NAVIGATING SHOCKS: THE PERFORMANCE OF THE EU CORPORATE SECTOR FROM THE PANDEMIC TO THE ENERGY CRISIS

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Abstract

The EU corporate sector has been subject to severe shocks in recent years, i.e., the administrative restrictions on activity in the context of the COVID-19 pandemic, the supply bottlenecks in its aftermath, and more recently the spike in energy prices in the context of the full-scale invasion of Ukraine by the Russian Federation. This paper uses the latest available industry- and firm-level data to quantify the impact of the spike in energy prices on cost-price dynamics and corporate profitability of non-financial corporations (NFCs). Firstly, we document price-cost margin developments at the country-industry level by computing production cost indices at quarterly frequency. In this step, input-output tables are used to construct implicit input deflators. Secondly, we plug these price-cost margin developments into the latest available financial statements of the firm to simulate the evolution of profitability over 2022-2023. Thirdly, we characterise the evolution of profitability for publicly listed EU firms, based on their published financial accounts up to 2023.

In the first step, we uncover a positive relationship between production cost increases and the energy intensity of the industry, only partly compensated by producer price growth. In the second step, we find that 20% of NFCs had negative cumulative operating profits over 2022-2023. About half of these firms posted positive profits in 2021, underpinning the contribution of partial pass-through to a deterioration of corporate profitability. In the third step, we provide an indirect robustness check of our simulations, by showing that the spike in energy prices had a negative effect on NFC profitability overall. Further, we assess the role of exposure to the shock. We find that profitability growth of energy intensive firms was pushed into negative territory over 2016-2023. This result holds for gross, operating, and net profit margins. Overall, the results suggest that while there has been substantial pass-through of production cost increases to producer prices, dampening the impact on profitability, the spike in energy prices was associated with a deterioration in cost competitiveness. Longer-term challenges remain, particularly for energy-intensive industries, that require more structural solutions.

JEL classification: C23, C67, D22, D24.

Keywords: Corporate profitability, COVID-19, energy prices, input-output linkages, firm-level data.

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1. INTRODUCTION

The EU corporate sector was hit by large shocks in recent years. The COVID-19 pandemic and the surge in energy prices in 2022-2023 have hurt the business model of several industries and raised concerns about the performance of firms and their financial health. While the corporate sector has been resilient overall, there have been important differences across industries. After the outbreak of the pandemic, the EU economy recovered swiftly in 2021 and avoided a recession in 2022-2023 despite the energy price shock. While the immediate emergencies have largely dissipated, some sectors that have been harder hit are still ailing. This is the case for contact-intensive services, hit by the COVID-19 shock (Archanskaia et al. 2023a), and energy-intensive industries (EEIs) in response to the energy crisis.

This paper takes stock of the performance in 2022 and 2023 of non-financial corporations (NFCs) in the EU, using various data sources to extract insights almost in real time. It explores the still patchy picture of corporate developments in 2022 and 2023 using three complementary approaches and data sources: (1) *Industry-level output deflators* combined with *input-output tables* to infer underlying price and cost developments at the industry-level; (2) combining these price-cost developments at the industry level for 2022-2023 with available 2021 *firm-level data* (Orbis) to *simulate* implications for *firm-level profitability* over 2022-2023; and (3) using financial accounts until 2023 of *publicly listed European firms* to infer the average effect of each shock (pandemic in 2020, energy shock in 2022-2023) on these firms' profitability, taking into account their exposure to the shocks.

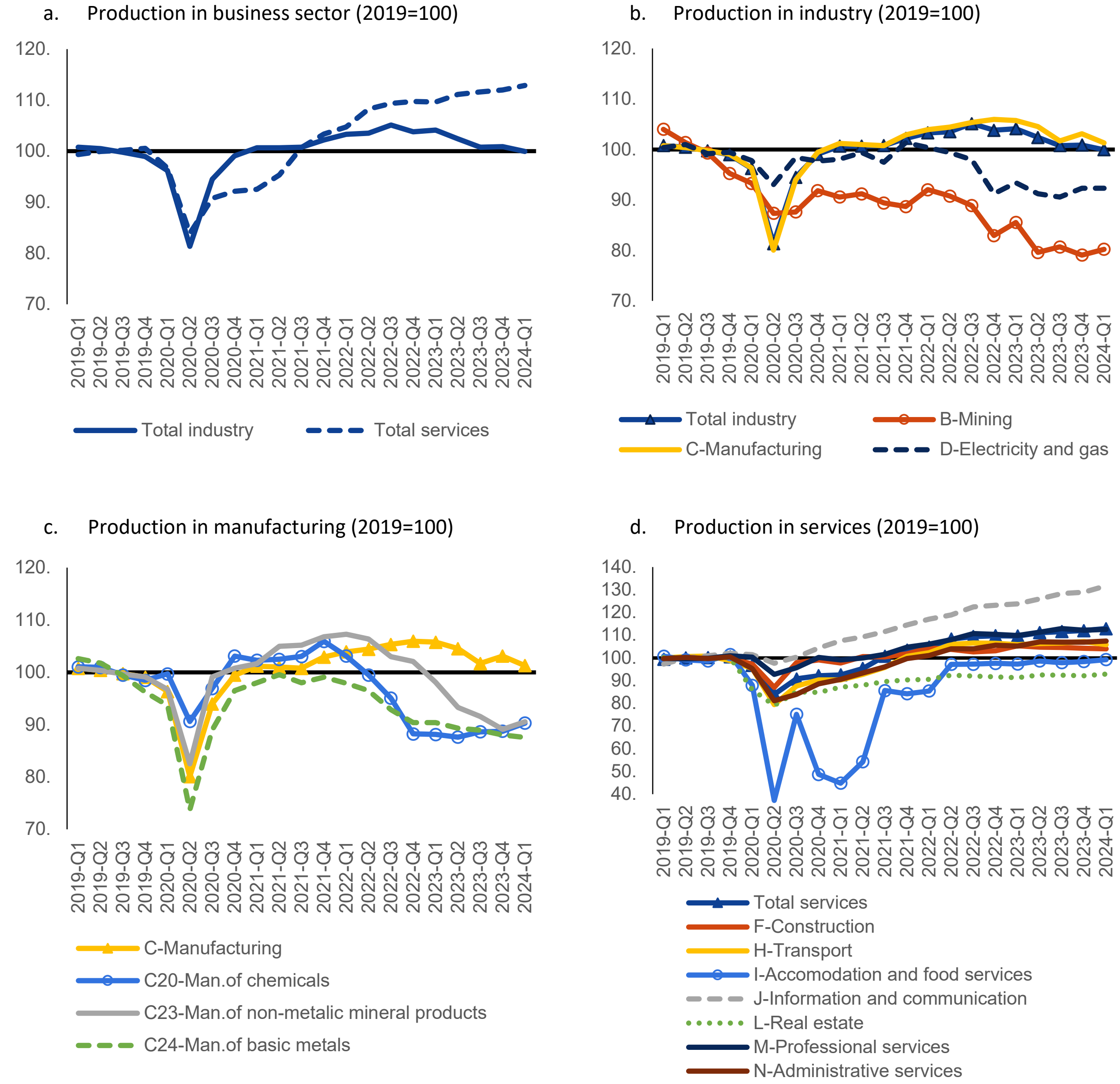
The paper builds on earlier analysis of corporate performance, while taking into account the most recent developments and leveraging additional data sources. Previous work, summarised in Archanskaia et al. (2023), looking at the period between the first quarter of 2021 and the fourth quarter of 2022 (2021Q4-2022Q4), concluded that firms were generally able to pass through the increase in energy costs to prices, with some cross-industry differences. The present paper extends the period of analysis to 2023Q4. Overall, production costs and output prices for the EU corporate sector have increased in the same proportion. However, the average masks substantial heterogeneity between sectors. We document that production costs increased more strongly for energy-intensive industries (EIIs). We also pick up a (weak) negative relationship between energy intensity and profitability at the industry level. We use granular data sources (firm-level, product-level) to quantify the deterioration of corporate performance in 2022 and 2023, and to evaluate whether this deterioration depends on the energy intensity of the activity. We also document a significant deterioration of export performance of more exposed industries. Further, we find a negative relationship between energy intensity and firm profitability, documenting that the energy price shock pushed profit margin growth into negative territory for sufficiently energy intensive firms.

The results in this paper resonate with findings from recent literature. Fontagné et al. (2024), based on firm-level data from the French manufacturing sector for the period 1996–2019, find that firms adapt to energy shocks through multiple channels of adjustment, including increased energy efficiency and input substitution. Firms in their sample appeared to be able, on average, to pass through energy price shocks fully into prices, but at the expense of lower production, employment, and exports. Reductions in profits in their sample have been largely limited to the most energy-intensive firms. Another study on French manufacturing firms over the period 2018-22, by Lafrogne-Joussier et al. (2023), finds complete pass through of energy price changes to downstream sectors on average. The authors also find evidence for some asymmetry in price adjustment, with pass-through more pronounced for positive as opposed to negative cost shocks, an issue not explored in this paper given the focus on the large negative energy price shock of 2022-2023. A study on firm-level data for Belgium by Bijnens et al. (2023) concludes that price increases in 2022 were largely attributable to rising intermediate input costs and markups appeared to play no role in driving up prices. Bijnens et al. (2024) show that profit margins of Belgian firms deteriorated across the economy in 2022, but, contrary to other sectors, firms in EIIs were not able to restore the margins in 2023, despite the reduction in energy prices compared to 2022. For the US, Alvarez et al. (2024) analyse changes in profit margins along the value chain. Based on firm-level data on production costs and retail prices covering mid-2018 to mid-2023 they find that retail has tended to absorb fluctuations in manufacturers' profit margins, i.e., the authors document a negative correlation between manufacturing and retail markups.

2. ACTIVITY AND EXPORTS IN THE CORPORATE SECTOR

The pandemic and the energy price increase have affected the EU corporate sector unevenly, depending on their sector. The COVID-19 pandemic translated into sector-specific shocks with supply (lockdowns) and demand (social distancing as preference shift) components. It affected directly and primarily contact-intensive services (accommodation, gastronomy, tourism). Meanwhile, Russia's war of aggression against Ukraine led to a disruption of fossil fuel supply, exposing a need to change the structure of EU's energy supply model. The resulting surge in energy prices implied a steep increase in production costs, particularly affecting energy-intensive industries (EIIs).

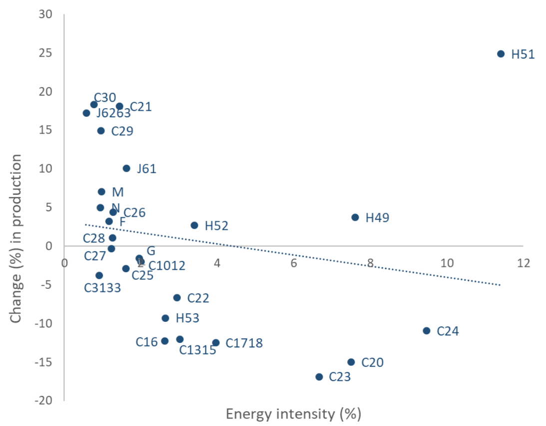
Graph 1. **NFC production volumes by sector, EU27**



Source: Eurostat Short-term Business Statistics (STS).

The EU economy has been resilient overall, but the strong sectoral heterogeneity in the impact of each shock is visible in the output data. Activity in industry and services contracted sharply in 2020, but industry output recovered quickly after the first lockdowns, whereas recovery in services took more time (Graph 1). Following the energy price shock, overall activity has been resilient in 2022-2023, but serious concerns emerged about a deindustrialisation of Europe in relatively energy-intensive industries. Real economic activity in industry declined in 2022-2023, driven by energy-intensive manufacturing (production volumes fell by 10-20% in chemicals (C20), minerals (C23), and basic metals (C24) compared to 2021Q4) and power supply, complemented by the downward trend in mining that started pre-2022. Service sector activity, by contrast, has grown over this period, continuing its recovery, especially in ICT services (Graphs 1 and 2).[1]

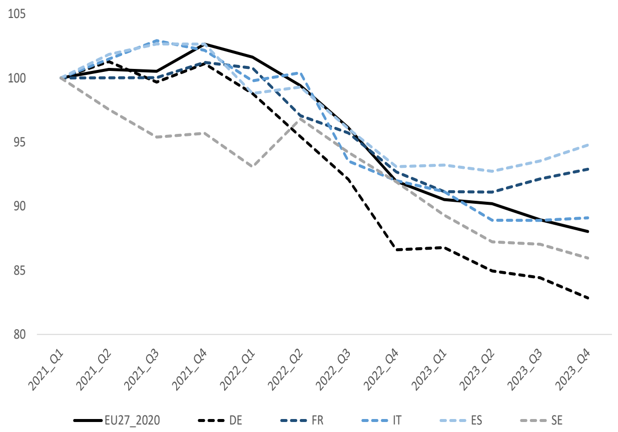
Graph 2. **Energy intensity and change in production volumes, EU27, 2021Q4-2023Q4**



Note: See the Annex for the list of NACE 2-digit industry codes.

Source: Own calculations, based on Eurostat Quarterly Sector Accounts (ESA 2010).

Graph 3. **EII production volumes for EU27 and selected EU countries (2021Q1=100)**



Note: Energy-intensive industries are the aggregate of the NACE 2-digit sectors: chemicals (C20), basic metals (C24), mineral products (C23), and paper products (C17-18).

Source: Own calculations, based on Eurostat Quarterly Sector Accounts (ESA 2010).

The response of activity by energy-intensive industries to the energy price shock has varied in depth and duration across EU countries. Output of EIIs fell across the EU in response to the energy price shock, but the severity of the decline has differed across countries (Graph 3). For example, the contraction has been sharp in Germany, where it fell by more than 15% by end-2023 compared to 2021, but shallower in France and Spain, where the decline of EIIs' activity was contained at around 5-10% in 2022 and came to a halt in 2023. Several factors explain differences in the depth and duration of the adverse effect on output among EU countries: i) differences in the industry composition; ii) differences in support policies; and iii) differences in the energy mix and in the functioning of energy markets. The latter two factors determine

[1] The initial contraction of overall and industry-level output raised concerns of massive corporate collapse and hysteresis effects. To prevent this, support policies, including the temporary suspension of insolvency procedures, were put in place, which even led to a decline in the number of bankruptcies during the pandemic. With the economy recovering from the COVID-19 recession and the related policy support being gradually withdrawn, overall bankruptcies increased gradually, but remained below pre-COVID levels until 2024. There has been an uptick in bankruptcies in the EU industry and in services during the energy crisis, notably in transport, accommodation, and food, which suffered from both the COVID-19 lockdowns and from higher energy bills. The number of newly registered businesses has remained stable, at levels like or above those seen before the COVID-19 pandemic. For a long-term perspective on corporate vulnerabilities and business dynamism in the euro area, see Nicoletti et al. (2022), and Deutsche Bundesbank (2024). Developments in output, profitability, and financial vulnerability in the EU NFC in the context of the pandemic are discussed in Archanskaia et al. (2023a).

the trajectory of the energy prices effectively paid by the corporate sector (Archanskaia et al. 2023a and 2023b).

The pass-through of energy price increases to output prices was associated to a deceleration of exports' growth, particularly strongly for the energy-intensive industries. As documented in section 3.1 below (see Graph 12), production costs increased relatively more for energy-intensive activities in the EU. In the context of an asymmetric shock to production costs (i.e. EU producers hit relatively more than non-EU producers), EU producers may have suffered a deterioration in cost competitiveness which is more pronounced in energy-intensive activities. We use monthly data on the volume of manufacturing exports over 2015-2023 to evaluate whether export growth of energy-intensive activities slowed in comparison to less energy-intensive activities in the context of the spike in energy prices in early 2022 (see Box 1 for details). Specifically, we test whether the deterioration in cost competitiveness was more pronounced in those activities in manufacturing for which the fraction of expenditure on energy inputs is relatively high. We look separately at intra-EU and extra-EU trade. As shown in Graph A (Box 1), the recent export performance of energy-intensive activities in manufacturing has been lacklustre, especially when considering export growth to non-EU countries. The results underpin that industries relying more on energy inputs in their production process experienced a significant slowdown in exports growth between mid-2022 and mid-2023, in comparison to the historical trends.[2] The negative impact of energy intensity on export performance between mid-2022 and mid-2023 is stronger and more persistent in non-EU markets (EU producers exporting to non-EU countries) compared to intra-EU trade (producer from one Member State exporting to another one), which is compatible with and could capture the fact that energy price and, hence, cost competitiveness differentials for energy intensive manufacturing were less pronounced within the EU than globally. Although the relative deceleration in EII export growth disappears in the second half of 2023, the weight of relatively energy intensive activities in the basket of EU exports remains lower by the end of 2023 than it used to be before the spike of energy prices. These results are in line with Fontagné et al. (2024) who, working with data on French firms over a longer horizon, document near perfect pass-through of changes in the price of energy inputs to producer prices (e.g. in the context of contract renegotiation), together with a significant reduction in the global demand for products which relative price has increased.

Box 1. **THE ENERGY PRICE SHOCK AND EU COST COMPETITIVENESS IN THE GLOBAL MARKET**

After a period of relative stability in the pre-pandemic period, global gas and oil prices strongly rebounded in 2021. The first quarter of 2022 brought about an additional significant spike in wholesale energy prices, in the aftermath of the full-scale invasion of Ukraine by the Russian Federation. The energy price shock has been asymmetric insofar as price increases in Europe were more pronounced and sustained for a longer period than in other regions of the world. The trajectories of retail prices for energy also differed within Europe, as a function of the energy mix, differences in network charges and taxation, support policies, etc. Hence, production costs of EU producers have also been affected differently, although the shock has been less asymmetric within Europe than between Europe and other regions of the world.(1)

Asymmetric shocks in production costs are expected to weaken the cost competitiveness of EU tradable goods' producers in the global market. Indeed, several recent papers document that changes in the cost of energy are passed on almost fully to output prices, and that firms exposed to such increases in the cost of energy lose market share (see, e.g., Fontagné et al. (2024), Lafrogne-Joussier et al. (2023)). The standard approach to testing for an across-the-board deterioration of cost competitiveness would be to use information on bilateral trade flows for EU producers and non-EU producers to the global market. The downside of this approach is that such data becomes available with a lag and is (typically) available at annual frequency. Moreover, one would need information on energy prices for all the countries included in the analysis to credibly estimate the elasticity of trade flows (market shares) to changes in relative prices driven by the asymmetric shock to the cost of energy.

A complementary approach – which we follow here – makes use of the prediction that the deterioration in

[2] Earlier evidence for a deterioration in euro area export performance in 2022, particularly in EIIs, is provided by Emter et al. (2023).

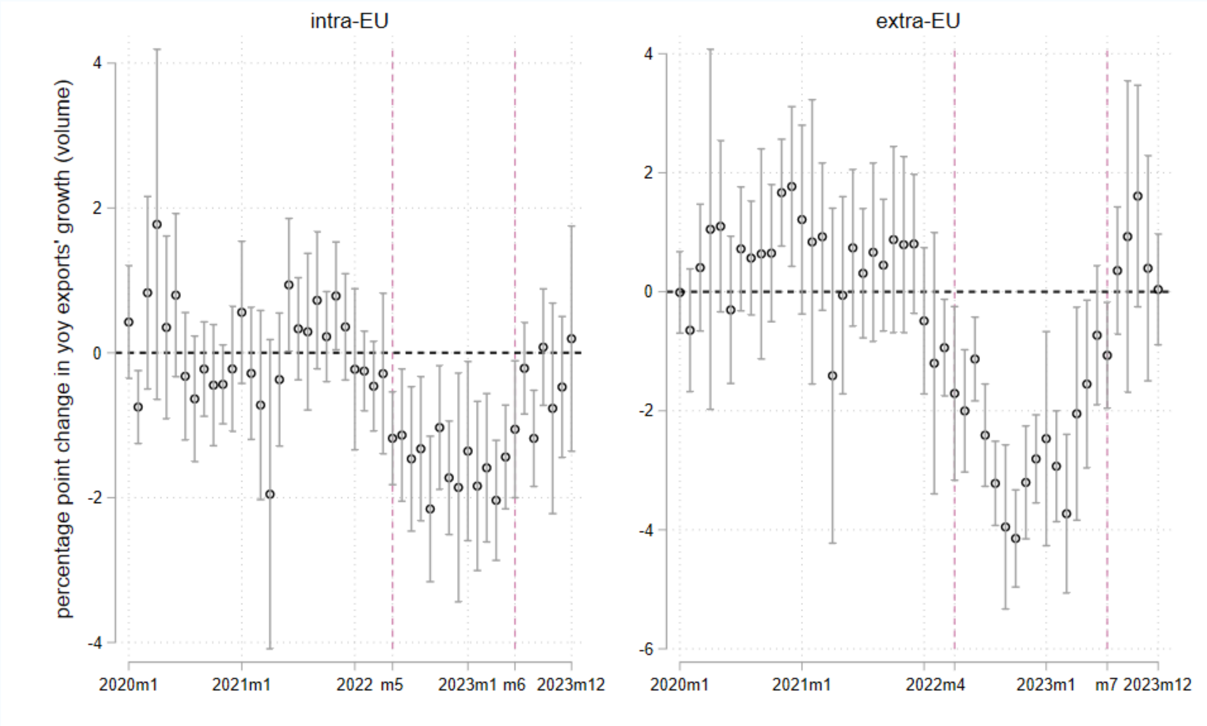
cost competitiveness is increasing in the reliance of the production process on energy. Specifically, under the assumption of perfect pass-through, the increase in the price of output is proportional to the energy intensity of the activity, with the energy intensity defined as the unit requirement in energy inputs per unit of output. The prediction would still hold with partial pass-through, as long as output price increases are positively linked to the reliance of the production process on energy inputs. In section 3.1 we document this pattern in cost-price dynamics in the EU: there is a positive relationship between the energy intensity of the industry and the observed increase in producer prices (PPI) of the industry over 2021-2023. It follows that for a given asymmetric shock to energy prices in the EU (relatively to other regions of the world), we expect prices of EU producers (relatively to global competitors) to increase relatively more in energy intensive industries.

As the deterioration of cost competitiveness is increasing in the reliance of the industry on energy inputs, we can identify it through the more pronounced slowdown in export growth of relatively energy-intensive industries in the EU. Identification through variation in energy intensity can be carried out on timely and higher frequency EU trade data made available in the Eurostat COMEXT database. Specifically, we use monthly data on the volume of exports in each EU country and industry over 2015-2023 to investigate whether export growth of energy-intensive activities slowed down in comparison to less energy-intensive activities in the context of the spike in energy prices in early 2022.

We compute year-over-year (yoy) monthly growth in the volume of exports in 2022 and 2023, which we normalise by yoy monthly growth observed in the years preceding the pandemic. For this normalisation we use the (geometric) average of yoy monthly growth rates observed in each year between 2015 and 2019. This normalisation accounts for industry developments unrelated to the trajectory of energy prices (e.g. global demand shocks as well as structural changes in the pattern of comparative advantage). We then estimate the relationship between the normalised yoy growth in the volume of exports for each exporter (o) and NACE 4-digit industry (k), to a given destination market (d) in month (m), and the energy intensity of the industry ($\bar{\omega}_k$), while controlling for developments specific to the exporter (f_m^o):

$$d\ln\left(Y_{km}^{od}\right) - d\ln\left(\bar{Y}_{km}^{od}\right) = \alpha + \eta_m \bar{\omega}_k + f_m^o + \varepsilon_{km}$$

Graph A: **EU export performance as a function of reliance on energy inputs**



Note: The Graph plots the coefficients estimated in each month, together with the 95% confidence interval. The estimated coefficient corresponds to the percentage point change in the normalised growth rate of monthly exports (to intra-EU; to extra-EU markets) stemming from a 1 percentage point increase in the energy intensity of the production process. The energy intensity is computed at the NACE 4-digit level as the fraction of expenditure on energy inputs, relatively to the value of output. The average expenditure share in the EU over 2017-2019 is used, as reported in Eurostat SBS. The estimation is carried out for manufacturing (NACE 10-32), while excluding NACE 19 (transformation of crude petroleum and coal into usable products). Exporter fixed effects are included to control for country-specific shocks in the month that may affect export growth. Standard errors are clustered at the NACE 2-digit industry level, to partially relax the assumption of iid errors (e.g., activities within a 2-digit NACE industry could be closer substitutes). Notice that we work with total exports from a given EU Member State to a given set of destination markets. The precision of the estimation could be improved by disaggregating exports by destination.

Source: Eurostat COMEXT and SBS.

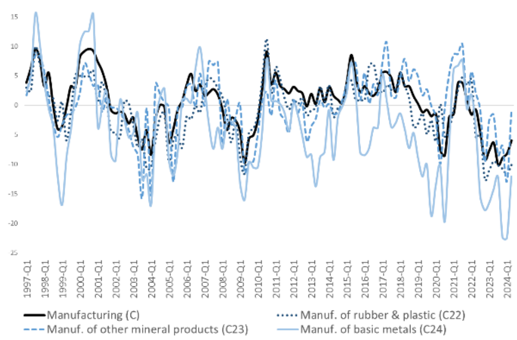
The estimated monthly coefficients (η_m) for export growth as a function of the energy intensity of the activity are plotted in Graph A. While the energy intensity of the activity has a close to nil and statistically insignificant impact on export growth in 2020-2021, it becomes an explanatory factor of exports growth (with a negative sign) in 2022. We pick up a significant deceleration in export growth for more energy intensive activities between mid-2022 and mid-2023, relatively to less energy-intensive activities. The effect is larger for extra-EU trade, as energy cost differentials between EU and non-EU exporters have been more pronounced than intra-EU cost differentials.

The relative deceleration in EII export growth appears temporary, disappearing in the second half of 2023. Yet, one must keep in mind that year-on-year monthly growth for energy-intensive activities in mid-2023 is evaluated from a particularly low starting point (i.e. growth relative to mid-2022). Thus, the weight of relatively energy intensive activities in the basket of EU exports remains lower by the end of 2023 than it used to be before the spike of energy prices.

Another important take-away is that all EU exporters that have passed on the higher cost of energy into their output prices have likely reduced their market share in the global market. Although we identify the deterioration of cost competitiveness through the differential exposure of EU producers to the increase in the cost of energy, one can interpret the results as providing the adverse impact of the asymmetric shock relatively to a hypothetical producer who would rely on a vanishingly small energy input requirement in production. Thus, our results underpin that the more pronounced increase in the price of energy for EU producers, relatively to producers in non-EU markets, has translated into an across-the-board cost competitiveness shock. Clearly, we estimate a partial effect. This adverse effect may have been mitigated by other developments in relative production costs (e.g., relatively less pronounced increase in labour costs, etc.).

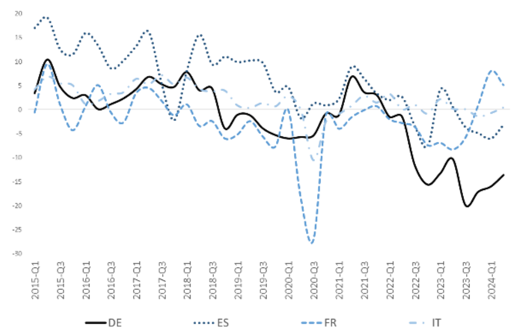
(1) Hernnäs et al. (2023) document the trajectories of wholesale and retail gas and electricity prices in the EU and discuss the determinants of pass-through. Archanskaia et al. (2023b) report the total change in energy prices faced by corporates in each EU country and quantify the implied increase in industry-specific production costs. Buelens (2023) documents the jump in inflation and in inflation dispersion for different product categories (including energy) in the euro area over the recent period.

Graph 4. **External competitiveness according to business surveys, EU27, manufacturing and selected EIIs**



Note: The survey asks managers the following question: "How has your competitive position on foreign markets outside the EU developed over the past 3 months?" The Graph plots the difference between the share of firms answering: "it has improved", and the share of firms answering: "it has

Graph 5. **External competitiveness according to business surveys, EU27 and selected member countries, manufacturing**



Note: The survey asks managers the following question: "How has your competitive position on foreign markets outside the EU developed over the past 3 months?" The Graph plots the difference between the share of firms answering: "it has improved", and the share of firms answering: "it has deteriorated".

Source: ECFIN business survey.

deteriorated".

Source: ECFIN business survey.

Complementing the hard data, business surveys also reveal a sentiment of deteriorating external competitiveness. The perception of external competitiveness in EU manufacturing as measured in the ECFIN business survey has deteriorated markedly in 2022-2023 (Graph 4), and it is more pronounced for competitiveness in markets outside the EU as opposed to competitiveness in markets of other EU countries.[3] Furthermore, the survey responses suggest non-negligible differences across EU countries, with a particularly negative assessment of external competitiveness dynamics by the German manufacturing industry in 2022-2023, contrasting which e.g., manufacturing in France, which had an extremely negative assessment of external competitiveness developments in the context of the COVID-19 pandemic but returned to a positive assessment of developments at the end of 2023 (Graph 5).

3. PRICE-COST MARGINS AND PROFITABILITY

The energy price shock can be characterised as a negative supply shock that has reduced economy-wide real income in the EU. The EU being a net importer of energy commodities, rising commodity prices translate into a deterioration of its terms of trade, implying a loss in the purchasing power of economy-wide income (e.g., Gunnella and Schuler 2022). As energy imports are difficult to replace in the short and medium term, the EU has effectively become poorer as a result.

Labour has borne initially a disproportional share of the welfare costs of rising energy prices. The temporary increase in corporate gross operating surpluses (GOS) as a share of gross value added (Graph 6), mirrored by an equivalent decline in the wage share, indicates that workers have initially absorbed more of the terms of trade shock, in line with the fact that prices tend to adjust faster than wages.[4] Nominal wages adjusted slowly to rising inflation, and real wages fell. This tendency has reversed since mid-2023, with labour costs catching up. The pattern is consistent with the observed decline of EU real unit labour costs (RULC) during 2022 and their recovery in 2023 (European Commission 2024).[5] Retained profits, which is gross operating surplus net of interest and dividend payments, taxes, capital depreciation and amortisation, relative to GVA have declined continuously since 2021. NFC net investment relative to GVA fell during the pandemic and has remained broadly stable at this lower level since.

A rise in the profit share is not equivalent to an increase in profit margins. The profit margin (markup) is the gap between the sales price and marginal production costs. The latter include the cost of labour and of intermediate inputs. Hence, it is possible that corporate gross operating surpluses (GOS) relative to gross value added (GVA) increase while growing prices of fossil fuels and energy lead to a decline in corporate profit margins (Arce et al. 2023, Colonna et al. 2023, Hahn 2023, Hansen et al. 2023).[6] The evidence below suggests a one-to-one change on average of costs and prices in the EU business sector in 2022-2023. Temporary fluctuations of profit margins are a standard feature of business-cycle models with price stickiness and commonly observed (e.g., Bilbiie and Känzig 2023, Glover et al. 2023). Increases in

[3] Energy prices and energy cost differentials with mayor competitors have been mentioned by businesses as an important barrier to investment. In the EIB (2023) survey around 70% of responding EU firms stated that their energy bills had increased by more than 25% between early-2022 and early-2023, compared to circa 30% equivalent replies for the sample of US firms.

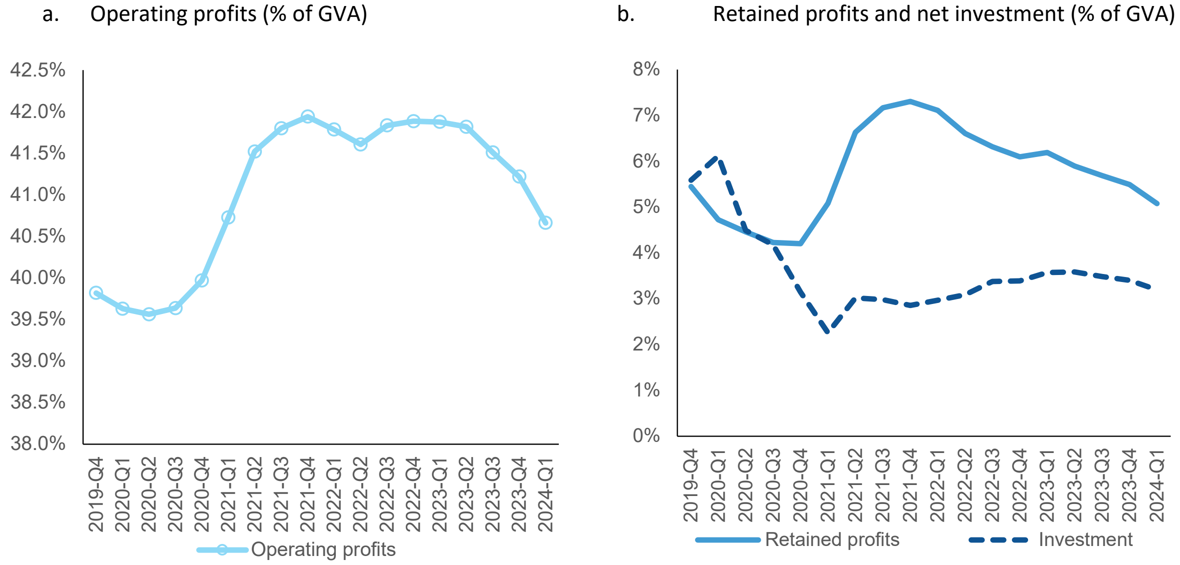
[4] For the evidence on price and wage stickiness in Europe, see, e.g., Druant et al. (2012) and the references therein.

[5] Aggregate real unit labour costs (RULC) correspond to the wage share in gross value added. With gross operating surpluses (GOS) to GDP defined as one minus the wage share and minus net tax payments on production relative to GDP, there is a strong link between RULCs and operating profits in the aggregate.

[6] The dominant role of rising energy (and food) prices for inflation acceleration in the euro area in 2022 and the subsequent reversal in 2023 is documented in, e.g., Arce et al. (2024), Bernanke and Blanchard (2024), and Dao et al. (2024). The theory for why relative price changes, such as commodity price shocks, affect overall inflation and for why inflation may react disproportionately to large shocks (costly price adjustment) is discussed, e.g., in Ball and Mankiw (1995) and the subsequent literature on state-dependent pricing.

long-run equilibrium markups, to the contrary, would require a decline in the price elasticity of demand, which is not obviously linked to a change in supply conditions (Syverson 2024).

Graph 6. **NFC profits and net investment, EU27**



Note: Data are for non-financial corporations (NFCs, S11). Operating profits in panel (a) is gross operating surplus and mixed income (B2A3G), retained profits and investment in panel (b) is net disposable income (B6N) and net fixed capital formation (P51N), respectively, all displayed relative to gross value added (GVA) and as four-quarter moving averages.

Source: Eurostat Quarterly Sector Accounts (ESA 2010).

We use the latest available industry- and firm-level data to quantify the impact of the spike in energy prices on cost-price dynamics and corporate profitability. Firstly, we document price-cost margin developments at the country-industry level by computing production cost indices at quarterly frequency. In this step, input-output tables are used to construct implicit input deflators. Secondly, we plug these price-cost margin developments into the latest available financial statements of the firm to simulate the evolution of profitability over 2022-2023. Thirdly, we characterise the evolution of profitability for publicly listed EU firms, based on their published financial accounts up to and including 2023.

3.1. EVOLUTION OF INDUSTRY-LEVEL PRICE-COST MARGINS

We approximate the evolution of corporate profitability at the industry level in each EU country with price-cost margin developments. While information on the evolution of output prices is readily available,[7] information on the evolution of production costs is not. Production costs consist of the cost of raw inputs (such as energy), intermediate inputs, labour, and capital. Input-output tables are used to quantify the unit requirements of each of these cost components for each industry and country.[8] Information on the unit requirement of each input in the production process is combined with output price deflators (ie. producer price indices or PPI) to construct implicit input deflators (i.e. output prices of

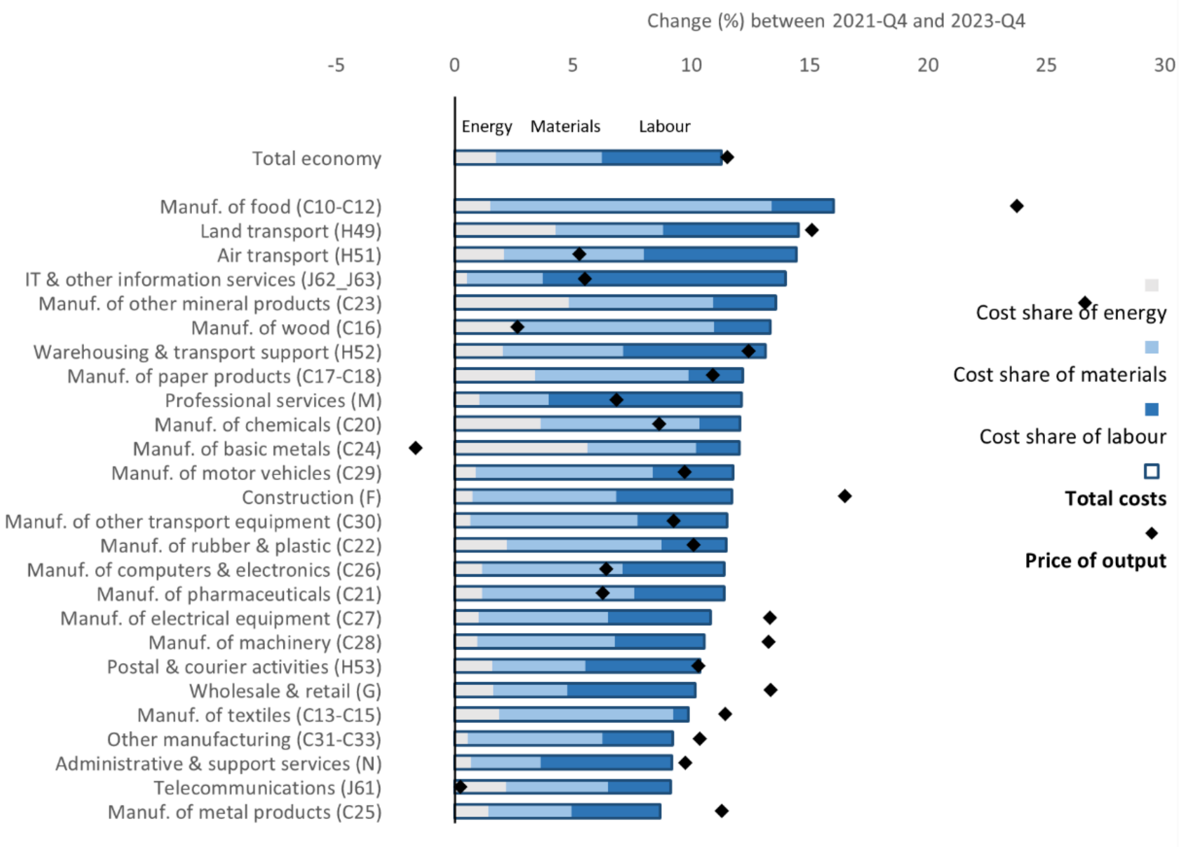
[7] Producer price deflators are published in the Eurostat STS dataset (monthly, quarterly, annual). Although the data is timely, one still needs to tackle the issue of missing values for a subset of country-industry cells. We work at the quarterly level as reporting at monthly frequency is more plagued by missing values.

[8] The regular ICIO tables produced by the OECD were used for these calculations.

upstream industries determine the material input costs of downstream sectors). To the best of our knowledge, we are the first to carry out this calculation and to deliver a time series of implicit input deflators at quarterly frequency for each industry and country in the EU. A complementary contribution of this approach is to enable us to separately identify the direct contribution of the energy price to the evolution of production costs in each industry, as well as the indirect contribution, via changes in the price of intermediate inputs. A proxy of production cost indices at quarterly frequency is obtained by combining the implicit input deflators with labour cost indices. An important assumption in the obtained trajectories of price-cost margin developments at the country-industry level is that expenditure shares on each type of input remain unchanged. Given the available evidence on the low substitutability of the energy input with other production factors,[9] our estimates likely provide an upper bound on price-cost margin developments in 2022-2023.

For the NFC aggregate, output prices have grown in line with production costs in 2022-2023, suggesting stable profit margins. Production costs and output prices have both increased by around 12% for the economy-wide aggregate between 2021Q4 and 2023Q4 (Graph 7). On average, cost increases were driven to a similar extent by material input and labour costs. Differences, however, appear at the sectoral level: in manufacturing, cost increases resulted mainly from growing material input prices, complemented by the (direct) contribution of energy costs, especially for energy-intensive sectors (chemicals, minerals, basic metals, paper products). In services, meanwhile, labour costs have played a larger role for cost growth.

Graph 7. **Change (%) in production costs and output prices between 2021Q4 and 2023Q4, EU**



Note: Output prices correspond to the industry-specific output price deflators. Production costs consist of costs of material inputs, derived from input-output linkages (output prices of upstream industries determine the material input costs of downstream sectors), and labour costs. The bars show the overall cost growth as sum of energy, materials, and labour cost growth, where the latter capture only the direct exposure (direct energy,

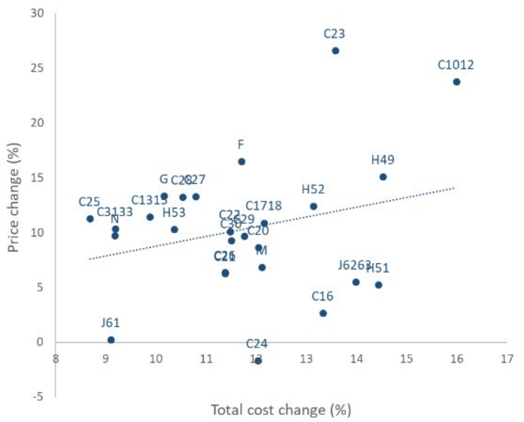
[9] See e.g., Hassler et al. (2021).

material, and labour inputs). The indirect impact of energy cost via material input prices, e.g., would be part of the materials group.

Source: Own calculations, based on Eurostat Quarterly Sector Accounts (ESA 2010).

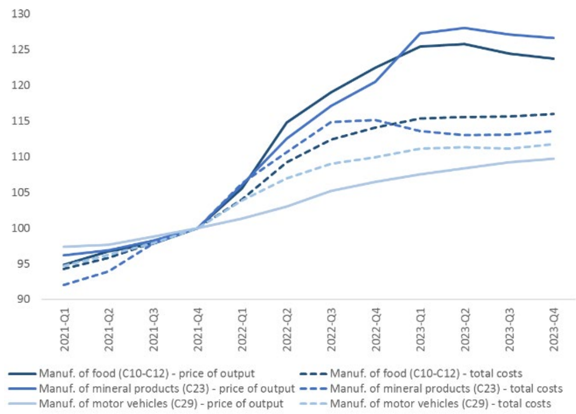
The relative dynamics of costs and prices has varied across sectors. Comparing rates of cost and price growth allows to impute the evolution of firm profits (gross operating surplus) and shows that there are sectors where prices grew more than costs and cases with the opposite pattern (Graphs 7 and 9). There is some evidence of a negative relationship between cost increases and price increases, suggesting that sectors which experienced relatively big increases in production costs were less likely to fully pass them on to the consumer by raising the price of their output. Sectors at the NACE 2-digit level are almost evenly split between stronger price versus stronger cost growth in 2022-2023 (Graph 8). The change in the price-cost margin is specific to the time horizon, however. The short time horizon considered does not allow for a causal interpretation of price-cost dynamics, in the sense of pass-through from costs to prices. Time series for a selection of sectors (Graph 9) suggest that growth in producer prices has moderated recently, whereas no moderation is visible in cost growth, despite moderating pressure from energy costs.

Graph 8. **Production cost and producer price (PPI) growth by industry, EU27 (2021Q4-2023Q4)**



Source: Own calculations, based on Eurostat Quarterly Sector Accounts (ESA 2010).

Graph 9. **Production cost and producer price (PPI) evolution for selected industries, EU27 (2021Q4=100)**

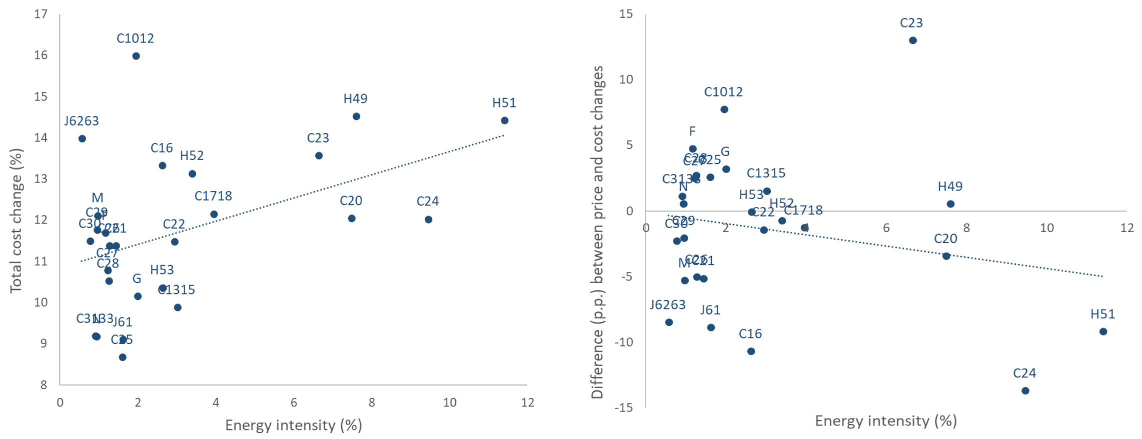


Source: Own calculations, based on Eurostat Quarterly Sector Accounts (ESA 2010).

Graph 10. **Change (%) in total costs versus level of energy intensity (left panel) and gap (pp) between price and cost change versus energy intensity (right panel), EU27, 2021Q4-2023Q4**

a. Change in total production costs (%)

b. Difference in price versus cost growth



Note: Total cost change is the aggregate nominal increase in energy, material inputs, and labour per unit of output.

Source: Eurostat Quarterly Sector Accounts (ESA 2010).

In energy-intensive industries, producer prices have generally grown less than production costs, contrary to several downstream industries and services. With the notable exception of minerals (C23, comprising products such as cement, ceramics, and glass), energy-intensive industries (EIIs), such as the manufacturing of basic metals, chemicals, and paper products, have recorded below-average producer price growth during 2021Q4-2023Q4, despite similar or higher cost increases compared to other industries (Graphs 7 and 10). The observed development of prices and costs suggests that EII found it difficult to pass through higher costs to their customers. The opposite pattern, i.e., increasing price-cost margins, has been observed in several downstream industries that use EII products as inputs (manufacturing of metal products, electrical equipment, machinery, and textiles), and services (construction, wholesale, and retail).[10]

3.2. SIMULATED EVOLUTION OF CORPORATE PROFITABILITY

Next, we simulate corporate profitability developments over 2022-2023 at the firm-level by combining available financial statements for each firm with information on price and cost developments in the industry. While industry-specific price and cost developments provide valuable information on the average evolution of profitability, more granular information on firm-specific cost structure and revenues is needed to capture the profitability dynamics masked by this average. Yet, information on financial accounts at the firm-level in 2022 and 2023 is only gradually becoming available.[11] We overcome this lag in the publication of the firm-level data by simulating the evolution of profitability over 2022-2023. We take the available firm-level financial accounts in 2021, and we use them as the starting point for firm profitability. Specifically, we use information on the revenues and costs (material inputs, labour) that the firm reported in 2021 to compute its operating profits. We then "shock" each of the variables affecting operational profits by plugging the quarterly information on output price and production cost developments calculated in section 3.1 into the latest available financial statement of the firm. Although the price-cost trajectory is common to all firms operating in a given industry, the evolution of profitability will depend on the firm-specific reliance on material inputs and labour in production.

Partial pass-through has contributed to the deterioration of corporate profitability. Around 10% of firms had negative operating profits in 2021. The results of our simulations on firm-level data suggest that over 2022-2023, about 20% of EU firms generated negative operating profits (Graph 11). These results imply that 10% of firms, which recorded positive profits in 2021, recorded negative profits over the period 2022-2023. Firms that recorded negative profits in 2021 tended to remain in negative profit territory in 2022-2023. The quantitative results on the deterioration of profitability should be interpreted with caution as we only take into account policy support measures that would have had a direct effect on the effective price of energy for EU corporates. Other policy support measures may have dampened the adverse effect of the surge in energy prices on profit margins, and those would not be captured by our simulations.[12] Further, firms may have adapted their production processes, e.g. investing to increase their energy efficiency, or shifted away from the use of relatively costly inputs. Hence, one could interpret our results as providing an upper bound on the deterioration of profitability. Our main contribution is to evaluate,

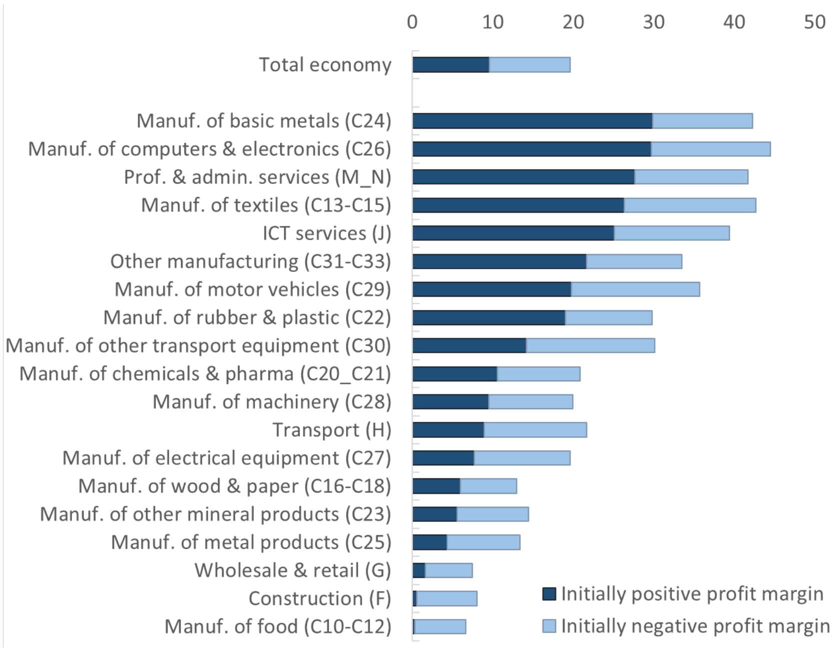
[10] The finding of one-to-one cost and price movement for the EU NFCs rests on two implicit assumptions: an unchanged price of capital as well as unchanged cost shares of input types and production factors.

[11] Published financial accounts are available for publicly listed firms for 2022 and partly (for about 2/3 of those firms) for 2023 in the ORBIS database. This information is exploited in subsection 3.3. below.

[12] Operating profit margins depend on sales and variable as well as fixed production costs. Any type of support that would have affected overhead costs would be missing, as well as production subsidies (in particular, if such subsidies would have allowed firms to increase output prices by less, thereby dampening the negative impact of price increases on sales). Yet other types of policy support may have affected net profit margins. The focus of subsection 3.3 on published financial accounts of listed firms, working with a much smaller sample of firms, aims at gauging the plausibility of our simulation results.

based on the currently available data, both the direct effect of the energy price shock and its indirect effect via the increase in the cost of other material inputs and of labour on operating profit margins.[13] There is a close link between the price-cost developments in Graph 7 and the increase in the share of firms with negative profits in Graph 11. There are also exceptions, such as textiles (C13-C15), where adverse profitability effects are stronger than what price-cost dynamics would suggest. This finding may be linked to specific characteristics of firms in this industry, such as relatively narrow initial margins.

Graph 11. **Share (%) of firms with simulated negative cumulative operating profits by end-2023, by initial profitability (2021), EU**



Note: See Annex for more details. The sample is restricted to firms with 10 or more employees. For reasons of (limited) data availability, Austria, Cyprus, Germany, Ireland, Luxembourg, Malta, and the Netherlands are discarded. The evolution of each firm's operating profits is simulated over 2022-2023 based on the price, cost and production patterns documented in previous sections. Developments in operating profits are computed in a cumulative manner over the whole period. The graph shows the share of firms with cumulative profits that are negative at the end of 2023. The incidence of negative cumulative profitability is computed at the EU sector-level. To perform this aggregation, information on the number of firms in each country-industry-size class (derived from Eurostat's Structural Business Statistics (SBS)) is used to construct a weighting scheme. Results at the firm level are re-weighted within each country-industry-size class cell to deliver aggregate results that mimic the evolution in the full population of firms. The share of firms with negative operating profits is split by the firm's initial profitability, i.e. the profit margin in 2021, taken from its financial accounts. In Manufacturing of basic metals (C24), the lion's share (ca. 30%) of the 42% of firms with negative margins by end-2023 consists of firms that were profitable at the start (in 2021).

Source: Own calculations, based on ORBIS database.

3.3. EVOLUTION OF CORPORATE PROFITABILITY IN THE SAMPLE OF LISTED COMPANIES

Direct evidence on the evolution of corporate profitability up to 2023 is available for a small yet macroeconomically relevant subset of companies, namely the publicly traded (listed) European NFCs. The simulated results on corporate profitability that we obtain in section 3.2 for the full sample of firms rely on the assumption that observed industry-level developments in costs and prices are a good proxy of

[13] This said, drawing on input-output data for material inputs and industry-specific wage developments, the simulations also include input price and wage dynamics that may not be driven strictly by the energy price shock.

firm-specific developments. In some sense, the simulation is constraining the behavioural response of any given firm to the average response of the industry. Yet, there exists a small sample of companies for which financial accounts become available with a much shorter delay, namely the publicly traded (listed) companies. For the listed European companies, the effects of the pandemic and of the energy price shock can be estimated rather than simulated. While this sample may fail to be representative of the overall population of European companies, it is macroeconomically relevant. These are big companies that tend to operate in multiple markets. An important literature has documented the significant explanatory power of granularity, i.e. shocks to big companies that do not 'wash out', but have macroeconomic effects (see e.g., Gabaix (2011), Gabaix (2024), di Giovanni et al. (2018)).

Financial accounts of listed European companies allow us to directly evaluate the impact of the spike in energy prices on corporate profitability. Financial accounts of listed European companies contain information on the actual revenues, material and labour costs, as well as other operating and financial expenses. This information enables us to construct multiple indicators of profitability (namely gross and operating profit margins, as well as net margins and markups) and to document the response of each profitability indicator to the pandemic and to the energy price shock. We work with consolidated accounts of European listed companies over 2016-2023, retrieved from the ORBIS database in July 2024.[14] The full sample contains about 6,000 companies in 2016-2019, 7,000 in 2021-2022, and 5,000 in 2023.[15] We use a sample of about 3,000 listed companies in industry (NACE sections B to E) and in construction (NACE section F). The sample is heavily dominated by manufacturing, which accounts for 75% of all included companies, while the remainder are (mainly) construction firms. The focus on this subset of industries is motivated by the availability of more granular information about the energy intensity of the production process. Energy intensity is constructed as the ratio of total expenditure on energy inputs to the value of production, as provided in the Eurostat SBS dataset at the NACE 4-digit level for industry (B to E) and construction (F). We map the measure of energy intensity of the production process to our sample of firms by assuming that all firms within a given NACE 4-digit industry have the same energy intensity.[16]

Our results show that in the absence of the recent systemic shocks, corporate profitability would have increased over 2016-2023. We look at four indicators of profitability. Gross margins and markups are the indicators that are particularly sensitive to the evolution of variable costs as a share of revenues.[17] The direct impact of the energy price shock is expected to be most visible on these two indicators. Additionally, the analysis also looks at the evolution of operating profit margins and net margins. Operating profits correspond to the gross operating surplus (GOS) reported in the national accounts, and they typically constitute the main measure of the ability of the company to generate a profit from its production process. The operating profit margins account for overhead costs and are thus likely affected in the context of, e.g., administrative restrictions on activity, such as under the COVID-19 shock. The net

[14] The results of the simulations on firm-level data that we report in section 3.2 rely on unconsolidated financial accounts of European companies. Unconsolidated accounts report the costs and revenues pertaining to the activity of the company (domestic sales and exports, if any) in a particular location. Such accounts represent more than 90% of all accounts available in the ORBIS database. For the subsample of listed companies, we opt for consolidated accounts (i.e. accounts that report the consolidated results of activities in all locations, directly or through affiliates) as the latter are more representative of the overall activity of the company. Consolidated accounts incorporate possible adjustment behaviour of the company that leverages its network of production units.

[15] The sample includes all listed companies of the EU member states as well as geographically close neighbours (Iceland, Norway, Switzerland, the UK) in NACE 1-digit sections B to F, which consolidated accounts are reported in the ORBIS database. The inclusion of neighbouring countries is motivated by the fact that these countries have been subject to comparable energy price shocks. Quantitatively, the results are not sensitive to the inclusion of these countries. Yet, the precision may be improved due to bigger sample size.

[16] Energy intensity is thus defined as the energy input requirement per unit of output in value terms. As documented in Table A.1, there is significant variability in energy intensity at the NACE 4-digit level within each of the NACE 1-digit sections. Most companies in the sample have relatively low energy intensity (between 0 and 2.2%). Yet, a non-negligible fraction of companies has significantly higher energy intensity, between 2.2 and 11%. A very small fraction of our sample (45 companies) spends more than 11% on energy inputs.

[17] The gross margin is obtained by subtracting material costs and labour costs from revenues, with the difference reported as a share of revenues. The gross margin is equal to 47.4% at the average point in our sample. The markup is obtained in two steps. First, we approximate the output elasticity of material inputs in the industry with the average cost share of materials over 2017-2019 as reported in the SBS database. Second, the company-specific markup is calculated as the ratio of this industry-level proxy of the output elasticity to the cost share of materials of the company in each year. While this approach may fail to pin down the level of the markup, it will adequately track the evolution of the markup over time, within a given company.

margin, in addition, also accounts for the company's financial operations (including debt servicing costs) as well as for corporate taxation. It hence captures the profit or loss of the company for a particular period of operations, excluding exceptional operations, as a fraction of revenues. The profitability of European publicly listed companies operating in industry and construction increased over 2016-2023 on average as indicated by the estimated annualised change in each of the profitability indicators being positive and statistically significant (Table 1). The estimated coefficients indicate that the annual increase in each of the profitability indicators was between 0.1 and 0.2 percentage points over 2016-2023. A cumulative increase of 1.4 percentage points for operating or net profit margins is non-negligible, given that these margins at the average point in our sample are equal to 6.5% and 3,6% respectively.[18]

Table 1. **Evolution of profitability in industry (B-E) and construction (F), European listed companies**

	Gross margin	**Markup**	**Operating profit margin**	**Net margin**
Year (annual trend)	**0.002*** **	**0.010*** **	**0.002*** **	**0.002*** **
	(0.001)	(0.002)	(0.001)	(0.001)
COVID-19 shock (dummy in 2020)	0.003	**0.017** **	**-0.020*** **	**-0.015*** **
	(0.003)	(0.008)	(0.002)	(0.002)
ENERGY shock (dummy in 2022-2023)	**-0.014*** **	**-0.039*** **	**-0.006** **	**-0.008*** **
	(0.004)	(0.010)	(0.003)	(0.002)
Energy intensity (interaction with ENERGY shock)	-0.156	**-0.796** **	**-0.220** **	-0.137*
	(0.120)	(0.360)	(0.094)	(0.079)
Contact intensity (interaction with ENERGY shock)	-0.138	**-0.778** **	-0.047	-0.029
	(0.140)	(0.392)	(0.115)	(0.101)
Constant	**0.474*** **	**1.612*** **	**0.065*** **	**0.036*** **
Observations	19,798	17,086	17,908	16,441
R-squared	0.773	0.812	0.618	0.592

Note: Significance of estimates: *** p<0.01, ** p<0.05, * p<0.1. Estimated on within-company variation: all specifications include company fixed effects. The standard errors are clustered at the company level. The constant can be interpreted as profitability at the average point in the sample. The estimation also includes two interaction effects that evaluate how profitability may have responded to the pandemic, in light of the energy intensity and of the contact intensity of the activity. The point estimates of these two interaction effects are not reported in Table 1, to focus attention on the interaction of industry characteristics with the energy price shock. Additional results (interaction effects in the context of the pandemic; results for companies operating in services) are available upon request. We find that the contact intensity of the industry plays a role in explaining variation in the adverse effect of the pandemic on profitability in services (NACE sections F to N), while it is never significant in the "industry+construction" sample (NACE sections B to F).

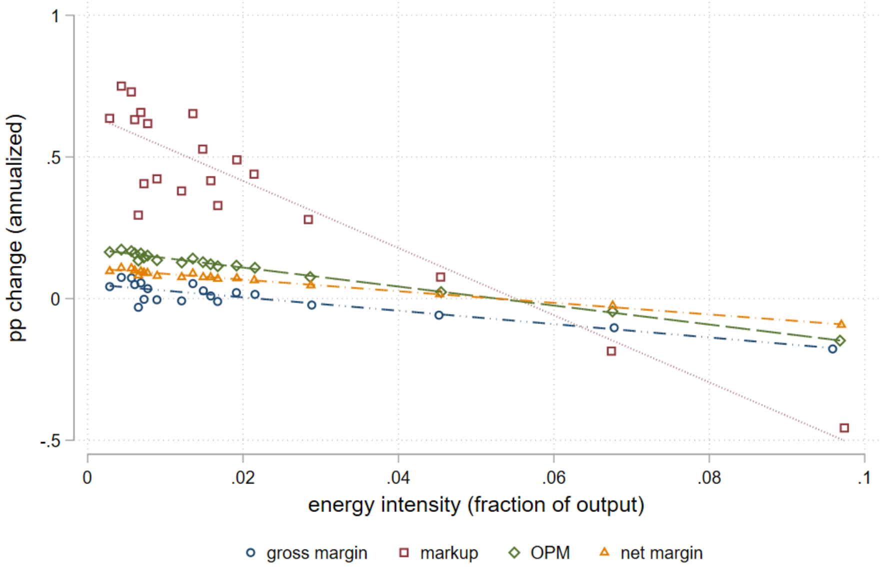
Source: Own estimates, based on ORBIS database. The sample includes all listed firms of EU27 + close neighbours (Iceland, Norway, Switzerland, the UK) in NACE 1-digit sections B to F, which consolidated accounts are reported in the ORBIS database.

Our results also underpin that both the pandemic and the energy price shock had adverse effects on corporate profitability. The impact of each shock in our sample of listed companies is identified with time dummies for 2020 (COVID-19) and 2022-2023 (energy). The main finding is that the spike in the price of energy had a significant and sizeable effect on all profitability indicators. This result suggests that

[18] The regressors are centred to reduce possible multicollinearity and to allow the constant to be interpreted as the value of the dependent variable at the average point in the sample, i.e. the average profitability margin in 2019.

independently of the energy intensity of the company, the increase in the price of energy led - on average - to a contraction in margins. The magnitude of this adverse effect is comparable for operating and for net profit margins. The latter finding provides a first indication that there is little support in the data for the notion of "greedflation", at least on average.[19] While we cannot pin down the impact of policy support, our results suggest that (on average) such support tended to dampen the adverse effects of each shock, rather than allow companies to increase profitability (relatively to trend). As regards the pandemic, results conform to priors in the sense that the COVID-19 shock reduced operating and net profit margins, while not having a significant impact on gross margins. This finding suggests that companies operating in industry or in construction were less able to reduce especially overhead costs when facing administrative restrictions on their activities in 2020.

Graph 12. **Predicted annualised change in profitability 2016-2023 given energy intensity**



Note: The graph plots the predicted evolution of each profitability indicator over 2016-2023 as a function of the energy intensity of the activity (NACE sections B to F). The annualised percentage point change is used on the y-axis. The energy intensity – plotted on the x-axis - is computed as the fraction of expenditure on energy inputs (relatively to the value of output) at the NACE 4-digit level, the average expenditure share in the EU over 2017-2019 is used (as reported in Eurostat SBS). For readability, we show a binscatter plot. The underlying data contains predicted changes in the profitability indicators for each firm in the sample. The data is split in a set of equal-sized bins, and the average in each bin is plotted (i.e. average energy intensity within each bin, average predicted change in profitability in each bin). For example, we estimate that the bin in which the average energy intensity of the firms is 2% experienced nil growth in gross margins over 2016-2023.

Source: Own calculations, based on ORBIS database and Eurostat SBS.

More exposed companies, i.e. with stronger reliance on energy inputs, were more severely affected by the spike in energy prices. We focus on two characteristics of the activity – its contact intensity and its energy intensity – to investigate the role of exposure to a particular shock on profitability developments

[19] Bijnens et al. (2023, 2024) do not find evidence of increasing profit margins for Belgium. They also document a temporary deterioration of profit margins in EIIs in 2022. Our results (available upon request) show that gross margins of EIIs deteriorated relatively more in 2022 and recovered in 2023, while operating profit margins of EIIs deteriorated relatively more in 2023.

within the company. We expect contact intensity to matter in conjunction with the pandemic, [20] while energy intensity may play a role in the context of the spike in energy prices. In the specification, time dummies for each shock are interacted with each of the two characteristics of the activity. The differential exposure to the energy price shock is identified through the interaction of the energy-shock time dummy with the energy intensity of the industry. All specifications include company fixed effects, so that the identification of the differential effect of the energy price shock on profitability comes from the time variation in profitability within the company, in conjunction with its exposure to the shock. The highly significant negative coefficient for markups that we estimate for the interaction of energy intensity with the time dummy for 2022–2023 underpins that the exposure effect materialises through the increase in the expenditure on intermediate inputs, with energy having a bigger weight in this input bundle for more energy intensive companies. We also estimate a significant negative exposure effect for operating profit margins, with this result underpinning that more energy intensive companies were not able to recover production cost increases via proportional changes in revenues, with cost-price pass-through potentially also leading to reduced sales. This finding in the actual financial accounts of listed European companies lends support to the approach we follow in section 3.2 to simulate profitability developments in the full sample of firms. Indeed, the output and cost-price developments that we document in section 3.1 at the industry level align well with the results we obtain when directly estimating profitability developments in the sample of listed companies. And it is these cost-price developments, which tended to be less favourable for more energy intensive activities over 2022-2023, which we use as the main source of data to evaluate the implications of the energy price shock on corporate profitability in section 3.2.

The energy price shock pushed profitability growth of energy intensive companies into negative territory. The estimated coefficients can be used to compute the predicted total change in profitability for each company over 2016-2023. Graph 12 plots the predicted annualised percentage point change in each profitability indicator in the sample of listed European companies, as a function of the energy intensity of the company. For readability, the sample of companies is first ranked in terms of energy intensity, and then split in equal size bins (each bin contains the same number of companies). The graph plots the average predicted change in profitability for companies in each bin, as a function of the average energy intensity of companies in that bin. The relationship is negatively sloped for each indicator, underpinning that more energy intensive companies had a less favourable evolution of profit margins over 2016-2023. Moreover, for each indicator of profitability, the zero threshold is crossed, indicating that for sufficiently high energy intensity bins, the predicted average change in profitability in the bin is negative. The threshold in terms of energy intensity is relatively low for gross margins (i.e., 2% expenditure on energy, as a share of output value). The threshold is higher for markups, operating profit margins, and net margins (i.e., 6% expenditure on energy, as a share of output value). These results suggest that the stronger exposure to the energy price shock pushed the change in profitability for energy-intensive companies into negative territory, overturning the otherwise positive trend in profitability that we pick up in this sample of companies over 2016-2023.

4. CONCLUSION

This paper has used several data sources to investigate the evolution of corporate profits of EU non-financial corporations (NFCs) following COVID-19 and the energy price shock. In particular, we have (i) used industry-level data together with information on input-output linkages to obtain estimates of production costs and compare them to the evolution of producer prices at the industry level, (ii) combined these estimates of price-cost margin developments at the industry-level with firm financial data in 2021 to derive implications for corporate financial vulnerability, and (iii) analysed available information from financial statements of publicly listed companies in the EU to characterise corporate profitability and the impact of the COVID-19 pandemic and the energy cost shock until end-2023.

[20] The measure of contact intensity relies on European Commission calculations combining LFS data at ISCO 2- digit level with O*NET-based information on the ability to telework and physical proximity requirements at the occupational level (Dingel and Neiman (2020)). See also Canton et al. (2021).

EU firms have been resilient to these large shocks overall, but sectors have nonetheless been hit adversely proportionately to their exposure. The industry-level data show that most activities have recovered quickly from the COVID-19 pandemic, and suggest that firms have been able, on average, to pass on cost increases in 2022-2023, related to the energy shock, to customers, thus preserving margins and profits. While contact-intensive services were more affected by the pandemic shock, the energy price increase of 2022-2023 – and increase in absolute terms and relative to other world regions – affected energy-intensive industries (EIIs) in particular. The latter have been less able to pass higher costs on to customers thus far. At the same time, EIIs also experienced a strong contraction of output volumes and a loss in export competitiveness.

Support policies have helped mitigating the impact of both the pandemic and the energy price shocks. These included targeted investments in the context of NextGenerationEU (REPowerEU) at the EU level, job retention schemes, and temporary energy cost subsidies at the national level. This paper does not provide evidence on the impact and effectiveness of support policies. Yet, it underpins that based on the available firm- and industry-level evidence, the relatively more exposed industries experienced a more pronounced adverse effect of the shock on their profitability than less exposed industries.

Gas and electricity prices have fallen compared to the peak in 2022 but remain elevated compared to other world regions. Against this background, at least some of the recent contraction of economic activity in EU EIIs risks being persistent, possibly indicating a shift in comparative advantage and reflected also in firms' concerns about energy costs and availability in the future (EIB 2023). The price of electricity will be key for the future prospect of energy-intensive production in Europe, and in the context of the green transition it will depend on the future energy mix. A potentially important challenge for EIIs is that their profits have been squeezed by the energy price shock, making it harder for these firms to internally finance the investments in green technologies that are needed to reduce carbon emissions (Bijnens et al. 2024). In addition, non-EU competitors have stepped up support policies for local production in recent years, and competition in manufacturing trade is likely to intensify as emerging economies move up the value chain (Al-Haschimi et al. 2024).

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ANNEX

Output price, cost, and volume indices at industry level

The aim is to obtain **indices of output prices, costs and production** for each industry in all EU countries. These measures will help to quantify price, cost and production developments in the EU over 2022-2023 (more precisely, between 2021-Q4 and 2023-Q4). When data are missing for a specific country-industry, the value is imputed, typically based on the average across the available EU countries. We rely on several data sources to collect the different pieces of the analysis. Eurostat's short-term business statistics (STS) provide quarterly information on industry-specific producer (output) prices, labour input prices (wages) and production. Eurostat Energy statistics are used to obtain pre-tax gas and electricity prices (bi-annually) for non-household consumers, while pre-tax prices of refined petroleum products are taken from the European Commission's Weekly Oil Bulletin.

Output price developments are computed from the industry-specific producer price index. Sectoral **production costs** consist, in the first place, of *costs of material inputs*, which are derived from input-output linkages and the output prices of upstream industries. These input-output production linkages, taken from the OECD's ICIO database (2021 release), allow determining the change in material input costs of any downstream sector as a weighted average of the changing output prices of all upstream industries it sources from. Second, *energy price* developments are weighted with the industry's reliance on energy inputs, also taken from the OECD's ICIO tables, to compute the second component of production costs. The third component consists of industry-level *labour costs* changes, which are computed using Eurostat's sectoral wage information and the information on value added and labour shares in the OECD's TiM and ICIO databases. These three components, i.e. material inputs, energy and labour cost growth, make up the overall cost growth for the country-industries in our sample. Finally, sectoral **production volumes** are derived from Eurostat's production volume index available at country-industry level.

Firm-level simulations of profit development

The **firm-level simulations** use these industry-specific cost (energy, material inputs, and labour), price, and output developments at the NACE 2-digit level over 2022-2023 to extrapolate corporate revenues and costs. Translating these industry-level price and cost shocks into cumulative changes in profitability of a given firm requires information on corporate balance sheets and profit and loss statements. We work with a recent comprehensive set of corporate financial statements, taken from the ORBIS database, which cover corporate activity in 2021. This data source has the advantage of providing better coverage for most of the EU Member States than other sources. We work with unconsolidated accounts of firms deemed active at the date on which they deposited their most recent financial statement.

Extensive cleaning is carried out on the set of financial statements to impute missing information or otherwise discard observations with insufficient information or implausible values. We restrict the sample used in the simulations to firms with 10+ employees. The final dataset contains 533,504 firms, of which 47% have 10–19 employees, 31% have 20–49 employees, 18% have 50–249 employees, and 4% have 250+ employees. For data availability reasons, we let go of seven EU countries: Austria, Cyprus, Germany, Ireland, Luxembourg, Malta and the Netherlands are discarded. The EU aggregates shown in this paper are thus computed for the set of 20 remaining Member States.

We combine the quarterly industry-specific cost, price, and output developments over 2022-2023 with firm-level financial information from 2021 to simulate each firm's profitability trajectory between 2021-Q4 and 2023-Q4. We proceed in two steps. In the first step, firm-level production quantities are kept fixed, and the monetary variables in the firm's financial statement (costs, revenue) are shocked with the price and cost developments obtained above. In the second step (cfr. below), the scale of operation is adjusted to reflect changes in production levels.

1. Information on a firm's expenses on **labour** is combined with country-sector developments in wages: the firm's wage bill is assumed to change proportionally to the change in sectoral wages. The firm's expenses on **material inputs**, which we assume to also cover expenses on energy products, move according to the sector's cost of inputs.[21] This latter index is a weighted average (using input-output production weights) of changes in the price of all types of inputs into production (incl. energy). The firm's **revenue** changes according to the output price developments in the industry. Therefore, our simulations translate a 10% increase in the output price deflator in a sector into a 10% increase in revenue for all firms active in that sector. Finally, other operating expenses incurred by the firm also change according to the industry's output price changes.
2. To factor in changes in output, our simulations adjust a firm's wage bill, its expenses on material inputs and its revenue proportionally to the change in the industry's production index. Therefore, our simulations translate a 10% decrease in output produced in a sector into a 10% decrease in revenue, wage bill and material expenses for all firms active in that sector. This quantity adjustment is not implemented for the other operating expenses, however, which are assumed to represent costs of a more fixed nature.

Changes in **firm profitability** over 2022-2023 are simulated based on these price, cost and production patterns. Each firm's *gross profits* are computed at every quarter of 2022-2023 using the shocked wage bill, material expenses and revenue. The shocked other operating expenses are further deducted to obtain the firm's *operating profits*. Developments in both profit measures are computed in a cumulative manner over the whole period. Only firms with cumulative profits that remains negative at the end of the period (2023-Q4) are considered to be in negative profitability territory in our analysis.

The incidence of negative cumulative profitability is then computed at several levels of aggregation, i.e. at the sector-level, country-level and EU-level. To perform these aggregations, information on the number of firms in each country-industry-size class (derived from Eurostat's Structural Business Statistics (SBS)) is used to construct a weighting scheme for each country-industry-size class cell. Results at the firm level are

[21] A detailed breakdown of firm-level costs into energy and non-energy expenditures is not available in ORBIS. For this reason, we assume that a firm's material bill covers expenses on energy too.

reweighted within each cell to deliver aggregate results that mimic the evolution in the full population of firms.

List of industry codes

C10-C12 Manufacturing of Food & Beverages

C13-C15 Manufacturing of Textiles

C16 Manufacturing of Wood

C17_C18 Manufacturing of Paper Products

C20 Manufacturing of Chemicals

C21 Manufacturing of Pharmaceuticals

C22 Manufacturing of Rubber & Plastic

C23 Manufacturing of Other Mineral Products

C24 Manufacturing of Basic Metals

C25 Manufacturing of Metal Products

C26 Manufacturing of Computers & Electronics

C27 Manufacturing of Electrical Equipment

C28 Manufacturing of Machinery

C29 Manufacturing of Transport Equipment

C30 Manufacturing of Other Transport Equipment

C31-C33 Manufacturing of Other Manufacturing

F Construction

G Wholesale and Retail Trade

H49 Land Transport

H50 Water Transport

H51 Air Transport

H52 Warehousing & Transport Support

H53 Postal & Courier Activities

J58-J60 Publishing & Broadcasting

J61 Telecommunications

J62_J63 IT & Other Information Services

M Professional Services

N Administrative & Support Services

Distribution of companies by energy intensity

Table A.1. **Energy intensity in industry (B-E) and construction (F), listed firms (EU27+neighbours)**

	energy intensity (%)	**Number of firms**	**NACE 1-digit**	**Most frequent NACE 4-digit**
> 3 standard deviations above mean	11.07-50	45	**C**, B, D	2351; 0910
<3 standard deviations above mean	8.12-11.06	143	**D**, **C**, B, E	3511; 0891

<2 standard deviations above mean	5.17-8.11	202	**B**, **C**, D	0729; 0899
<1 standard deviation above mean	2.21-5.16	441	**C**, **D**, E, F, B	3512; 3522
<1 standard deviation below mean	0-2.20	2405	**C**, F, B, D, E	2120; 2611

Note: The table reports the distribution of companies in our sample in terms of energy intensity. The NACE 4-digit measure of energy intensity obtained on the basis of Eurostat SBS is attributed to all companies in that NACE 4-digit industry. The mean sample value of energy intensity is 2.21%. The sample includes all listed firms of EU27 + close neighbours (Iceland, Norway, Switzerland, the UK) in NACE 1-digit sections B to F, which consolidated accounts are reported in the ORBIS database. NACE 1-dig listed if at least 1% of firms in the category are in it. In bold, if at least 10% of firms in the category are in it.

Source: Eurostat SBS, ORBIS database (listed firms).

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