I. WHAT'S BEHIND THE SPIKE IN FOOD INFLATION – RECENT DEVELOPMENTS, DRIVERS AND OUTLOOK IN THE EURO AREA

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Abstract*: The chapter discusses the recent surge in euro area food inflation in 2022-23 to a peak of 15.5% in March 2023, which has significantly impacted low-income households. The rise in food inflation, affecting both processed and unprocessed food, has contributed significantly to overall inflation. The dispersion of food inflation across countries increased to unprecedented levels in 2022, with the hardest hit countries being the Baltic countries (Estonia, Latvia and Lithuania), Slovakia and Croatia. This chapter analyses quantitatively the drivers of the recent spike along the pricing chain of food products in two steps. First, an input-output price analysis looks at input costs, wages and operating surplus of the food manufacturing sector comparing it with the output prices of the sector. Second, an econometric analysis looks at how food producer prices and the main inputs and the value added of the distribution sector impacted food consumer price inflation. Thus, the impact of global shocks such as global commodity prices, Russia's war of aggression against Ukraine, global supply bottlenecks are captured through their effects on input prices and value added. The results indicate that the main contributors to the rising costs of the food manufacturing industry were agricultural produce, energy, distribution and packaging costs. Input prices rose faster than output prices until the end of 2021, a development which has however been partly reversed since then. This indicates that current profits are probably compensating for losses in profitability sustained in the previous 1.5 years. Regarding food consumer prices, the rise of 2022-23 was driven mostly by food producer prices, while energy prices and the value added of the distribution sector also played a role. Looking ahead, as past shocks have been priced in and passed through the entire food value chain, food inflation should continue to fall unless there are renewed pressures on input prices or a strong reaction of wages and profits in the food or the distribution sectors.*

I.1. INTRODUCTION

Headline inflation in the euro area reached record levels in autumn last year, peaking at 10.6% in October 2022 before easing to 2.9% in October 2023. The rise was mostly driven by energy prices but was strong in other consumption categories as well. Energy prices started a considerable downward correction in autumn 2022 and contributed negatively to headline inflation in the second half of 2023. This put the focus on other components of inflation which continued to exert upward pressure on prices from that time onwards. One component that has been of particular concern in 2023 is food which accounted for around 40% of headline inflation throughout the period January-October. This is all the more important as food is an important item of households' consumption basket, most notably for low-income households. (2)

This chapter looks at the sudden rise in food inflation in 2022-23 in the euro area with the aim to assess the driving factors behind the spike. The chapter starts with an overview of the recent developments in food inflation. It then looks at the cross-country dispersion of food inflation in the euro area. The last two sub-sections provide the quantitative analysis which is implemented through a two-step approach: first looking at the input and output costs of the food manufacturing industry, and in the second step through an econometric analysis of HICP food inflation. Finally, the chapter presents some concluding remarks.

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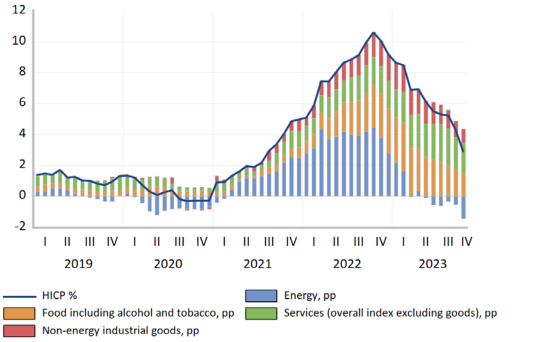
(2) The social consequences of inflation is analysed in Menyhért, B. "Inflation and its diverse social consequences across the euro area", Quarterly Report on the Euro Area, 2023/1.

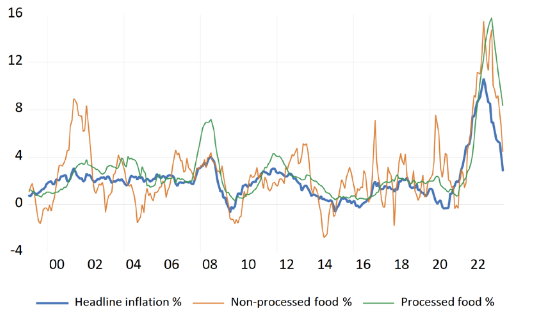
I.2. EVOLUTION OF FOOD INFLATION

Graph I.1: **Contributions of main consumption categories to headline inflation in the euro area**



Source: Eurostat, own calculations.

Graph I.2: **Evolution of headline inflation, and processed food and unprocessed food inflation in the euro area**



Source: Eurostat, own calculations.

Starting from mid-2021, food was making a growing contribution to headline inflation, and that contribution only started to decline in the middle of 2023 (Graph I.1). The rise in food prices affected both processed and unprocessed food and was significant in all euro area countries (3). However, the contribution of food to headline inflation varied from country to country, depending notably on the national food expenditure share (see subsection on cross-country dispersion).

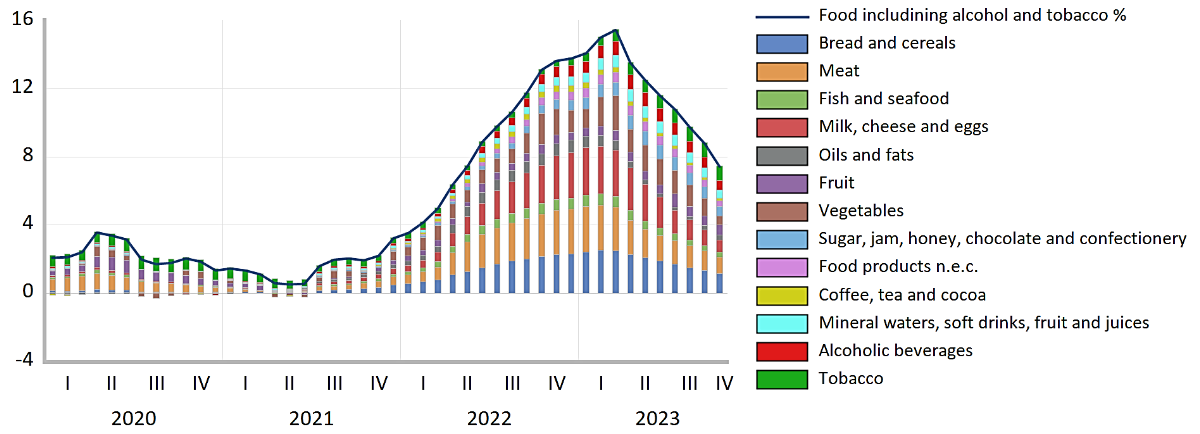
Looking back over the past two decades, the recent spike in food inflation stands out for its unprecedented magnitude (Graph I.1). Food inflation has historically been more volatile than headline inflation, particularly unprocessed food. This is because unprocessed food inflation is influenced more strongly by factors such as commodity price movements, weather patterns etc., and also because of a lower level of processing (4). The recent spike is also exceptional as processed and unprocessed food inflation surged simultaneously (5). Historically, both subgroups have exhibited low inflation persistence and have shown downward corrections relatively quickly following upward spikes; even so, inflation has tended to move more slowly for processed than for unprocessed food. This can also be seen in the inflation out-turns throughout 2023, when unprocessed food inflation showed a much faster fall than processed food. In the past, unprocessed food inflation tended to lead processed food inflation, which points to further downward correction for processed food inflation in the near future.

(3) Processed food made a bigger contribution to headline inflation, reflecting its larger share of the consumption basket.

(4) In terms of product coverage, the distinction between the two groups is not straightforward as the notion of 'processing' is not well defined; however, the lower volatility of processed food inflation is clearly visible.

(5) A potential explanation could be that the post-pandemic supply disruptions and transport bottlenecks affected both processed and unprocessed food alike. Moreover, the energy price shock hit both processed and unprocessed food alike, driving inflation up in 2022.

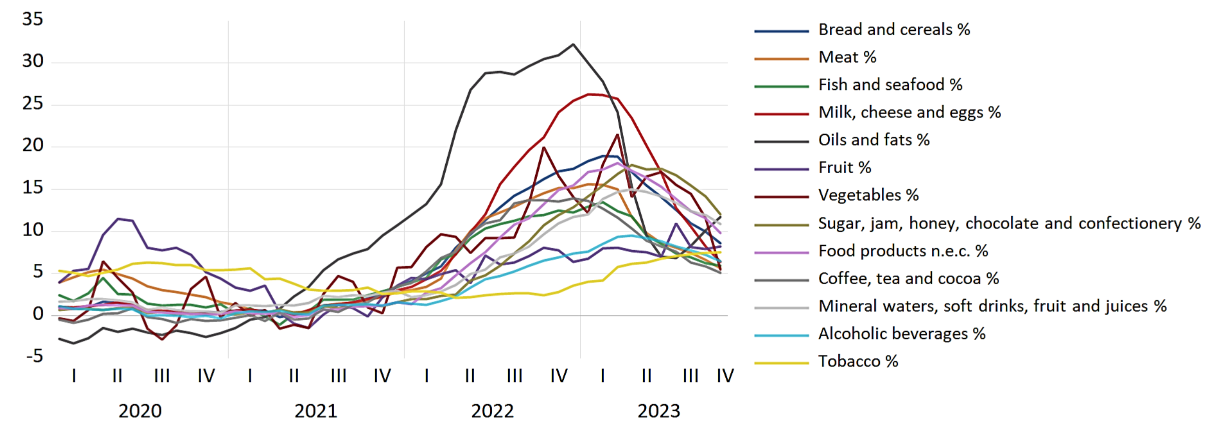
Graph I.3: **Contributions of the various sub-categories to food inflation in the euro area**



Source: Eurostat, own calculations.

Looking at a more detailed breakdown of food inflation, the main contributors to the recent spike in food inflation have been the following: bread and cereals; meat; milk, cheese and eggs; and vegetables (Graph I.3). However, the major contribution of these food categories reflects their weight in the consumption basket rather than their inflation rates. Graph I.3 plots inflation developments for the 13 subgroups making up the food aggregate (including alcohol and tobacco). It shows that all groups saw inflation increases but to differing extents. Inflation increased most for oils and fats, reaching a peak of 32% in December 2022. While the other food categories showed more muted growth, nearly all categories exceeded the path of headline inflation. Alcoholic beverages and tobacco stayed below headline inflation (6); however, these are subject to considerable excise taxation dampening the effect of changes in input prices. More recently, inflation for alcohol and tobacco also exceeded the headline inflation. Overall, this indicates that the surge in food inflation was broad-based across product groups.

Graph I.4: **Inflation developments for the various food sub-categories in the euro area**

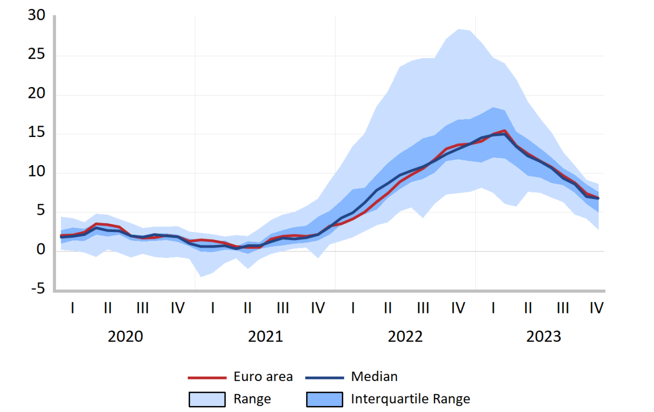


Source: Eurostat, own calculations.

(6) Alcoholic beverages and tobacco are included in the special aggregate of food, alcohol and tobacco in the Eurostat classification, which is usually referred to as food inflation.

I.3. DISPERSION OF FOOD INFLATION ACROSS COUNTRIES IN THE EURO AREA

Graph I.5: **Cross-country dispersion of food inflation in the euro area (% yoy)**



Source: Eurostat, own calculations.

The dispersion of food inflation across euro area countries increased to unprecedented levels in 2022, with a distribution that became strongly skewed upwards. Graph I.5 shows that while in previous years the range across countries (i.e. the gap between the countries with the highest and the lowest inflation rates) was fluctuating around 5 percentage points, it increased to around 20 percentage points at the end of 2022. More recently, the dispersion has been declining, approaching the levels seen before the inflation spike. The hardest hit euro area countries were Estonia, Latvia, Lithuania, Slovakia and Croatia, where cumulative food inflation reached around 32-42% in the past two and a half years. Moreover, there was a noticeable co-movement between the size of the food price shock in the past 2 years and the importance of food in the overall consumption basket (Graph I.6). This implies that the countries that saw the strongest rise in food prices are also the ones with the highest share of food in total inflation. This further increases the contribution of the food price shock to total inflation and to the dispersion of inflation across Member States.

Graph I.6: **Weight of food in HICP (%) and cumulative food inflation between January 2021 and August 2023**

Source: Eurostat, own calculations.

Several factors could explain why these five countries experienced higher food inflation. These include: i) a higher exposure to the energy price shock; ii) lower absolute price levels due to a lower share of non-commodity costs, which imply a higher relative price increase in response to a commodity shock; and iii) a past history of medium to high inflation that could imply a higher sensitivity to external inflation shocks. The importance of a history of comparatively higher inflation is supported by a positive relation across Member States between cumulative past headline HICP inflation in the past two and a half decades and cumulative food inflation in 2021-2023.

An additional explanation relates to distribution costs, which are a major component of intermediate costs in the food sector and in the final consumer prices of food items. The increase of the value-added deflator of the distribution sector was comparatively much higher in the five countries identified above: the peak of the year-on-year deflator was 14-30% in the five countries compared with 8% in the euro area as a whole. Consequently, both unit labour costs and gross operating surplus in the food sector increased faster in the five countries than in the euro area as a whole. This could also be linked to the history of comparatively higher inflation mentioned previously. The importance of wage developments in the cross-country dispersion of food inflation in the euro area is also highlighted by Peersman (2022) even though on a more limited set of countries and excluding the ones with the highest inflation ([7]).

I.4. ANALYSIS OF THE DRIVERS OF FOOD INFLATION

According to econometric estimates published by the IMF on a global sample of countries in 2022 ([8]), cereal prices increase by about 2% after three to four quarters following an oil price shock of 10%. Fertiliser prices are estimated to have a greater effect: a 10% rise in fertiliser prices leads to a 7% rise in cereal prices in the next quarter, but the effect dies out after a year. Finally, a 1-standard deviation negative harvest shock is estimated to increase cereal prices by 23% in the following quarter and the effect seems highly persistent over subsequent quarters. Global food prices are estimated to pass-through to local food price inflation only partially: a 1 percentage point rise in global food commodity prices raises domestic food inflation by about 0.3 percentage points in a time horizon of 10-12 months. The partial pass-through can be explained by the cost share of commodities in final food products, and also by taxes, subsidies, price controls, distribution costs etc.

Peersman (2022) estimates that a 1% rise in international food commodity prices increases euro area headline HICP by 0.08% after eight quarters. This is explained on the one hand by an incomplete pass-through of global commodity prices to EU farmgate prices, and on the other by other factors such as an impact on wages and the exchange rate. This research also estimates that, historically, global food commodity prices explain almost 30% of euro area inflation volatility over the medium term.

Looking at the recent data, the spike in food inflation was preceded by a rise in many important inputs to the food industry. Graph I.7 shows that global commodity prices, such as energy, fertilisers and food, started increasing already in early 2021. Fertilisers saw the sharpest spike with prices rising by 300% by April 2022. The main drivers behind food, energy and fertiliser prices were the post-pandemic recovery (supply chain and transport bottlenecks amid a recovery of demand) and Russia's war of aggression against Ukraine ([9]). While fertiliser prices have fallen significantly since their peak, they are still more than twice as high as at the outset of the pandemic. Energy and (global) food commodity prices showed a less sharp increase, but their peaks exceeded their levels of early 2020 by 130% and 70%, respectively ([10]). Following a downward correction in recent months, they are still about 30-40% above their pre-pandemic levels. Adverse weather conditions also played a role; an extreme drought took place in 2022 in Europe and many other parts of the world, influencing food commodity prices. The drought coincided with the energy and fertiliser price shock in 2022, increasing their effect on food commodity prices.

Movements in global commodity prices (measured in USD) were further amplified by changes in the nominal exchange rate of the euro against the dollar. From the beginning of 2021 until mid-2022, the euro weakened by about 20% (although this followed a year of strengthening of around 10% in 2020). As of mid-2022, the euro appreciated by about 10% at the same time when energy and fertiliser prices also eased.

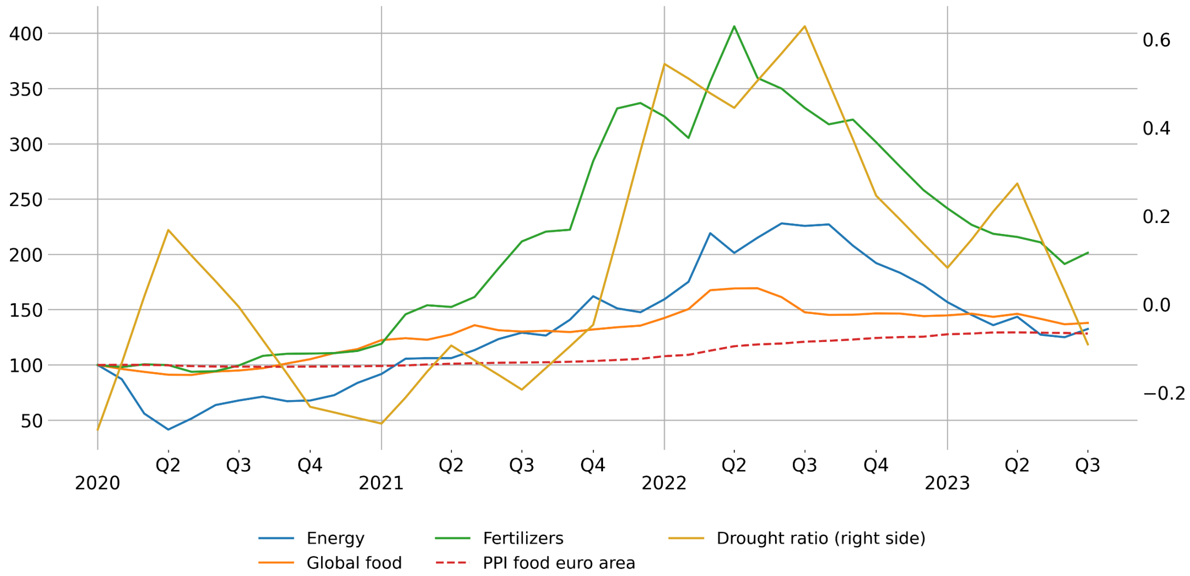
([7]) Peersman, G. (2022), 'International food commodity prices and missing (dis)inflation in the euro area', The Review of Economics and Statistics, January 2022, 104(1).

([8]) IMF World Economic Outlook, October 2022.

([9]) For a discussion on the impact of the war on food inflation in the euro area, see Bodnár, K. and Schuler T. 'The surge in euro area food inflation and the impact of the Russia-Ukraine war, ECB Economic Bulletin, Issue 4/2022.

([10]) Energy prices affect food inflation through several channels. Firstly, petroleum products are used as fuel for agricultural machinery and transportation, while gas is the main input for nitrogen-based fertilisers. Secondly, some agricultural commodities, in particular certain cereals, are used as biofuels.

Graph I.7: **Global commodity price index, euro area drought ratio and food PPI 2020-2023 (2020 January = 100)**



The drought ratio is defined as the ratio between the recorded drought values (% of euro area land in a state of drought alert, warning or watch under the Combined Drought Indicator of the European Drought Observatory (11)) and its quarterly average observed in the period 2012-2023 normalised to zero.

Source: World Bank, Eurostat, JRC European Drought Observatory, own calculations.

The subsections that follow undertake a quantitative assessment of the drivers behind the 2021-2023 spike in food consumer inflation. This is done through a price chain analysis consisting of two steps. In the first step, an input-output price analysis is carried out for the food manufacturing sector (food, beverages and tobacco), using price indices for producer prices of intermediate products to the food industry (PPIs of industries, services and agricultural output prices) and wages. This sheds light on how the prices of inputs and wages evolved in the food manufacturing sector between 2019 and 2023. The evolution of input costs is then compared with that of producer prices in the food manufacturing sector, which is the price of the output of this sector. This gives an indication about which inputs were the main drivers in the increase in costs and also sheds light on how the profitability of the sector developed over this period. In the second step, an econometric analysis is performed to explore how final consumer prices of food (HICP) were affected by the PPI of the food manufacturing industry, agricultural output prices, food and agricultural imports, and other factors such as energy, distribution margins and taxes.

I.4.1. From farm to factory: input and output prices of the food manufacturing industry

An analysis of input-output tables can shed light on the importance of the various inputs used by the sector and also on the respective roles of wages and profits (12). As can be seen in Table I.1, the largest input for the production of food, beverages and tobacco are the products of agriculture (26% of the output of the food sector) (13). Altogether, services are also important and account for 28% of the

(11) For more details on the Combined Drought Indicator, see: factsheet_combinedDroughtIndicator.pdf (europa.eu).

(12) This analysis is based on the input-output table for the year 2019. The latest available input-output table in ESTAT refers to 2020, but data in that year was highly influenced by the break-out of the COVID-19 pandemic, and therefore does not represent a reliable basis for analysis.

(13) Self-consumption (i.e. the use of food manufacturing outputs within the same sector) is not shown separately in the table, as it has been proportionally reallocated across other sectors to ensure a more accurate representation of sectoral input distribution.

output. Of this, land transport, and warehousing and transport support services make up a combined 5% of output. Transport is an intensive user of both energy and labour, whereas the other services are highly labour intensive. Distributive trade (wholesale and retail services) makes up 12% of output. Sectors that can be linked to packaging are also important with rubber, plastic, paper, chemical and metal products reaching a combined share of about 6% of output. Interestingly, electricity, gas, steam and air conditioning only account, directly, for about 1.7% of output, and coke and refined petroleum products for only 0.2% (14).

Table I.1: **Share of direct inputs used for the production of food, beverages and tobacco in the euro area**

Product input used for producing food, beverages and tobacco	Share in output
Products of agriculture, hunting and related services	26%
Wholesale trade services, except of motor vehicles and motorcycles	9%
Packaging related (rubber, plastic, paper, chemical and metal products)	6%
Retail trade services, except of motor vehicles and motorcycles	3%
Land transport services and transport services via pipelines	3%
Warehousing and support services for transportation	2%
Legal and accounting services; of head offices; management consultancy	3%
Advertising and market research services	2%
Electricity, gas, steam and air conditioning	2%
Employment services	1%
Financial services, except insurance and pension funding	1%
Other (including taxes less subsidies)	13%
Value added, gross	29%
of which: Compensation of employees	18%

Based on the symmetric, product by product, input-output table for the euro area for the year 2019.

Source: Eurostat, own calculations.

Graph I.8 indicates a notable trend during the early phase of the post-pandemic recovery in 2021, where input prices increased more rapidly than output prices. Specifically, the final quarter of 2021 witnessed input prices surging by 10.5% compared with the start of 2020, in contrast to the more modest 5.4% rise in cumulative output prices over the same time frame. However, this dynamic started shifting at the end of 2021. Output prices began to grow more steadily, initially catching up with and then exceeding input prices. Between Q4 2021 and Q2 2023, output prices grew by 23%, compared with a 14% increase in input prices, marking a recovery in producer profit margins in the post-pandemic period. Over 2021-2022, the rise in the price of inputs was primarily driven by the agriculture, energy, transport and distribution sectors, but packaging-related inputs were also important. Agricultural prices reflect the changes in both commodities and energy prices, while the energy sector clearly had an impact on the inputs of all other sectors as well. Transport and logistics was also affected by the global transport bottlenecks in 2021-2022. The fall in input costs from mid-2022 was driven by agriculture and energy, but was also observable in other sectors. The contribution from wages of the food sector was modest during 2021-2022, but picked up somewhat in 2023 in line with overall wage developments.

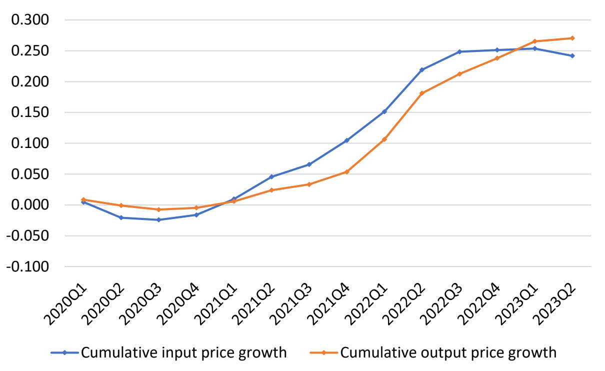
([14]) Energy, however, also has important indirect effects that are not quantified here.

Box I.1: **Methodological framework for the input-output price analysis of the food manufacturing sector in the euro area**

This box explains how the evolution of unitary costs and margins in the food sector is computed at the quarterly frequency since the beginning of 2020. Eurostat provides input-output ('I-O') tables at the yearly frequency at the end of year t+2. It is therefore necessary to combine existing price data with existing I-O tables to project the evolution of costs and prices. The box explains in detail how those projections are made here.

The food column (CPA_C10-12 – Manufacture of food products, beverages and tobacco, hereinafter food manufacturing) of the 2019 Eurostat I-O table with the product-by-product breakdown for the euro area in 2019 ([1]) is the starting point of the analysis. This contains a breakdown of domestic and imported intermediate inputs into 64 CPA categories ([2]) , as well as value-added components, all quantified in euro, used in the production of food manufacturing.

Graph 1: **Input and Output Price Evolution**



Under the assumption of a constant production structure ([3]), the evolution of unitary costs is equal to the evolution of input price deflators from Q1 2020 up to Q2 2023 weighed using the shares ([4]) of the corresponding production components. Input price deflators for intermediate inputs were computed as q-o-q growth rates of quarterly producer price index (PPI) data of the corresponding category for the euro area by Eurostat from 2019 to Q2 2023 ([5]). Specifically, for agricultural goods (CPA_A01), which are a main input to food manufacturing, q-o-q growth rates were computed from a weighted average of the price index of animal products and the one of agricultural products. For services sectors for which price data were not available, the average inflation of services was used. A similar approach was implemented for compensation of employees ([6]), i.e. q-o-q growth rates were computed based on the gross wage index of the whole manufacturing sector. Taxes less subsidies were assumed to remain constant throughout the duration of the period analysed.

Therefore, total input price growth is calculated as the weighted average of price deflators for intermediate inputs and compensation of employees using as weights the coefficients of the I-O table of 2019. The growth rate of Eurostat PPI for the food manufacturing sector serves as a measure of output price changes, and therefore as a proxy for the increase in unitary revenues. Graph 1 shows the

(1) The year 2019 was selected as the baseline, despite 2020 being the latest available year at the time of analysis, to prevent the distortion effects of COVID-19 in subsequent years' estimates. The 2019 euro area I-O table is available at: Statistics | Eurostat (europa.eu).

(2) Classification of products by activity, version 2.1.

(3) This assumption means that the ratio of intermediate and labour cost to output are kept constant, as if they were production coefficients of a Leontief production function.The shares of the 64 production components over the total output of food manufacturing have been stable in the past, although recent structural shocks (COVID-19, Ukraine-Russia war, energy price shocks) could have had an impact.

(4) The self-consumption share (i.e. food production share) has been proportionally reallocated to the other sectors/value-added components.

(5) For imported intermediate goods the price deflator was computed as q-o-q (Comext). The unit price for the relevant goods was found by employing quarterly trade quantities and values for euro area imported goods. These were then allocated to corresponding CPA categories. For imported services, lacking similar data, the domestic services' PPI values were applied.database on international trade in goods (Comext). The unit price for the relevant goods was found by employing quarterly trade quantities and values for euro area imported goods. These were then allocated to corresponding CPA categories. For imported services, lacking similar data, the domestic services' PPI values were applied.

(6) This component was corrected to include self-employment.

(Continued on the next page)

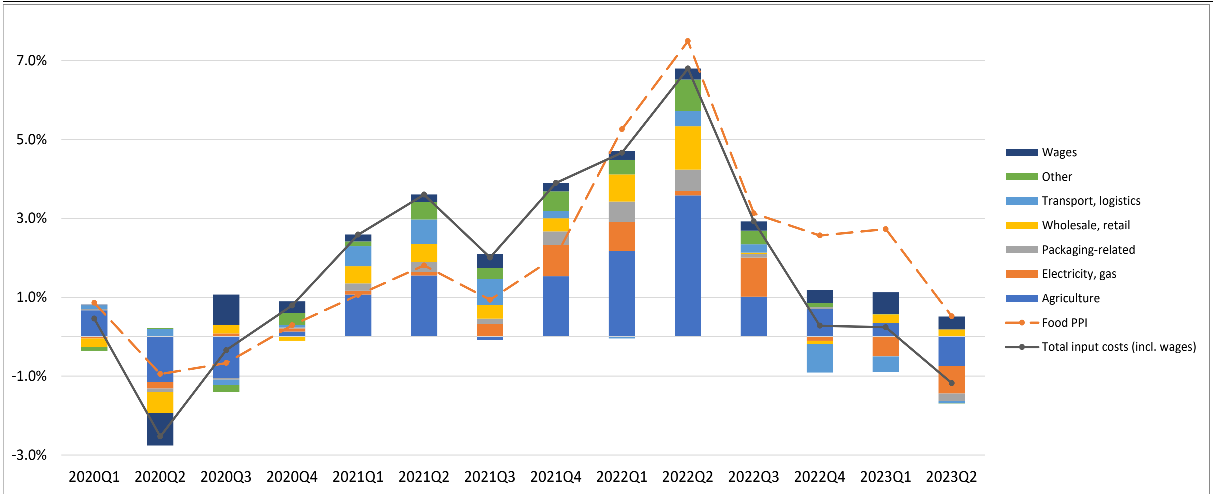
Box (continued)

evolution of unitary input and output prices, assuming an arbitrary starting level of 0 at Q1 2020. The early post-pandemic recovery phase of 2021 showed a faster rise in input prices than output prices, pointing to deteriorating margins at the sectoral level in the euro area. This later reversed as input prices increased more steadily for seven quarters, pointing to some cumulative reduction in margins until the end of 2022. The cumulative output price growth overtook that of input costs only in Q1 2023, since when prices have remained more stable.

In the first half of 2023, the only positive contributions to input costs came from a moderate rise in food sector wages and in the price of wholesale and retail sector inputs, likely because the latter are also sensitive to wage developments. On the other hand, decreasing agricultural and energy prices acted to counterbalance these increases, ultimately leading to a significant decrease in the food PPI.

Overall, the analysis indicates that the food sector saw its input costs increasing faster than its output prices until the end of 2021, which implies worsening profitability on the unit level. This reversed itself as of the beginning of 2022, when profitability started improving. This indicates that current profit increases are probably compensating for the losses in profitability sustained in the previous 18 months.

Graph I.8: **Changes in food PPI and input costs (including labour) of food manufacturing in the euro area (quarter-on-quarter growth rates)**



(1) To compute the costs of intermediate inputs, price indices (PPIs, service PPIs, and agricultural output prices) are weighted by their respective shares in the input-output table for 2019. A constant production structure is assumed over the time horizon of the analysis, which is consistent with the stability observed in past input-output data. The contributions of sectors are based on the calculated direct effects. Self-consumption of the food manufacturing sector is reallocated to all other items proportionally.

Source: Own calculations based on Eurostat data.

I.4.2. From factory and farm to consumers: drivers of the final consumer prices (HICP)

In the second step, an econometric estimation is carried out regressing HICP food inflation (food including alcohol and tobacco at constant tax rates) in the euro area on producer price index of the food manufacturing sector (food, beverages and tobacco); PPI of electricity and gas (PPI energy); and unit labour cost and unit gross operating surplus in the distribution sector as a proxy for non-energy distribution costs (15); price indices for imported processed food; and both domestic and imported

(15) The distribution sector is approximated with NACE G-I, i.e. wholesale and retail trade, transport, accommodation and food services, for which data is available in the sectoral national accounts. This is wider than food distribution, and it

agricultural products (goods and animals). The estimation is implemented through autoregressive distributed lag regressions (ARDL) including also a long-run cointegrating relationship.

The rationale for the choice of regressors follows the main drivers of food consumer prices along the pricing chain. Producer prices of processed food from the food manufacturing sector are a key input to final food products delivered to consumers. So too are unprocessed food products, some of which are sourced by the distribution sector directly from agricultural producers, i.e. not only from the food manufacturing sector. Furthermore, imports of both processed food and agricultural products can also be important ([16]). Finally, these goods are brought to consumers by the distribution sector, whose role is captured on the one hand by the value added of the distribution sector, split into unit labour cost and unit gross operating surplus. Regarding the input costs of the distribution sector, energy is captured by electricity and gas PPI, while other input costs (including fuel, services such as warehousing, legal, and advertising) did not produce significant estimates. Finally, the output price of the distribution (retail) sector is the consumer price index, which is measured here by the HICP.

Simple pairwise correlations indicate high comovement between food HICP and food PPI as expected, with a correlation coefficient of 75%. The value added of the distribution sector is also highly correlated with food HICP (60%), while the other regressors show a relatively lower correlation with food consumer inflation. There is a moderately strong correlation between energy and food PPI, and energy and agricultural imports, and also among domestic and imported agricultural products and processed food imports. As the agri-food variables are cross-correlated with each other and with food PPI and also energy, this could potentially cause multicollinearity issues in the estimation.

Table I.2 shows the estimated long-run cointegrating relations of the drivers of food HICP inflation in the euro area from the ARDL regressions. Food PPI shows a strongly significant estimated coefficient in all specifications. The coefficient is 0.8 when food PPI is the only regressor, but in the other equations it varies between 0.34-0.49 which indicates the importance of controlling for other factors. The results imply that a 1 percentage point increase in food PPI is estimated to lead to around one third to half a percentage point increase in consumer HICP food inflation. Unit labour costs of the distribution sector are also strongly significant and are estimated to have a multiplier of 0.23-0.46, while unit gross operating surplus of the sector is estimated between 0.07-0.13, also strongly significant throughout. The size of the sum of these two effects is comparable to that of food PPI; it underlines the importance of the distribution sector as a driver of consumer food inflation. Electricity and gas PPI is also significant in many specifications, but the effect is much smaller, around 0.02-0.09. The energy variable loses its significance when prices indices for agricultural goods and animals are also included. However, the estimated effects of these agricultural variables (domestic and imported agricultural goods and animals) have the wrong sign as they are slightly negative and are likely affected by the instability caused by multicollinearity. Separate estimations were also carried out using as regressors food PPI and imported processed food and domestic and imported agricultural produce (i.e. without energy and the distribution sector). However, all the variables in these were close to zero and not significant with the exception of PPI food, which was strongly significant. Imported processed food is either non-significant or only significant when the agricultural variables are added but have the wrong sign indicating multicollinearity. All in all, the data does not indicate a strong direct role for either agricultural produce (both domestic and imports) or imported processed food in the evolution of consumer food inflation beyond their impact through the food manufacturing sector that is captured by food PPI.

can possibly be impacted by extraordinary developments of the energy wholesale and energy retail sectors in the period 2021-2022. Therefore, caution is necessary when interpreting the results.

([16]) Note, however, that the first step of the analysis showed that including or excluding imports did not have a noticeable impact on the costs of the food manufacturing sector, indicating a lesser importance of imports for this sector when looking at prices on an aggregate level. Here, the aim of the analysis is to see if imports have a more significant impact on consumer prices, as distribution companies can also buy food directly from agricultural producers or from abroad.

Table I.2: **Long-run cointegrating relation of the drivers of food HICP inflation in the euro area**

Dependent variable: food HICP inflation at constant taxes	1	2	3	4	5	6	7	8
food PPI	0.8***	0.34***	0.49***	0.37***	0.47***	0.38***	0.39***	0.39***
	(0.19)	(0.07)	(0.06)	(0.07)	(0.04)	(0.04)	(0.04)	(0.02)
electricity, gas PPI		0.09***		0.03***	0.02	0.03*	0.02	-0.01
		(0.02)		(0.01)	(0.01)	(0.01)	(0.02)	(0.01)
unit labour cost, distribution sector			0.46***	0.32***	0.35***	0.30***	0.25***	0.23***
			(0.09)	(0.07)	(0.11)	(0.07)	(0.06)	(0.04)
unit gross operating surplus, distribution sector			0.13***	0.10***	0.10**	0.11**	0.07**	0.07***
			(0.03)	(0.03)	(0.05)	(0.03)	(0.03)	(0.02)
imported processed food price index						0.01	0.06**	0.11***
						(0.01)	(0.03)	(0.02)
domestic agricultural goods and animals price index							-0.03**	-0.01*
							(0.01)	(0.01)
imported agricultural goods and animals price index								-0.04***
								(0.01)
Maximum lags: dependent variable, regressors	6, 6	6, 6	6, 6	6, 6	1, 6	6, 6	6, 6	6, 6

(1) ARDL specification chosen by Akaike information criterion. Quarterly, seasonally adjusted data in logarithmic differences are used in the estimations; time horizon: Q1 2005-Q2 2023; number of observations: 70-73 depending on lag specification. *, **, *** show significance at 10%, 5% and 1% level respectively. Standard errors in parentheses.

Source: Own calculations based on Eurostat data.

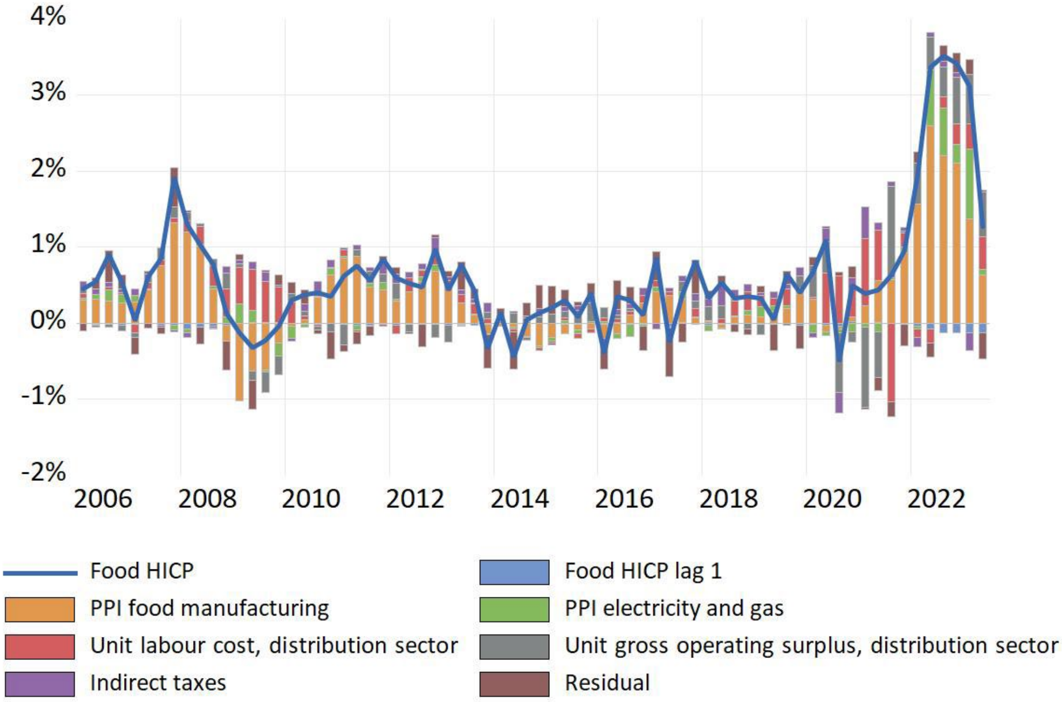
The ARDL estimation also enables an error correction modelling approach, which shows the speed of adjustment back to the long-run relationship following a shock. The estimated coefficients for the speed of adjustment are all negative (as expected, as this ensures the stability of the system) and significant. In equation 1, the speed of adjustment is 0.4, meaning a rather slow adjustment, while in equations 2, 3 and 5 they are close to 1. The latter means that the system converges back to the long-run equilibrium within 1 quarter. In equations 4, 6, 7 and 8, the speed of adjustment is greater than 1, though it is often found in the literature that this coefficient is sensitive to the number of lags included in the estimation. The estimated cumulative dynamic multipliers reach their maxima at around quarters 2-4 in most equations.

The estimated ARDL equations can also be used to decompose the historical evolution of food HICP into contributions implied by the estimated equation. For that purpose, the specification of equations 4 and 5 are chosen, and among these, equation 5 is used for the decomposition. In equation 5, the lag of the dependent variable is restricted to 1, which is a standard approach in the literature, and it implies that most of the dynamics take place in the explanatory variables ([17]). Graph I.9 shows the historical decomposition from equation 5. The model generally captures the evolution of food HICP well, and in particular the recent food price shock is shown with only modest estimation residuals. The decomposition indicates that the food HICP inflation spike started off in late 2021 on the back of increasing food PPI, which was coupled with the energy price shock as of Q2 2022. From Q1 2022, profits of the distribution sector started to play an increasing role which continued up until the end of the sample in Q2 2023. The contribution of unit labour costs of the distribution sector started building up

([17]) Equations 1-3 are subject to omitted variable bias, while equations 6-8 show problems of multicollinearity. A decomposition based on equation 4 shows an important role for the lagged dependent variable and a somewhat larger role for the energy PPI. However, the qualitative conclusions are similar to the decomposition using equation 5.

gradually as of Q3 2022 ([18]). Unit gross operating surplus of the distribution sector made a major and rather stable contribution throughout 2022 to mid-2023. The observed fall in food HICP inflation in 2023 is mostly explained with declining PPI inflation in the food and energy sectors, which implies that profits and wages are becoming a more important driver of food inflation. This highlights the importance that profits and wages will play in ensuring that food inflation returns to the low levels observed before the shock of 2022-2023.

Graph I.9: **Historical decomposition of the food HICP inflation in the euro area (Q1 2006 – Q2 2023)**



(1) Quarter-on-quarter seasonally adjusted data. Food HICP is normalised with the estimated constant to zero. Food HICP here includes indirect taxes. Taxes are not included in the econometric estimation; their contribution here is calculated directly as the difference between the two variants of food HICP: i.e. including and excluding taxes.

Source: Own calculations based on Eurostat data.

I.5. CONCLUSION

The recent spike in food inflation stands out compared with the developments registered over the last two decades, with food inflation having reached a peak of 15.5% in March 2023. The increase has been observed across all euro area countries, although the magnitude of the shock varies greatly. The rise in food inflation has contributed significantly to inflation, with both processed and unprocessed food being affected.

The main items accounting for the recent spike in food inflation are bread and cereals, meat, milk, cheese and eggs, and vegetables, but this is partly due to their relatively high shares in the overall

([18]) The large movements in gross operating surplus and unit labour costs in 2020-2021 should be looked at with caution as these were strongly affected by the COVID pandemic and related government measures.

consumption basket. Nearly all product groups showed inflation rates above headline inflation, indicating that the surge in food inflation was general across various food items. Only tobacco, alcoholic beverages and fruits stayed below headline inflation during the spike, though the first two are subject to high levels of excise taxation, which dampens the effect of input prices.

The dispersion of food inflation among euro area countries has reached unprecedented levels, with some countries experiencing a cumulative food price increase of around 32-42% in the past 2 years. In addition, countries with the highest food price shocks, such as Estonia, Latvia, Lithuania, Slovakia and Croatia, also tend to have the highest share of food in the overall consumption basket. This worsens the impact of the price shock on their cost of living. Several factors could explain why these five countries experienced higher food inflation. These include: i) a higher exposure to the energy price shock; ii) lower absolute price levels due to a lower share of non-commodity costs, implying a higher relative price increase in response to a commodity shock; and iii) a past history of medium to high inflation that could imply a higher sensitivity to external inflation shocks. In addition, the value-added deflator of the distribution sector – which is shown to be a major driver of food consumer prices – increased much more strongly (up to 3.5 times faster) in these countries than the average of the euro area.

Various factors have driven the increase in food inflation, including global commodity price movements due to supply bottlenecks and more lately Russia's military aggression against Ukraine, and also weather conditions. Commodity prices such as energy, fertilisers, and food have been on the rise since early 2021. Climate change and extreme weather events, in particular droughts, have also affected agricultural production, adding to the volatility of food inflation through food commodity prices. While commodity prices have shown a sizeable correction recently, they are still at elevated levels. This suggests that food price levels may also stay elevated, posing continued challenges in terms of cost of living, particularly for low-income consumers. Furthermore, profit and wages in both the food and distribution sectors have picked up in the last 2 years, further driving up consumer prices.

A quantitative analysis based on input-output data indicates that the food manufacturing sector saw its input costs increasing faster than its output prices up until the end of 2021, which implied a worsening of profit margins over that period. However, profit margins started to recover as of the beginning of 2022. This indicates that current profits are probably compensating for losses in profitability sustained in the previous 18 months. The main contributors to rising costs were agricultural produce, energy, distribution, and packaging costs. As these price pressures eased and some even turned negative in 2023, overall input prices also fell despite a moderate pickup in wages.

The second step of the quantitative analysis shows that food manufacturing PPI and the value-added deflator of the distribution sector (decomposed into unit labour cost and unit gross operating surplus) are the most important drivers of food consumer inflation in the euro area. Electricity and gas PPI also have a small but significant multiplier, most likely through the energy use of the distribution sector. Agricultural produce and food imports do not show significant coefficient estimates, indicating their lower importance in the final consumer prices once the other factors are controlled for ([19]). The main driver of the pickup in food HICP inflation in 2022 was the food manufacturing PPI. Due to the size of the energy price shock, there was also a substantial impact of electricity and gas inflation on food inflation that year. The unit gross operating surplus of the distribution sector also contributed significantly to food inflation in 2022-2023, while unit labour costs started to play an increasing role as of the end of 2022.

As the past shocks were priced in and passed through the entire food value chain, food inflation started falling quickly in 2023. In the absence of renewed pressures on input prices, and if wages and profits stay in line with price stability, disinflation should continue and food inflation should return to historically observed low levels. However, climate change-induced weather volatility, a worsening of the geopolitical

([19]) However, agriculture and food imports do have an important role on the food manufacturing sector and this is taken into account in the estimation through the PPI of food manufacturing.

situation, potential disruptions in global commodity markets, or excessive growth in wages or profits could pose ongoing challenges to food inflation in the future.