DRIVERS OF INFLATION IN THE GREEK ECONOMY

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ABSTRACT

One of the hallmark achievements of modern central banking has been to quell high inflation. However, after over two decades of low inflation, a series of shocks, including the pandemic recession, supply bottlenecks, highly accommodative policy, and, perhaps most saliently, the war in Ukraine, have led to multi-decade inflation highs across most advanced economies. Understanding the ultimate causes of this inflation surge is vital for the proper design of policy, yet disentangling the various shocks is hard, particularly when they affect prices in the same direction. In this paper, we apply the novel shock decomposition framework of Shapiro (2022) to Greek data and estimate the contribution of supply and demand shocks to inflation developments over the recent episode, as well as for the 2001-2019 period. For the recent episode, we find that supply forces were slightly more important for headline inflation, but much more important for underlying inflation.

Keywords: inflation; demand; supply; energy shocks

JEL classification: E31; E37; Q02

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ΠΡΟΣΔΙΟΡΙΣΤΙΚΟΙ ΠΑΡΑΓΟΝΤΕΣ ΤΟΥ ΠΛΗΘΩΡΙΣΜΟΥ ΣΤΗΝ ΕΛΛΗΝΙΚΗ ΟΙΚΟΝΟΜΙΑ

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ΠΕΡΙΛΗΨΗ

Ένα από τα σημαντικότερα επιτεύγματα της σύγχρονης κεντρικής τραπεζικής υπήρξε η καταπολέμηση του υψηλού πληθωρισμού. Ωστόσο, μετά από περισσότερες από δύο δεκαετίες χαμηλού πληθωρισμού, μια σειρά διαταραχών, όπως η πανδημία, τα προβλήματα στις εφοδιαστικές αλυσίδες, η επεκτατική μακροοικονομική πολιτική και, ίσως κυρίως, ο πόλεμος στην Ουκρανία, οδήγησαν τον πληθωρισμό σε υψηλά δεκαετιών στις περισσότερες ανεπτυγμένες οικονομίες. Η κατανόηση των αιτιών αυτής της ραγδαίας ανόδου του πληθωρισμού είναι ζωτικής σημασίας για τον κατάλληλο σχεδιασμό της πολιτικής, αλλά είναι δύσκολο να προσδιοριστούν οι παράγοντες που συνέβαλαν σε αυτή την άνοδο, ιδίως όταν επηρεάζουν τις τιμές προς την ίδια κατεύθυνση. Στην παρούσα μελέτη, εφαρμόζουμε το νέο πλαίσιο ανάλυσης διαταραχών του Shapiro (2022) στα δεδομένα για την Ελλάδα και εκτιμούμε τη συμβολή των διαταραχών προσφοράς και ζήτησης στην εξέλιξη του πληθωρισμού κατά την πρόσφατη περίοδο, καθώς και για την περίοδο 2001-2019. Για την πρόσφατη περίοδο, διαπιστώνουμε ότι οι δυνάμεις της προσφοράς ήταν ελαφρώς πιο σημαντικές για το γενικό πληθωρισμό, αλλά πολύ πιο σημαντικές για τον πυρήνα του πληθωρισμού.

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1 INTRODUCTION

One of the greatest achievements of monetary policy in recent decades has been inflation stability. In advanced economies, inflation rates that were in the double digits during the 1980s gradually declined to levels nearing 2% by the 1990s. Although Greece experienced a delayed decline, inflation reached historically low levels after meeting the convergence targets for entry into the Economic and Monetary Union (EMU). Throughout this period, inflation remained below 5% and, during the fiscal adjustment in the middle of the last decade, it even turned negative for a significant duration.

However, starting from the second half of 2021, inflation began to rise notably, reaching decade highs across most developing economies by 2022. The war in Ukraine triggered a big surge in energy costs, primarily for Europe. This surge was noticeable in both headline and core inflation, with inflation levels rising consistently. This shock came at the heels of the global COVID-19 pandemic, which had caused major disruptions in economic activity and supply chains. In addition, the unprecedented monetary and fiscal measures implemented by central banks and governments to mitigate the economic impact of the pandemic have also played a part in inflation developments. The combined effect of these forces had a profound influence on inflation, contributing to its overall trajectory.

The objective of this article is to examine the factors that contributed to inflation in the Greek economy during the recent period. It employs the model of Shapiro (2022), which provides a framework for analysing inflationary pressures arising from supply and demand disruptions. The model has been used extensively in similar exercises by the Federal Reserve and the ECB (Gonçalves and Koester 2022).

The decomposition of inflation into demand and supply drivers is crucial for policymakers and analysts to better understand the underlying causes of inflation and to determine appropriate responses. For instance, if demand-pull inflation is driving up prices, policymakers can respond by raising interest rates. On the other hand, if cost-push inflation is the primary driver, policymakers may focus on addressing the underlying supply-side factors. Overall, decomposing inflation into demand and supply drivers can provide a more accurate insight into the causes of inflation and, thus, make it easier to address them more effectively.

The paper is structured as follows. Section 2 provides a brief literature review, while Section 3 explains in further detail the consensus view on the drivers of inflation. Section 4 provides a detailed explanation of the empirical framework used to identify demand and supply shocks, while Section 5 presents the data, providing a detailed description of the matching between price and quantity data, a central aspect of the empirical exercise. Section 6 shows the results and Section 7 concludes.

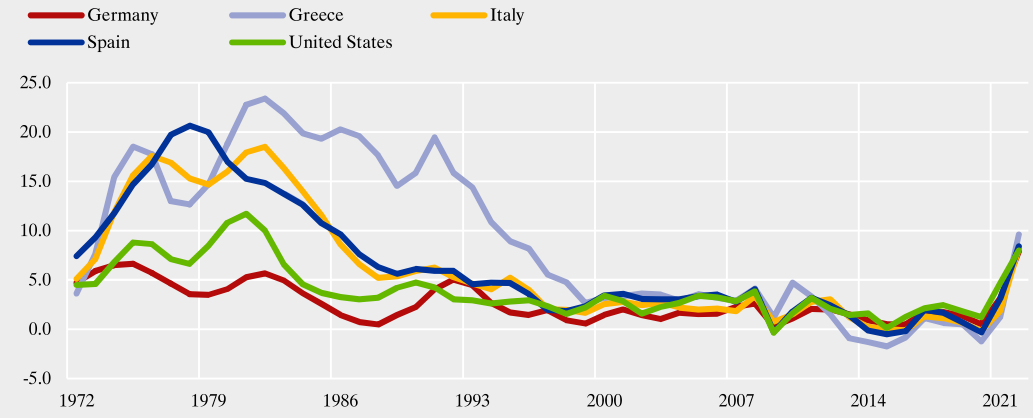
2 LITERATURE REVIEW

In this section, we provide a brief, selective overview of the relevant literature, focusing in particular on what we know about the drivers of inflation, both historically and for the current episode.

* The views expressed in this article are of the authors and do not necessarily reflect those of the Bank of Greece. The authors are responsible for any errors or omissions.

Chart 1 Inflation across selected economies (1970-2022)

(% of GDP)



Source: Ha et al. (2023).
Note: Annual inflation in two-years moving average form.

The nature of inflation dynamics is one of the most contested issues in macroeconomics, because it holds crucial implications for the conduct of policy. A short-run trade-off between inflation and unemployment, as embodied in the Phillips curve, together with a role for expectations, is at the heart of the New Keynesian paradigm (Gali and Gertler 1999). This framework recognises roles for both demand and supply shocks; indeed, allowing for both can help explain the stagflation of the 1970s and 1980s as an inadequate monetary policy (demand) response to severe supply shocks in the global oil markets.

Inflation came down from its 1980s highs to modest levels in the early 1990s, ushering in a roughly 30-year period of a low inflation regime, a period which coincided with inflation targeting and a Taylor rule. The era during and after the global financial crisis was characterised by persistently low (but rarely negative) inflation, seemingly severing the link between real activity and inflation, and led many to question the validity of the Phillips curve. A large literature developed, which tried to provide an explanation why the Phillips curve flattened (Del Negro et al. 2020; McLeay and Tenreyro 2019; Hazell et al. 2022; Bianchi et al. 2023 and references therein).

Reis (2022) investigates the causes behind the surge of inflation in 2021-2022 and evaluates the conduct of monetary policy in this regard across advanced economies, focusing on the misdiagnosis of shocks during this period. Monetary policy must always deal with various aggregate shocks, but correctly diagnosing the sources of these shocks is very difficult in real time. As such, he argues that, given that central banks need to, explicitly or implicitly, trade off between their objectives (price and financial stability, and employment growth), they may inadvertently allow inflation to rise because they misjudged the nature of these shocks. The framework used in this paper cannot directly identify the nature of these shocks, but it can shed light on their sources, i.e. whether they come from the demand or the supply side. Determining whether the supply shocks themselves are temporary (and monetary policy should see through them) or affect potential output is very difficult in real time.

Research on inflation typically focuses on some aggregate inflation measure, but much can be learned from studying its components. Stock and Watson (2016) improve upon measurements of trend inflation by using sectoral inflation data. Stock and Watson (2020) fur-

ther show that some components have a stable and strong correlation with the business cycle, while others do not. They construct an index which weighs components by their cyclical covariance with real activity and find that it provides a real-time indicator of cyclical inflation.

Shapiro (2022) exploits the informational content of disaggregated items for structural estimation and provides a simple framework for a real-time decomposition of inflation into its drivers, based on standard supply and demand arguments. He proposes to classify temporal shocks for each consumption category depending on the relative movements of prices and quantities: if they move together, the demand shock must have been larger. If they change in opposite signs, the opposite must hold. This empirical framework is similar in logic to the more general sign restrictions strategy commonly used in empirical macro models and in structural vector autoregression (SVAR) models (Uhlig 2005; Baumeister and Hamilton 2015, 2018). This framework, which allows only for set identification of parameters, recognises that different shocks are expected to have effects of differing signs on the variables of interest. The approach of Shapiro (2022) is a simplified special case of the more general framework applied to single-equation models, but across different sectors of the economy.[1] The results of this, using a sample from 1990-2022, are consistent with historical intuition; the role of demand is accentuated during booms and falls in downturns. For the COVID-19 episode, he finds an initial large decline, followed by a big rise in demand in 2021, consistent with the large fiscal expansion, with supply surging in 2022, after the Russia-Ukraine war raised energy prices.

Shapiro's framework was inspired by Jump and Kohler (2022), who use such a framework to study the sources of aggregate shocks to the UK economy over a period longer than a century. Using restrictions from the workhorse New Keynesian model, they use a bivariate SVAR model with inflation and unemployment to identify aggregate demand and supply shocks. Their findings align well with contemporaneous narrative accounts and they find a larger role for demand, with 20 out of the 30 largest shocks being accounted for by demand. They find that the 1970s-1980s episode was a sequence of positive demand and negative supply shocks. This is useful since Shapiro (2022) does not include data for large supply shocks other than COVID-19. One insight is that supply shocks are especially problematic if they occur after demand shocks, which makes it harder for policymakers to understand the shocks in real time.

Relevant to the current episode is the extensive literature studying the effects of commodity developments on headline inflation. The link was strong up until the 1980s and commodities, especially oil, were, hence, useful in forecasting inflation at the time, but have been less successful since (Stock and Watson 2003). In a highly influential paper, Kilian (2009) argues that the primary driver of oil prices is either aggregate demand or oil-specific demand shocks and that supply shocks have historically been of little importance, as they tend to simply reflect OPEC responses to demand shocks. This implies that oil developments are essentially driven by the global cycle, rather than influencing it, and so output effects are small. More recently, Baumeister and Hamilton (2019) find a larger role for supply shocks in output fluctuations. Regarding inflation, Ha et al. (2023) find that, while global oil shocks explain a quarter of inflation variability in the median country (in a large panel of countries), and more so recently, a small fraction of this is due to either supply or price shocks. Sekine and Tsuruga (2018) find that for a large cross-country panel the effects of commodity price shocks on inflation are transitory on average across countries, although effects are more

1 Brinca et al. (2021) and Petroulakis (2023) also employ the SVAR sign restrictions framework of Baumeister and Hamilton (2015) in a multi-sector setup. Note that the approach of Shapiro (2022), following Jump and Kohler (2022), has the additional benefit that it is only concerned with the sign of the relationship, rather than the identification of structural parameters, in which case further non-sign assumptions have to be made.

persistent for dollar-pegged countries, which constrains monetary policy.

3 DETERMINANTS AND CLASSIFICATION OF INFLATION

3.1 DETERMINANTS

The literature typically groups the causes of inflationary pressures into three sources: demand-pull, cost-push and expectational. This grouping combines standard Phillips curve aspects of inflation together with rational expectations and inertia. While these shocks are conceptually distinct, they can interact in complex ways. This section is purposely pedagogical and uses the formalisation of Gordon's (1988) "triangle model".

Demand-pull

Demand-pull inflation is the result of excess demand for goods and services in an economy, for a given level of productive capacity. Supply is relatively rigid in the short run, as firms need to expand their labour pool and increase their capital through investment in order to respond to increased demand. This is especially the case when the economy is at or near full employment and so any increase in capacity will have to come through investment. In this case, any increase in aggregate demand can lead to inflation, as there are not enough resources available to meet the increased demand without raising prices (Machlup 1960). As such, a shift in demand when supply is inelastic will tend to raise prices, as firms try to balance out the shortage. Several factors may cause aggregate demand to rise, including higher government spending, lower taxes, more accommodative monetary policy or any other shock which increases disposable income, all of which lead to higher consumer spending.

Cost-push

Cost-push inflation, on the other hand, is the result of adverse shocks to supply, which raise the cost of production, such as an increase in wages, raw materials or taxes. When production costs rise, companies raise their prices to cushion the hit to their profit margins. This, in turn, causes the general price level to rise, leading to inflation. Cost-push inflation can occur as a result of supply-side shocks, such as natural disasters or political instability, which disrupt production and increase the cost of goods and services. It can also be caused by external factors, such as tariffs, embargoes or changes in the exchange rate, which increase the cost of imports, and by internal factors, such as price controls, which discourage production and reduce supply. Most notably, cost-push shocks can arise due to shocks in energy markets, especially oil, as in the 1970s, when the economy suffered from two large oil shocks, leading to periods of high unemployment and inflation (stagflation).

It should be noted that, while it is undisputed that cost shocks can lead to higher price levels, whether they can lead to sustained increases in inflation (price changes) is debated. Most famously, Milton Friedman and the monetarists rejected the validity of cost-push inflation, arguing that higher aggregate demand, due to an increase in money supply, is the ultimate factor. The New Keynesian literature has argued that supply shocks may indeed lead to persistent cost-push inflation, as workers and firms continuously bid up the prices for their products (Blanchard 1986; Lorenzoni and Werning 2023a, b), leading to a wage-price spiral.[2]

Expectational

The expectational channel refers to the pricing behaviour of firms and households relating to how they expect inflation to evolve in the future and is due to the well-known stickiness of price and wage formation. If nominal contracts were fully flexible, then expectations would trivially be irrelevant for pricing decisions. In the traditional Phillips curve, expectations were backward-looking, i.e. current inflation was affected by lagged inflation, giving rise to inertial or "built-in" inflation. This can result from adap-

2 Empirical evidence suggests that such episodes rarely lead to sustained wage and price inflation (Alvarez et al. 2022).

tive expectations, as agents slowly adjust their behaviour to new levels of inflation with a lag or naïve rule-of-thumb pricing strategies (Roeger and Herz 2012). The idea is that long periods of high inflation become ingrained in the pricing behaviour (e.g. due to the wage-price spiral mentioned above), which can explain why high inflation in some emerging economies can persist over decades.

The New Keynesian literature (Gali and Gertler 1999) instead emphasises optimising behaviour in the presence of price stickiness, giving rise to a forward-looking term of inflation expectations. In the New Keynesian Phillips curve (NKPC), this forward-looking term in fact encapsulates future marginal shocks and, thus, expectations of cost-push shocks. The logic of the NKPC is that, if people expect prices to rise in the future, and given that prices are generally sticky and only subject to periodic changes, they will adjust their behaviour accordingly, by demanding higher wages or raising the prices of the services they provide.[3] Thus, a self-fulfilling cycle can be established, in which expectations of inflation lead to actual inflation. The conventional wisdom is that such inflation can be difficult to control because it is embedded in the economy and in people's expectations (Reis 2022).[4] Indeed, the literature has centered around the idea that inflation became more persistent, as expectations became better anchored (Watson 2014).

3.2 INFLATION CATEGORIES

Inflation is typically thought to reflect the rate of change in prices in some basket of goods and services consumed by the average household. Relative prices between goods change all the time to reflect different productivity and relative demand and supply trends across different items. Such movements are desirable, as they aid the price discovery mechanism, which is crucial for the efficient allocation of resources in market economies.

Headline inflation, the most commonly used measure of inflation, is the rate of change in the consumer price index (CPI), constructed by a weighted average of all items consumed by the representative household. This is the measure targeted by most central banks engaged in inflation targeting, because it reflects the prices paid by households.[5] It is considered to reflect the overall inflation rate in an economy. For the purposes of conducting policy, however, headline inflation has some drawbacks, most importantly the fact that it can display short-term swings as a result of changes in the prices of its most volatile items, in particular food and energy.

Commodity supply is subject to large short-term fluctuations, which can affect the overall index. As monetary policy affects the real economy only with "long and variable lags" (Friedman 1961), it is imprudent to react forcefully to temporary changes induced by transitory supply shocks. At the same time, since commodity prices also tend to be determined in global markets, monetary policy is unlikely to influence them, which further reduces the usefulness of reactions to these shocks. As such, central banks also consider core inflation, a measure of inflation that excludes food and energy prices (HICPX for the euro area). Such items, which are excluded from core inflation, can be affected by factors like weather conditions and geopolitical events, thus causing temporary price spikes. By excluding them, core inflation proves to be a more stable measure of inflation, less affected by transitory price movements. This is because prices tend to be sticky in the short term and it is typically assumed that transitory shocks in energy and food are less likely to affect pricing policies in other sectors. On the other hand, if high inflation becomes embedded, then core inflation may remain elevated

3 The full-information rational expectations (FIRE) version of the NKPC has had mixed empirical success and the literature has moved to more sophisticated specifications; see Coibion et al. (2018).
4 Interestingly, workhorse models can differ substantially in the pass-through of expectations (Werning 2022).
5 A notable exception is the Federal Reserve, which targets the price index for Personal Consumption Expenditures (PCE). The major difference with CPI is that PCE is measured on the basis of business surveys instead of consumer surveys.

even while headline inflation comes down, after energy or food shocks subside. This is in fact the situation in the Greek economy in the second quarter of 2023, with core inflation higher than headline.

It is important to understand that both headline and core inflation are useful to analysts and policymakers for different purposes. Headline inflation, as mentioned earlier, is the most widely used measure of inflation and has proved useful in assessing the general price level and the purchasing power of households. On the other hand, core inflation is effective in filtering out volatile components and providing a more accurate picture of underlying price trends, which tend to be more persistent. Nevertheless, both core and headline inflation are useful measures that can provide valuable insights into changes in the general price level. Apart from this distinction into core and headline inflation, other groups can be created according to the needs of the analysis being conducted. The remainder of this section proposes the more appropriate inflation groups for the study.

In addition to headline and core inflation, we will consider inflation in services and non-energy industrial goods (NEIG). Each merits attention due to the different informational content that the prices of these goods have for overall inflation. Services inflation is an important indicator of underlying, slow-moving pressures on inflation, as it is strongly influenced by labour costs and much less so by commodities. An uptick in services inflation is often considered evidence of higher wage growth, but also of second-round effects of inflation, since wages tend to comove across sectors.

NEIG inflation, on the other hand, essentially corresponds to the goods portion of core inflation. NEIG markets are internationally contestable and benefit from productivity growth and trade, and, thus, their prices tend to grow more slowly (or, in fact, fall) over time. Industrial goods, whether imported or not, tend to be produced over multiple locations and are the result of energy-intensive production. As such, surges in commodity prices tend to produce so-called "pipeline" pressures, especially in the early stages of production and distribution.[6] An uptick in NEIG inflation after increases in commodity prices is, hence, a useful indicator of the pass-through of such shocks to the rest of the economy.

4 FRAMEWORK

This paper uses the novel framework of Shapiro (2022) to distinguish the sources of the rise in inflation between demand and supply shocks, using the refinement of Gonçalves and Koester (2022) for European data. The model of Shapiro (2022) is based on the observation that although negative supply and positive demand shocks both lead to a price increase, they have opposite effects on consumption: negative supply shocks reduce consumption and positive demand shocks raise it. As such, an unexpected change in prices and quantities in the same direction is due to a demand shock, while an unexpected change in opposite directions is due to a supply shock.

To operationalise this framework, we estimate price and consumption regressions separately for each consumption category. When the estimation errors (deviations of actual prices and quantities from those predicted by the model) of price and consumption have the same sign, the disturbance is assumed to come from demand; if they have a different sign, it is assumed to come from supply. In fact, supply and demand shocks coexist and, thus, the model can identify the relative strength of the shocks. Strictly speaking, it is the net demand and supply shocks that can be identified.

We run ten-year rolling window regressions (40 quarters), with four lags. The model is formally given as follows:

6 See https://www.ecb.europa.eu//pub/economic-bulletin/focus/2021/html/ecb.ebbox202105_07~d799754f4e.en.html.

$$q_{i,t} = \sum_{j=1}^{4} \gamma_j^{qp} p_{i,t-j} + \sum_{j=1}^{4} \gamma_j^{qq} q_{i,t-j} + v_{i,t}^{q}$$

$$p_{i,t} = \sum_{j=1}^{4} \gamma_j^{pp} p_{i,t-j} + \sum_{j=1}^{4} \gamma_j^{pq} q_{i,t-j} + v_{i,t}^{p}$$

In the expressions above, t is time in quarters, i denotes consumption category, q is the log change in quantity and p is the log change in price. We classify each quarter for each consumption category as being driven by a supply or demand disturbance, according to the classification above, if the error is statistically significant; otherwise, the given observation is classified as ambiguous. This flexible procedure can be used to separately analyse the drivers of inflation across a variety of product groups. As such, we aggregate the estimates for each category, using the appropriate weights, to measure demand and supply shocks for headline inflation, as well as for HICPX, NEIG and services inflation.

As has been highlighted in the recent literature, the huge shock of the lockdowns imposed in early 2020 due to the COVID-19 pandemic makes statistical inference problematic in time series analysis. The presence of huge outliers means that ignoring them may lead to inconsistent estimates. A variety of methods has been proposed by the literature to deal with this concern, mostly for vector autoregression models (e.g. Lenza and Primiceri 2022; Ng 2021; Carriero et al., forthcoming). In our simple single-equation setting, we follow the suggestion of Lenza and Primiceri (2022), who argue that, for the purposes of estimating structural parameters, it is sufficient to simply remove the COVID-19 sample from the data. As such, we use a sample up to the fourth quarter of 2019 to estimate the models. At the same time, the choice of four lags means that, in order to avoid using the two quarters that were particularly affected by the pandemic (second and third quarters of 2020), we can measure shocks from the fourth quarter of 2021 onwards.

5 DATA

The analysis in this paper requires data on prices and quantities of goods and services produced in the Greek economy. Price data consist of the price indices for the components of the Harmonised Index of Consumer Prices (HICP), obtained from the European Central Bank (ECB). The classification system according to which the HICP data are organised is the COICOP system, also at the two- and three-digit aggregation level, where appropriate. We use different levels of disaggregation in order to maximise the match between NACE and COICOP. This part of our data is essentially identical with Shapiro (2022).

Quantity data, however, are not readily available for our purposes. Eurostat publishes detailed consumption aggregates at the sectoral level only at annual frequencies, which is not sufficient for our analysis, given that opposing shocks in successive quarters may wash out during the year. Even then, granularity is limited and using production data would conflate local with foreign consumption (for exporting sectors). As such, we follow Gonçalves and Koester (2022) and use sectoral turnover data from Eurostat's Short-Term Business Statistics database, for both retail trade and services. These indices are classified according to the NACE Rev. 2 standard, at the two-digit level of aggregation. The turnover indices for retail trade come from the sts_trtu_q dataset, and for services from sts_setu_q. The original analysis of Shapiro (2022) used four-digit aggregation, which unfortunately is not available for Europe at quarterly frequencies. Retail turnover data are further broken down in several subcategories by type of establishment, allowing us to match turnover indices with price indices at a sufficiently granular level. Note that while Gonçalves and Koester (2022) end up with 45 categories of goods and services for the euro area, Greek data are available in less granular aggregations and our final sample consists of 23 different sectors of goods and services.

The turnover series for both services and retail trade come at quarterly frequency, from the first quarter of 2010 to the third quarter of 2022. The price indices obtained come at monthly frequencies and were converted to quarterly frequencies using period means.

One complication in this analysis was that several of the series used in the exercise were only available in raw format. Seasonal adjustment is crucial in these exercises for horizons different than 12 months. We hence used X13 – Tramo Seats to seasonally and calendar adjust the turnover indices on services and retail trade, as well as the HICP component series.

A final step in the data preparation stage was to deflate the turnover series in order to obtain real consumption measures. The retail trade turnover series collected by Eurostat were already deflated, with the exception of "Sale of motor vehicles", which we instead obtained from the Hellenic Statistical Authority (ELSTAT). The turnover series for services were only available in nominal form and we deflated them using the corresponding HICP component.

5.1 NACE-COICOP MATCHING

In order to implement the framework of Shapiro (2022) on Greek data, we need to link prices and consumption data for each consumption category, which requires consistent measurement of both series. However, a major complication in this study is the fact that the data on prices and quantities are compiled from different sources using different classification systems. Even though both are produced by Eurostat, there exists no official correspondence table between the two datasets. As such, these two sets of data need to be manually matched; given the central role of this aggregation for the results of this paper, in this section we detail the steps taken to achieve this match.

Turnover data are classified according to production, at the sectoral level, using the NACE Rev. 2 classification system. The NACE (Nomenclature of Economic Activities), used by Eurostat to classify economic activities, categorises businesses according to the type of goods and services they produce; this is the most common categorisation of industrial activity in Europe, corresponding to the NAICS classification in the United States and is used in essentially all structural analyses of European economies.

On the other hand, COICOP (Classification of Individual Consumption According to Purpose) is the classification system developed by the United Nations Statistics Division to categorise individual consumption expenditure based on the purpose for which the goods and services were purchased. COICOP is organised on the basis of household expenditure and, hence, consumption; as NACE is organised on the basis of production, matching NACE with COICOP data is not straightforward. The most obvious complication occurs in manufacturing; with few exceptions, final goods are purchased by households through retail establishments and not by the entity that produced the goods. As such, an increase, for instance, in the price index of furniture cannot be easily matched to fluctuations in the consumption of furniture, since our data would only record turnover in retail, and this would need to be sufficiently granular to be useful. On the other hand, production and consumption of services, especially personal services, tend to be close and so this matching is more straightforward.

We manually matched NACE and COICOP data using the crosswalk table of Cai and Vandyck (2020). Throughout this process, we matched some NACE turnover indices one-to-one with the corresponding HICP component, whenever possible. For the most part, however, one turnover series was matched to more than one HICP component, using the appropriate HICP weights. For example, turnover in the retail sale of food and beverages (NACE G47_FOOD) corresponds to the COICOP categories of food goods (CP01.1) and non-alcoholic beverages (CP01.2). All in

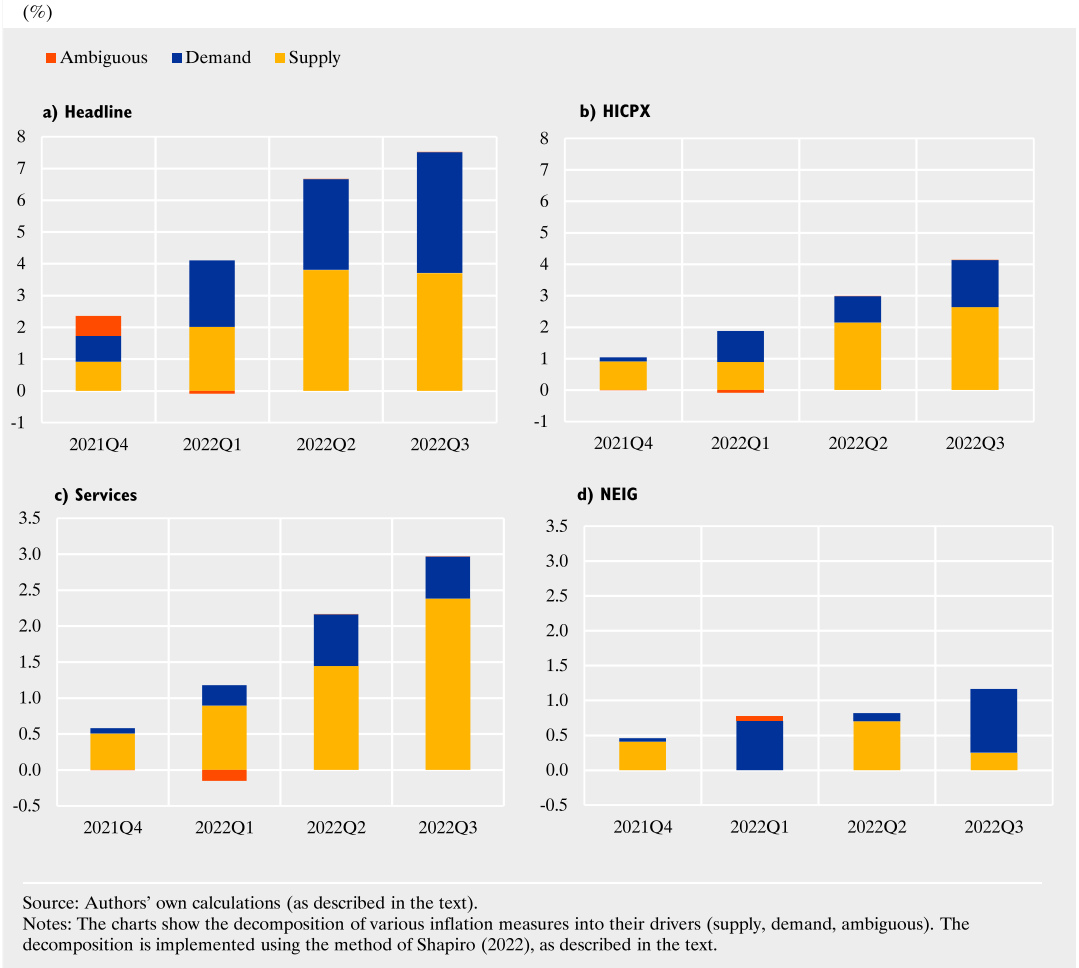
all, we matched fifteen series for services turnover (sts_setu_q) and eight series for retail trade turnover (sts_trtu_q) to forty-one HICP series.

As Gonçalves and Koester (2022) point out, the matching between NACE and COICOP is experimental and unofficial, and, therefore, the results are indicative. This mainly concerns goods, which are usually sold by intermediate retail businesses, and, therefore, production is relatively distant from distribution. The final sample corresponds to about 85% of the total consumer basket, as for some consumption categories there are no turnover indices. These are tobacco, furniture repair, tools and equipment for house and garden, education, health services, some transportation categories, as well as financial services and insurance and social services.

6 RESULTS

We report the results of our decomposition exercises in Chart 2 below. For each quarter, we take all consumption categories classified as having been hit by demand shocks, and calculate the weighted sum of (annual) inflation from these categories. We do the same for those classified as having been hit by supply shocks and those with ambiguous shocks, and plot the contribution of shocks for the given quarter. The sum of these three components

Chart 2 Inflation decomposition (2021-2022)



Source: Authors' own calculations (as described in the text).
Notes: The charts show the decomposition of various inflation measures into their drivers (supply, demand, ambiguous). The decomposition is implemented using the method of Shapiro (2022), as described in the text.

gives the overall annual inflation rate that we can account for (roughly 85% of total, as mentioned above). The yellow part of each bar shows the contribution of supply shocks, the blue part shows the contribution of demand shocks and the red part shows the part that was labeled as ambiguous. We run these exercises for headline, HICPX, services and NEIG inflation.

Beginning with headline inflation, we see that during the early stages of the episode, when inflation was still moderate, individual effects balanced each other out. In the fourth quarter of 2021, there is a notable element of uncertainty. As inflation started to accelerate in 2022, the supply factor became increasingly significant, accounting for 52% of the overall inflation rate. A similar pattern is observed for core inflation, which excludes energy and food items. Supply shocks had an even greater contribution to core inflation, particularly in the second and third quarters of 2022, when inflation reached its highest point in over 20 years. In total, approximately two-thirds of core inflation during these two quarters can be attributed to supply shocks.

We then break down headline inflation into two different categories: services inflation and non-energy industrial goods (NEIG) inflation. Results are shown in Chart 2, panels c) and d). As already discussed, services, in particular, are considered to reflect underlying inflationary pressures, since the main variable cost for services production (other than energy) is labour. Results indicate an even greater role for supply, accounting for around three-fourths of services inflation. On the other hand, results are more mixed and volatile for NEIG inflation, with a large role for demand.

Finally, Chart 3 shows the determinants for the four inflation categories over the period 2001-2019. Consistent with the results of Shapiro (2022) for the United States, the supply shocks dominate over long horizons. During the period leading up to the financial crisis, when the economy is conventionally understood to have been overheated, the role of positive demand shocks in driving inflation, especially for services, was at its largest. This is also consistent with the reduction of real interest rates which accompanied euro accession, a result of the elimination of borrowing spreads within the euro area through the elimination of devaluation and country risk (Alogoskoufis 2019).

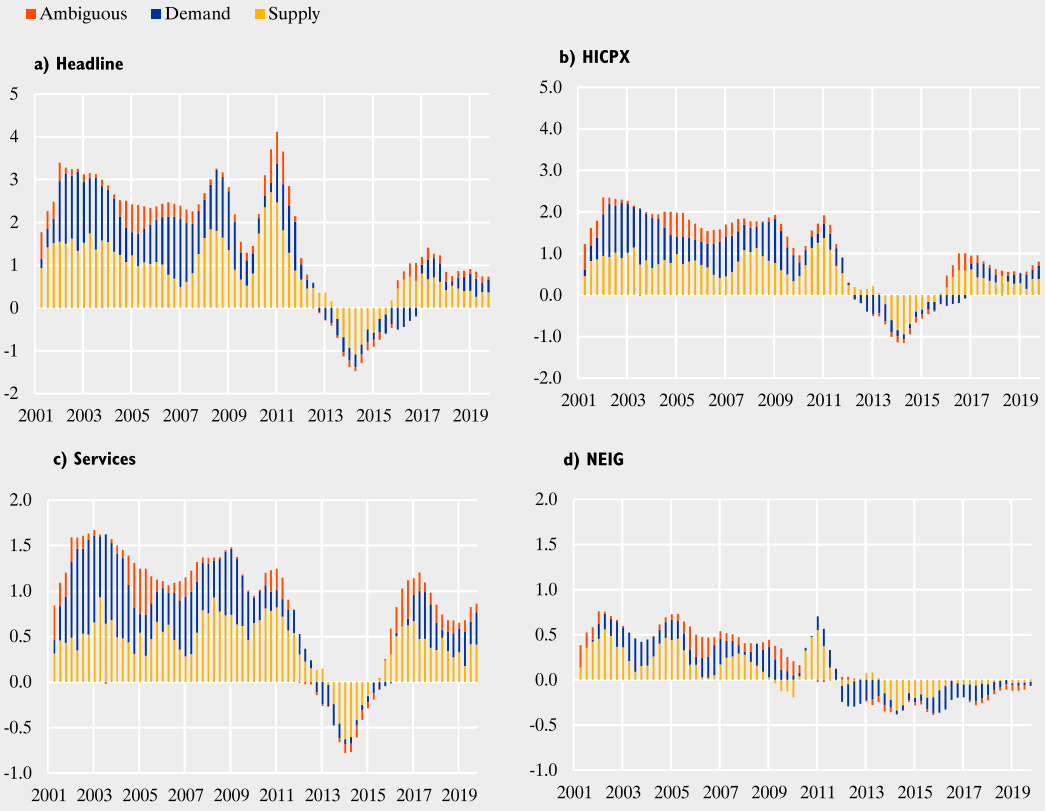
The collapse of inflation started in 2008 and continued with brief interruptions, probably due to a sequence of oil shocks in 2008 and 2010-2011, as can also be surmised by a large and persistent spike of supply shocks. This collapse was also primarily driven by falling demand pressures, which eventually turned negative in 2012 and remained negative until 2016 to rebound once the economy recovered, from 2016 onwards. Supply pressures also turned negative around 2012, possibly as a result of extensive reform programmes undertaken by successive governments. During the interim period, it is interesting that demand shocks are negative for far longer than supply shocks. This may reflect the fact that reform-driven supply shocks are more likely to have level effects on prices.

The most striking difference between longer-term developments and the current episode is in NEIG inflation, which has surged after almost a decade of negative growth. This highlights the exceptional circumstances of this inflation surge.

It is important to note that the model does not take into account shocks to supply and demand in the global economy. This is particularly important for categories of goods with a high import share, such as non-energy industrial goods. Shocks for these goods reflect a combination of domestic demand, domestic distribution costs and international production costs. For example, if there is a global supply shock, but domestic demand is strong, the model is likely to attribute the simultaneous rise in prices and consumption to a demand shock, when in fact domestic demand does not affect prices,

Chart 3 Inflation decomposition (2001-2019)

(%)



Source: Authors' own calculations (as described in the text).
Notes: The charts show the decomposition of various inflation measures into their drivers (supply, demand, ambiguous). The decomposition is implemented using the method of Shapiro (2022), as described in the text.

which are set internationally.[7] Thus, the model has an inherent tendency to overstate the role of demand for imported products.[8]

7 CONCLUSION

The combined pandemic-induced and energy crisis shocks have given rise to intense inflationary pressures, posing a complex challenge for policymakers. A key source of uncertainty stems from the difficulty in distinguishing the relative impacts of demand and supply factors driving this surge in inflation. This paper has used a new framework, based on a simple and transparent identification framework, to dissect Greek inflation and discern the contributions of supply and demand drivers. The results show that both supply and demand shocks have made comparable contributions to headline inflation in the 2021Q4-2022Q4 period, but supply shocks have exerted a notably stronger influence on core inflation, particularly in services. As a result, the primary source of underlying inflationary pressures can be traced back to supply shocks, which unfortunately restricts

7 This is graphically represented by a flat supply curve for the domestic economy, implying that prices depend solely on the supply shock, while consumption depends on both supply and demand shocks.

8 According to the literature, large multinational manufacturing companies apply a similar pricing policy across countries sharing the same currency. See Cavallo et al. (2014).

the effectiveness of monetary policy instruments. Nonetheless, it remains essential for monetary policy to respond promptly to prolonged supply shocks so as to avert the buildup of inflation expectations. The recent interest rate increases implemented by the ECB are a step in the right direction towards addressing this need. The fact that the contribution of supply shocks remains relatively modest is an encouraging indication that disinflation can be achieved without significantly compromising economic activity.

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