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Shockflation in the EU: sectoral shocks, cost-push inflation and structural asymmetries in core and periphery countries

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Shockflation in the EU: sectoral shocks, cost-push inflation and structural asymmetries in core and periphery countries

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Abstract

The return of inflation in Western economies has fueled the debate on its main drivers, bringing sector-specific shocks and supply chain bottlenecks to the forefront. Building on the seminal approach of Weber et al. (2024), this paper develops a method to assess the degree of exposure to these shocks in EU countries. Using inter-country input-output data stemming from the FIGARO database, we identify systemically significant sectors in four regions within the EU: Core, Southern Periphery, Eastern Periphery, and financial hubs. We also analyze exposure to foreign shocks. Two main conclusions can be drawn: on the one hand, periphery countries are more exposed to shocks originating in the EU core than the other way around; on the other hand, all EU regions are considerably exposed to price shocks originating from non-EU countries (namely, Russia and China). The strategic dependencies of the block pose challenges for price stability and require targeted policies.

Keywords: Inflation, Supply chain shocks, Input-Output, Core-periphery

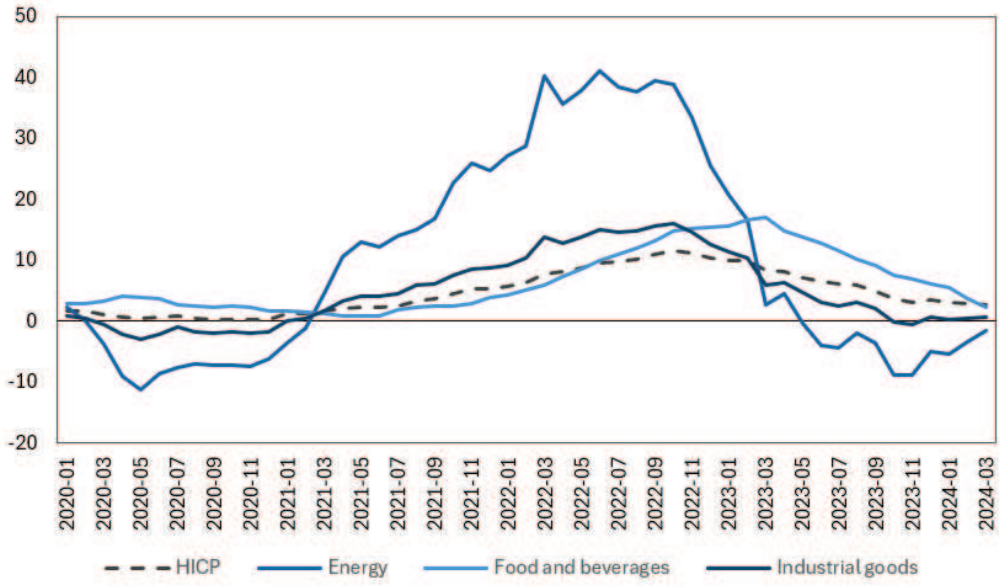
JEL codes: C67, E31, E61

1. Introduction

Inflation has been the subject of hot debate among economists for several decades. Over the last three years, inflation in the Euro Area (EA) has reached double digits for the first time since the introduction of the euro. Inflationary pressures began building up in 2021, as most countries' economic activity gradually returned to normality. In 2022, with the onset of the war in Ukraine, the annual inflation rate in the Euro Area reached 8,4%, well above the 2% target set by the European Central Bank (ECB). The inflation rate remained above this target in 2023 but has consistently decreased, nearing the 2% target by the first half of 2024. While the rise and fall of inflation co-occurred across the European Union (EU), there were differences between member states.

The significant increase in the general price level has brought the debate on the causes and consequences of inflation back to the forefront. Some authors lend support to the canonical 'demand-pull' explanation, blaming excessive aggregate demand as the root cause of inflation and stressing the role played by public authorities in pursuing expansionary fiscal and monetary policies, which, according to this view, turned out to over-stimulate the economy following the COVID-19 pandemic (Blanchard and Bernanke, 2023; Reis, 2022; Gagliardone and Gertler, 2023). Other authors, in turn, argue in favour of a 'cost-push' explanation, focusing on pivotal sectors/goods responsible for spreading inflation throughout the economy (Vernengo and Caldentey, 2023; Stiglitz and Regmi, 2023). An explanation gaining popularity as it seems to be reflected in the data: almost everywhere, rising energy prices and bottlenecks in key supply chains (e.g., semiconductors) have been the prelude to a rapidly growing inflation.

Figure 1. Total inflation and price variations in selected categories in EU countries



Source: Eurostat and own elaboration

The COVID-19 pandemic and the Russia-Ukraine war have shown that sectoral shocks can significantly impact the overall price level. As Covid-19 started spreading, the fragmented and 'weaponizable' nature of key supply chains (e.g., pharmaceuticals, medical devices) translated into (asymmetric) shortages of essential goods and, hence, rising prices. Likewise, when the war stepped in, a large number of EU countries faced skyrocketing energy prices, as their main gas supplier (i.e., Russia) started threatening to cut off supplies while alternatives (e.g., LNG) proved to be significantly more expensive (Guarascio et al., 2024a). In fact, as sectoral interdependences become more complex and ramified, economies may develop sector-specific vulnerabilities, which can result in sudden inflation, among other things. The more critical and interconnected the sectors driving the price shock – particularly those supplying key raw materials and intermediate goods – the more intense and persistent inflation will be.

In the context of weaponized interdependencies and as inflation becomes (again) a key economic policy concern, understanding critical sectors' role in spreading price shocks becomes crucial for appropriately designing policies. Yet, while a rather detailed evidence has been provided on the role of critical sectors contributing to the spread of inflation in the US, further research is needed regarding the EU case. This paper's goal is to contribute to this literature gap by providing two key contributions. First, identifying the main sectoral drivers of inflation in EU countries, as well as the underlying reasons for the relevance of such sectors for inflation dynamics and the channels through which these price shocks are transmitted to the rest of the economy. Secondly, it highlights the differences between the EU core and peripheries, while recognizing their structural differences. The paper is inspired by the approach of Weber et al. (2024), who define "systemically significant" sectors as "industries that have the greatest total inflation impact and are as such systemically significant for price stability" (pp. 2).

Methodologically, we rely on an input-output (I-O) approach. It consists of simulating price shocks in specific sectors to assess how they reverberate throughout the economy and translate into changes in each country's general price level, taking into account not only its direct impact on the Consumer Price Index (CPI) but also its indirect impact through intersectoral linkages. We employ our methodology in all EU countries using 2019 I-O tables and sectoral price data for the period between 2000 and 2019. Moreover, taking advantage of inter-country I-O tables, we capture how price shocks originating in a specific sector are transmitted not only to domestic industries but also to foreign ones. In this way, we can test whether well-documented core-periphery relationships, so far mostly studied in terms of competitiveness differentials (Celi et al., 2022), are also reflected in the heterogeneous degree of vulnerability of EU economies to external sectoral shocks that can fuel inflation at home.

To analyse inflation dynamics in the EU, we adopt a core-periphery approach (Celi et al., 2018; Grabner et al., 2020), which consists of distinguishing EU countries based on their level of economic development and on the sectoral composition of the economy. Core countries – namely, those located in the centre and northern regions – have stronger productive and technological capabilities and are characterized by higher levels of GDP per capita, relatively lower levels of unemployment, a larger industrial base, and greater product sophistication when compared to the (Southern) periphery (SP). On the other hand, the Eastern periphery (EP) (including the Visegrad countries that are part of the 'German manufacturing core') has significantly strengthened its manufacturing base, becoming the leading supplier of intermediate goods to the German export industry. However, the EP has also increased its economic dependency vis-à-vis the core, including its energy supply chain, potentially increasing its vulnerability in the event of external shocks.

The rest of the paper is structured as follows: section 2 presents the theoretical framework, namely, the role of sectoral supply shocks in inflation dynamics and the EU's core-periphery structure; section 3 outlines the data and the methodology used to assess the impact of sectoral price shocks in EU economies; section 4 presents the results of the empirical analysis and a discussion of the key findings and implications for public policy; finally, section 5 offers some concluding remarks.

2. Inflation in the EU: the role of sectoral and regional heterogeneities

Several empirical studies documented the role of sectoral supply shocks during the 2021-2023 inflationary bout. While most contributions focus on the developments of the US economy, the most notable being Bernanke & Blanchard (2023), there is also research on the dynamics of the Euro Area. The impact of global supply chain shocks on the evolution of consumer prices in Europe has been documented by Finck & Tillman (2022), who use a VAR model with sign and narrative restrictions to account for the macroeconomic implications of global supply chain shocks, finding that these have a considerable impact on consumer prices. Carrière-Swallow et al. (2023) show that changes in global shipping costs significantly impact inflation in several European countries. More generally, Acharya et al. (2023) show that supply chain disruptions translated into a price surge in pivotal sectors, leading to the rise of inflation in Europe in 2021-2022. Concerning the main channels linking sector-specific dynamics to rising inflation, a key element concerns supply constraints reducing the availability of relevant inputs and raising the cost of production for firms, leading these to increase prices to maintain their profit margins. In this respect, Banbura et al. (2023) develop a Bayesian VAR to identify the structural roots of inflation in the EA and account for the impact of global supply chain bottlenecks and energy prices, finding that "core inflation in the euro area has been largely driven by supply-side shocks in the post-pandemic recovery" (ibid., p. 30). Similarly, Arce et al. (2024) assess the drivers of inflation in the EA using the methodology proposed by Bernanke & Blanchard's (2023), showing that "inflation in the euro area was mainly driven by large positive contributions from energy prices shocks between the second quarter of 2021 and the first quarter of 2023. Higher food price inflation has added to inflationary pressures since the first quarter of 2022" (ibid., p. 27).

Sectoral supply shocks are likely to occur more frequently due to growing risks of supply chain disruptions because of geopolitical tensions, wars, or extreme weather events amplified by climate change. Earlier attempts to quantify the economic costs of climate change, such as Nordhaus (2018), suggested that the impacts could be limited, but recent research points to substantially larger costs (Bilal & Känzig, 2024). Extreme climate events, such as droughts, heatwaves, and wildfires, are expected to produce increasing economic damages (Coronese et al., 2019) and trigger sectoral shocks, as they affect the supply of agricultural products and critical raw materials. The ECB is already acknowledging that climate-related risks pose new challenges to its objective of maintaining price stability:

> "*The impacts of climate and nature-related risks will spread throughout the economy, affecting central banks' tasks. The recent energy crisis, although unrelated to the green transition, illustrates how volatile energy prices and shifts in energy markets can significantly influence inflation dynamics. The increase in prices of energy and energy-sensitive goods and services contributed around 6 percentage points to euro area inflation at its peak in October 2022.*" (Lagarde, 2024)

From a policy perspective, identifying economies' critical points with regard to price stability is of crucial importance, as it allows policymakers to design measures intended to stabilize supply

and avoid excessive price fluctuations in those sectors before they spread to the rest of the economy. Systemically significant sectors are the ones in which price changes have a greater impact on the general price level of an economy. Following the approach of Weber et al. (2024), there are three factors that influence the systemically significance of each sector: (1) the average price volatility of the sector, (2) the forward linkages of the sector to the rest of the economy, and (3) the weight of the sector's output in household consumption. While some sectors are systemically significant due to their relevance in the household consumption basket, others exhibit systemic significance due to their relevance as suppliers of inputs to other sectors in the economy. The identification of systemically significant sectors – and the origins of such significance – makes it possible to design targeted measures to reduce price volatility in these sectors, which is of crucial importance for the EU, where these measures are either missing and/or applied in as uncoordinated way (Vant' Klooster & Weber, 2024).

We adopt a core-periphery approach to assess systemically significant sectors in EU countries (Celi et al., 2018). The latter is rooted in a structuralist understanding of the different growth trajectories of the countries that joined the single currency. Grabner et al. (2020) distinguish four main groups: core countries (Austria, Belgium, Denmark, Finland, France, Germany, Sweden)[1], (Southern) periphery countries (Cyprus, Greece, Italy, Portugal, Spain), catch-up countries[2] (Bulgaria, Croatia, Czechia, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovenia, Slovakia) and financial hubs (Ireland, Luxembourg, Malta, Netherlands). Core countries are characterized by higher GDP per capita levels, relatively low unemployment, and greater weight of industrial production in total value added, while periphery countries entered the monetary union with relatively higher unemployment and weaker productive structures. Eastern catch-up countries, in turn, entered the EU at a later stage and had lower GDP per capita and wages but an important industrial sector, whereas financial hubs are the countries with a greater share of financial activities in total output and rely on large foreign investment flows.

The process of integration in the EU single market was asymmetrical: core countries, which had greater productive capacity and technological capabilities, adopted an export-led strategy, while SP countries, which registered a significant increase in real exchange rates with the adoption of the single currency, were pushed into a consumption/debt-led strategy which made them increasingly dependent on imports from core countries and hindered technological upgrading (Dosi et al., 2015; Storm & Naastepad, 2016). Following the 2008 crisis and the collapse of SP imports, these countries were further harmed by the redirection of Germany's commercial relations towards Eastern countries and, above all, China (Guarascio et al., 2024a). In this scenario, SP countries should be expected to be more vulnerable to sectoral price shocks originating from core countries.

Nevertheless, the process of European integration has also resulted in increased vulnerability to foreign price shocks in core countries. The adoption of pro-cyclical fiscal rules has led to a suppression of aggregate demand in the region, with negative impacts on productivity growth and the accumulation of capabilities in the region (Celi et al., 2018; Hein, 2016). Additionally, the EU's competition rules prevented Member-States from implementing industrial policies aimed at promoting innovation and technological upgrading, lagging behind competing economic

[1] Notice that some authors analyzing core-periphery dynamics in the EU have highlighted that, due to the weakening of its industrial structure and competitiveness, nowadays France tend to be closer to the SP rather than to the core (for a discussion, see Celi et al., 2018). Yet, in this study we follow Grabner et al (2020)'s approach including France into the core also because of the peculiar nature of its energy supply (i.e., relevance of nuclear power in its overall energy portfolio), which makes it structurally more resilient than the periphery.
[2] This group is what other authors call EP (see, Celi et al., 2018).

blocks such as the US and China. Exposure to sectoral supply shocks is, therefore, amplified by the EU's strategic dependencies (Vicard & Wibaux, 2023). The war in Ukraine has shown how EU countries – particularly Germany and the EP – were considerably dependent on Russia as a supplier of oil and gas (Carfora et al., 2022; Guarascio et al., 2024b). The EU is also significantly dependent on foreign supply of intermediate inputs: the region's lack of critical raw materials (CRMs) and rare earth elements and its delay in the transition from fossil fuels to renewable energies has left it increasingly dependent on imports of raw materials and key technologies from foreign suppliers such as China (Rabe et al., 2017; Caravella et al., 2024). These strategic dependencies amplify the EU's exposure to supply disruptions and foreign sectoral price shocks, which may significantly impact the block's inflation dynamics. The methodology used in this paper allows us to draw a connection between the EU's dependencies on strategic products and its degree of exposure to imported inflation.

3. Identifying systemically significant sectors using I-O tables

3.1. Methodology

Contrary to other macroeconomic modelling techniques, the I-O method allows analyzing in greater detail the role that price changes in specific sectors play in overall inflation dynamics. Auer et al. (2019) show that global I-O linkages play a decisive role in the evolution of producer prices. Following the approach proposed by Weber et al. (2024) for the US economy, it is possible to disentangle the direct impact of sectoral price shocks on inflation – i.e. the impact that is originated by the weight of the shocked sector in the household consumption basket which is used to build the CPI – and the indirect impact – i.e. the impact that results from the input-output linkages in the production network. Ipsen et al. (2023) have followed this approach to analyze inflation dynamics in the Euro Area, but they rely on a significantly different grouping of countries and employ a different methodology to account for the reverberation of price shocks across the input-output network (mainly focused on differences in consumption patterns, instead of differences in productive structures).

In this exercise, we use a Leontief price model to simulate price shocks to a single industry in a single period and estimate the impact on the CPI (Dietzenbacher, 1997). However, instead of using national I-O matrices, we rely on the FIGARO inter-country I-O matrix. This means that imports are endogenized, and sectoral price shocks can reverberate not only to the rest of the sectors within a country but also to foreign countries, allowing for a comprehensive analysis of imported inflation. In this I-O model, the economy is decomposed into its constituent sectors, and the value of each sector's output is obtained as the sum of the value of its inputs (both domestic and imported ones) and total value added (Miller and Blair, 2009):

$$\mathrm{X}.\mathrm{P} = \mathrm{X}.\mathrm{A}'.\mathrm{P} + \mathrm{V} \tag{1}$$

Where X is a diagonal matrix with each sector's total output; P is the price vector; A is domestic technical coefficients matrix and V is the vector of value added.

To obtain the price per unit, we divide the value of total output by the quantity produced:

$$\mathrm{P} = \mathrm{A}'.\mathrm{P} + \mathrm{v} \tag{2}$$

In each sector, prices depend on the cost of the inputs it requires from other sectors and on the costs per unit of output of value added (v, which can be decomposed into wages and profits). Hence:

(3)

$$P = (I - A')^{-1}v$$

By assuming that the technical coefficients are constant – i.e., that the quantities that each sector requires from other sectors to produce one unit of its output do not vary – it is possible to estimate the impact of price shocks: a change in the price of one product will directly affect the costs of the sectors that use it as an input and indirectly affect the costs of the sectors that use inputs from sectors in which costs have risen through the direct effect. We assume constant nominal wages and profits to capture the effects of cost-push inflation.

I-O tables only present total values for each sector and do not include separate data on physical output and prices. However, it is possible to normalize the system by measuring each sector's output so that its unit prices are equal to 1; then, a price shock in one sector leads to changes in the price vector, which depicts percentage changes in the price of each of the other sectors. It is assumed that there is a full pass-through of costs and that there are no changes in technical coefficients, which means that there is no possibility of substituting inputs that become more expensive with others. While this may be a strong hypothesis in the medium and long term, it is plausible for the short term, since it is difficult for firms to quickly shift away from key inputs.

In line with the approach of Weber et al. (2024), we define the sectoral price shocks as the average volatility of each sector's price in the two decades before the COVID-19 pandemic (i.e., the period of 2000-2019). This volatility is calculated as the standard deviation of price changes in each sector:

$$\sigma^{x}_{t_0,t_1} = \sqrt{\frac{1}{T}\sum_{t=t_0}^{t_1}\left(\Delta P^{x}_{t} - \Delta P^{\bar{x}}_{t_0,t_1}\right)^2} \quad (4)$$

Where t_0 is the initial period, t_1 is the final period, *T* stands for the number of years, ΔP^{x}_{t} represents the yearly price change in the sector and $\Delta P^{\bar{x}}_{t_0,t_1}$ represents the average yearly price change in the whole period under analysis.

To build a synthetic Consumer Price Index (CPI) for each country, we use the share of the goods produced by each domestic or foreign sector in domestic household consumption (Valadkhani & Mitchell, 2002). The total impact of each price shock on the CPI is composed of two elements: the direct impact and the indirect impact. The direct impact, denoted by α^{a}_{x}, is the one which results from the price change in good *x*, produced in country *b* and consumed in country *a*, ΔP^{b}_{x}, multiplied by its respective consumption share in country *a,* ${c_x}^{ba}$:

$$\alpha^{a}_{x} = {c_x}^{ba}.\Delta P^{b}_{x}$$

The indirect impact, denoted by β^{a}_{x}, is the one which results from the impact of the sectoral price shock in all other sectors through intersectoral linkages, both within and across countries. To obtain the indirect impact, we multiply the consumption shares of all the other sectors (for households in country a), ${c_i}^{ba}$, by the respective price change which resulted from the initial price shock, ΔP_i. Formally:

$$\beta^{a}_{x} = \sum_{i \neq x} {c_i}^{ba}.\Delta P_i$$

Hence, the total impact (Φ) of the price shock imputed to sector *x* on the CPI of country *a* is given by the sum of the direct and indirect impacts:

$$\Phi = \alpha_x^a + \beta_x^a$$

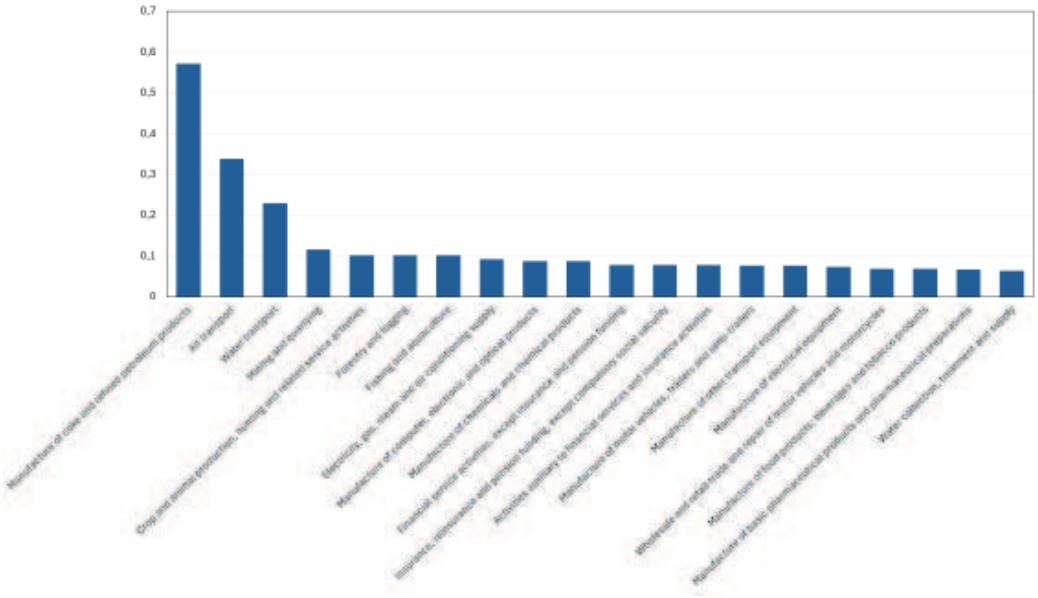
It is worth noting that, when $a = b$, we are analysing the inflation impact of shocks imputed to domestic sectors (in line with the approach of Weber et al., 2024). When $a \neq b$, we assess the impact of shocks imputed to foreign sectors. This methodology allows us to capture cross-border spillover effects, which are highly relevant for open economies in a world marked by significant interdependencies between countries.

3.2. Systemically significant sectors and inflation in the Euro Area: data and empirical strategy

The empirical exercise is carried out using the FIGARO inter-country I-O tables, compiled by Eurostat. These tables include information on 64 industries for 45 countries (including the 27 EU Member-States) plus the Rest of the World. To build the Leontief price model, we use the domestic industry-by-industry requirements table (matrix A). The CPI is built based on a vector of personal consumption of each industry (also taken from ICIO tables). Sectoral price data for the 2000-2019 period comes from different sources: for EU countries, we take the data from the EUKLEMS & INTANProd database, whose annual price data for all sectors is compatible with the FIGARO IO tables; for non-EU countries, since such data is not available, we use global price data from the International Monetary Fund for sectors which are associated with the production of commodities (such as petroleum, gas, food products, chemicals or metals, since these prices tend to be significantly influenced, if not determined, by trade in international markets) and use the evolution of the domestic CPI as a proxy of price swings in the rest of the sectors. A detailed description of these data choices is provided in the Appendix.

There is significant heterogeneity in sectoral price volatility over the 2000-2019 period. Three sectors stand out as the ones with the highest price swings: “Manufacture of coke and refined petroleum products”, “Air transport” and “Water transport”. Since the latter two are highly dependent on petroleum as a source of fuel, it is reasonable to assume that their prices are affected by the significant volatility of this sector. “Mining and quarrying”, “Agriculture, forestry and fishing” and “Electricity, gas, steam and air conditioning supply” also register considerable price volatility, suggesting that commodity prices are subject to greater swings. “Manufacture of computer, electronic and optical products” and “Manufacture of chemicals and chemical products” also register above-average price volatility, possibly due to their dependence on critical inputs from non-EU countries. In contrast, service activities are generally associated with greater price stability in this period.

Figure 2. Industries with highest average sectoral price volatility in EU countries (2000-2019), non-weighted



Source: own elaboration on EUKLEMS & IntanProd data.

Energy, food and housing are the most important items in household consumption: “Real estate activities”, “Manufacture of food products, beverages and tobacco products” and “Electricity, gas, steam and air conditioning supply” rank among the sectors with greater weight in household expenditure, as well as “Retail trade” and “Accommodation and food service activities”. The sectoral shares of household consumption influence inflation dynamics since these are used to build the synthetic CPI and assess its variation following each sectoral price shocks.

The inflationary impact of sectoral shocks may be also driven by forward linkages, which determine the (indirect) impact that sectoral price shocks exert on inflation as they are transmitted through the rest of the economy via the cost channel. Sectors with the highest forward linkages in EU countries (on average) include those associated with key inputs – “Wholesale trade, except of motor vehicles and motorcycles”, “Electricity, gas, steam and air conditioning supply” – transportation – “Land transport and transport via pipelines”, “Warehousing and support activities for transportation” – and services that are essential for commercial activities – “Legal and accounting activities; activities of head offices, management consultancy activities”, “Financial service activities, except insurance and pension funding”. “Real estate activities” and “Construction” also exhibit high forward linkages, possibly due to their relevance in the provision of commercial infrastructure.

Table 1. Industries with highest forward linkages in EU countries

Among the top-10 in most countries	Electricity, gas, steam and ar conditioning supply Wholesale trade Land transport and transport via pipelines Construction Real estate activities Financial service activities, except insurance and pension funding Legal and acounting activities; activities of head offices; management consultancy activities
Other relevant industries	Manufacture of fabricated metal products, except machinery and equipment Warehousing and support activities for transportation Computer programming, consultancy, and information service activities

Source: own elaboration on data from FIGARO I-O tables. Notes: industries classified as "among the top-10 in most countries" feature as one of the top-10 industries with highest forward linkages in at least 70% of the countries; industries classified as "other relevant industries" feature as one of the top-15 industries with highest forward linkages in at least 80% of the countries.

4. Results

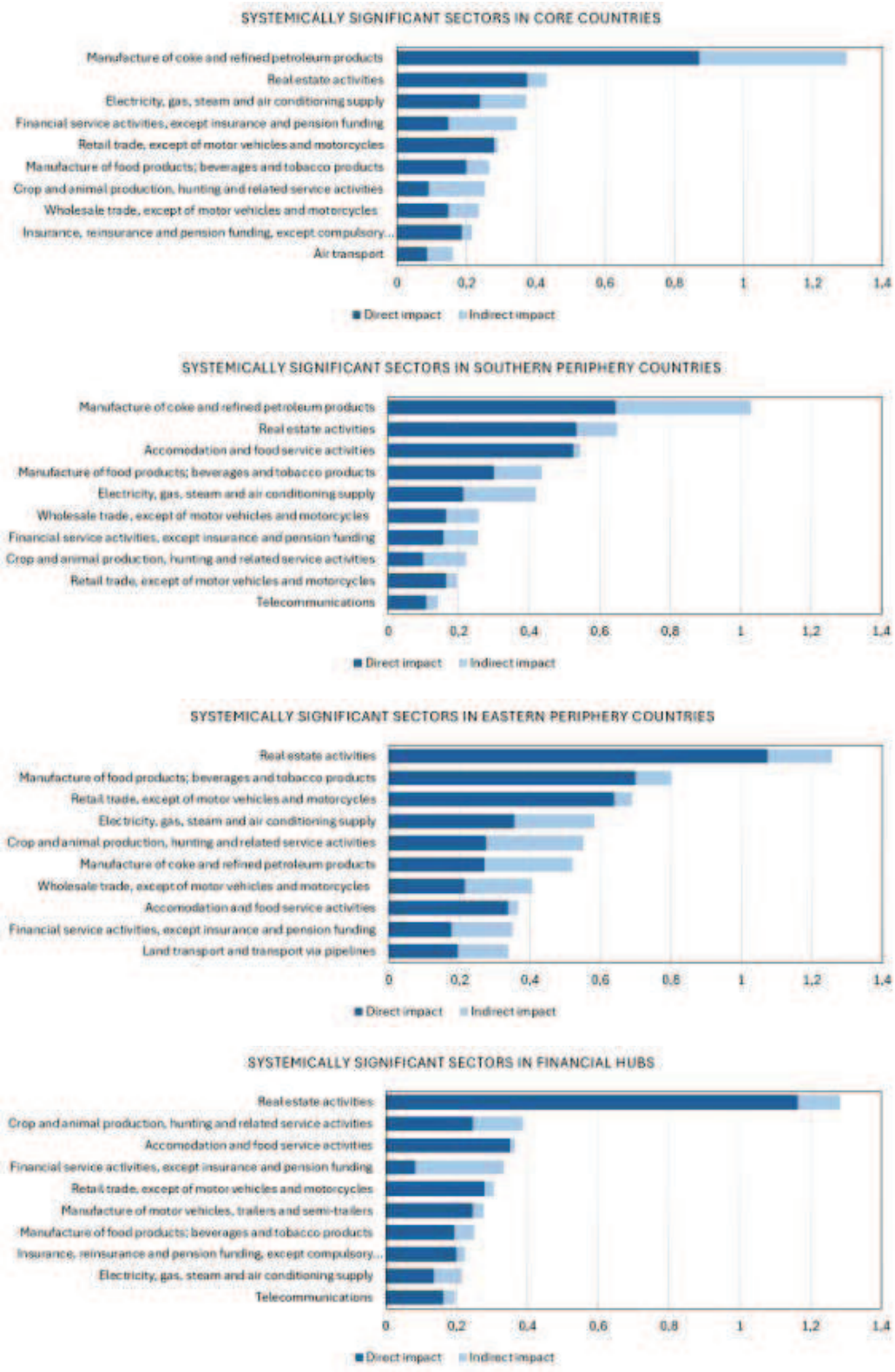
In what follows, we present the main results of our analysis. As argued, the main aim is the identification of key sectors having the greater impact on inflation due to their relevance in household consumption, their average price volatility and/or their forward linkages to the rest of the sectors in the economy. We therefore present the ten most systemically significant sectors – i.e., those in which price changes have a greater impact on total inflation – for each country, leaving a more comprehensive presentation of results to the Appendix. This is in line with the idea that systemic significance is an ordinal category (Weber et al., 2024).

Sectoral systemic significance is influenced by three elements: the average price volatility in each sector (which is used as the exogenous price shock in our simulation), the share of each sector in household consumption (which reflects its importance in the average consumption basket and affects the direct impact of sectoral price changes in the CPI), and their forward linkages (which determine which sectors are more relevant as suppliers of inputs for the rest of the economy and, therefore, influences the extent of the indirect impact on inflation via increased production costs for the rest of the sectors in the economy).

4.1. Systemically significant sectors in the EU core and peripheries

Figure 3 highlights systemically significant sectors in EU regions building on the taxonomy proposed by Graebner et al. (2020): core (Austria, Belgium, Denmark, Finland, France, Germany, Sweden), SP (Cyprus, Greece, Italy, Portugal, Spain), EP (Bulgaria, Croatia, Czechia, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia) and the so-called financial hubs (Ireland, Luxembourg, Malta, Netherlands). As expected there are both similarities as well as remarkable heterogeneities between groups.

Figure 3. Systemically significant sectors in EU core, peripheries and financial hubs



Source: own elaboration on the results of the simulations.

The bars depict both the total inflation impact of each sector as well as its direct and indirect components, represented in dark blue and light blue, respectively. The direct impact is related to the sector's weight in household consumption, whereas the indirect impact is associated with the relevance of the sector as a supplier of intermediate products for all remaining industries in the production network: price shocks in sectors with greater forward linkages will affect production costs in a wider group of sectors and translate into broader price increases across the economy.

At first glance, there are six systemically significant sectors in common in these countries, which may be grouped into the following categories: key inputs – including energy products such as coal, petroleum, electricity and gas, as well as wholesale trade –, basic necessities – including food products and housing – and financial services. The systemic significance of these sectors comes from different sources, which are worth investigating in further detail:

i) *Key inputs.* Unsurprisingly, the oil sector is the one with the highest inflationary impact in almost all countries. Despite the fact that refined oil is an important input for several productive activities, this sector is not among the top 10 sectors when it comes to forward linkages or the share of household consumption in European countries. Its systemic significance is associated with its considerable price volatility – it is the sector which registered the largest price changes, on average, in the countries under consideration, reflecting its commodity nature. The "electricity and gas" sector, in turn, is characterized by stronger forward linkages in all European countries, meaning that a significant part of its inflationary impact comes from the indirect impact on other industries' cost structure (and, hence, prices). It also represents the 6th highest share in European household consumption and the 8th largest price volatility among the 64 sectors included in the analysis, which helps explaining its systemic significance for inflation. In the case of "wholesale trade", it is the sector with the highest forward linkages, on average, in European countries, meaning that its inflationary impact is closely linked to its relevance as a supplier of inputs for the rest of the sectors in these economies.

ii) *Basic necessities.* While "manufacture of food products; beverages and tobacco" does not show high price volatility in the period under consideration, it is the 4th most relevant sector when it comes to household consumption, which explains its considerable direct impact on inflation. In contrast, "crop and animal production" is more relevant for inflation through its indirect impact. This sector does not feature among the most relevant in the average household consumption basket, but it registered the 5th highest price volatility in the period under consideration and has a relevant impact in other sectors. Finally, "real estate activities" is the sector with the highest share in household consumption, while also ranking among the five sectors with greater forward linkages.

iii) *Financial services*. "Financial service activities, except insurance and pension funding" has the 11th largest weight in European household consumption and is among those with highest forward linkages. This sector includes monetary intermediation and, specifically, the granting of credit, which is likely to play a relevant role in both households' expenditures and firms' costs. This result may have important policy implications. While the dominant approach to control inflation is based on interest rate hikes by central banks, increasing the cost of credit – i.e.

increasing interest rates – can have counterproductive results, as increased debt service costs may spread to the rest of the economy and exert upward pressure on prices.

Now we move to the analysis of the differences between core and periphery. On the one hand, "Accommodation and food service activities" – which includes the provision of short-stay accommodation for visitors and the provision of meals and drinks for immediate consumption – appears to be systemically significant across the SP but not in core countries (except for Denmark). However, the significance of this sector for inflation dynamics should be read with caution, since its inflationary impact is essentially explained by the direct impact on the CPI and the effect comes mostly from the weight of this sector in household consumption, possibly due to the greater dependency on tourism activities in SP countries (Burgisser & Di Carlo, 2023). This means that price increases in this sector may have a relevant impact on measured inflation, even if their actual impact on the cost of living of domestic households is relatively smaller.

Even what we define as 'basic necessities' seems to have an heterogeneous impact on inflation in core and periphery countries. The impact of housing prices is considerably stronger in the EP, which register the largest price variations in the period under analysis, as well as in financial hubs; while core countries display the smallest impact of housing price shocks, arguably due to the fact that they have higher shares of social housing which may contribute to mitigate price fluctuations in the housing market (Housing Europe, 2021). As for food products, Eastern countries are also the ones experiencing the greatest inflationary impact. With lower levels of GDP per capita, these countries are characterized by greater shares of household consumption in food products, meaning that they are more exposed to price variations in this sector.

4.2. Intra-EU foreign sectoral shocks

A deeper analysis into the total inflation impact of the sectoral shocks allows us to conclude that periphery countries are more affected by shocks originating from core countries than vice-versa[3]. On average, sectoral price shocks originating in core countries have a greater impact on the inflation rate in SP countries than the opposite, pointing to a dependency of the latter vis-à-vis the former.[4]

Table 2. Intra-EU foreign sectors with greater inflationary impact on core countries

	Country	Sector	Impact on inflation		
			Direct	Indirect	Total
Core	Austria	Germany: coke & refined petroleum	0,141	0,113	0,254
		Poland: coke & refined petroleum	0,042	0,061	0,103
		Germany: food products & beverages	0,058	0,024	0,082
		Italy: coke & refined petroleum	0,039	0,040	0,079
		Netherlands: coke & refined petroleum	0,004	0,066	0,070
	Belgium	Netherlands: coke & refined petroleum	0,205	0,275	0,480
		France: crop & animal production	0,026	0,060	0,086
		Germany: coke & refined petroleum	0,022	0,049	0,071
		France: coke & refined petroleum	0,019	0,046	0,065

[3] In this section, we focus on the EU core, SP and EP while leaving out "financial hubs", since we are interested in exploring the implications of core-periphery relations for inflation dynamics.

[4] This is in line with the results of Ipsen et al. (2023), although they use a different methodology and rely on a substantially different grouping of EU countries.

	Netherlands: mining & quarrying	0,000	0,005	0,005
Denmark	Netherlands: coke & refined petroleum	0,006	0,070	0,076
	Germany: water transport	0,019	0,037	0,056
	Germany: food products & beverages	0,032	0,021	0,053
	Sweden: coke & refined petroleum	0,010	0,038	0,048
	Germany: crop & animal production	0,015	0,032	0,047
Finland	Sweden: coke & refined petroleum	0,066	0,136	0,202
	Denmark: water transport	0,081	0,074	0,155
	Netherlands: coke & refined petroleum	0,031	0,103	0,134
	Denmark: coke & refined petroleum	0,018	0,084	0,102
	Germany: water transport	0,035	0,023	0,058
France	Netherlands: coke & refined petroleum	0,048	0,068	0,116
	Spain: coke & refined petroleum	0,040	0,025	0,065
	Germany: coke & refined petroleum	0,021	0,025	0,046
	Italy: coke & refined petroleum	0,017	0,021	0,038
	Denmark: water transport	0,013	0,023	0,036
Germany	Netherlands: coke & refined petroleum	0,080	0,187	0,267
	Poland: coke & refined petroleum	0,009	0,051	0,060
	Austria: coke and refined petroleum	0,005	0,026	0,031
	Denmark: water transport	0,000	0,030	0,030
	Czechia: manufacture of motor vehicles, trailers & semi-trailers	0,017	0,013	0,030
Sweden	Denmark: coke & refined petroleum	0,176	0,348	0,524
	Netherlands: coke & refined petroleum	0,039	0,113	0,152
	Finland: coke & refined petroleum	0,048	0,096	0,144
	Denmark: water transport	0,002	0,065	0,067
	Poland: coke & refined petroleum	0,010	0,048	0,058

Source: own elaboration on the results of the simulations.

Table 2 presents the five EU sectors which have a greater impact on inflation in each country included in the core. As expected, "Manufacture of coke and refined petroleum products" is rather ubiquitous, as it can either be directly consumed by domestic households, used as an input by domestic firms to fuel productive processes or used as an input by firms in other EU countries to which domestic households acquire goods and services.[5] Remarkably enough, core countries turn out to have significant trade ties between each other, which means that sectoral price shocks in one of these countries may have a relevant impact on the others. It is also worth noting that there seems to be greater linkages with the EP rather than with SP countries, lending further support to the argument put forth by Simonazzi et al. (2013) and Celi et al. (2018). Poland's "coke & refined petroleum" has a significant impact in half of the core countries. Additionally, Czechia's manufacture of motor vehicles (which includes the manufacture of parts and accessories) is relevant to inflation dynamics in Germany, signaling not only the importance of the Czech automotive industry for German consumers but also its relevance as a supplier of

[5] Netherlands' coke & refined petroleum sector is the one with the largest price volatility in the whole sample, which may help to explain the size of its impact on most EU countries.

inputs for the automotive industry in Germany and the interdependencies between the two countries.[6]

Table 3. Intra-EU foreign sectors with greater inflationary impact in the Southern periphery

	Country	Sector	Impact on inflation		
			Direct	Indirect	Total
Southern periphery	Cyprus	Greece: coke & refined petroleum	0,542	0,461	1,003
		Italy: coke & refined petroleum	0,138	0,129	0,267
		France: coke & refined petroleum	0,117	0,099	0,216
		Spain: coke & refined petroleum	0,111	0,097	0,208
		Greece: air transport	0,120	0,009	0,129
	Greece	Netherlands: coke & refined petroleum	0,003	0,051	0,054
		Spain: coke & refined petroleum	0,022	0,029	0,051
		Denmark: water transport	0,012	0,026	0,038
		Italy: coke & refined petroleum	0,010	0,028	0,038
		Bulgaria: coke & refined petroleum	0,014	0,018	0,032
	Italy	Denmark: water transport	0,060	0,018	0,078
		Netherlands: coke & refined petroleum	0,004	0,043	0,047
		Denmark: coke & refined petroleum	0,013	0,024	0,037
		Greece: coke & refined petroleum	0,014	0,022	0,036
		Poland: coke & refined petroleum	0,007	0,028	0,035
	Portugal	Spain: coke & refined petroleum	0,086	0,147	0,233
		Spain: food products & beverages	0,047	0,043	0,090
		Netherlands: coke & refined petroleum	0,010	0,066	0,076
		Spain: crop & animal production	0,012	0,054	0,066
		Spain: electricity, gas, steam	0,000	0,059	0,059
	Spain	Netherlands: coke & refined petroleum	0,004	0,075	0,079
		Denmark: water transport	0,039	0,030	0,069
		Denmark: coke & refined petroleum	0,003	0,052	0,055
		Portugal: coke & refined petroleum	0,004	0,048	0,052
		Italy: coke & refined petroleum	0,003	0,046	0,049

Source: own elaboration on the results of the simulations.

In contrast to core countries, the SP seems to be more exposed to sectoral price shocks from other regions of the EU. While these countries also have strong trade relations with each other which translate into inflation spillovers within the SP, they are more exposed to sectoral shocks originating from core countries.

[6] The exceptions of Austria, which is affected by a price shock in Italy, and France, which is significantly impacted by price shocks in Italy and Spain, are understandable, as in both cases the countries under consideration share borders, making commercial linkages and, hence, inflation spillovers more likely.

Table 4. Intra-EU foreign sectors with greater inflationary impact in the Eastern periphery

	Country	Sector	Impact on inflation		
			Direct	Indirect	Total
Eastern periphery	Bulgaria	Romania: coke & refined petroleum	0,055	0,090	0,145
		Greece: coke & refined petroleum	0,027	0,064	0,091
		Romania: food products & beverages	0,057	0,019	0,076
		Romania: crop & animal production	0,024	0,052	0,076
		Poland: coke & refined petroleum	0,010	0,065	0,075
	Croatia	Italy: coke & refined petroleum	0,165	0,153	0,318
		Hungary: coke & refined petroleum	0,050	0,052	0,102
		Austria: coke & refined petroleum	0,032	0,070	0,102
		Hungary: electricity, gas, steam	0,036	0,046	0,082
		Hungary: food products & beverages	0,048	0,029	0,077
	Czechia	Poland: coke & refined petroleum	0,079	0,142	0,221
		Germany: coke & refined petroleum	0,102	0,111	0,213
		Austria: coke & refined petroleum	0,058	0,076	0,134
		Slovakia: coke & refined petroleum	0,047	0,044	0,091
		Germany: food products & beverages	0,058	0,022	0,080
	Estonia	Finland: coke & refined petroleum	0,149	0,103	0,252
		Poland: coke & refined petroleum	0,033	0,079	0,112
		Denmark: water transport	0,044	0,067	0,111
		Denmark: coke & refined petroleum	0,047	0,064	0,111
		Netherlands: coke & refined petroleum	0,011	0,070	0,081
	Hungary	Austria: coke & refined petroleum	0,273	0,208	0,481
		Poland: coke & refined petroleum	0,039	0,094	0,133
		Slovakia: coke & refined petroleum	0,044	0,039	0,083
		Netherlands: coke & refined petroleum	0,010	0,069	0,079
		Germany: food products & beverages	0,036	0,024	0,060
	Latvia	Finland: coke & refined petroleum	0,160	0,097	0,257
		Poland: coke & refined petroleum	0,033	0,117	0,150
		Denmark: water transport	0,043	0,082	0,125
		Estonia: food products & beverages	0,086	0,009	0,095
		Netherlands: coke & refined petroleum	0,015	0,070	0,085
	Lithuania	Poland: coke & refined petroleum	0,098	0,143	0,241
		Finland: coke & refined petroleum	0,098	0,054	0,152
		Netherlands: coke & refined petroleum	0,012	0,068	0,080
		Poland: food products & beverages	0,062	0,015	0,077
		Denmark: water transport	0,009	0,065	0,074
	Poland	Germany: coke & refined petroleum	0,033	0,061	0,094
		Netherlands: coke & refined petroleum	0,005	0,067	0,072
		Germany: food products & beverages	0,032	0,022	0,054
		Denmark: water transport	0,001	0,046	0,047
		Germany: crop & animal production	0,009	0,035	0,044
	Romania	Poland: coke & refined petroleum	0,164	0,075	0,239
		Hungary: coke & refined petroleum	0,061	0,022	0,083
		Netherlands: coke & refined petroleum	0,026	0,054	0,080
		Hungary: food products & beverages	0,062	0,014	0,076
		Hungary: crop & animal production	0,021	0,042	0,063
	Slovakia	Austria: coke & refined petroleum	0,279	0,180	0,459
		Poland: coke & refined petroleum	0,078	0,128	0,206
		Czechia: food products & beverages	0,146	0,014	0,160
		Czechia: crop & animal production	0,020	0,110	0,130
		Germany: coke & refined petroleum	0,036	0,059	0,095
		Austria: coke & refined petroleum	0,471	0,151	0,622

Slovenia	Italy: coke & refined petroleum	0,448	0,135	0,583
	Greece: coke & refined petroleum	0,441	0,112	0,553
	Portugal: coke & refined petroleum	0,080	0,023	0,103
	Poland: coke & refined petroleum	0,031	0,044	0,075

Source: own elaboration on the results of the simulations.

In the EP, in addition to the expected within-group inflation spillovers, there seems to be a significant link to the EU core (Celi et al., 2018): German, Austrian, Danish and Finnish sectors – in both energy inputs and food products – turn out to have a relevant impact in the EP's inflation dynamics.

Table 5 provides a quantitative summary of the results of this exercise for the EU's core and peripheries. It presents the average impact from the imputed sectoral price shocks in all these regions. The results are obtained as follows. First, the average impact of core-to-core shocks stems from the calculation of the average impact on each core country of the sectoral shocks from the rest of the core countries. Likewise, the average impact of core-to-SP shocks is obtained calculating the average impact on each core country of the shocks from the SP. Results are presented for the average impact of the 10 sectors from each region with the largest inflationary impact for each country.

Table 5. Average inflationary impact of the top-10 sectoral price shocks in the EU's core and peripheries

		Impact from shocks originating in…		
		Core	Southern periphery	Eastern periphery
Impact on…	Core	0,051	0,011	0,018
	Southern periphery	0,032	0,060	0,014
	Eastern periphery	0,061	0,030	0,060

Source: own elaboration on the results of the simulations.

The main takeaway is that, on average, sectoral price shocks originating in core countries have a greater impact on peripheries' inflation than the other way around. The average inflationary impact that price shocks stemming from core countries have on the SP is 0,025; while price fluctuations in the SP have a negligible (average) impact in the core: 0,009. This confirm the asymmetry between EU's core-periphery: the latter is more vulnerable to price shocks originating from the former since it is more dependent on their products, either as consumption goods for households or as intermediate inputs for firms, probably due to the well-documented differences in terms of productive and technological capabilities (Celi et al., 2018; Grabner et al., 2020). A practical example may help in reading these results: the price shocks imputed to the five German industries with the greatest relevance for the Italian ("water transport", "manufacture of motor vehicles", "manufacture of food products; beverages and tobacco", "manufacture of coke and refined petroleum" and "wholesale trade") inflation had a combined impact of 0,12 on Italy's CPI, whereas the equivalent price shocks imputed to the five Italian industries with the greatest relevance for the German inflation ("manufacture of coke and

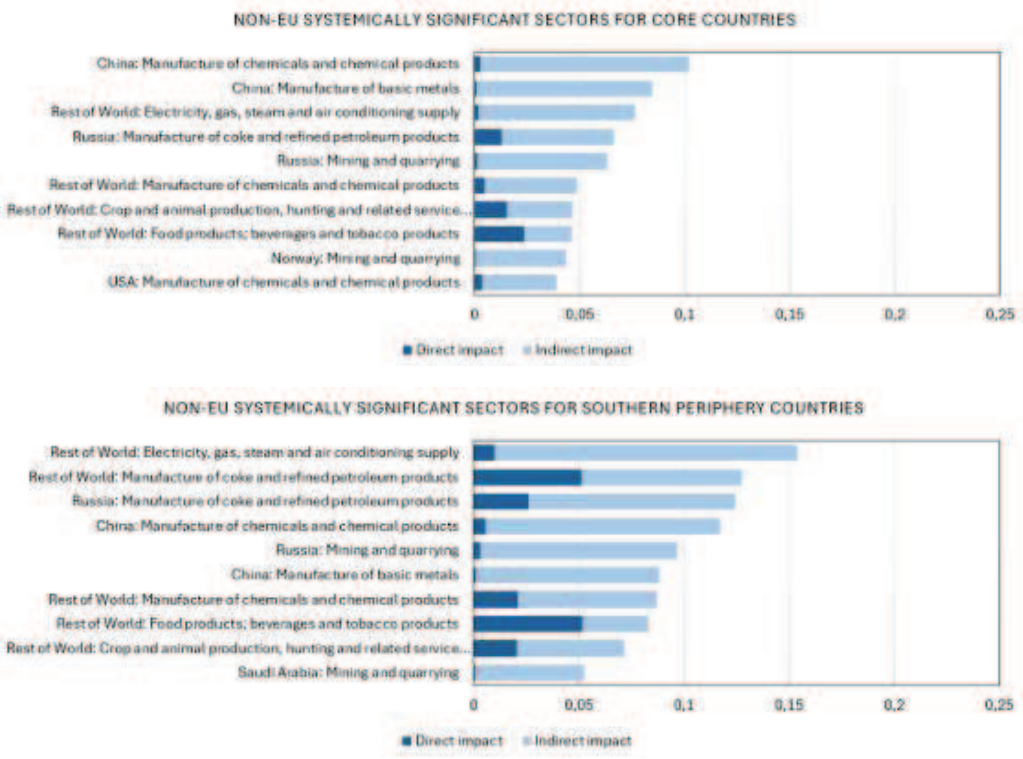
refined petroleum", "air transport", "manufacture of food products; beverages and tobacco", "manufacture of chemicals and chemical products" and "crop and animal production") had a combined impact of only 0,06 on Germany's CPI, i.e. half the impact on inflation.

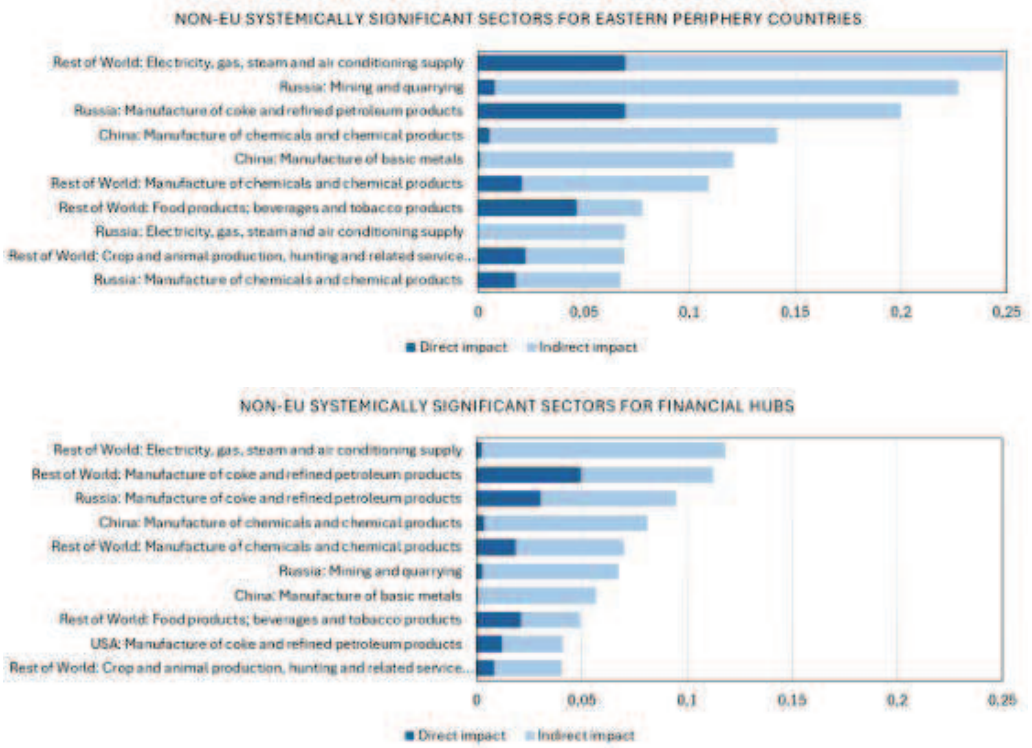
Indeed, a similar asymmetry is also observable when looking at core-EP relationships. The average inflationary impact that price shocks stemming from the core may have on the EP amounts to 0,063; whereas price swings in the Eastern periphery have an average inflationary impact of only 0,016 in core countries. Notably, the average inflationary impact of price shocks coming from core countries is actually greater than that of the shocks coming from other Eastern countries. Despite the process of relative convergence vis-à-vis the core (Gräbner & Hafele, 2020), EP countries are significantly exposed to sectoral price swings in core countries.

4.3. Exposure to extra-EU sectoral shocks

In addition to the impacts of intra-EU price shocks, the 2021-2024 inflationary episode has shown that it is important to assess the role played by sectoral price shocks stemming from non-EU countries. Figure 4 focuses on the role of non-EU sectoral price shocks as drivers of inflation in core, SP and EP countries, as well as financial hubs.

Figure 4. Non-EU systemically significant sectors in EU core, peripheries and financial hubs





Source: own elaboration on the results of the simulations.

As explained above, the bars depict the direct and indirect impacts of each sectoral shock. The inflationary impact of most of the non-EU sectors comes from the indirect channel: even if European households do not directly consume these products, they still have a significant impact on EU's inflation since they are incorporated as intermediate inputs in the production of several products that are consumed in the region.

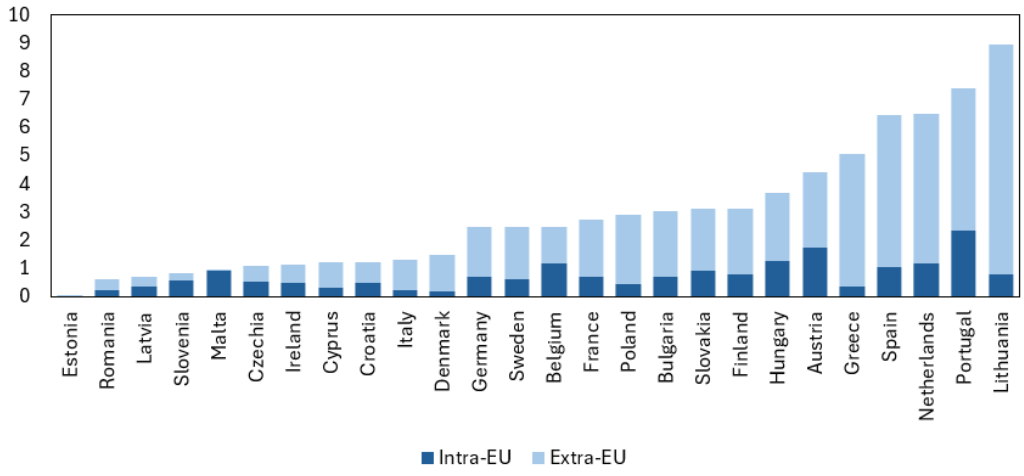
The non-EU systemically significant sectors are closely associated with its strategic dependencies and exposure to supply chain disruptions (Vicard & Wibaux, 2023). Energy products are one of the key dimensions in which the EU is dependent on foreign suppliers, which explains the systemic relevance of Russia's mining – which includes the extraction of coal, oil and gas –, refined petroleum and electricity and gas, with Eastern countries being the most exposed to price volatility in Russian energy products (on this point, see the evidence provided in Guarascio et al., 2024b). Norway is also a relevant supplier for core (namely, Nordic) countries, while Saudi Arabia is relevant for the SP.

Non-energy inputs are also systemically significant for the EU. Remarkable cases include chemical products, including fertilizers, pesticides and other inputs used in agricultural production, and basic metals, comprising iron, steel and non-ferrous metals which are critical to the production of semiconductors, batteries and other technologies. Concerning these sectors, the EU is particularly vulnerable to price volatility in China, signaling its dependence on Chinese imports of key inputs and its inability to ensure sufficient domestic production capacity, as European institutions are already officially recognizing (European Commission, 2023).

EU countries are also relatively vulnerable to price variations in manufactured food products from the rest of the world. In this case, a significant share of the inflationary impact comes from the direct impact on the CPI, which means that the consumption of imported food by EU households is considerable. With climate change affecting agricultural production both at home and abroad, imported food products may become a source of inflationary pressures in the future.

To assess the degree of exposure to external shocks in EU countries, it is also important to analyze import dependency in systemically significant sectors. Using the data available in the FIGARO input-output table, it is possible to assess the ratio of imported inputs in each sector, defined as the total value of imported inputs in a specific sector divided by the total value of domestic inputs used in that sector (Lima & Banacloche, 2022). Figure 5 presents the ratio of imported inputs in the sector with the greatest inflation impact in most countries – manufacture of coke and refined petroleum –, depicting the share of imported inputs from EU and non-EU sectors/countries. The ratio is greater than 1 in the majority of countries, meaning that the value of imported inputs is greater than that of domestic inputs in most countries. In addition, the share of imported inputs from non-EU countries is larger than that of the EU, in most cases. However, the extent to which EU countries are dependent on non-EU imports varies significantly. For instance, while some SP countries – Portugal, Spain and Greece – display substantially higher ratios than the core, which means that they are far more exposed to supply disruptions and price shocks stemming from outside of the EU, some others, like Italy and Cyprus, appear to be less susceptible to such shocks.

Figure 5. Ratio of imported inputs in the sector "Manufacture of coke and refined petroleum" in EU countries



Source: own elaboration on data from FIGARO I-O tables.

Since this is the sector with the larger inflation impact in most countries, a larger ratio of imported inputs in this sector signals greater exposure to external cost shocks that translate into increased costs for the rest of the sectors in the economy and increased prices for domestic consumers. In other words, these countries have a lower degree of autonomy to ensure price stability due to their external dependence. Our results suggest that the most foreign-dependent countries should focus their efforts in boosting the domestic productive capacity of key inputs and reducing the consumption requirements of oil to shield themselves from external shocks. This can be achieved with a combination of public and private investments to improve energy

efficiency in most industries and buildings and strengthen the public transport network (and, specifically, the railroad network).

5. Conclusions

Almost like a bolt from the blue, inflation has reemerged as a major economic policy concern after the pandemic crisis. This resurgence has reignited longstanding debates over its causes and, consequently, the most effective policies to mitigate it. What is clear, however, is that today's inflation unfolds within a context of ongoing strains across value chains, especially in sectors crucial to price dynamics, such as energy, raw materials, and the technologies and intermediate goods vital to the ecological and digital transitions. We can expect these strains to be amplified by the fundamental challenges of our times: climate change and geopolitical tensions.

This work presents new evidence on the role of cost-push factors – particularly those in systemically significant sectors – in driving inflation within the EU. Building on the approach pioneered by Weber et al. (2024) and using inter-country input-output tables, it provides an in-depth mapping of EU Member-States, highlighting: i) systemically significant sectors and their direct and indirect impacts within each country; ii) inter-country linkages, specifically the influence of foreign sectors on inflation; and iii) the additional inflationary pressures stemming from non-EU sectors.

The main results can be summarized as follows. Firstly, systemically significant sectors in the EU core and peripheries can be grouped into three main categories: key inputs (including energy products such as coal, petroleum, electricity and gas, as well as wholesale trade), basic necessities (including housing and food) and financial services. These are the critical points in which price swings pose greater threats to price stability, both due to their relevance for household consumption and/or due to significant forward linkages to the rest of the production network. Secondly, exposure to sectoral price shocks originating outside of the EU is closely associated with the block's strategic dependencies, namely associated with energy products (primarily imported from Russia), non-energy inputs (mainly supplied by China) and, to a lesser extent, food products.

Several policy implication can be derived from the evidence provided in this work. Instead of relying on an inadequate "one-size-fits-all" monetary policy approach, identifying systemically significant sectors allows us to locate industries that are critical to maintain overall price stability and design targeted measures to stabilize supply, ranging from investment to boost domestic productive capacity to strategic reserves or inventory requirements aimed at reducing the vulnerability to supply chain disruptions.

This methodology has limitations: the I-O methodology assumes that technical coefficients are fixed, meaning that it does not account for substitution effects. While we believe that this is a reasonable assumption for the short-term, as it is difficult for firms to quickly replace their input requirements when faced with an exogenous price shock, it is not well-suited to assess longer-term dynamics.

Systemically significant sectors are contingent on the productive structure of the economy in each historical context. It would be relevant to trace the evolution of sectoral systemic significance over the last decades and, specifically, since the turn of the century, in order to assess how the process of European integration shaped exposure to internal and external sectoral price shocks in the EU's core and peripheries. This is a possible avenue for future research.

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Appendix 1: Industry codes and description in FIGARIO I-O tables

Table A1. Industry codes and full description

Code	Description
A01	Crop and animal production, hunting and related service activities
A02	Forestry and logging
A03	Fishing and aquaculture
B	Mining and quarrying
C10-12	Manufacture of food products; beverages and tobacco products
C13-15	Manufacturing of textiles, wearing apparel, leather and related products
C16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
C17	Manufacture of paper and paper products
C18	Printing and reproduction of recorded media
C19	Manufacture of coke and refined petroleum products
C20	Manufacture of chemicals and chemical products
C21	Manufacture of basic pharmaceutical products and pharmaceutical preparations
C22	Manufacture of rubber and plastic products
C23	Manufacture of other non-metallic mineral products
C24	Manufacture of basic metals
C25	Manufacture of fabricated metal products, except machinery and equipment
C26	Manufacture of computer, electronic and optical products
C27	Manufacture of electrical equipment
C28	Manufacture of machinery and equipment n.e.c.
C29	Manufacture of motor vehicles, trailers and semi-trailers
C30	Manufacture of other transport equipment
C31_32	Manufacture of furniture; other manufacturing
C33	Repair and installation of machinery and equipment
D35	Electricity, gas, steam and air conditioning supply
E36	Water collection, treatment and supply
E37-39	Sewerage, waste management, remediation activities
F	Construction
G45	Wholesale and retail trade and repair of motor vehicles and motorcycles
G46	Wholesale retail, except of motor vehicles and motorcycles
G47	Retail trade, except of motor vehicles and motorcycles
H49	Land transport and transport via pipelines
H50	Water transport
H51	Air transport
H52	Warehousing and support activities for transportation
H53	Postal and courier activities
I	Accomodation and food service activities
J58	Publishing activities
J59_60	Motion picture, vídeo, television programme production; programming and broadcasting activities

Code	Description
J61	Telecommunications
J62_63	Computer programming, consultancy, and information service activities
K64	Financial service activities, except insurance and pension funding
K65	Insurance, reinsurance and pension funding, except compulsory social security
K66	Activities auxiliary to financial services and insurance activities
L	Real estate activities
M69_70	Legal and accounting activities; activities of head offices; management consultancy activities
M71	Architectural and engineering activities; technical testing and analysis
M72	Scientific research and development
M73	Advertising and market research
M74_75	Other professional, scientific and technical activities; veterinary activities
N77	Rental and leasing activities
N78	Employment activities
N79	Travel agency, tour operator reservation service and related activities
N80-82	Security and investigation, service and landscape, office administrative and support activities
084	Public administration and defence; compulsory social security
P85	Education
Q86	Human health activities
Q87_88	Residential care activities and social work activities without accommodation
R90-92	Creative, arts and entertainment activities; libraries, archives, museums and other cultural activities; gambling and betting activities
R93	Sports activities and amusement and recreative activities
S94	Activities of membership associations
S95	Repair of computers and personal and household goods
S96	Other personal service activities
T	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use
U	Activities of extraterritorial organisations and bodies

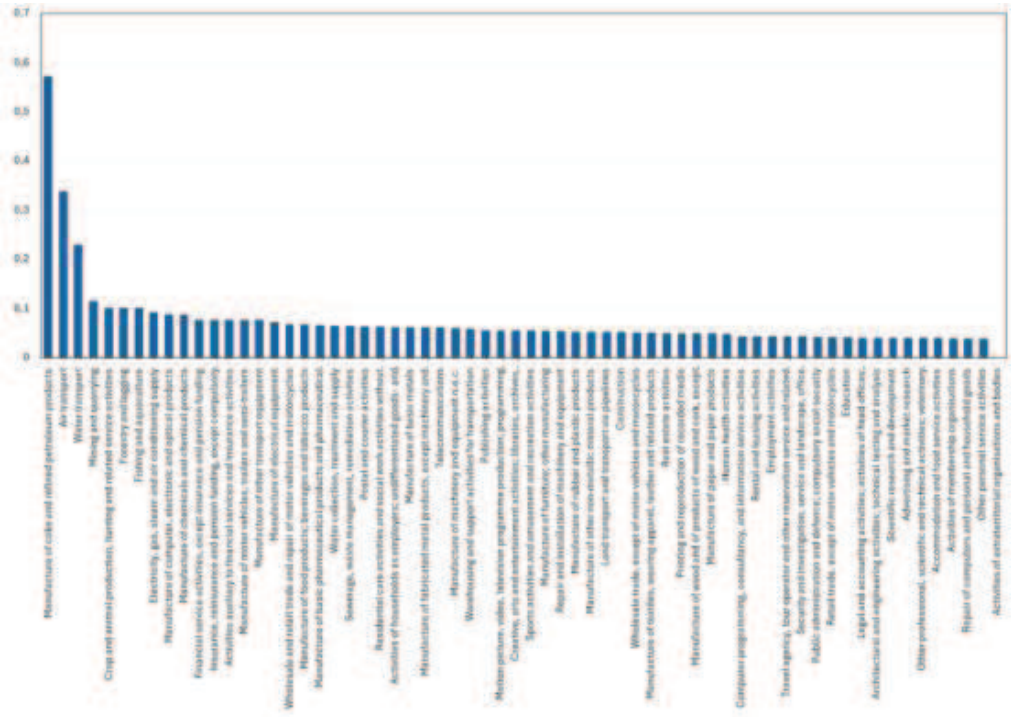
Source: FIGARO Input-Output tables

Appendix 2: Additional information on sectoral price data

Table A2. Average sectoral price volatility: sources

Country	Industry code	Source
EU countries	All industries	EUKLEMS & IntanProd database
Non-EU countries	A01, A02, A03, B	IMF Primary Commodity Prices – "Aggregate raw materials"
	C10-C12	IMF Primary Commodity Prices – "Food and beverage"
	C19	IMF Primary Commodity Prices – "APSP crude oil"
	C20	IMF Primary Commodity Prices – "Fertilizer"
	C24	IMF Primary Commodity Prices – "Metal"
	D35	IMF Primary Commodity Prices – "Energy (total)"
	All other industries	World Bank – respective country CPI

Figure A1. Average sectoral price volatility in EU countries (2000-2019), non-weighted



Source: own elaboration on EUKLEMS & IntanProd data

Appendix 3: Supplementary information on country-level simulations

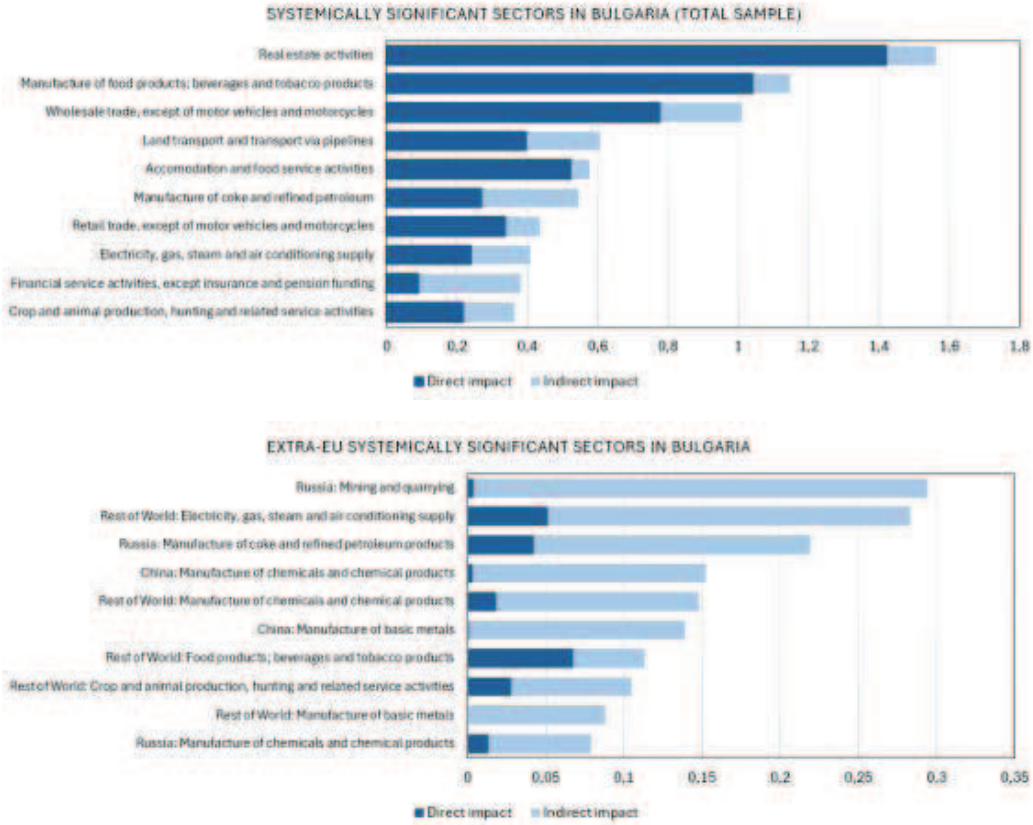
Figure A2. Top-10 systemically significant sectors in Austria: total sample and non-EU countries

Source: own elaboration. The figure displays the top-10 results of all the price shock simulations for each individual industry using the I-O model. The total impact on inflation is given by the total length of each bar and represents the total change in the country's synthetic CPI following the price shock which was imputed to a given industry. Each bar is divided into two segments: the direct impact of the price shock in the synthetic CPI (in dark blue) and the indirect impact of the shock in the synthetic CPI through intersectoral linkages (in light blue). Systemically significant industries from foreign countries are identified with the name of the respective country before the description of the industry.

Figure A3. Top-10 systemically significant sectors in Belgium: total sample and non-EU countries

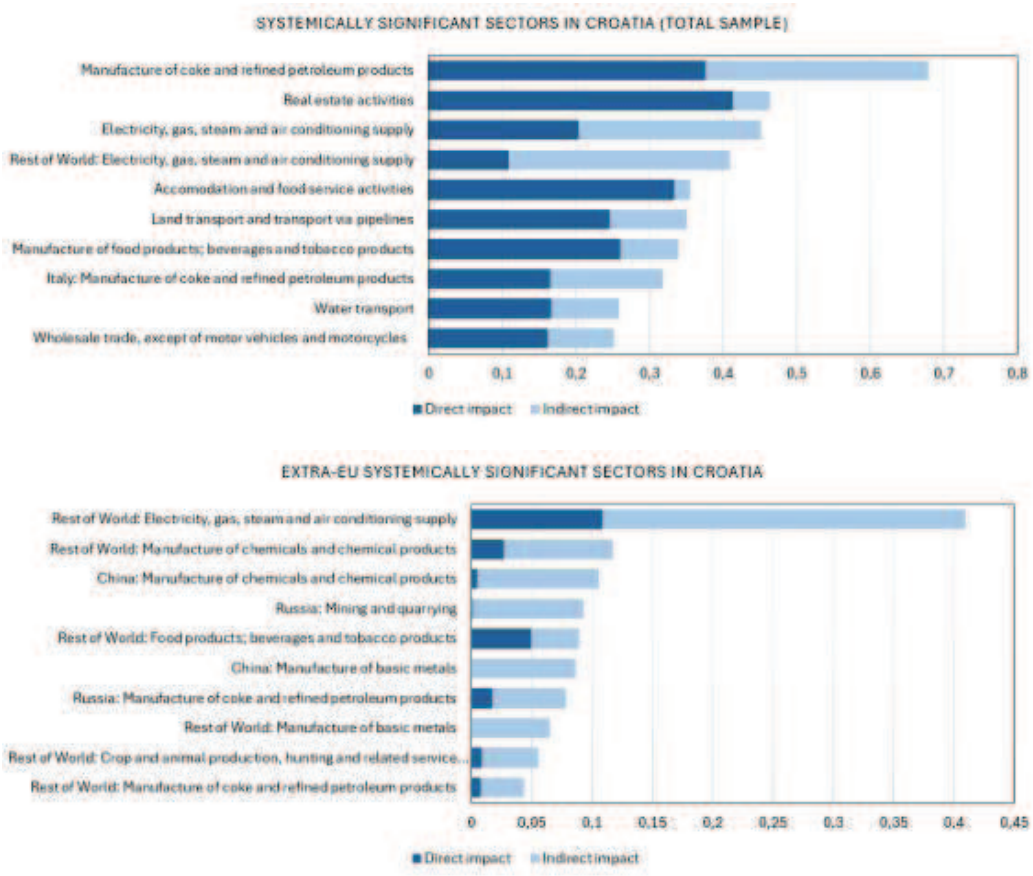
Source: own elaboration. The figure displays the top-10 results of all the price shock simulations for each individual industry using the I-O model. The total impact on inflation is given by the total length of each bar and represents the total change in the country's synthetic CPI following the price shock which was imputed to a given industry. Each bar is divided into two segments: the direct impact of the price shock in the synthetic CPI (in dark blue) and the indirect impact of the shock in the synthetic CPI through intersectoral linkages (in light blue). Systemically significant industries from foreign countries are identified with the name of the respective country before the description of the industry.

Figure A4. Top-10 systemically significant sectors in Bulgaria: total sample and non-EU countries



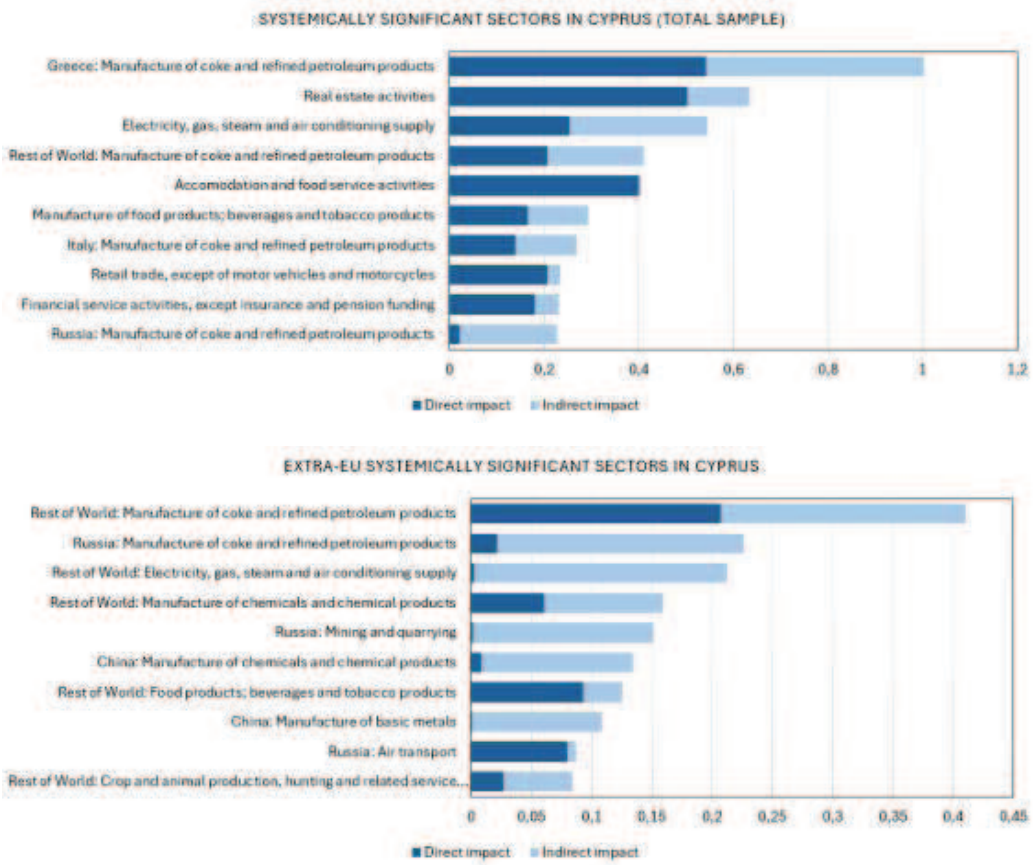
Source: own elaboration. The figure displays the top-10 results of all the price shock simulations for each individual industry using the I-O model. The total impact on inflation is given by the total length of each bar and represents the total change in the country's synthetic CPI following the price shock which was imputed to a given industry. Each bar is divided into two segments: the direct impact of the price shock in the synthetic CPI (in dark blue) and the indirect impact of the shock in the synthetic CPI through intersectoral linkages (in light blue). Systemically significant industries from foreign countries are identified with the name of the respective country before the description of the industry.

Figure A5. Top-10 systemically significant sectors in Croatia: total sample and non-EU countries



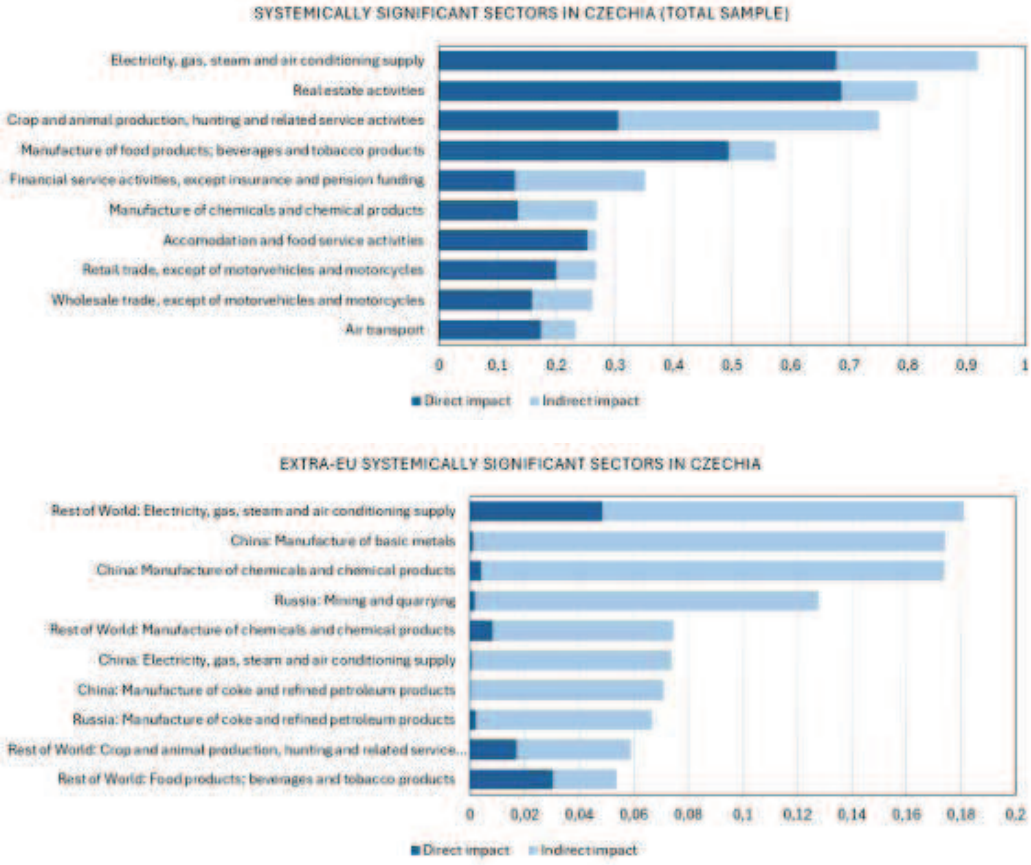
Source: own elaboration. The figure displays the top-10 results of all the price shock simulations for each individual industry using the I-O model. The total impact on inflation is given by the total length of each bar and represents the total change in the country's synthetic CPI following the price shock which was imputed to a given industry. Each bar is divided into two segments: the direct impact of the price shock in the synthetic CPI (in dark blue) and the indirect impact of the shock in the synthetic CPI through intersectoral linkages (in light blue). Systemically significant industries from foreign countries are identified with the name of the respective country before the description of the industry.

Figure A6. Top-10 systemically significant sectors in Cyprus: total sample and non-EU countries



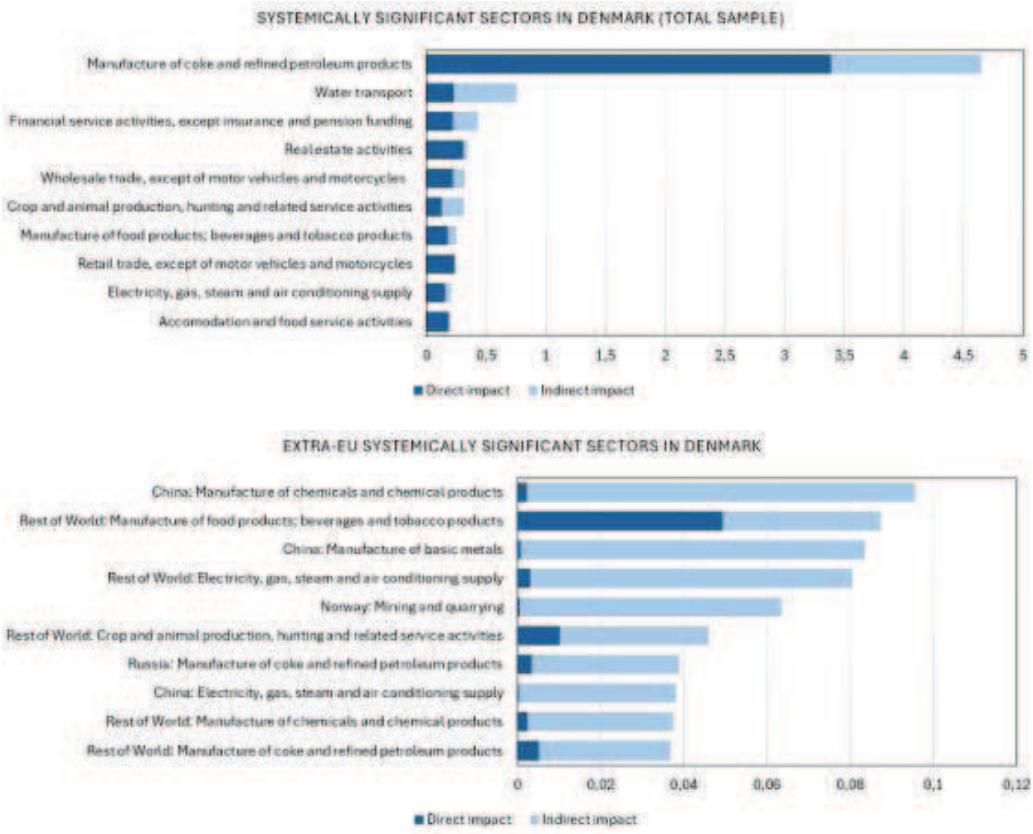
Source: own elaboration. The figure displays the top-10 results of all the price shock simulations for each individual industry using the I-O model. The total impact on inflation is given by the total length of each bar and represents the total change in the country's synthetic CPI following the price shock which was imputed to a given industry. Each bar is divided into two segments: the direct impact of the price shock in the synthetic CPI (in dark blue) and the indirect impact of the shock in the synthetic CPI through intersectoral linkages (in light blue). Systemically significant industries from foreign countries are identified with the name of the respective country before the description of the industry.

Figure A7. Top-10 systemically significant sectors in Czechia: total sample and non-EU countries



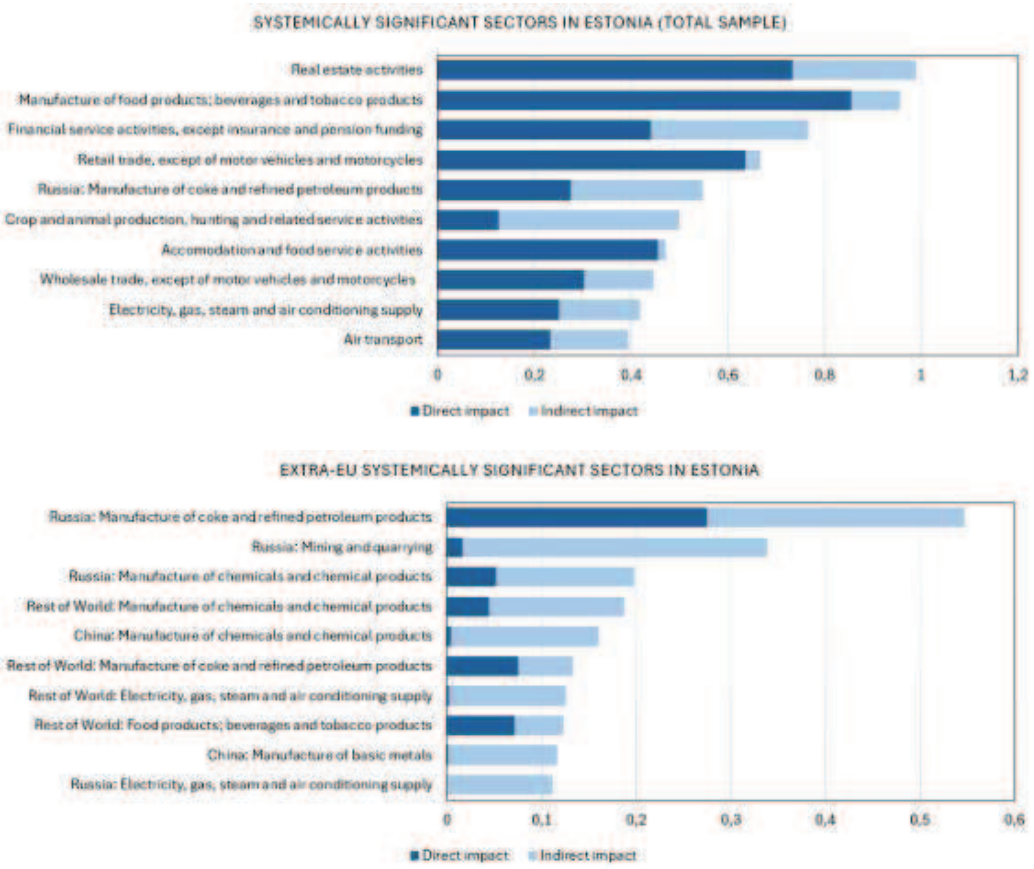
Source: own elaboration. The figure displays the top-10 results of all the price shock simulations for each individual industry using the I-O model. The total impact on inflation is given by the total length of each bar and represents the total change in the country's synthetic CPI following the price shock which was imputed to a given industry. Each bar is divided into two segments: the direct impact of the price shock in the synthetic CPI (in dark blue) and the indirect impact of the shock in the synthetic CPI through intersectoral linkages (in light blue). Systemically significant industries from foreign countries are identified with the name of the respective country before the description of the industry.

Figure A8. Top-10 systemically significant sectors in Denmark: total sample and non-EU countries



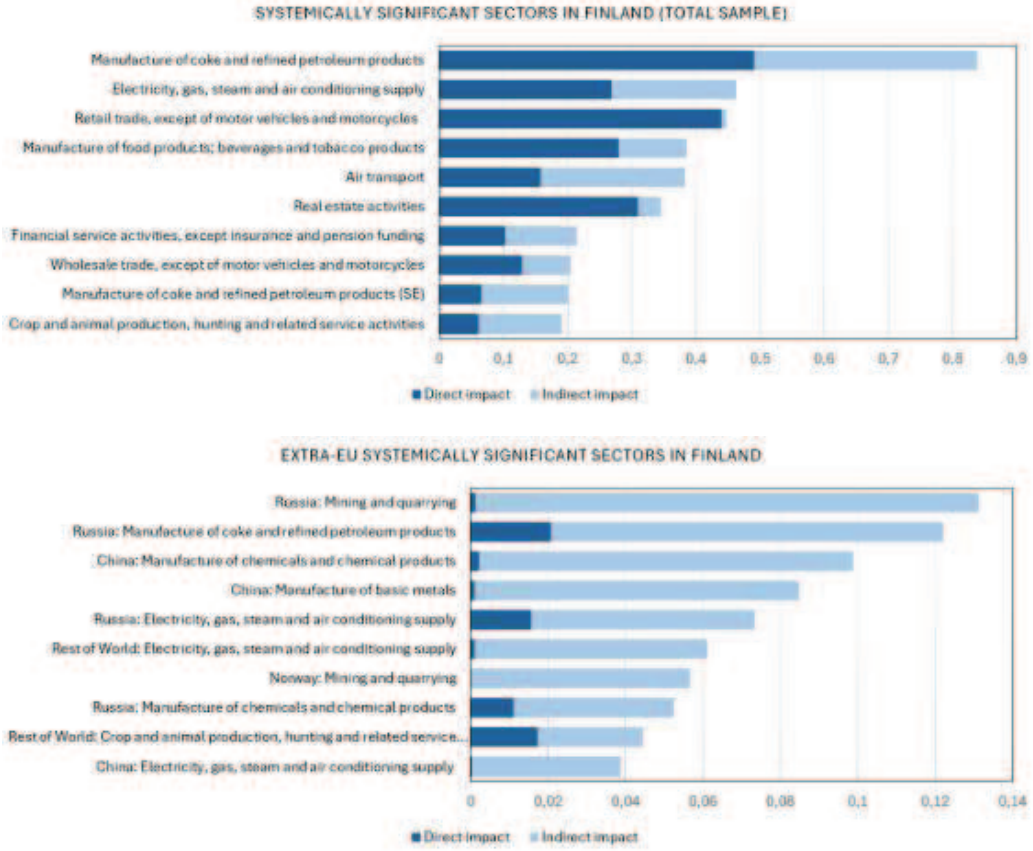
Source: own elaboration. The figure displays the top-10 results of all the price shock simulations for each individual industry using the I-O model. The total impact on inflation is given by the total length of each bar and represents the total change in the country's synthetic CPI following the price shock which was imputed to a given industry. Each bar is divided into two segments: the direct impact of the price shock in the synthetic CPI (in dark blue) and the indirect impact of the shock in the synthetic CPI through intersectoral linkages (in light blue). Systemically significant industries from foreign countries are identified with the name of the respective country before the description of the industry.

Figure A9. Top-10 systemically significant sectors in Estonia: total sample and non-EU countries



Source: own elaboration. The figure displays the top-10 results of all the price shock simulations for each individual industry using the I-O model. The total impact on inflation is given by the total length of each bar and represents the total change in the country's synthetic CPI following the price shock which was imputed to a given industry. Each bar is divided into two segments: the direct impact of the price shock in the synthetic CPI (in dark blue) and the indirect impact of the shock in the synthetic CPI through intersectoral linkages (in light blue). Systemically significant industries from foreign countries are identified with the name of the respective country before the description of the industry.

Figure A10. Top-10 systemically significant sectors in Finland: total sample and non-EU countries

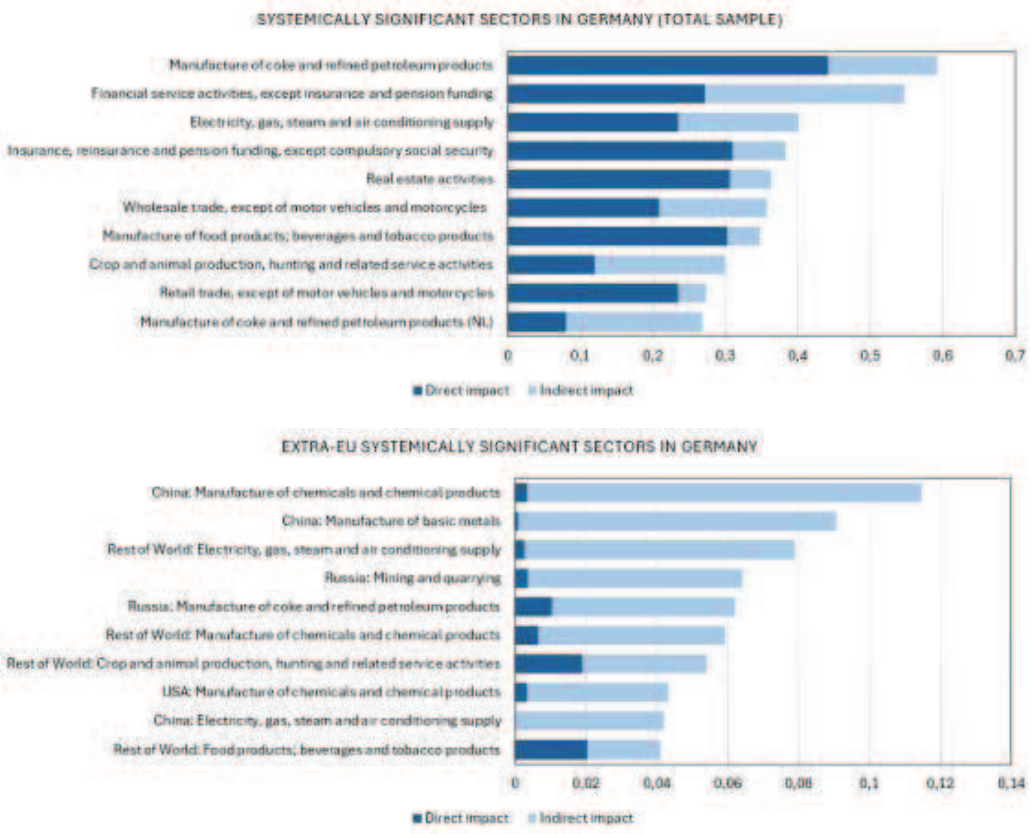


Source: own elaboration. The figure displays the top-10 results of all the price shock simulations for each individual industry using the I-O model. The total impact on inflation is given by the total length of each bar and represents the total change in the country's synthetic CPI following the price shock which was imputed to a given industry. Each bar is divided into two segments: the direct impact of the price shock in the synthetic CPI (in dark blue) and the indirect impact of the shock in the synthetic CPI through intersectoral linkages (in light blue). Systemically significant industries from foreign countries are identified with the name of the respective country before the description of the industry.

Figure A11. Top-10 systemically significant sectors in France: total sample and non-EU countries

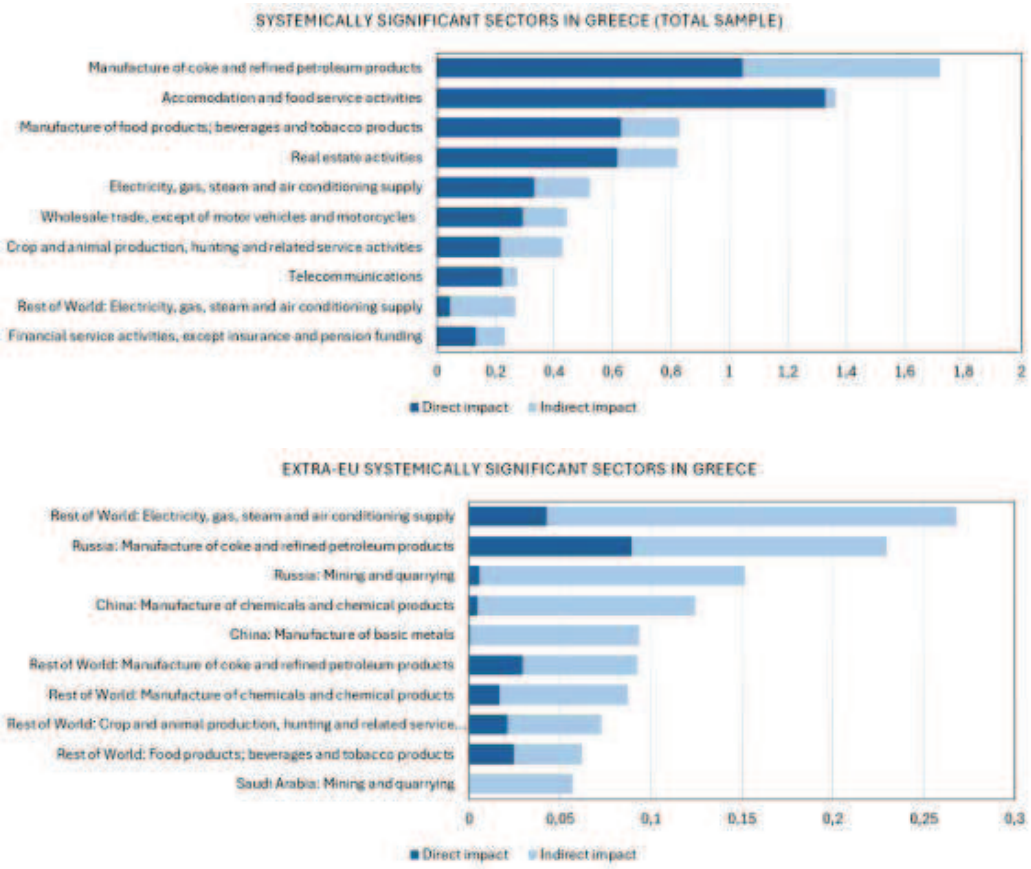
Source: own elaboration. The figure displays the top-10 results of all the price shock simulations for each individual industry using the I-O model. The total impact on inflation is given by the total length of each bar and represents the total change in the country's synthetic CPI following the price shock which was imputed to a given industry. Each bar is divided into two segments: the direct impact of the price shock in the synthetic CPI (in dark blue) and the indirect impact of the shock in the synthetic CPI through intersectoral linkages (in light blue). Systemically significant industries from foreign countries are identified with the name of the respective country before the description of the industry.

Figure A12. Top-10 systemically significant sectors in Germany: total sample and non-EU countries



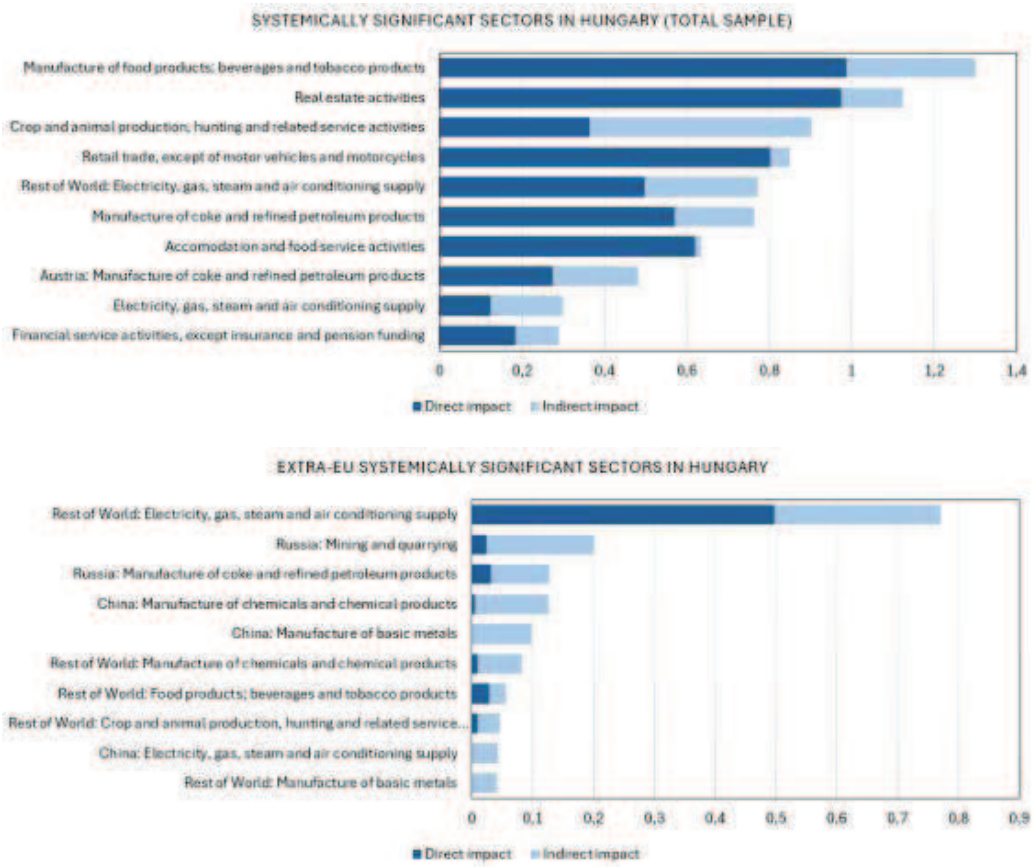
Source: own elaboration. The figure displays the top-10 results of all the price shock simulations for each individual industry using the I-O model. The total impact on inflation is given by the total length of each bar and represents the total change in the country's synthetic CPI following the price shock which was imputed to a given industry. Each bar is divided into two segments: the direct impact of the price shock in the synthetic CPI (in dark blue) and the indirect impact of the shock in the synthetic CPI through intersectoral linkages (in light blue). Systemically significant industries from foreign countries are identified with the name of the respective country before the description of the industry.

Figure A13. Top-10 systemically significant sectors in Greece: total sample and non-EU countries



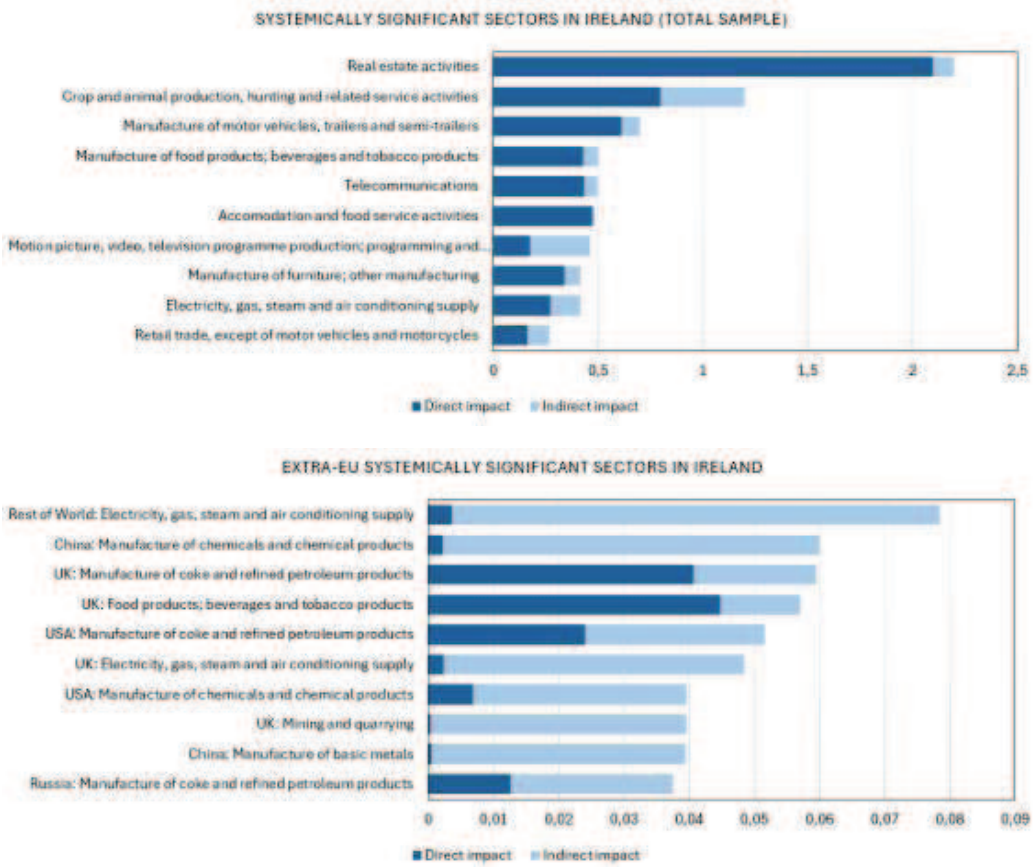
Source: own elaboration. The figure displays the top-10 results of all the price shock simulations for each individual industry using the I-O model. The total impact on inflation is given by the total length of each bar and represents the total change in the country's synthetic CPI following the price shock which was imputed to a given industry. Each bar is divided into two segments: the direct impact of the price shock in the synthetic CPI (in dark blue) and the indirect impact of the shock in the synthetic CPI through intersectoral linkages (in light blue). Systemically significant industries from foreign countries are identified with the name of the respective country before the description of the industry.

Figure A14. Top-10 systemically significant sectors in Hungary: total sample and non-EU countries



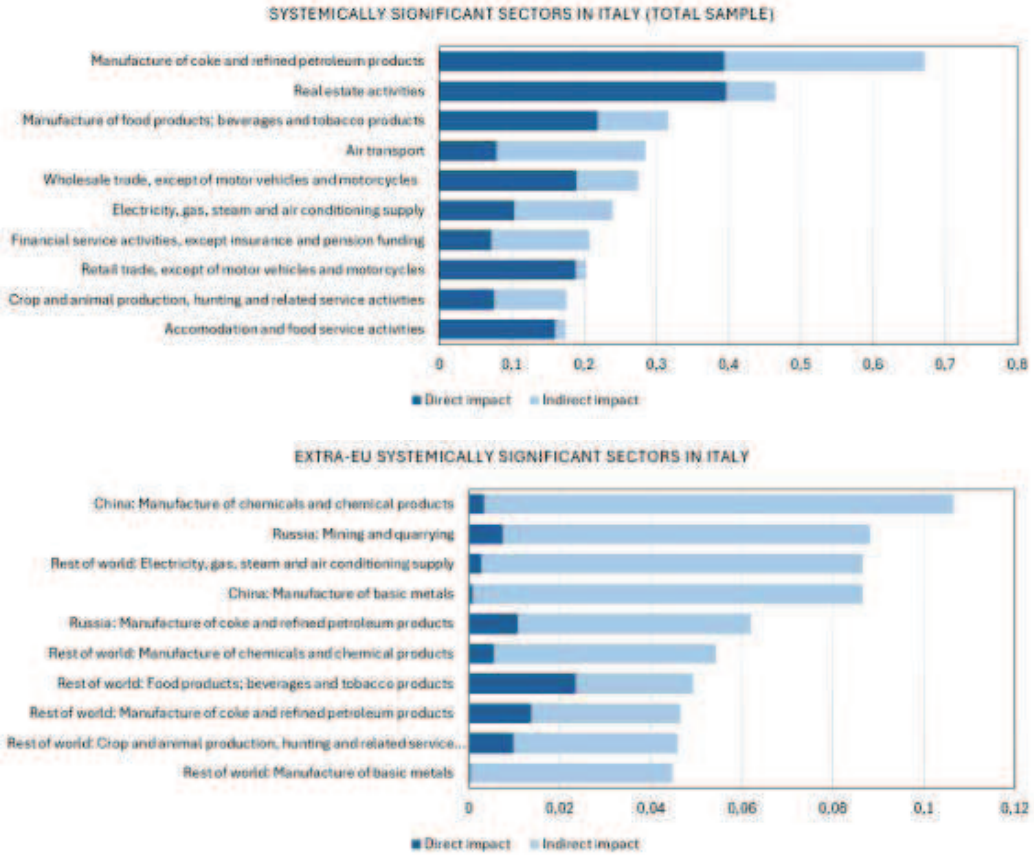
Source: own elaboration. The figure displays the top-10 results of all the price shock simulations for each individual industry using the I-O model. The total impact on inflation is given by the total length of each bar and represents the total change in the country's synthetic CPI following the price shock which was imputed to a given industry. Each bar is divided into two segments: the direct impact of the price shock in the synthetic CPI (in dark blue) and the indirect impact of the shock in the synthetic CPI through intersectoral linkages (in light blue). Systemically significant industries from foreign countries are identified with the name of the respective country before the description of the industry.

Figure A15. Top-10 systemically significant sectors in Ireland: total sample and non-EU countries



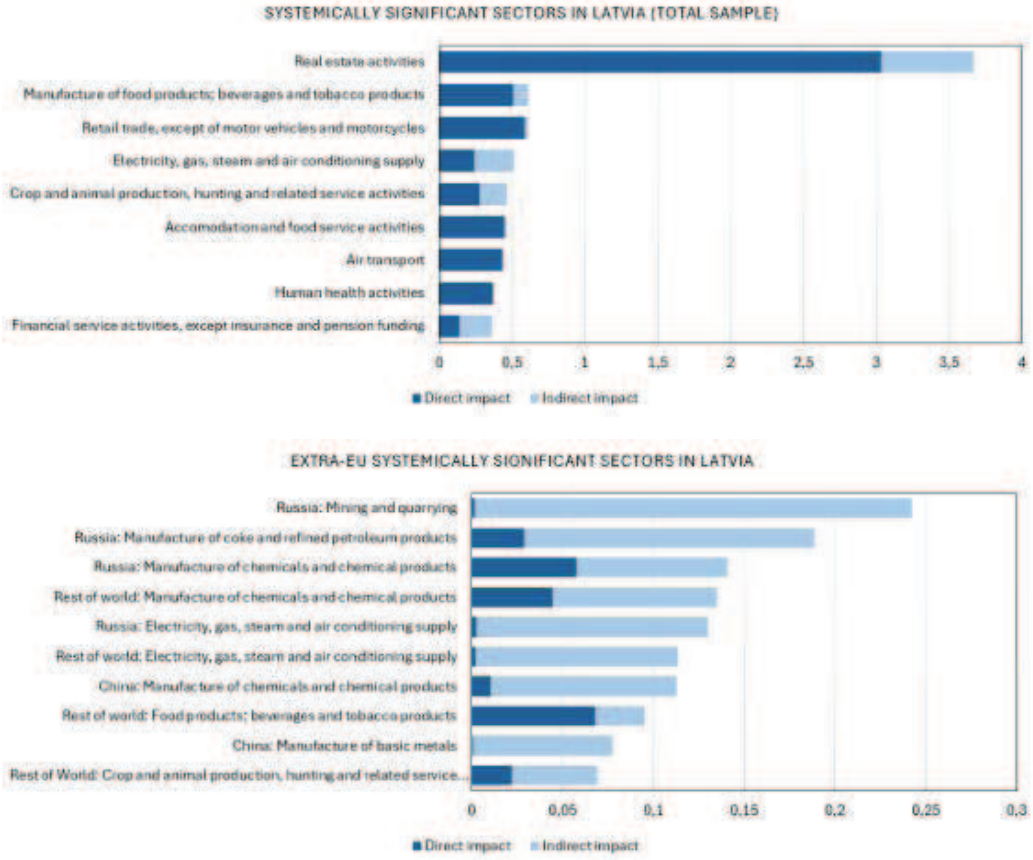
Source: own elaboration. The figure displays the top-10 results of all the price shock simulations for each individual industry using the I-O model. The total impact on inflation is given by the total length of each bar and represents the total change in the country's synthetic CPI following the price shock which was imputed to a given industry. Each bar is divided into two segments: the direct impact of the price shock in the synthetic CPI (in dark blue) and the indirect impact of the shock in the synthetic CPI through intersectoral linkages (in light blue). Systemically significant industries from foreign countries are identified with the name of the respective country before the description of the industry.

Figure A16. Top-10 systemically significant sectors in Italy: total sample and non-EU countries



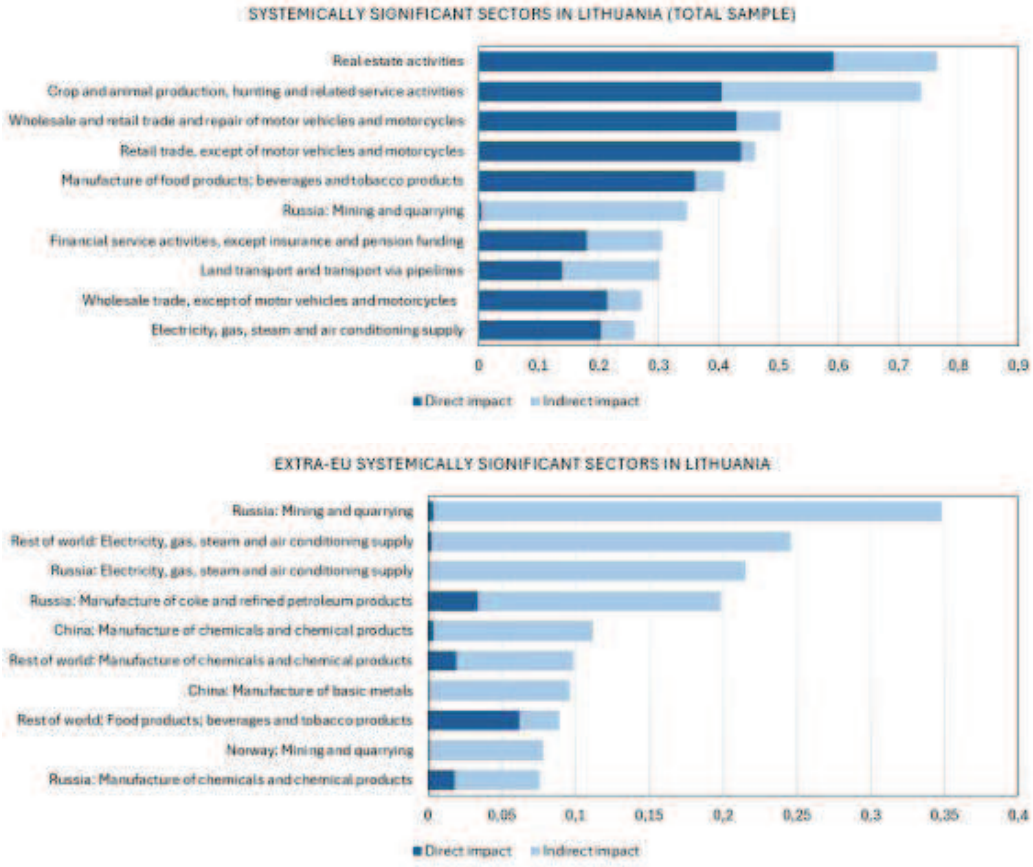
Source: own elaboration. The figure displays the top-10 results of all the price shock simulations for each individual industry using the I-O model. The total impact on inflation is given by the total length of each bar and represents the total change in the country's synthetic CPI following the price shock which was imputed to a given industry. Each bar is divided into two segments: the direct impact of the price shock in the synthetic CPI (in dark blue) and the indirect impact of the shock in the synthetic CPI through intersectoral linkages (in light blue). Systemically significant industries from foreign countries are identified with the name of the respective country before the description of the industry.

Figure A17. Top-10 systemically significant sectors in Latvia: total sample and non-EU countries



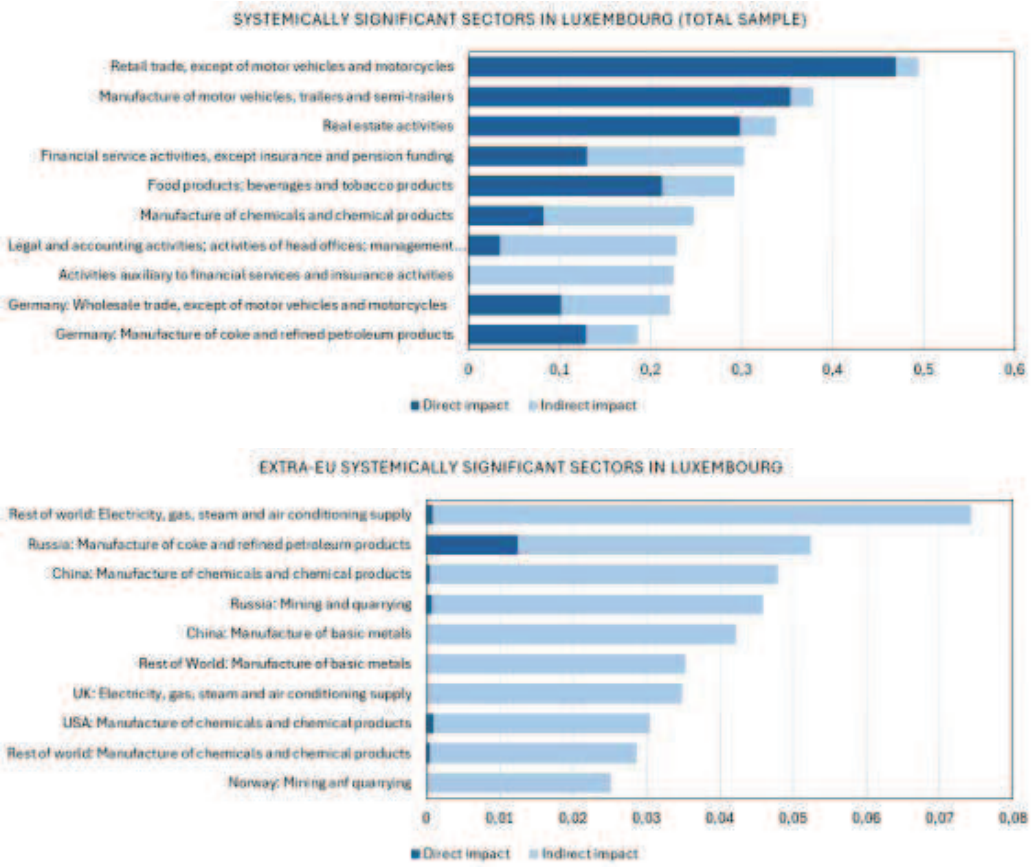
Source: own elaboration. The figure displays the top-10 results of all the price shock simulations for each individual industry using the I-O model. The total impact on inflation is given by the total length of each bar and represents the total change in the country's synthetic CPI following the price shock which was imputed to a given industry. Each bar is divided into two segments: the direct impact of the price shock in the synthetic CPI (in dark blue) and the indirect impact of the shock in the synthetic CPI through intersectoral linkages (in light blue). Systemically significant industries from foreign countries are identified with the name of the respective country before the description of the industry.

Figure A18. Top-10 systemically significant sectors in Lithuania: total sample and non-EU countries



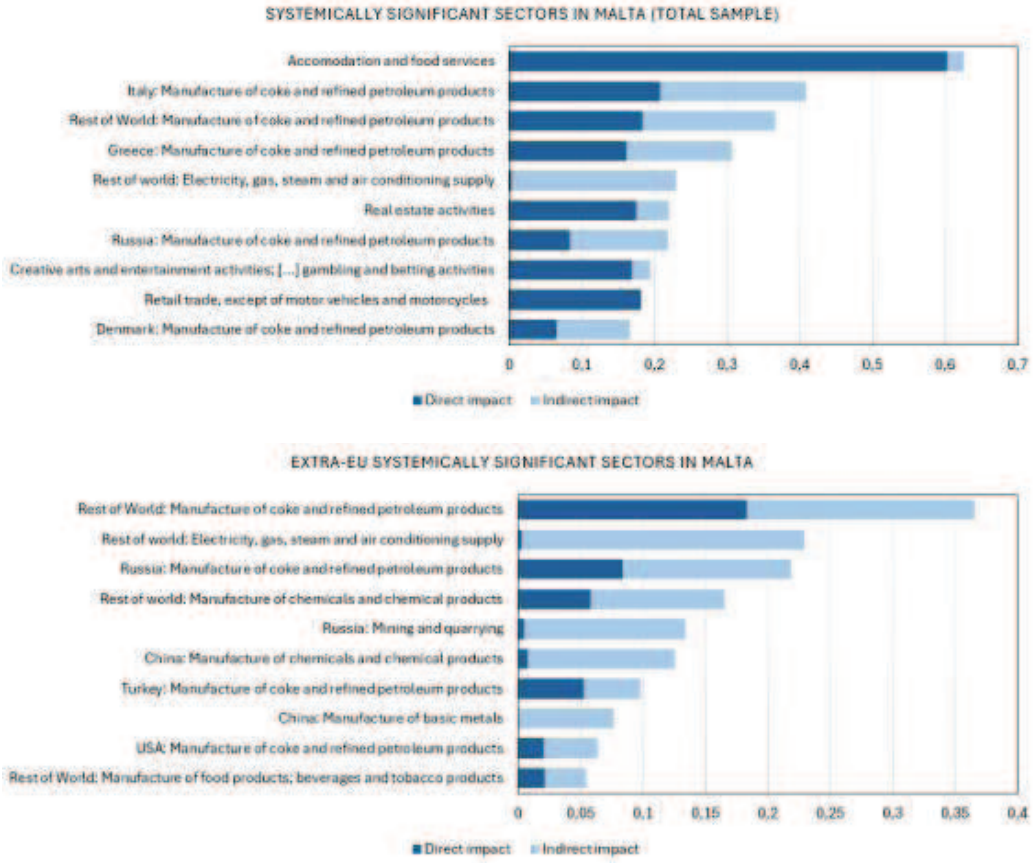
Source: own elaboration. The figure displays the top-10 results of all the price shock simulations for each individual industry using the I-O model. The total impact on inflation is given by the total length of each bar and represents the total change in the country's synthetic CPI following the price shock which was imputed to a given industry. Each bar is divided into two segments: the direct impact of the price shock in the synthetic CPI (in dark blue) and the indirect impact of the shock in the synthetic CPI through intersectoral linkages (in light blue). Systemically significant industries from foreign countries are identified with the name of the respective country before the description of the industry.

Figure A19. Top-10 systemically significant sectors in Luxembourg: total sample and non-EU countries



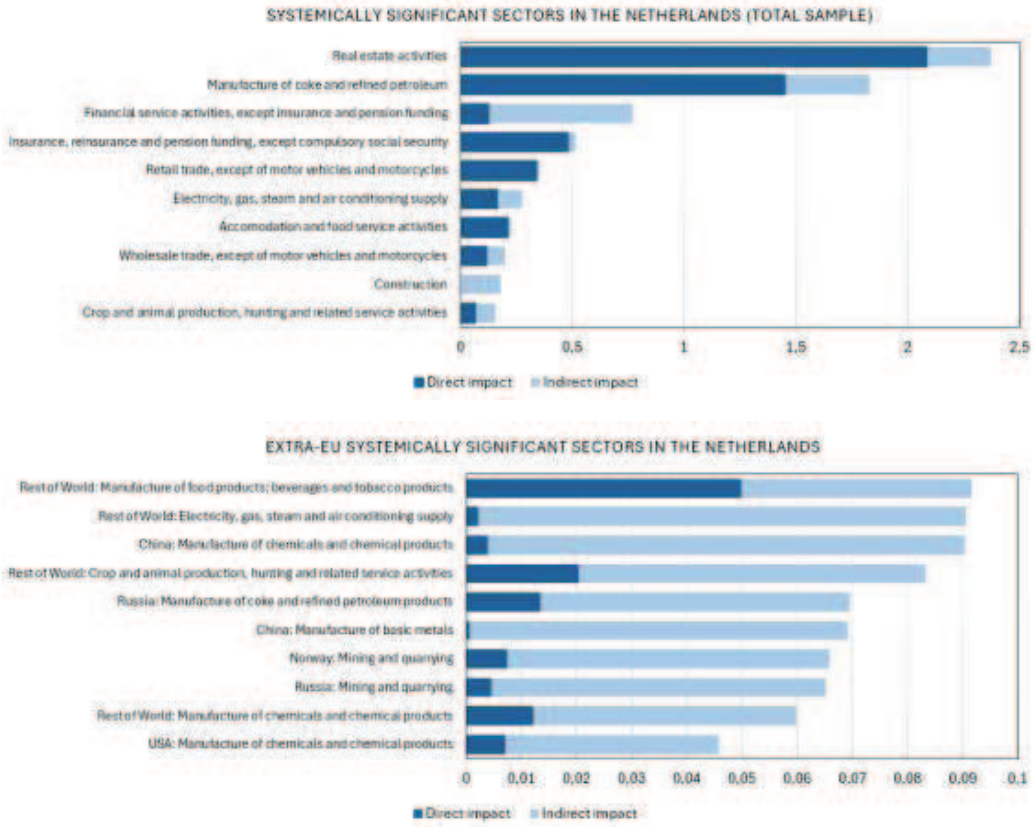
Source: own elaboration. The figure displays the top-10 results of all the price shock simulations for each individual industry using the I-O model. The total impact on inflation is given by the total length of each bar and represents the total change in the country's synthetic CPI following the price shock which was imputed to a given industry. Each bar is divided into two segments: the direct impact of the price shock in the synthetic CPI (in dark blue) and the indirect impact of the shock in the synthetic CPI through intersectoral linkages (in light blue). Systemically significant industries from foreign countries are identified with the name of the respective country before the description of the industry.

Figure A20. Top-10 systemically significant sectors in Malta: total sample and non-EU countries



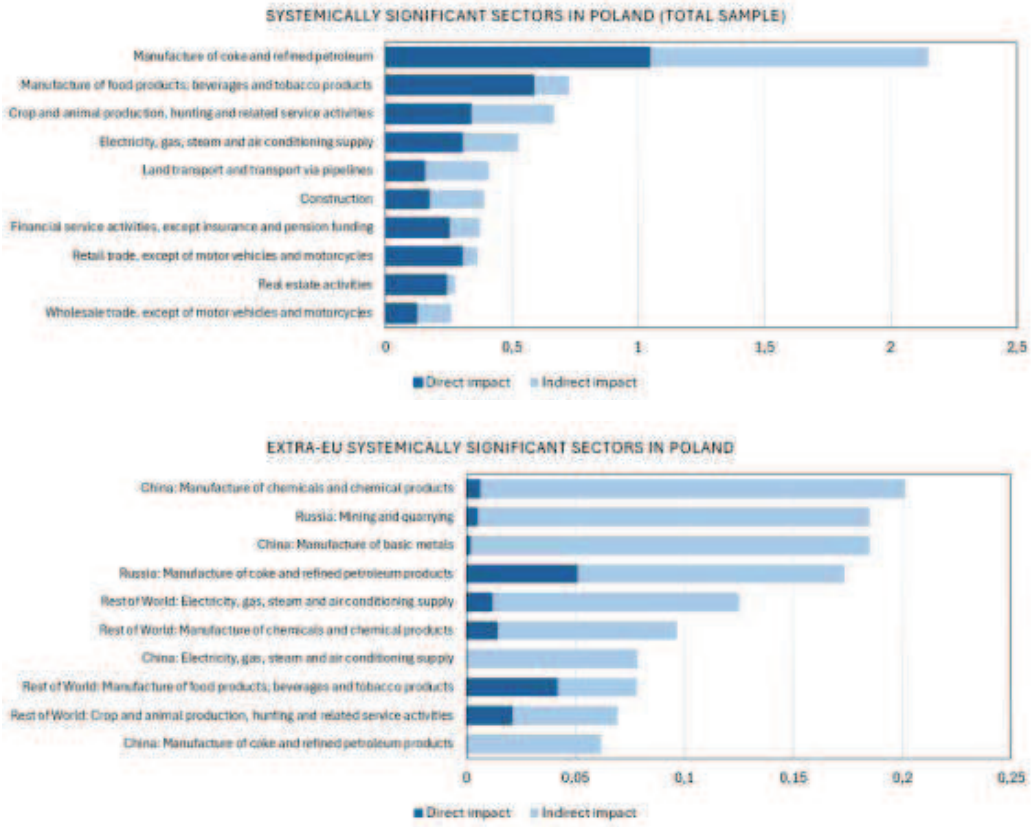
Source: own elaboration. The figure displays the top-10 results of all the price shock simulations for each individual industry using the I-O model. The total impact on inflation is given by the total length of each bar and represents the total change in the country's synthetic CPI following the price shock which was imputed to a given industry. Each bar is divided into two segments: the direct impact of the price shock in the synthetic CPI (in dark blue) and the indirect impact of the shock in the synthetic CPI through intersectoral linkages (in light blue). Systemically significant industries from foreign countries are identified with the name of the respective country before the description of the industry.

Figure A21. Top-10 systemically significant sectors in Netherlands: total sample and non-EU countries



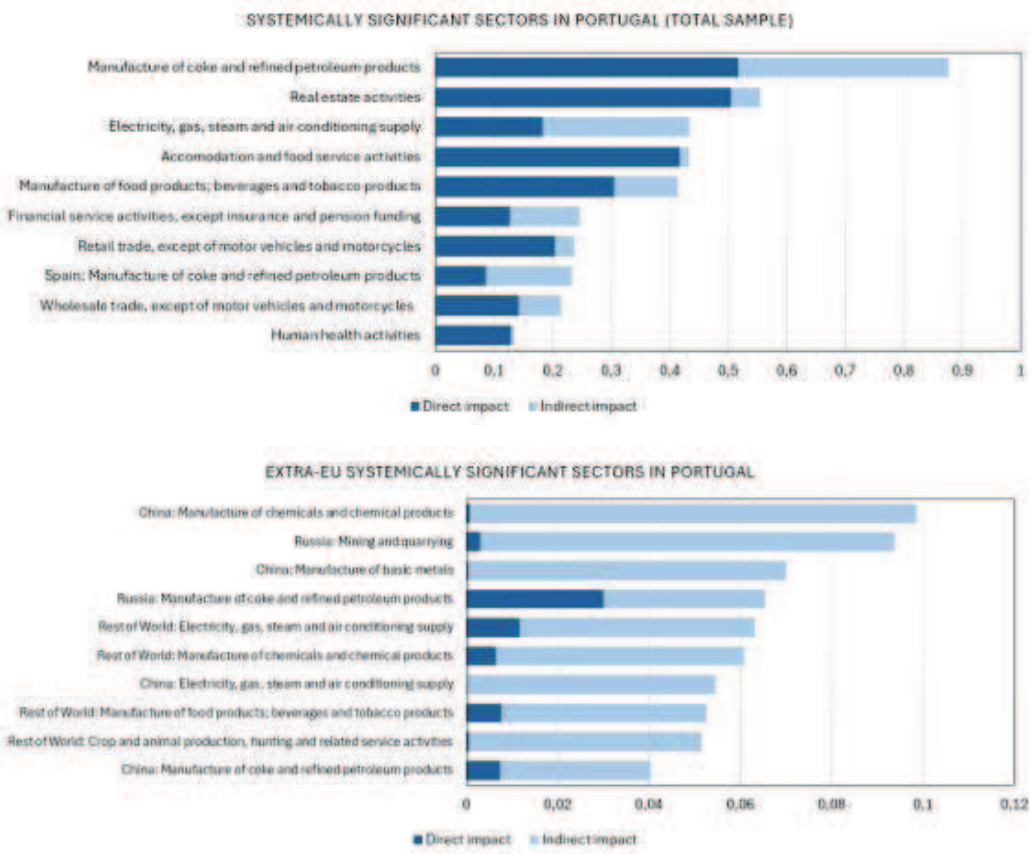
Source: own elaboration. The figure displays the top-10 results of all the price shock simulations for each individual industry using the I-O model. The total impact on inflation is given by the total length of each bar and represents the total change in the country's synthetic CPI following the price shock which was imputed to a given industry. Each bar is divided into two segments: the direct impact of the price shock in the synthetic CPI (in dark blue) and the indirect impact of the shock in the synthetic CPI through intersectoral linkages (in light blue). Systemically significant industries from foreign countries are identified with the name of the respective country before the description of the industry.

Figure A22. Top-10 systemically significant sectors in Poland: total sample and non-EU countries



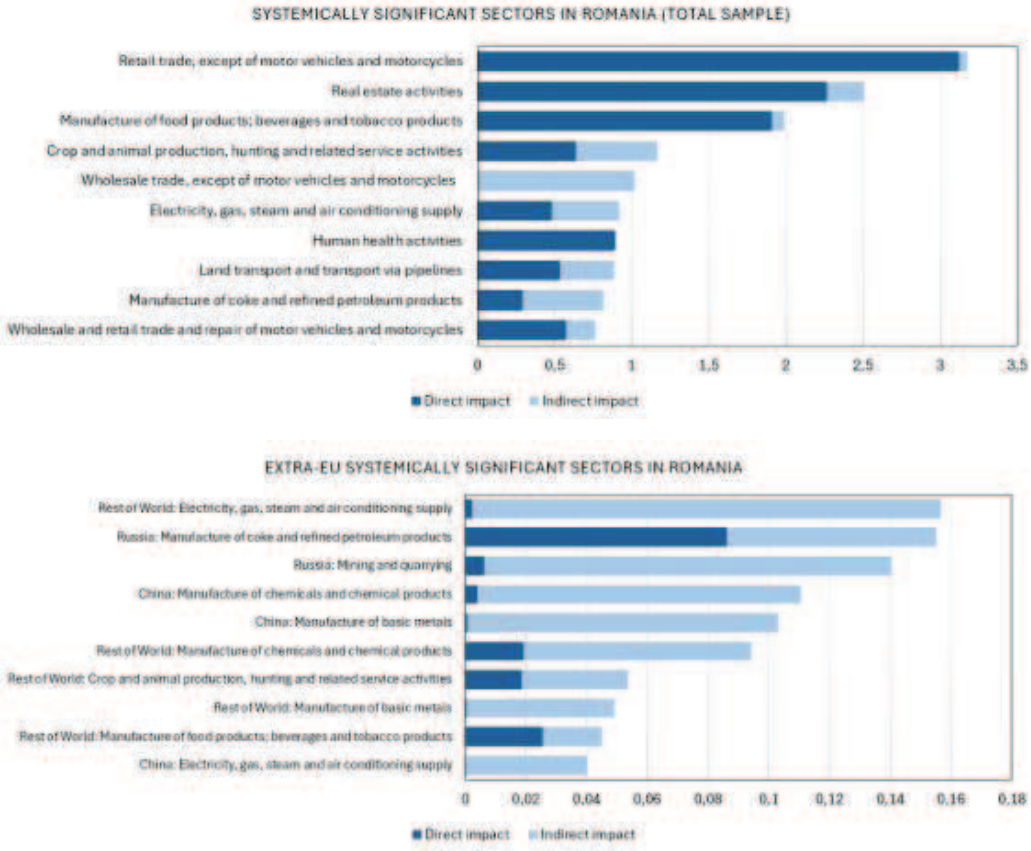
Source: own elaboration. The figure displays the top-10 results of all the price shock simulations for each individual industry using the I-O model. The total impact on inflation is given by the total length of each bar and represents the total change in the country's synthetic CPI following the price shock which was imputed to a given industry. Each bar is divided into two segments: the direct impact of the price shock in the synthetic CPI (in dark blue) and the indirect impact of the shock in the synthetic CPI through intersectoral linkages (in light blue). Systemically significant industries from foreign countries are identified with the name of the respective country before the description of the industry.

Figure A23. Top-10 systemically significant sectors in Portugal: total sample and non-EU countries



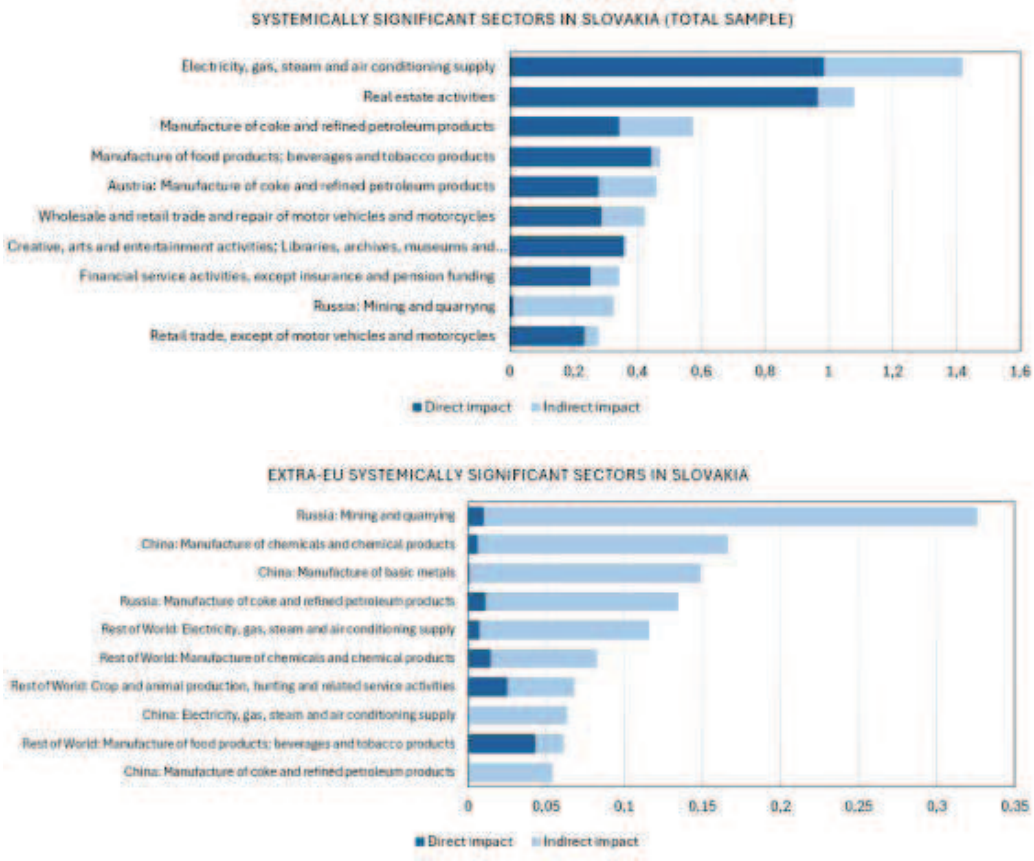
Source: own elaboration. The figure displays the top-10 results of all the price shock simulations for each individual industry using the I-O model. The total impact on inflation is given by the total length of each bar and represents the total change in the country's synthetic CPI following the price shock which was imputed to a given industry. Each bar is divided into two segments: the direct impact of the price shock in the synthetic CPI (in dark blue) and the indirect impact of the shock in the synthetic CPI through intersectoral linkages (in light blue). Systemically significant industries from foreign countries are identified with the name of the respective country before the description of the industry.

Figure A24. Top-10 systemically significant sectors in Romania: total sample and non-EU countries



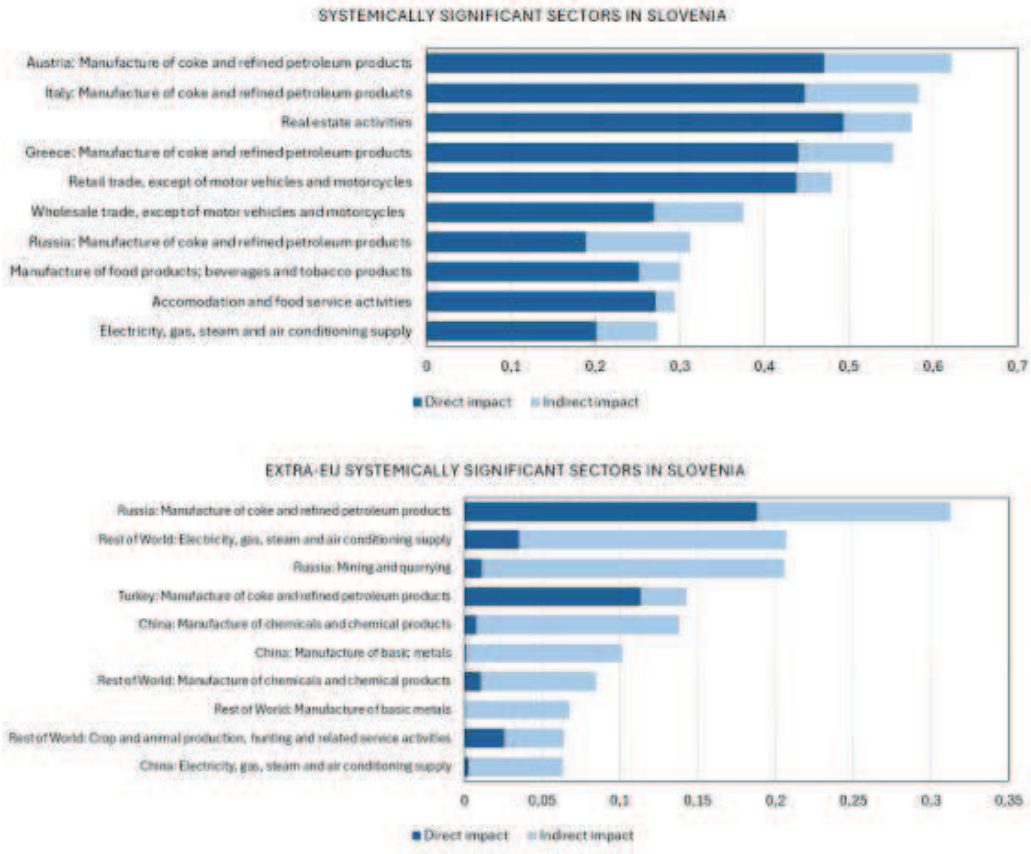
Source: own elaboration. The figure displays the top-10 results of all the price shock simulations for each individual industry using the I-O model. The total impact on inflation is given by the total length of each bar and represents the total change in the country's synthetic CPI following the price shock which was imputed to a given industry. Each bar is divided into two segments: the direct impact of the price shock in the synthetic CPI (in dark blue) and the indirect impact of the shock in the synthetic CPI through intersectoral linkages (in light blue). Systemically significant industries from foreign countries are identified with the name of the respective country before the description of the industry.

Figure A25. Top-10 systemically significant sectors in Slovakia: total sample and non-EU countries



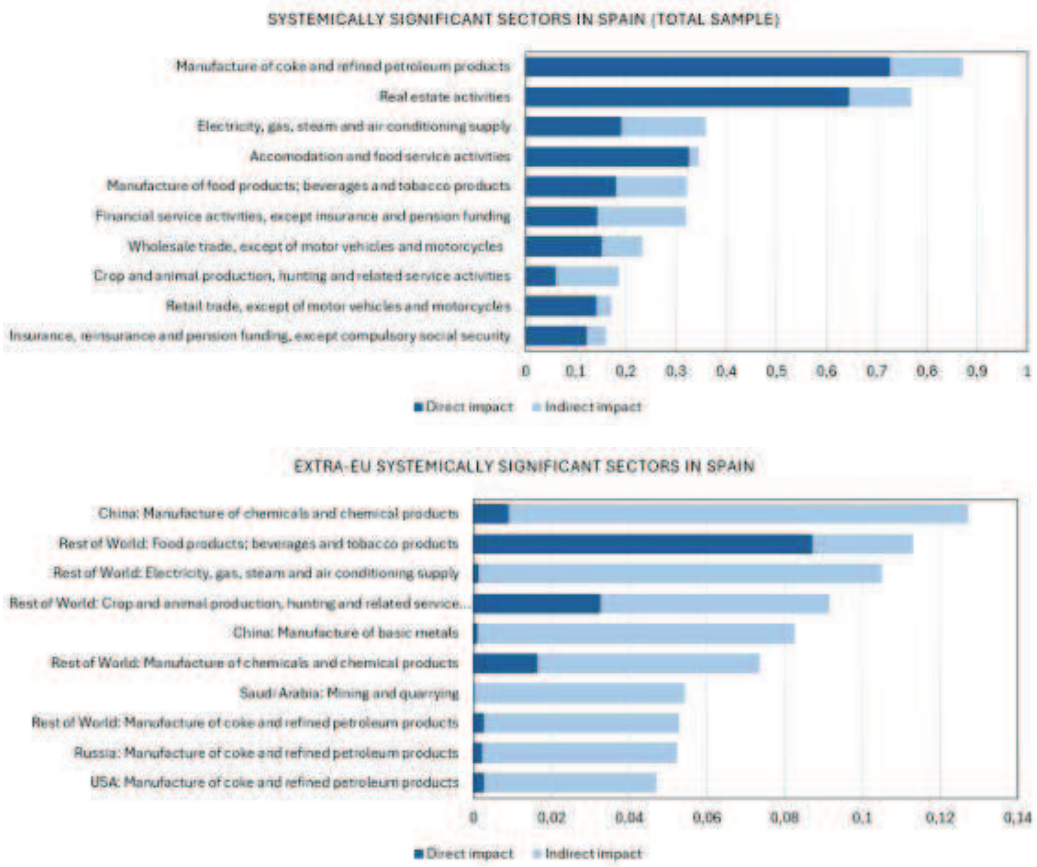
Source: own elaboration. The figure displays the top-10 results of all the price shock simulations for each individual industry using the I-O model. The total impact on inflation is given by the total length of each bar and represents the total change in the country's synthetic CPI following the price shock which was imputed to a given industry. Each bar is divided into two segments: the direct impact of the price shock in the synthetic CPI (in dark blue) and the indirect impact of the shock in the synthetic CPI through intersectoral linkages (in light blue). Systemically significant industries from foreign countries are identified with the name of the respective country before the description of the industry.

Figure A26. Top-10 systemically significant sectors in Slovenia: total sample and non-EU countries



Source: own elaboration. The figure displays the top-10 results of all the price shock simulations for each individual industry using the I-O model. The total impact on inflation is given by the total length of each bar and represents the total change in the country's synthetic CPI following the price shock which was imputed to a given industry. Each bar is divided into two segments: the direct impact of the price shock in the synthetic CPI (in dark blue) and the indirect impact of the shock in the synthetic CPI through intersectoral linkages (in light blue). Systemically significant industries from foreign countries are identified with the name of the respective country before the description of the industry.

Figure A27. Top-10 systemically significant sectors in Spain: total sample and non-EU countries



Source: own elaboration. The figure displays the top-10 results of all the price shock simulations for each individual industry using the I-O model. The total impact on inflation is given by the total length of each bar and represents the total change in the country's synthetic CPI following the price shock which was imputed to a given industry. Each bar is divided into two segments: the direct impact of the price shock in the synthetic CPI (in dark blue) and the indirect impact of the shock in the synthetic CPI through intersectoral linkages (in light blue). Systemically significant industries from foreign countries are identified with the name of the respective country before the description of the industry.

Figure A28. Top-10 systemically significant sectors in Sweden: total sample and non-EU countries

Source: own elaboration. The figure displays the top-10 results of all the price shock simulations for each individual industry using the I-O model. The total impact on inflation is given by the total length of each bar and represents the total change in the country's synthetic CPI following the price shock which was imputed to a given industry. Each bar is divided into two segments: the direct impact of the price shock in the synthetic CPI (in dark blue) and the indirect impact of the shock in the synthetic CPI through intersectoral linkages (in light blue). Systemically significant industries from foreign countries are identified with the name of the respective country before the description of the industry.