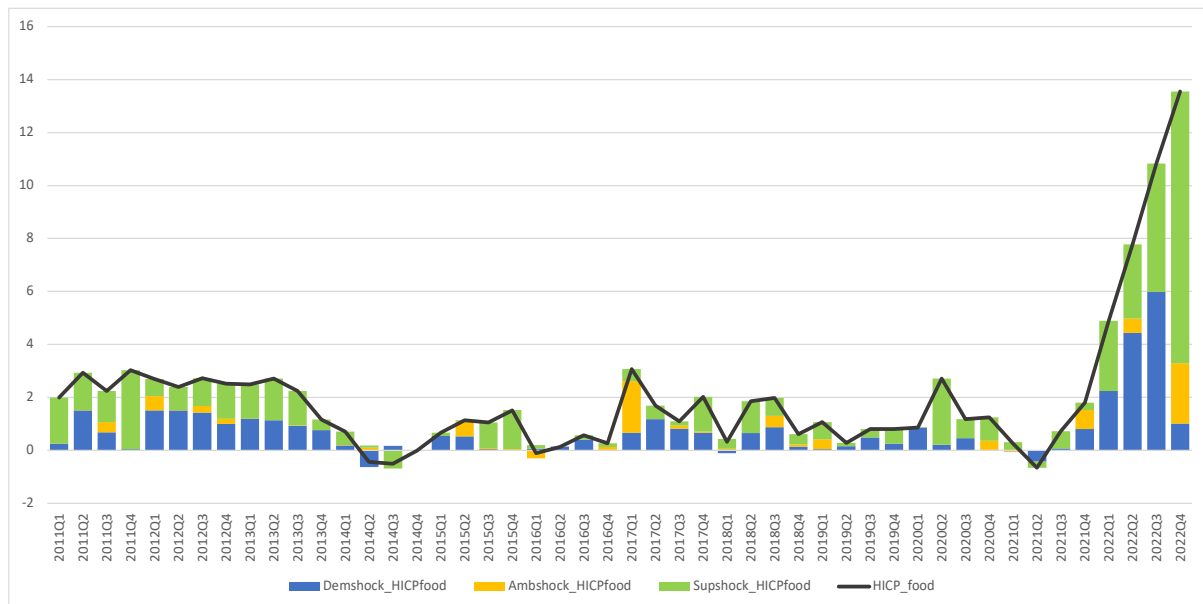


Note: Author's calculations.

It is interesting to analyze the factors driving the price component of foodstuffs which in Italy have been dramatically growing since the end of 2021 with a marked acceleration from the second half of 2022 (on average equal to 0.5% in 2021 and 8% in 2022, respectively). Figure 2 shows that even starting from the fourth quarter of 2021, both demand and supply shocks drive the growth of this component, which is so important for household spending and has an immediate impact on consumers' perception of inflation. In the last quarter of 2022, when the food inflation rate is 13.5%, the supply shock and uncertainty component prevails due to the slowdown in domestic consumption and the persistence of price increases of some agricultural commodities. In particular, in 2022 food that mainly influenced the dynamics of the demand-driven component in the first two quarters were meat, bread and cereals, fish and fish products; as regards the supply-driven component in the fourth quarter, in addition to bread and meat, the greatest contribution was determined by oils, fats fruit, and vegetables.

The increase in services inflation has been recorded since 2022, unlike the euro area, where it has already been growing since mid-2021 (on average in 2022 it is equal to 3.4% in Italy and 3.5% in the euro area, respectively). Both demand factors and supply factors affected the rise in services inflation in our country (figure 3). In detail, supply and demand factors were broadly similar contributors to services inflation in 2021, when services inflation was

Figure 2: HICP Food inflation rate. Contributions of demand shocks, supply shocks, and ambiguous (Hicp index: percentage values; contributions: percentage points).

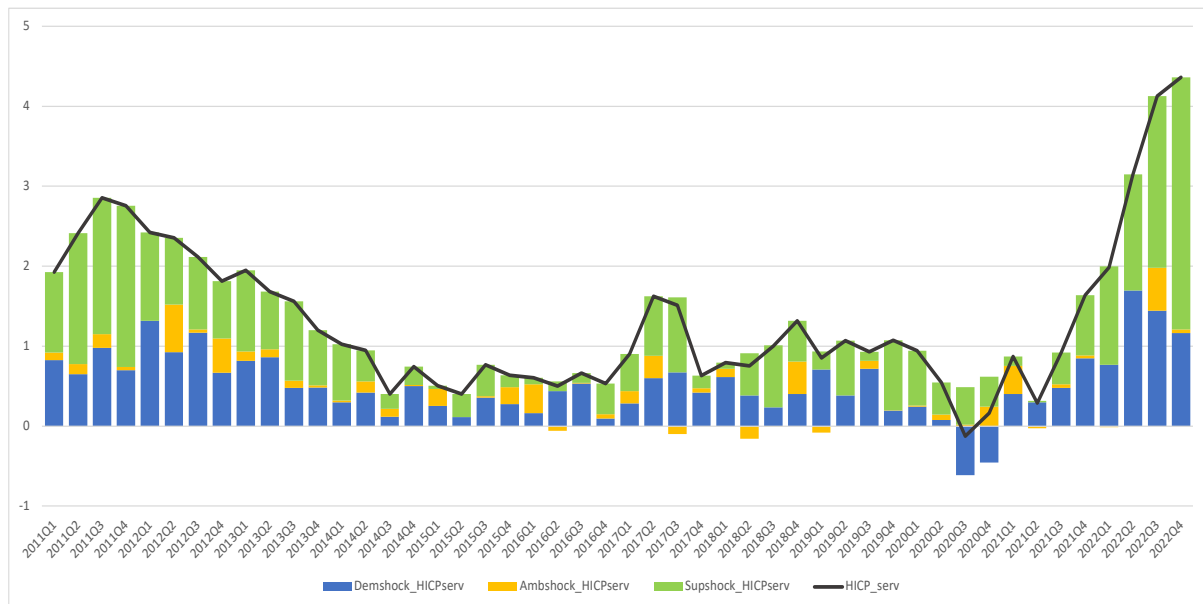


Note: Author’s calculations.

fairly stable in the first part of the year and then upsurged in the second half. The sharp increase from early 2022 onwards was mainly driven by supply factors. The contributions of the predominantly supply-driven components remained stable until mid-2022 and then increases in the second half of 2022. The role of demand factors in services inflation only started to increase in the last months of 2021 – with the intensifying effects of post-pandemic reopenings – and continued to increase through mid-2022. In the last two quarters of 2022, the inflation contributions of supply-driven components exceeded those of demand-driven components. Following the disaggregated approach, the demand-driven component is mainly driven by housing services, while the supply-driven component is driven by air transport, accommodation, and catering services.

As a last element of the analysis, we also broke down the contribution of the shocks to the growth of the total HICP inflation rate. Given the information available, it was possible to carry out the breakdown only for the period from 2019 to 2022. The possibility of calculating this decomposition depends on the availability of data relating to the quantities of energy and gas. The aggregate data on household consumption at a quarterly level are from the Italian Regulatory Authority for Energy, Networks, and Environment (ARERA) and are available from the first quarter of 2012; the VARs for these two categories are therefore estimated with a rolling window of seven years instead of ten. Furthermore, the latest data available for electricity consumption relates to the third quarter of 2022, gas consumption is available until the fourth quarter of 2021. The trend in energy consumption for the missing period was foreseen on the basis of a forecast combination exercise among univariate models (see [Newbold and Harvey \(2002\)](#), [Timmermann \(2006\)](#)); gas consumption along the four quarters of 2022 was estimated with an autoregressive dis-

Figure 3: HICP Service inflation rate. Contributions of demand shocks, supply shocks, and ambiguous (Hicp index: percentage values; contributions: percentage points).



Note: Author's calculations.

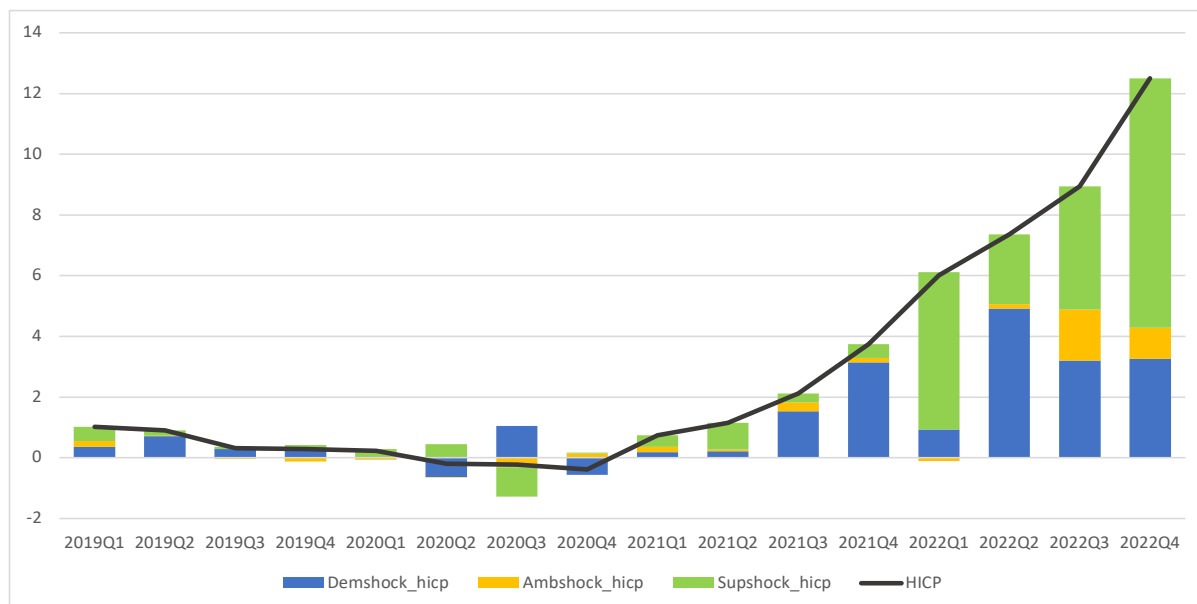
tributed lags model (ARDL) (Pesaran et al. (1995), Jordan and Philips (2018)) using fuel and household maintenance items as regressors (source: National Accounts).

As a result, in the first part of 2021 headline inflation is mainly driven by supply shocks due to supply disruptions, the shortages of intermediate goods, and bottlenecks generated by pandemic in many industrial and service sectors, while in the second part of the year, there are both supply and demand shocks also thanks to the post-pandemic reopenings which have reactivated the demand for many goods and services, such as recreational, catering and accommodation services, more visible in the last quarter of the year coinciding with Christmas holidays. In 2022, supply shocks are mainly driving inflation growth in Italy, particularly in the first and last quarters of the year. However, the recovery in domestic and foreign demand also for other services and consumer goods (e.g. food, clothing, accommodation, catering, and transport), in addition to energy, contributed to the acceleration of inflation from the second quarter onwards. However, it is worth noting that in the second half of the year, there is also a component of uncertainty that affects inflationary dynamics, meaning that factors characterizing the inflation dynamics in that period are not clearly attributable (figure 4).

5 Conclusion

To conclude, both demand and supply factors have played an important role in determining the rise in HICP inflation in Italy, particularly in the recent period.

Figure 4: HICP inflation rate. Contributions of demand shocks, supply shocks, and ambiguous (Hicp index: percentage values; contributions: percentage points).



Note: Author’s calculations.

Persistent supply bottlenecks in intermediate goods and input shortages due in part to the effects of the coronavirus (COVID-19) pandemic together with high oil and gas prices have contributed to a sharp increase in the core and headline inflation starting from the second quarter of 2021 with a prevalence of supply factors that influenced the growth of the prices of the energy component and of the headline inflation.

Subsequently, following the lifting of restrictions due to the pandemic, the recovery in demand has also contributed to the current high rates of inflation, particularly in the services sector and food which have seen their inflation rate accelerate mainly from the end of 2021. These contributions, the relative weight of which has evolved over time, are well summarized by the breakdown of the HICP index net of food, tobacco, and energy (“core” HICP). Finally, the sharp acceleration in food, both processed and unprocessed, since the end of 2021 has also been driven by both supply and demand factors. This evidence supports the economic theory according to which after a negative supply shock, the subsequent expansion of demand, thanks to a recovery in consumption and net exports, contributed to the growth of inflation but at the same time prevented the Italian economy from falling into a severe recession. In the last quarter of 2022, the decline in domestic demand together with the ECB’s choice of restrictive monetary policy led to a reduction in demand-driven factors. This was not followed by a reduction in inflation which was mainly driven by supply shocks.

The update of the VAR estimates to the first quarter of 2023, following the downside dynamics of input and consumer energy prices, could enrich the analysis extensively.

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