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ENERGY EXPENDITURE OF SPANISH INDUSTRIAL
AND SERVICES FIRMS

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ABSTRACT

The article examines industrial and services firms' direct energy costs as a proportion of their turnover in 2019, differentiating by fuel type (electricity, natural gas and other fuels) and by firm size and economic sector. The analysis shows that the proportional expenditure on different energy inputs is highly heterogeneous across productive sub-sectors. For energy-intensive sub-sectors, there are also differences in the composition of energy expenditure by firm size. In general, the larger the firm, the lower the proportion of turnover spent on electricity and other fuels, but the higher the proportion spent on natural gas.

Keywords: natural gas prices, electricity prices, fuel prices, economic sector and firm size.

JEL classification: L00, M21, Q49.

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Introduction

For more than a year, international energy prices have been rising at an unprecedented pace. Specifically, international benchmark prices of the petrol and diesel consumed by Spanish firms were more than 2.5 times higher in June 2022 than the average prices in 2019 (see Chart 1.1). These benchmark prices have fallen since June, but they continue to be much higher than 2019 prices (petrol 1.8 times higher and diesel 2.1 times higher). Gas prices have increased even more markedly. The Iberian gas market (MIBGAS) index has risen from slightly more than €15 per MWh, on average, in 2019 to well over €200 per MWh on several occasions in 2022 (see Chart 1.2). At the same time, the prices of CO₂ emission allowances on the European market have increased rapidly in 2022, reaching prices that are slightly more than triple average 2019 levels (see Chart 1.3). The higher prices of natural gas and CO₂ emission allowances pass through to wholesale electricity prices via natural gas or fossil fuel power plants. As Chart 1.4 shows, wholesale electricity prices stood at €48 per MWh on average in 2019, while in 2022 YTD this figure is five times higher. These price increases on the international markets have passed through to wholesale prices in Spain, resulting in substantially higher costs for Spanish firms. Given the importance of energy – especially electricity – as a productive input, these price rises could jeopardise the viability of some otherwise profitable firms, with a potentially adverse impact on employment and economic recovery.¹

Against this backdrop, quantifying Spanish firms' energy expenditure in detail is considered appropriate, especially as this expenditure is highly heterogeneous, both across economic sectors and across firms in different sub-sectors. This article addresses this issue, starting by examining industrial and services firms' direct energy costs as a proportion of their turnover, differentiating by fuel type (electricity, natural gas and other fuels) and by firm size and economic sector. The analysis is made for 2019, to rule out any possible pandemic-related disruptions to firms' activity and cost structures in 2020, the last year for which information is available.

¹ Izquierdo, Moral-Benito and Prades (2019) find, using 2014 input-output tables, that electricity is Spain's most systemic industry in terms of impact on the economy overall, and that this impact is significantly greater than in other countries.

Chart 1

INTERNATIONAL ENERGY PRICES AND WHOLESALE ELECTRICITY PRICES

International energy prices have soared in 2021 and 2022 to date. The increase in natural gas prices and CO₂ emission allowance prices passes through to wholesale electricity prices via natural gas or fossil fuel power plants.

1 INTERNATIONAL BENCHMARK FUEL PRICES (a)



2 IBERIAN GAS MARKET (MIBGAS) INDEX FOR SPAIN



3 CO₂ EMISSION ALLOWANCE PRICES



4 AVERAGE MONTHLY WHOLESALE ELECTRICITY PRICES (b)



SOURCES: Comisión Nacional de los Mercados y la Competencia (CNMC), Mercado Ibérico de Gas (MIBGAS), Operador del Mercado Ibérico de Electricidad (OMIE) and Sistema Europeo de Negociación de CO₂ (SEDECO₂).

a Weighted average of market prices in Genoa (70%) and Rotterdam (30%).

b The blue line denotes the wholesale electricity market price. Since 15 June 2022, owing to the Iberian exception, wholesale market bids from coal and combined-cycle power plants are capped. To compensate these power plants for the difference between the price cap and their generation costs, they are awarded an adjustment price, which is borne by consumers. The red line denotes the wholesale market price plus the adjustment price.



The picture obtained for 2019 may help to understand how Spanish firms may have been affected by the recent increase in energy prices.

The rest of the article is organised as follows. The next section describes the breakdown by energy source, by sub-sector and firm size, in 2019. To gain a better measure of firms' vulnerability to rising energy prices, this is followed by an analysis of firms' energy expenditure as a proportion of turnover, first by sub-sector and then by firm size. The last section presents a summary of the findings.

Spanish firms' energy sources, by sub-sector and firm size

The analysis made here draws on data contained in the Structural Business Statistics for 2019 (*Estadística Estructural de Empresas 2019*) for industry, services and trade published by the National Statistics Institute (INE).² The aim is to determine how much energy bills represent as a proportion of firms' turnover, analysing the heterogeneity of energy bills by productive sub-sector (3-digit CNAE headings), firm size and energy input (electricity, natural gas, and other fuels which include diesel, fuel oil, petrol and others, although the composition of this heading may vary substantially by sub-sector).

By economic sector, in transportation other fuels account for the bulk of energy expenditure (93%), while all the other sectors rely more on electricity (which accounts for around 70% of the energy bill in other service activities and trade, and for 57% in industry). Natural gas accounts for 26% of energy expenditure in industry (see Chart 2.1). However, these differences across economic sectors mask major differences across sub-sectors (see Chart 2.2). Thus, for example, natural gas accounts for a substantial percentage of the energy expenditure of manufacture of coke and refined petroleum products (C19, 53%), manufacture of other non-metallic mineral products (C23, 43%), the chemical industry (C20, 36%) or the paper industry (C17, 32%).

In order to determine the proportion of energy inputs by firm size, firms have been split into three main groups: microenterprises (up to nine employees), small enterprises (between ten and 49 employees), and medium-sized and large enterprises (50 or more employees). There are notable differences in the energy expenditure breakdown by firm size both in industry and trade. Thus, in industry, for microenterprises other fuels account for 43% of their energy expenditure and natural gas for 2%, while for medium-sized and large enterprises, other fuels account for 12% of their energy expenditure and natural gas for 30%. Electricity accounts for somewhat less than 60%, irrespective of firm size (see Chart 3.1). With a varying degree of intensity, similar differences are observed in extractive industries (section B) and manufacturing industries (section C), but they are less marked in others (see Chart 3.2). Meanwhile, in trade, differences are observed in usage of electricity (63% for microenterprises, compared with 81% for medium-sized and large enterprises) and other fuels (34% for microenterprises, compared with 16% for medium-sized and large enterprises).

Energy expenditure as a proportion of turnover, by sub-sector

The energy breakdown can provide information on the relative impact of shocks stemming from different energy sources. Thus, it seems probable that a vehicle fuel

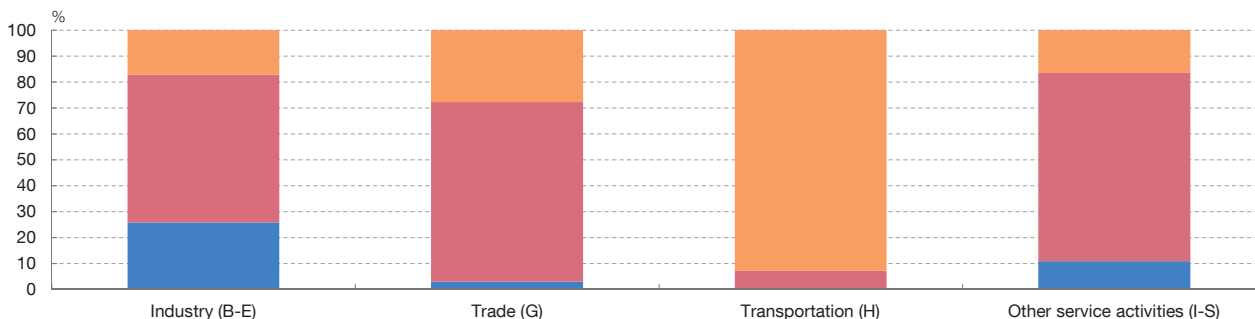
² Matea Rosa, Martínez Casares and Vázquez Martínez (2021) perform a similar analysis for 2016-18, but analysing only the cost of electricity for industry. Moreover, that article does not include a methodological change introduced in the survey in 2018 that affects the definition of firms and which is reflected in this article.

Chart 2

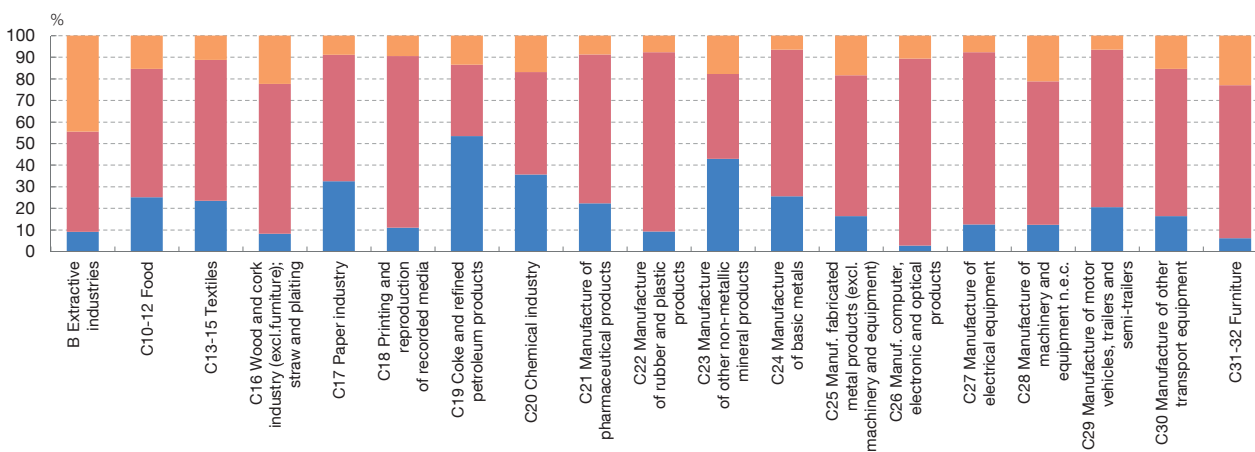
BREAKDOWN OF ENERGY EXPENDITURE BY PRODUCT IN 2019, BY ECONOMIC SECTOR AND SUB-SECTOR

In transportation, other fuels account for the bulk of energy expenditure (93%), while all the other sectors rely more on electricity (which accounts for around 70% of the energy bill in other service activities and trade, and for 57% in industry). Natural gas accounts for 26% of energy expenditure in industry. However, these differences across economic sectors mask major differences across sub-sectors.

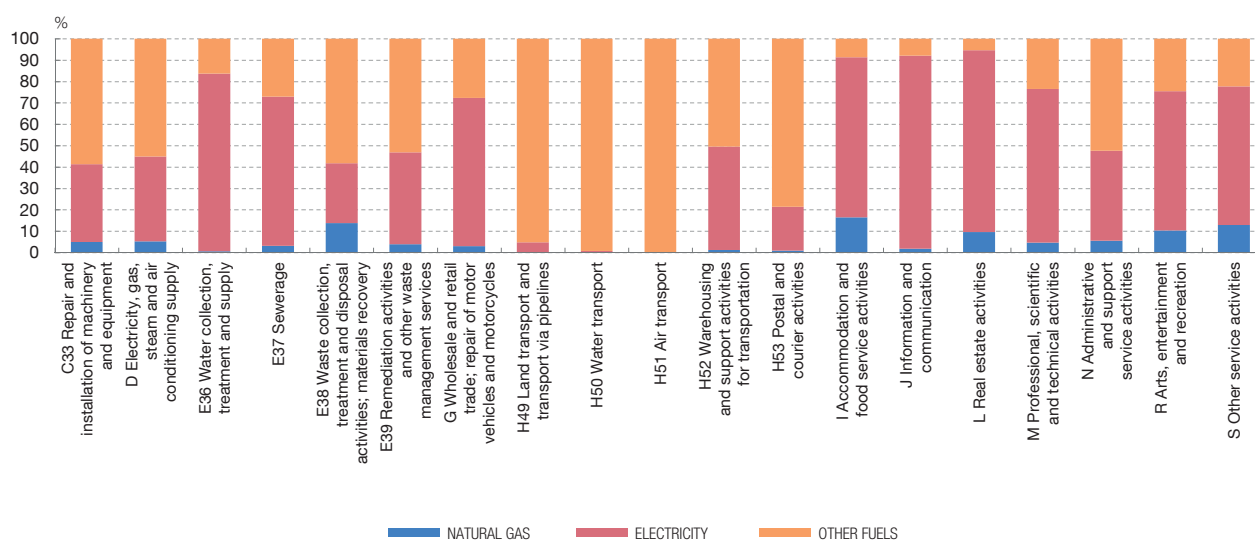
1 ECONOMIC SECTORS



2 1- AND 2-DIGIT LEVEL SUB-SECTORS



2 1- AND 2-DIGIT LEVEL SUB-SECTORS (cont'd)



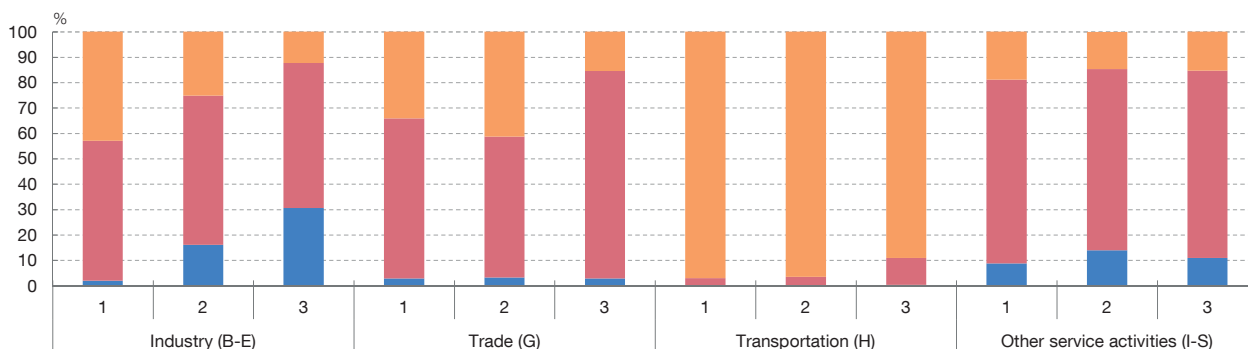
SOURCE: Banco de España calculations, drawing on *Estadística Estructural de Empresas 2019* (INE).

Chart 3

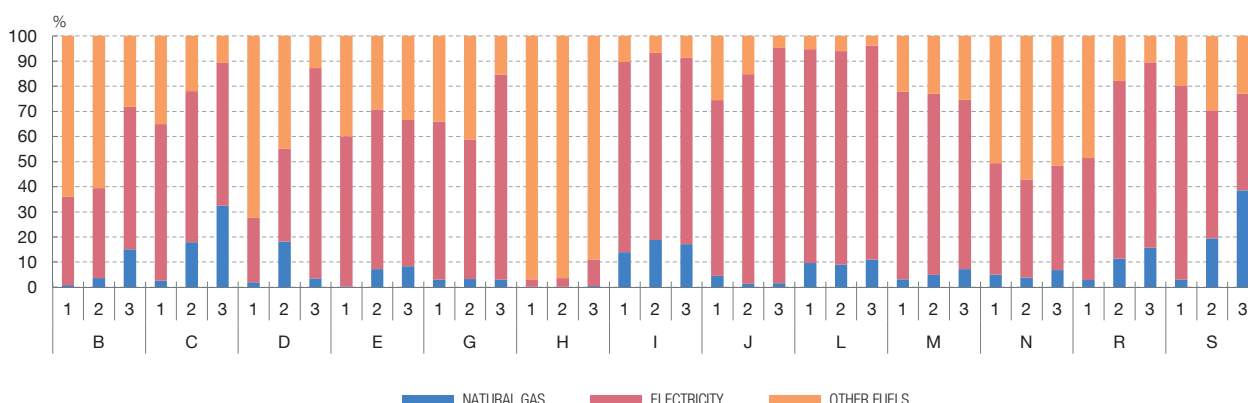
BREAKDOWN OF ENERGY EXPENDITURE BY PRODUCT AND FIRM SIZE IN 2019, BY ECONOMIC SECTOR AND SUB-SECTOR

There are notable differences in the energy expenditure breakdown by firm size both in industry and trade. Thus, in industry, for microenterprises other fuels account for 43% of their energy expenditure and natural gas for 2%, while for medium-sized and large enterprises other fuels account for 12% and natural gas for 30%. Meanwhile, in trade there are differences in usage of electricity and other fuels, with electricity amounting to a higher proportion of turnover for medium-sized and large enterprises and other fuels for microenterprises.

1 BY ECONOMIC SECTOR (a)



2 BY 1-DIGIT LEVEL SUB-SECTOR (a) (b)



SOURCE: Banco de España calculations, drawing on *Estadística Estructural de Empresas 2019* (INE).

- a The numbers “1”, “2” and “3” denote, respectively, microenterprises (firms with up to nine employees), small enterprises (between ten and 49 employees) and medium-sized and large enterprises (50 or more employees).
- b The letters denote: “B”, Extractive industries; “C”, Manufacturing industries; “D”, Electricity, gas, steam and air conditioning supply; “E”, Water supply, sewerage, waste management and remediation activities; “G”, Wholesale and retail trade and repair of motor vehicles and motorcycles; “H”, Transportation and storage; “I”, Accommodation and food service activities; “J”, Information and communication; “L”, Real estate activities; “M”, Professional, scientific and technical activities; “N”, Administrative and support service activities; “R”, Arts, entertainment and recreation; and “S”, Other service activities.

price shock would have a greater impact on transport firms than on firms in other economic sectors. Yet this information is less useful to predict whether an electricity price shock should have a greater impact on industrial firms or services firms. This is not only because they have much more similar energy sources, but also because, in each sub-sector, the electricity bill accounts for a different percentage of turnover.³

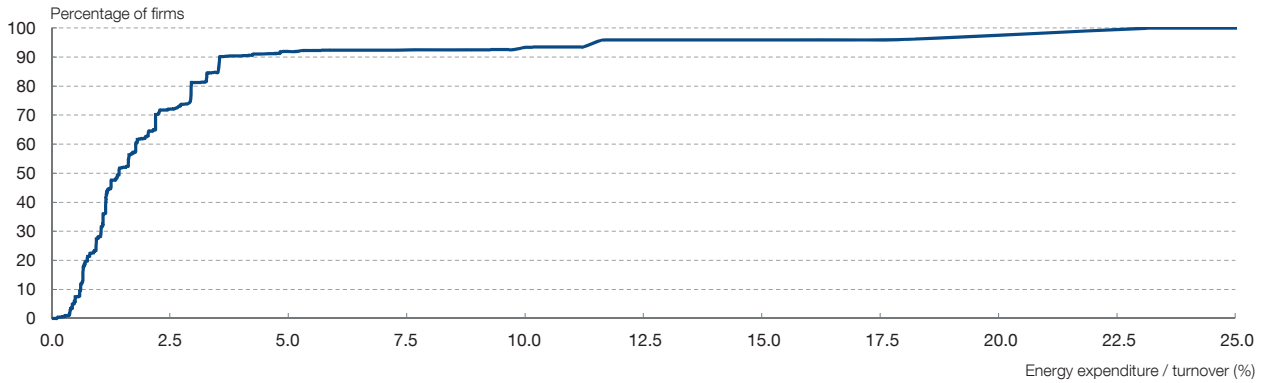
³ This article only analyses each sector’s direct exposure to the rising cost of energy inputs. For an analysis of the different economic sectors’ indirect exposure – which depends on the inputs that each acquires from other economic sectors – see Quintana (2022).

Chart 4

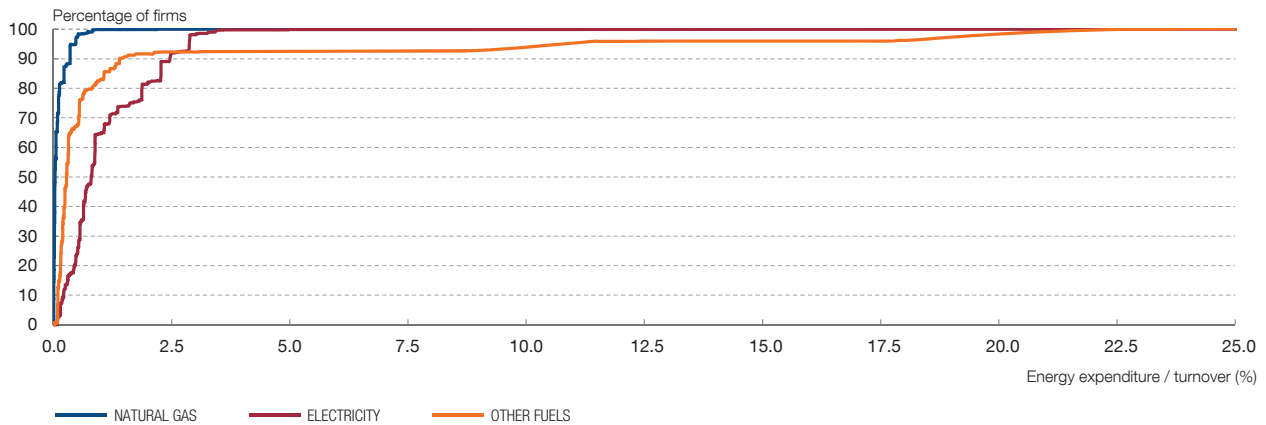
CUMULATIVE DISTRIBUTION FUNCTION OF ENERGY EXPENDITURE TO TURNOVER IN 2019

For half of firms in 2019, energy expenditure amounted to less than 1.5% of their turnover, for 40% of firms it stood between 1.5% and 3.5%, and for just 10% of firms it amounted to more than 3.5%. For most firms, electricity accounted for the highest energy cost as a proportion of turnover; for 10% of firms, other fuels accounted for a significant proportion. Natural gas represents a considerable cost for only a few firms.

1 TOTAL ENERGY PRODUCTS



2 BY TYPE OF ENERGY



SOURCE: Banco de España calculations, drawing on *Estadística Estructural de Empresas 2019* (INE).

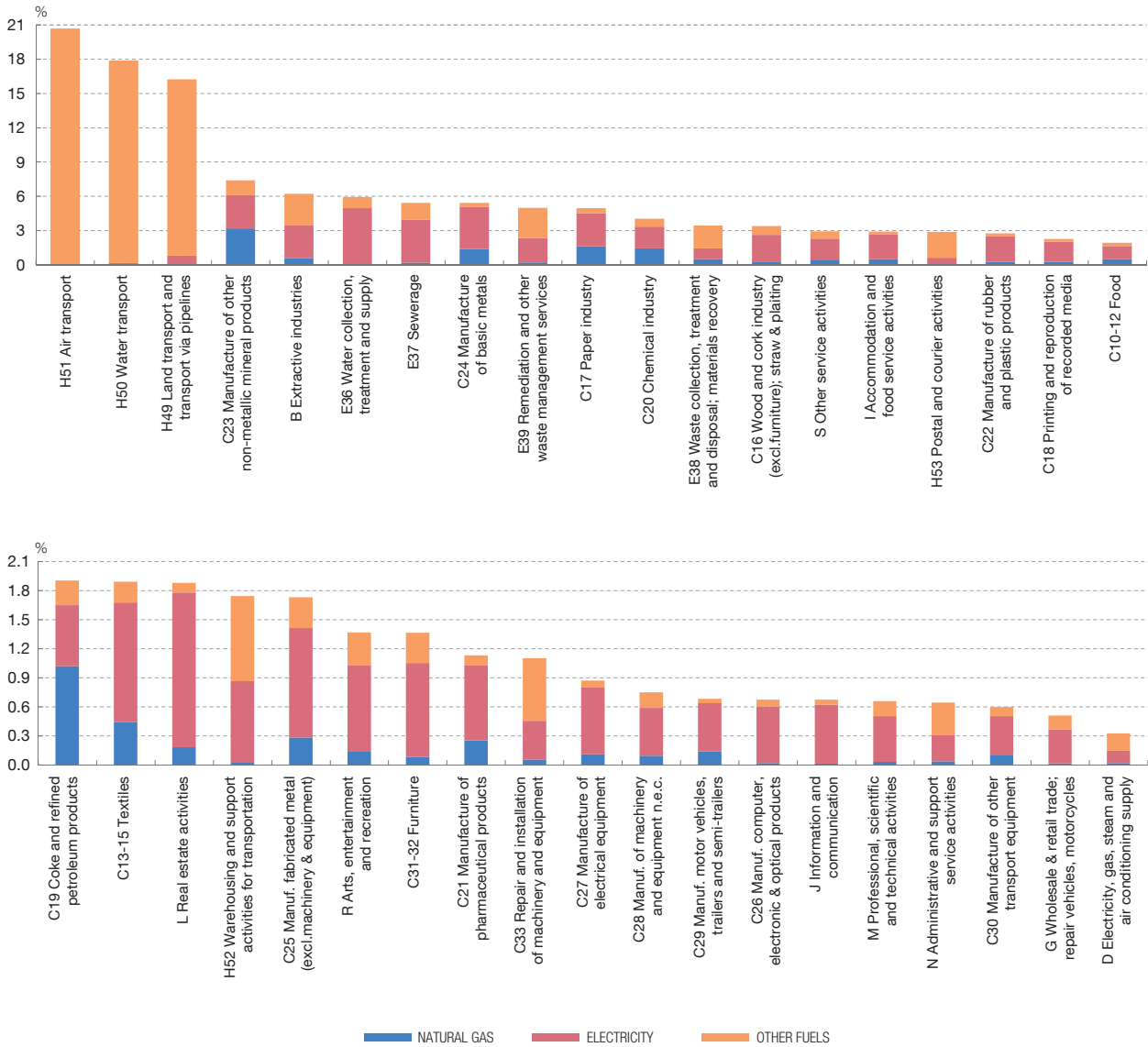
To take these differences into consideration, in this article energy expenditure is analysed as a proportion of turnover by economic sector and firm size.

Chart 4.1 shows that for half of firms in 2019, energy expenditure amounted to less than 1.5% of their turnover, for 40% of firms it stood between 1.5% and 3.5%, and for just 10% of firms it amounted to more than 3.5%. By energy source, electricity was the main energy cost for most firms, followed by other fuels, while natural gas accounts for a considerable cost for a small number of firms. For instance, for 90% of firms, electricity expenditure amounts to less than 2.6% of their turnover, whereas expenditure on other fuels amounts to less than 1.4% and expenditure on natural gas to less than 0.4% (see Chart 4.2).

Chart 5

BREAKDOWN OF ENERGY EXPENDITURE AS A PROPORTION OF TURNOVER IN 2019, BY SUB-SECTOR (a)

The transport sub-sectors are by far those whose energy expenditure (mainly on other fuels) is highest as a proportion of turnover, reaching 21% in the case of air transport. For industry and other service activities, electricity accounts for the bulk of energy expenditure.



SOURCE: Banco de España calculations, drawing on *Estadística Estructural de Empresas 2019* (INE).

a Note that in the bottom chart, the scale has been divided by ten.

Across sub-sectors at the 1- or 2-digit level, there is considerable heterogeneity in energy costs as a proportion of turnover. Moreover, in sub-sectors where the energy bill is highest, other fuels are the main energy source (see Chart 5). Specifically, the three sub-sectors with the highest energy expenditure as a proportion of turnover are air transport (H51), water transport (H50) and land transport and transport via pipelines (H49), where energy costs amount to 21%, 18% and 16%, respectively, of turnover. In all three sub-sectors, energy costs correspond almost exclusively to

other fuels. There follow a number of industrial sub-sectors, including in particular manufacture of other non-metallic mineral products (C23, which includes manufacture of ceramic and glass products), in which energy inputs amount to slightly more than 7% of turnover and which has the highest level of natural gas as a proportion of turnover (3%). Next are extractive industries (section B), where energy costs amount to slightly more than 6% of their turnover (almost 3% for electricity and for other fuels), followed by other industrial sub-sectors where electricity is the main energy input. Electricity is also the main energy source in services (except for transport services) and trade.

Energy costs by product are also very different across sub-sectors at the 3-digit level. Chart 6 shows the industries where expenditure on electricity, natural gas and other fuels is highest as a proportion of turnover. As the chart shows, interurban passenger rail transport has the highest level of electricity expenditure as a proportion of turnover (around 10%), followed by manufacture of cement, lime and plaster (9.5%) and freight rail transport (8.6%). The industries with the highest expenditure on natural gas as a proportion of turnover are manufacture of ceramic products (around 7%) and finishing of textiles (5%). Lastly, the different transport services stand out for their expenditure on other fuels as a proportion of turnover (ranging from 7.5% for freight air transport to 21.5% for passenger air transport).

Energy expenditure of Spanish firms, by firm size

As Chart 7.1 shows, generally and based on the above-mentioned firm size groups, the larger the firm, the lower their energy expenditure as a proportion of turnover. This mainly reflects the inverse relationship between firm size, on the one hand, and electricity expenditure to turnover, and especially expenditure on other fuels to turnover, on the other, while among larger firms expenditure on natural gas is higher.⁴

Generally, however, differences by firm size across the four economic sectors considered are not very significant and are much smaller than those observed across sub-sectors (see Chart 7.2). Nevertheless, there are considerable differences in more energy-intensive industries.

Specifically, in transportation, energy expenditure amounts to 14% of turnover for microenterprises, 10% for small enterprises and 9% for medium-sized and large enterprises. The electricity bill is highest as a proportion of turnover for medium-sized and large enterprises, although it accounts for only a small percentage

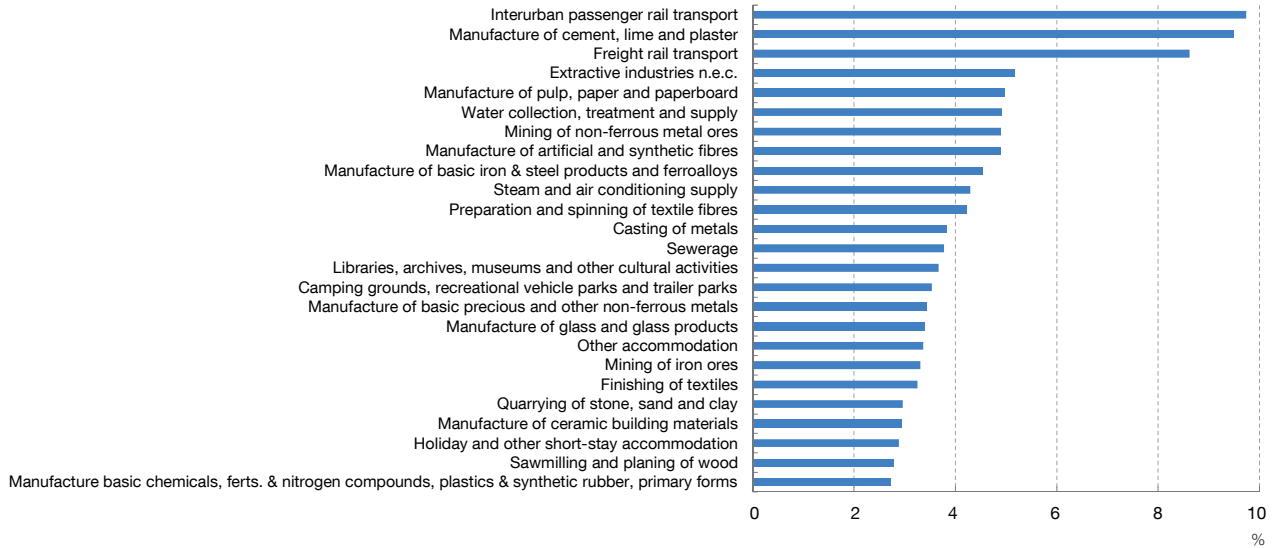
⁴ These findings are unchanged if the expenditure to turnover ratio of each of the energy products considered is regressed on firm size, with the latter expressed as differences compared with microenterprises and controlling for sub-sector.

Chart 6

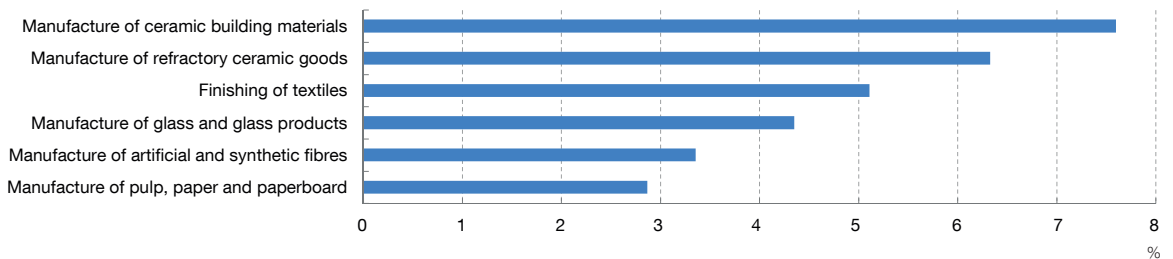
MAIN 3-DIGIT LEVEL ENERGY-INTENSIVE SUB-SECTORS (a)

Interurban passenger rail transport has the highest level of electricity expenditure as a proportion of turnover (around 10%), followed by manufacture of cement, lime and plaster (9.5%) and freight rail transport (8.6%). The industries with the highest expenditure on natural gas as a proportion of turnover are manufacture of ceramic building materials (around 7%) and finishing of textiles (5%). Lastly, the different transport services stand out for their expenditure on other fuels as a proportion of turnover (ranging from 7.5% for freight air transport to 21.5% for passenger air transport).

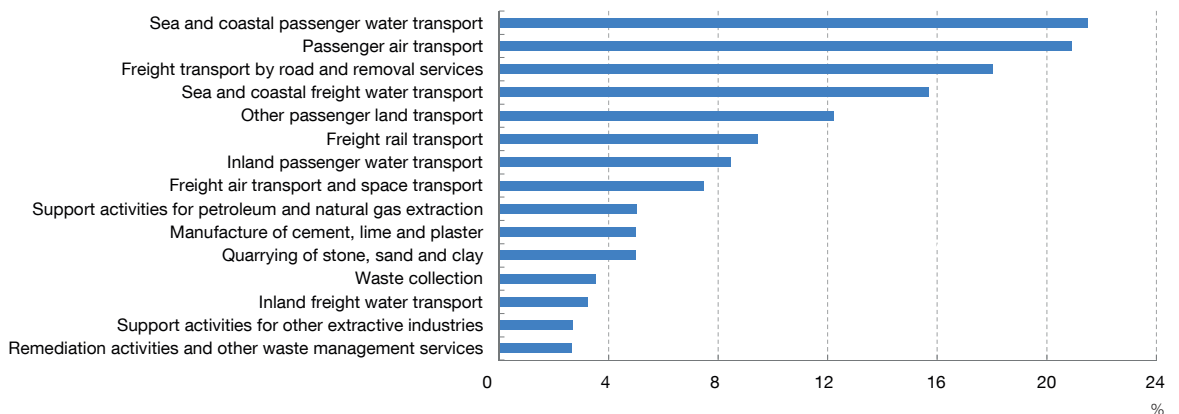
1 ELECTRICITY



2 NATURAL GAS



3 OTHER FUELS



SOURCE: Banco de España calculations, drawing on *Estadística Estructural de Empresas 2019* (INE).

a Of the 205 sub-sectors at 3-digit level for which information is available, those with an energy expenditure (differentiated by energy type) to turnover ratio over 2.5% were selected.

Chart 7

BREAKDOWN OF ENERGY EXPENDITURE AS A PROPORTION OF TURNOVER IN 2019, BY FIRM SIZE

Generally, the larger the firm, the lower their energy expenditure. This reflects the inverse relationship between firm size, on the one hand, and expenditure on other fuels to turnover, on the other. Firm size differences are not very significant in the case of electricity expenditure, but there is a direct relationship between firm size and the ratio calculated for expenditure on natural gas.



SOURCE: Banco de España calculations, drawing on *Estadística Estructural de Empresas 2019* (INE).

- a The numbers “1”, “2” and “3” denote, respectively, microenterprises (firms with up to nine employees), small enterprises (between ten and 49 employees) and medium-sized and large enterprises (50 or more employees).
- b The letters denote: “B”, Extractive industries; “C”, Manufacturing industries; “D”, Electricity, gas, steam and air conditioning supply; “E”, Water supply, sewerage, waste management and remediation activities; “G”, Wholesale and retail trade and repair of motor vehicles and motorcycles; “H”, Transportation and storage; “I”, Accommodation and food service activities; “J”, Information and communication; “L”, Real estate activities; “M”, Professional, scientific and technical activities; “N”, Administrative and support service activities; “R”, Arts, entertainment and recreation; and “S”, Other service activities.

compared with their expenditure on other fuels.⁵ Apart from the transportation sector (section H), differences are observed by firm size in water supply, sewerage, waste management and remediation activities (section E) and extractive industries (section B). Microenterprises have the highest energy expenditure (mainly electricity and other fuels) as a proportion of turnover (see Chart 7.3) in water supply, sewerage, waste management and remediation activities, whereas among small and medium-sized and large enterprises, energy expenditure (primarily other fuels) is highest in transportation and storage, followed by extractive industries.

Conclusions

The analysis shows that expenditure on the different energy inputs as a proportion of turnover is heterogeneous across productive sub-sectors and by firm size. This suggests that the effects of the recent surge in energy prices may be highly uneven across productive units, especially across sub-sectors. The differences by firm size across sub-sectors are not particularly pronounced, but they are significant in transportation (section H), water supply, sewerage, waste management and remediation activities (section E) and extractive industries (section B). This suggests that, at least for these sub-sectors, it may be useful to incorporate firm size into the design of possible support programmes for energy-intensive industries.

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5 For statistical confidentiality reasons, information by firm size for some industries at the 3-digit level is not available. This makes it impossible to verify whether this is, at least in part, because in rail transport, which is a high electricity consumer, there tend to be no micro or small enterprises.

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