6 Energy competitiveness

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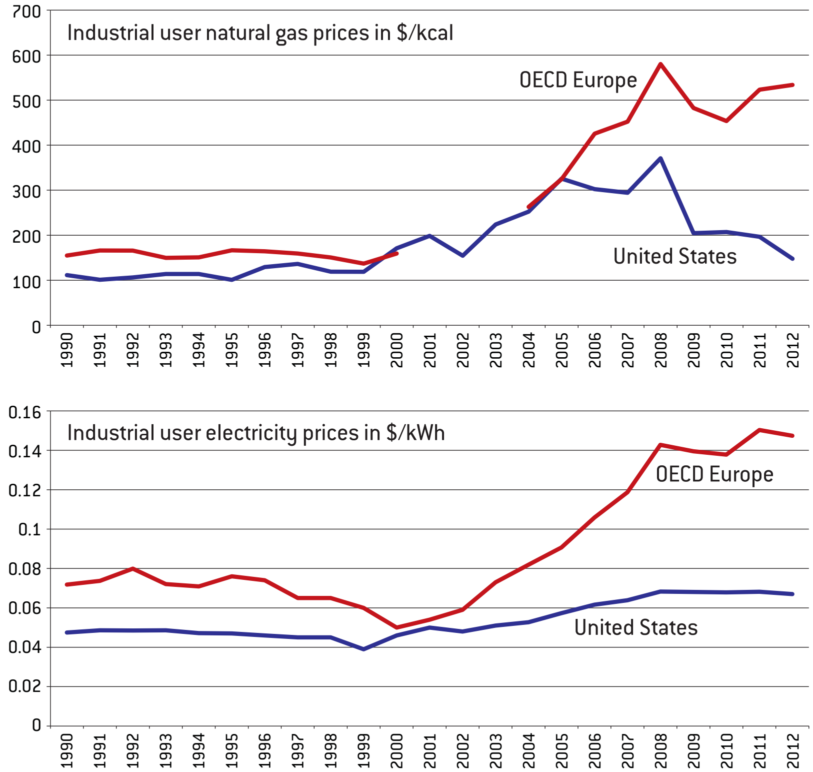
High energy prices have raised concerns that the competitiveness of European manufacturing will suffer. In this chapter, we describe the recent development of energy prices and qualitatively explore what is driving them. We then provide an empirical assessment of which sectors are likely to be most negatively affected by high international energy prices, and the implication of this for overall competitiveness. We conclude with recommendations to policymakers.

6.1 Energy is becoming relatively expensive in Europe

In Europe, natural gas prices for industrial users quadrupled and electricity prices for industrial users more than doubled in nominal terms between 1990 and 2012, according to the International Energy Agency. The European electricity price increase has hugely outstripped the modest price increase in the United States (Figure 1). European industrial-user electricity prices, which were 35 percent above US prices in 1990, were 120 percent above US prices in 2012. For natural gas, the development has been even more striking. US prices returned to their 1990 level in 2012. Consequently, the price divergence that started after 2005 resulted in European natural gas prices exceeding the corresponding US prices by almost a factor of four.

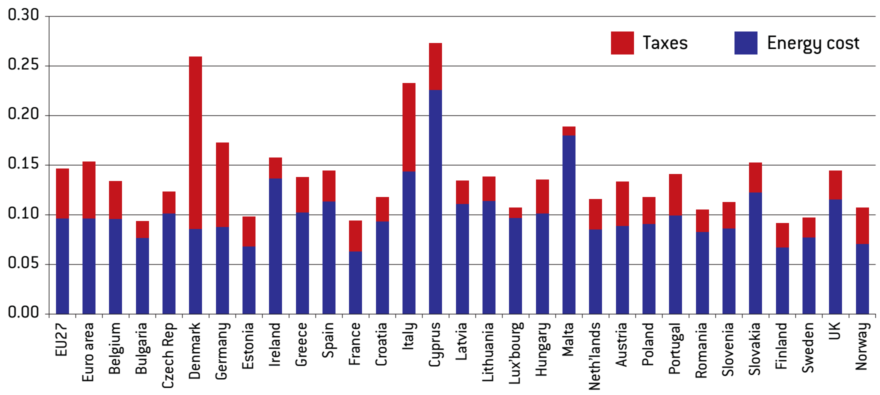
Figure 1: Natural gas and electricity price paid by industrial users, 1990-2012



Source: IEA.

These aggregate numbers, however, should be treated with caution. Energy prices for different groups of industrial user vary significantly and prices are different in different US states and in different European countries or even regions. For example, a Deloitte (2013) report on Belgian electricity prices found that industrial consumers pay €6.5 to €10 /MWh more for electricity in Flanders and €7 to €25 /MWh more in the Walloon region, compared to the average price similar consumers pay in surrounding countries. In different countries, electricity prices for industrial users are driven by different combinations of wholesale electricity prices, network tariffs and taxes and levies. In France, for example, consumers benefit from comparatively lower taxes and partly regulated wholesale prices, and in Germany consumers benefit from low wholesale prices as a result of subsidised renewables, and partial exemption from the cost of the network and the feed-in tariffs.

Figure 2: Industrial user electricity prices in €/kWh in Europe, second half 2012



Source: Eurostat. Note: 500 MWh < Consumption p.a. < 2 000 MWh.

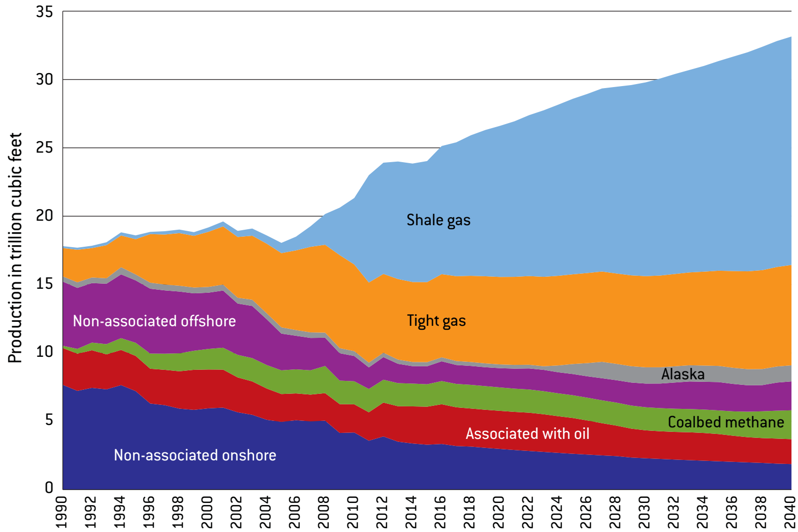
Nevertheless, the general trend of increasingly higher European energy prices compared to the US is uncontested and is a cause for serious concern on the part of European Union energy-intensive industry, which is reflected in EU policy. For example the *Action Plan for a competitive and sustainable steel industry in Europe*, adopted by the European Commission in June 2013, states that *"European industry is faced with higher energy prices than most of its international competitors, a trend which has been amplified by price development dynamics of recent years".*

There are five main reasons for the absolute and relative increase in European energy prices:

First, **global commodity prices have increased** in the past two decades. The price of Brent oil increased from about $40 /barrel in 1990 to more than $100 in the first half of 2013. The price of Australian coal – a proxy for internationally traded coal – increased from about $65/tonne in 1990 to almost $100/tonne in the first half of 2013. And the price of US natural gas increased from about $2.30/million British thermal units (mmbtu) to $3.75/mmbtu in the first half of 2013 (all prices expressed in 2013 values). Increasing consumption in emerging economies is one of the main reasons for this development. China's energy consumption alone increased from 26 billion gigajoules in 1990 to 110 billion gigajoules in 2011, surpassing that of the US in 2010.

Second, US natural gas and electricity prices have increased less than global energy prices because the US has been able to develop **huge cheap US hydrocarbon resources**. Since 2008, the production of tight and shale gas has exceeded the reduction in conventional gas sources, leading to an increase in US production from 21 trillion cubic feet (tcf) in 2008 to 25 tcf in 2012[1]. Because of a lack of natural-gas exporting infrastructure in North America, increased supply has led to a surplus that has caused regional prices to drop from around $9/mmbtu to less than $4/mmbtu[2]. Despite the economic crisis, US natural gas consumption has not decreased because low prices made it attractive – especially in power generation. Between 2007 and 2012, natural gas consumption in the US power generation increased by 34 percent, while coal consumption dropped by 21 percent. This switch to natural gas led to a stabilisation of the electricity production cost, and industrial-user electricity prices marginally decreased after 2008.

Figure 3: US natural gas production in trillion cubic feet



Source: US Energy Information Administration, *Annual Energy Outlook 2013 Early Release*.

Third, European natural gas and electricity prices have increased faster than global energy prices. While the **supply situation for natural gas** in the US has been very

1. US natural gas marketed production (millions of cubic feet) according to www.eia.gov/dnav/ng/hist/n9050us2A.htm.
2. North America was a net importer of natural gas until 2011. In 2008 it consumed about 2 percent more natural gas than it produced. In 2012, production in North America exceeded consumption by 1 percent for the first time.

favourable, domestic production in the EU has declined faster than consumption. The dependency rate[3] increased from 49 percent in 2000 to 66 percent in 2012. At the same time, declining natural consumption (-15 percent between 2005 and 2012) because of the economic crisis and an increased share of coal in power production (the US switch from coal to natural gas put pressure on global coal prices) has been unable to bring natural gas prices in Europe down. The reason is that natural gas prices in Europe are largely determined by long-term contracts – many of them including take-or-pay provisions. A large proportion of imported natural gas is still purchased at oil-indexed prices that do not reflect current market conditions.

A fourth reason for Europe's above-average increase in energy prices is its energy policy. Europe is pursuing a comparatively ambitious decarbonisation agenda. For some years, carbon prices of €15-20 resulted in higher electricity prices – since 2011, this effect has withered with the collapse of the carbon price. Several EU countries have invested heavily in electricity generation from renewable energy sources. This policy is motivated by an aim to reduce the cost of these new technologies, which can replace imported fuels and reduce carbon emissions. Such deployment-driven reduction in the cost of new technologies brings about reductions in the cost of energy in the long-term. Between 2000 and 2012, 93 gigawatts of wind turbines and 53 gigawatts of solar panels were deployed in the EU. The cost of electricity produced by these facilities was higher than that of conventional units. Furthermore, the large-scale deployment of solar panels and wind turbines in some regions required network extensions and greater levels of system services. The increased cost of the electricity system was mainly borne by electricity consumers.

Finally, European energy prices are comparatively high because market structure (number and ownership of energy-sector assets), market design (the way prices are set) and policy do not incentivise the most economic investment, production and consumption choices (see Zachmann, 2013). Significant regulatory uncertainty biases investment decisions towards high-variable and low-capital cost intensive technologies (eg extensions to the lifetime of low-efficiency plants instead of new high-efficiency units). Regulated prices are a disincentive for energy efficiency investment. National renewable support schemes cause substantial inefficiencies (solar PV in Germany instead of Greece). And incompatible national rules for ensuring national supply security create expensive over-redundancies and prevent effective competition between energy companies in different countries.

3. The share of imports in total energy consumption.

BOX 1: SOURCES OF LONG-TERM CONVERGENCE

In the long-term there are numerous drivers that cause the energy price in different countries to converge:

Direct **trade** in energy between the low-cost and the high-cost country is the most obvious channel for price convergence. If the US decides to allow exports of natural gas to Europe and both sides invest in the necessary infrastructure – LNG liquefaction plants in the US, LNG regasification plants in the EU, and the necessary vessels and pipeline network extensions – the price differential between the two sides of the Atlantic will converge towards the transport cost. If the US decides to not export to Europe directly, because European natural gas prices are lower than Asian prices, prices might still converge. Asian imports of US gas might replace imports from other parts of the world – such as the Middle East. The capacities in these exporting countries might be rerouted to Europe.

A second source of convergence is the **relocation of energy consumption**[4]. Just five energy consuming industries – chemicals and petrochemicals, non-metallic minerals, food and tobacco, iron and steel and paper, pulp and print – are responsible for more than 25 percent of European natural gas consumption. If some of those industries were to relocate, natural gas demand would shift. The resulting lower demand in Europe would put downward pressure on prices, while the higher demand in the US would put upward pressure on prices.

A third source of convergence arises from the effect of the **US fuel switch**. As a result of low gas prices, other fossil fuels such as oil and coal will be less in demand in the US. This will drive down the prices of these globally traded commodities – eventually reducing the cost of energy in Europe.

A fourth source of convergence stems from increased **investment in alternative energy sources and energy efficiency** in Europe. Higher energy prices in Europe will incentivise more investment in replacements for natural gas. In the longer-term, these investments will reduce the demand for natural gas and its price in Europe.

Finally, forward-looking natural-gas suppliers with market power in Europe might have an incentive to reduce prices in **anticipation** of the above-mentioned effects. In our view, the future development of natural gas prices in Europe will be driven by

4. Energy behaves like other production factors in the Samuelson factor-price equalisation theory. See Samuelson (1948).

Russian exporters, and whether they start to aggressively price gas in order to stabilise/increase their European market volume. There is a strong rationale for such a strategy in the medium term, because otherwise Europe has strong incentives to invest in (i) diversifying natural gas production and imports, (ii) offshoring energy-intensive activities to low-energy cost regions, (iii) invest in energy efficiency, and (iv) invest in replacements for natural gas.

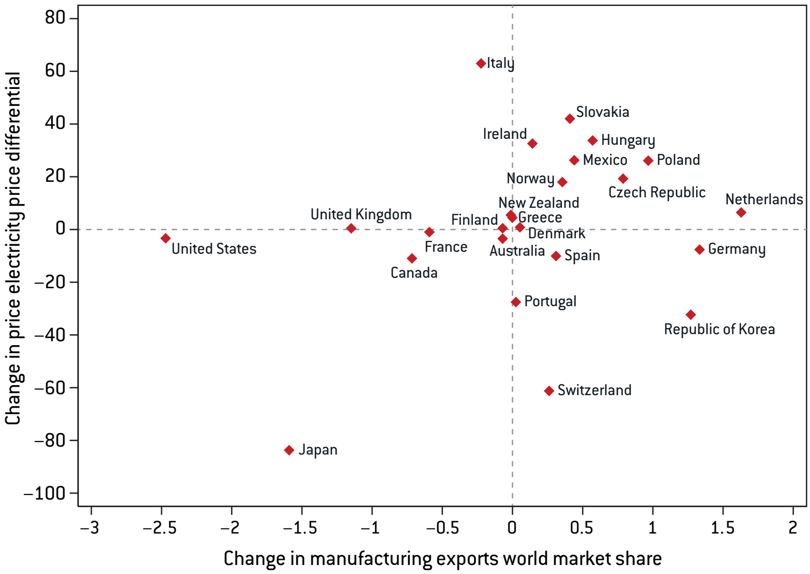
6.2 Electricity prices and the competitiveness of manufacturing

Electricity is a major production factor in many sectors. Therefore, policymakers are concerned that above-average electricity prices make domestic products uncompetitive on international markets. One would expect countries that experience increasing electricity prices compared to their competitors to see a fall in their export market share. This effect cannot be easily confirmed by trade data. In fact, an increase in the electricity price relative to other countries in most cases during the 1990s and 2000s has coincided with an increase in manufacturing export market share (Figure 4). As the effect is not significant[5] and many major factors[6] are ignored we cautiously conclude that electricity price movements are unlikely to be significantly responsible for changes in export shares during the 1990s and the 2000s.

But even if energy prices are not major drivers of countries' total exports, they certainly affect the competitiveness of individual sectors. Sectoral competitiveness is a multidimensional concept that involves supply side, demand side and institutional determinants. On the *supply side*, cost, quality and availability of sector-specific production factors are key drivers. For example, many textile products require cheap plentiful labour, while low capital costs allow specialisation in exporting chemical products produced in capital-intensive refineries. On the *demand side*, the size of, and distance to, the market is an important determinant of sectoral competitiveness. A large domestic market might, for example, allow producers of aircraft to reach a size that is competitive globally. On the institutional level, the legal, regulatory and tax system of a country co-determine whether a country is likely to specialise in a certain sector. For example, environmental regulations could drive dirty production offshore. Finally, there is no simple cause-and-effect relationship between determinants and

5. A regression with the 'change in export market share' as dependent and the 'change in relative electricity price' as independent variable, results in a beta of 0.010. But, even if the model were well specified we could only be 90.6 percent sure that beta is indeed larger than zero.
6. For example, in some countries electricity prices might increase because of high electricity demand caused by a booming export economy.

Figure 4: Effect of a change in relative electricity price on a change in average manufacturing export market share between 1996-2000 and 2001-2008 for OECD countries



Source: Bruegel.

sectoral specialisation. Sectoral specialisations within countries interact through knowledge spillovers, shared supply-chains and other effects that result in agglomerations of sectors not explained by the previous factors. For example, countries that export cars are likely to be good at exporting motorcycles as well. The development of the individual drivers of specialisation is itself affected by the current specialisation. For example, countries that have a strong chemical industry are likely to invest in the education of chemical engineers and the infrastructure for importing raw materials and exporting final products, reinforcing the sector. Because of this complexity, it is difficult to reliably model how external shocks on an individual determinant affect a country's export specialisation pattern.

In order to explore how high European energy prices might affect sectoral competitiveness, we analyse how energy prices interacted with sectoral specialisation in the past. We use electricity prices as a proxy for country-specific energy costs because electricity – because of its network-dependence – is not a globally traded commodity, and in fact is significantly heterogeneous in different countries. To evaluate the role of energy costs for sector specialisation we consider 27 OECD countries between 1996 and 2011. This allows us to compute the revealed comparative advantage, which captures a country's level of specialisation in certain exports, and to see how this is affected by country-level differences in energy prices. So, for each sector, we estimate whether countries with above-average electricity prices are more likely to specialise in it, or not.

As discussed, other factors are likely to play an important role for specialisation patterns. Countries with above average unit labour costs tend not to specialise in labour-intensive products such as textiles, and countries with above-average capital costs tend not to specialise in capital-intensive products such as chemicals and metals[7]. Consequently, some of the specialisation patterns we might have attributed to energy price differentials previously might actually be driven by other factors. To reduce the risk of overstating the importance of energy prices for sectoral specialisation because of such omitted variables, we control for four other important factors: cost of capital, cost of labour, size of the home market and level of development of the country[8]. In the analysis, cost of labour is represented by average hourly compensation, cost of capital is proxied by the 10 year interest rate for each country's sovereign bond, size of the home market is represented by the nominal GDP and level of development is represented by *per-capita* GDP.

The results confirm that larger countries are more likely to specialise in many products[9]. This effect appears to be more because of the population size of the country than its wealth[10]. In terms of capital and labour cost, some products behave as expected: 'cotton sacks/bags' is more likely to be found in countries with low wages and high interest rates; and 'electric and electronic keyboard instruments' in countries with low interest rates and high wages. Others behave contrary to expectation: according to our results, 'ball bearings' are more likely to be found in countries with high wages and low interest rates. Hence, we cannot exclude that we seriously under-represent the complexity of the drivers of sectoral specialisation in our model[11].

7. According to the Heckscher-Ohlin theorem, trade flows are driven by factor abundance: a country will export products that require factors relatively abundant on its territory and import the others.
8. Introducing more factors and more complex interactions between factors would be desirable but is limited by the number of available observations.
9. The probability that a country specialises in about 1300 of the 2800 product categories covered by the analysis is positively related to the country's GDP. The reverse is only true for about 400 product categories.
10. We find that in product categories for which specialisation is positively related to GDI, it is typically negatively related to GDP per capita.

According to our analysis, about 600 product types are more likely to be produced in low electricity-price countries than in high-price countries (those products have a negative coefficient in the 'electricity price' columns in Table 1). Some of them are quite intuitive – such as sodium chlorate (used for bleaching paper) or ammonium nitrate fertiliser[12] – because energy costs represent a high share of the production cost. We also count about 1000 products that are more likely to be exported by countries with high electricity prices (those products have a positive coefficient in the 'electricity price' columns in Table 1). These products come from rather diverse sectors that are typically less energy intensive.

We have so far focused on whether countries with above or below average energy prices export more or less of a certain product. But export specialisation in manufactured products can only to a limited extent react to the current energy price. Past investment patterns are strong drivers of export specialisation – an existing aluminium smelter might continue producing even if the electricity price rises comparatively high, while even if the electricity price is very low, the absence of a fertiliser plant prevents exports of ammonium nitrate. In the long-term however, investment also reacts to energy prices. Anecdotal evidence suggests that investment in energy-intensive sectors drops when energy prices rise. Germany had rising energy prices and saw investment increase more than in the US in the less energy-intensive 'machinery and equipment' sector. At the same time, the US increased investment in the energy-intensive basic metals sector by more than twice as much as Germany (Figure 5).

To somewhat capture these investment effects, we look at the differences in the revealed comparative advantage in 2011, 2006 and 2001, and the price differential over the respective preceding five-year periods. Country production specialisation appears to be influenced by energy prices also over the medium-term[13]. We find more than 100 products that countries with low energy prices tend to specialise in. Again, ammonium nitrate and sodium chlorate feature in this group of energy-intensive products that are more likely to be exported by low-energy cost countries. But we also find more than 500 products that are more likely to be exported by high-energy cost countries. These tend again to be of a rather diverse nature.

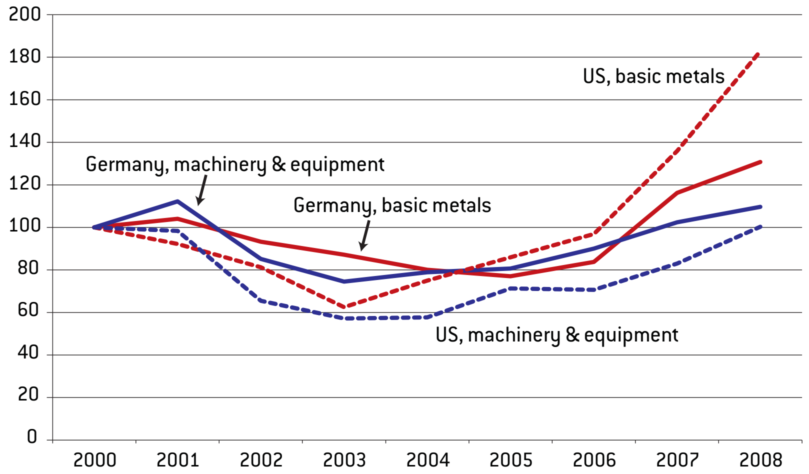
11. Our model explains about 15 percent of the variation of specialisation in the analysed products. Only for 2 percent of the products we explain more than half of the specialisation. It is difficult to do better, as the limited sample size constrains the degrees of freedom and hence the number of control variables we could sensibly include in the estimation.
12. About 3-5 percent of the world's natural gas production is consumed in the production of ammonium nitrate.
13. We consider 3-10 years as medium-term.

Table 1: Selected results for a logistic regression of product-level competitiveness on electricity prices (short-term)

Product name	Electricity price coefficient	Extent of fit (R^2)*	Product name	Electricity price coefficient	Extent of fit (R^2)*
Sports gloves etc.	10.3	72%	Goat meat, fresh/chld/frz	-9.3	45%
Cellulose acetate plasd	6.1	70%	Sodium chlorate	-8.3	36%
Shotgun barrels	6.0	61%	Newsprint rolls/sheets	-8.0	42%
Wig making materials	6.0	45%	Conif wood pulp semi-blc	-6.8	39%
Indust driers non-electr	5.9	48%	Cotton seeds	-6.2	41%
Ammonium chloride	5.7	51%	Flax tow/waste	-5.9	24%
Silk yarn non waste, bulk	5.5	45%	Meat, equine, frsh/chl/frz	-5.8	26%
Cellulose acetate non-pl	5.4	66%	Chem wood pulp disolving	-5.6	45%
Raw silk not thrown	5.1	45%	Mixed alkylbenzenes nes	-5.5	27%
Cotton sacks/bags	5.1	46%	Semi-chemical wood pulp	-5.4	22%
Honing/lapping machines	5.0	61%	Ammonium nitrate fert.	-5.1	20%
Elec keyboard instrumnts	5.0	58%	Silicon dioxide	-5.1	57%
Vulc rubber thread/cord	4.9	66%	Potassium sulphate fert.	-5.0	24%
Sawing machs,metalworkng	4.9	38%	Tall oil	-5.0	32%
Shotgun/rifle parts nes	4.8	34%	Wooden shingles/shakes	-5.0	33%
Dry-cleaning machines	4.8	46%	Potatoes, presvd/frozen	-4.9	29%
Tetracyclines and derivs	4.7	36%	Zirconium wrt/artics nes	-4.9	42%
Parts for fans/gas pumps	4.6	43%	Radiation detectors etc	-4.8	44%
Safety/relief valves	4.3	34%	Urea (fertilizer)	-4.8	31%
Motorcycles etc >800cc	4.1	56%	Cotton garnetted stock	-4.8	26%
Leather sandals	4.1	33%	Nickel unwrought	-4.5	46%

Source: Bruegel. Note: We report here the 21 largest and 21 smallest coefficients. All coefficients are significant at the 0.1% level. The regression controls for country differences in labour compensation, interest rate, GDP and GDP per capita. * R^2 is the McFadden pseudo R^2 for the logit estimate, and indicates how much of the differences between countries in export competitiveness is actually explained by the factors under consideration.

Figure 5: Gross fixed capital formation in two sectors in two countries at current prices (index = 2000)



Source: OECD STAN.

Table 2: Selected results for a logistic regression of product-level competitiveness on electricity prices (medium-term)

Product name	Electricity price coefficient	Extent of fit (R^2)*	Product name	Electricity price coefficient	Extent of fit (R^2)*
Metal non-rmvl tools nes	10.4	72%	War munition / parts	-18.6	73%
Printing machinery	8.5	59%	Plywood-standard	-9.9	35%
Indust driers non-electr	8.4	53%	Fish fillets/ meat.frs/ch	-8.6	55%
Wig making materials	7.9	52%	Flax tow/waste	-8.5	37%
Theophylline etc/derivs	7.9	38%	Aircraft undercarriage	-7.7	30%
Footw all rub/plast nes	7.3	45%	Brandies/ marcs etc.	-7.3	26%
Sports gloves etc.	7.1	53%	Radiation detectors etc	-7.2	55%
Shotgun/rifle parts nes	6.9	43%	Newsprint rolls/sheets	-7.1	33%
Bookbinding machinery	6.5	46%	Semi-chem wood pulp	-6.9	34%
Laser/photon mach tools	6.4	60%	Wood chips - non-conifer	-6.5	40%
Silk yarn non waste, bulk	6.4	47%	Semi-chem fluting paper	-6.4	30%
Unit construct machines	6.3	51%	Ammonium nitrate fert.	-6.4	29%
Mink skins unassembled	6.1	46%	Chem wood pulp disolvin	-6.3	37%
Ski-boots leather uppers	6.0	39%	Goat meat. fresh/ chld/frz	-6.2	29%
Cutlery sets nes	5.7	43%	Silicon dioxide	-6.1	58%
Irn,smple stl shapes nes	5.6	51%	Sodium chlorate	-5.8	29%
Punching etc mchines nes	5.4	45%	Quicklime	-5.7	29%
Camera parts/ accessories	5.4	48%	Tapioca/sago/etc	-5.5	21%
Tetracyclines and derivs	5.3	36%	Hydrogen peroxide	-5.2	23%
Metal mch-tl work holder	5.3	52%	Conif wood pulp semi-blc	-5.2	28%
Dry-cleaning machines	5.3	46%	Iron/steel dross/scale	-5.1	21%

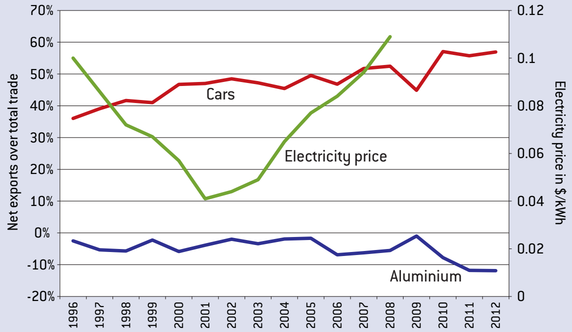
Source: Bruegel. Note: We report here the 21 largest and 21 smallest coefficients. All coefficients are significant at the 0.1% level. The regression controls for country differences in labour compensation, interest rate, GDP and GDP per capita. * R^2 is the McFadden pseudo R^2 for the logit estimate, and indicates how much of the differences between countries in export competitiveness is actually explained by the factors under consideration.

BOX 2: A GLOBAL VALUE CHAIN CASE STUDY: ALUMINIUM, ELECTRICITY PRICES AND THE CAR INDUSTRY

The aluminium sector is very energy intensive. Electricity accounts for about 30 percent of the production cost. Our analytical results confirm that aluminium is exported mainly by countries with low electricity prices[14]. Aluminium is increasingly used to replace steel in car manufacturing. Currently, the aluminium content of a European car is 140 kg, three times the 1990 amount. Consequently, it is interesting to consider if car exports are indirectly affected by electricity prices. Our results indicate that they are not.

The case of Germany is illustrative. Between 2001 an 2008, energy prices increased by 166 percent. This coincided with a substantial increase in German net imports of aluminium of 242 percent. At the same time, car exports continued to rise. Net exports increased by 142 percent independently from the variation in the domestic production of one of the most important inputs. So the competitiveness of the German car industry has not suffered from the increase in energy prices. To what degree this is because other favourable production factors (eg comparatively low unit labour costs) have compensated for higher aluminium prices, and to what degree the increasing cost of aluminium production in Germany was not passed-through to the German car industry because of international competition in the aluminium market, cannot be analysed here.

Figure 6: German net exports of cars and aluminium versus industrial-user electricity price



Source: Bruegel based on UN Comtrade and IEA.

14. The regression coefficient for the electricity price on the revealed comparative advantage for not alloyed unwrought aluminium is -3.7. It is significant at the 95 percent confidence level (R^2=38%).

6.3 What drives sectoral specialisation?

To widen the scope of the analysis, we aggregate products into their respective sectors. Going from more than 2800 products categories to fewer than 100 sectors allows us to see the bigger picture. Sectoral aggregation[15] confirms the findings of the product category analysis. Countries with high energy prices are likely to specialise in 19 rather diverse sectors. Countries with low energy prices exhibit significant specialisation in nine, typically energy intensive, sectors such as 'pulp, paper and paperboard', 'refined petroleum', and 'basic precious and non-ferrous metals'. There is no greater or lower likelihood of occurrence in low or high energy price countries for 67 sectors. For some of these, the reason is that they include both products that are primarily exported by high-price countries and products that are primarily exported by low-price countries. For example, 'basic chemicals' is not significant on the sectoral level even though ammonium nitrate is typically exported by low-price countries and sulphites are typically exported by high-price countries.

Table 3 identifies the sectors in which according to our analysis either low electricity price countries reveal a competitive advantage (negative electricity price coefficient) or high electricity price countries reveal a competitive advantage (positive electricity price coefficient). We will use this as the basis for further analysis of how electricity prices shape countries' manufacturing sectors.

We have, however, to add a note of caution. On the sectoral level, the variables we have chosen (electricity cost, labour cost, capital cost, GDP, GDP per capita) can on average explain only slightly more than 30 percent of which countries specialise exporting in this sector (see the R^2 in Table 3). In addition, there can be a number of reasons for the observed coincidences:

1. Causality: the most straightforward reason is that high energy prices discourage specialisation in energy-intensive products;
2. Joint cause: high energy prices in a country might be the effect of a certain economic factors (such as economic policy, level of economic development or factor availability), which also encourage certain sectors. For example, strong preferences for environmental protection might increase energy prices and

15. We aggregate the product categories (that are classified according to HS) into sectors (classified according to NACE) using concordance tables provided by United Nations Statistics Division. For each year, between 4409 and 4131 HS products have been linked to 2808-2623 SITC products and to 95 NACE sectors.

Table 3: Selected results for a logistic regression of sector level competitiveness on electricity prices (medium-term)

Product	Electricity price coefficient	Extent of fit (R^2)*
Miscellaneous manufacturing n. e. c.	11.1	61%
Glass and glass products	8.2	62%
Ceramic goods	7.3	59%
Games and toys	6.2	37%
Paints, coatings, printing ink	6.2	71%
Machinery for production, use of mech. power	6.2	61%
Textile weaving	5.0	46%
Electric motors, generators and transformers	4.6	51%
Cutlery, tools and general hardware	4.6	48%
Optical instruments and photographic equipment	4.0	46%
Accumulators, primary cells and primary batteries	3.8	50%
Electricity distribution and control apparatus	3.5	35%
Watches and clocks	3.4	52%
Other wearing apparel and accessories	2.7	39%
Ceramic tiles and flags	2.7	48%
Bricks, tiles and construction products	2.6	26%
Motorcycles and bicycles	2.6	22%
Footwear	2.4	31%
Beverages	2.2	15%
Other transport equipment n. e. c.	-1.9	23%
Refined petroleum	-1.9	17%
Sawmilling, planing and impregnation of wood	-2.2	16%
TV, and radio transmitters, apparatus for line telephony	-2.3	24%
Nuclear fuel	-2.6	22%
Pulp, paper and paperboard	-3.7	21%
Fish and fish products	-3.9	35%
Aircraft and spacecraft	-4.8	46%
Basic precious and non-ferrous metals	-6.7	45%

Source: Bruegel. Note: We report here the betas for all sectors with coefficients significants significant at the 5% level. The regression controls for country differences in labour compensation, interest rate, GDP and GDP per capita.
* R^2 is the McFadden pseudo R^2 for the logit estimate, and indicates how much of the differences between countries in export competitiveness is actually explained by the factors under consideration.

encourage environmental technologies, or high cost of capital make both energy production and production of capital-intensive products expensive;
3. Reverse causality: a historic strength in energy-intensive products might support the development of a very competitive energy industry;
4. Statistical effects: because of the high number of products (2800), some observed coincidences might be random.

Even though we do not see an obvious reason why our methodology might over/under-represent certain sectors, the results entail a high degree of uncertainty.

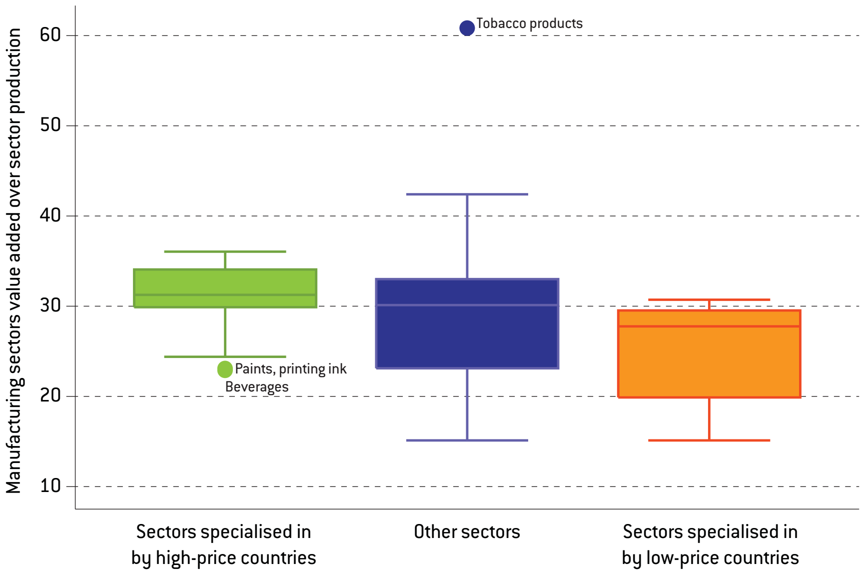
6.4 Value-added and employment in energy-price sensitive sectors

We evaluate whether the sectors that appear to be negatively affected by high energy prices are of particular economic importance. We check if these sectors typically have a higher value added share than sectors that are not or are positively affected by the energy price. Figure 7 shows that sectors in which countries with high energy prices are more likely to specialise are characterised by higher value added than sectors in which countries with low energy prices specialise. Consequently, low energy prices do not help a country to focus its exports on manufacturing sectors that promise high value added. There are several reasons for this:

1. Low energy prices seem to encourage specialisation in a few energy-intensive products. Those are often rather homogeneous and face stiff international competition and are consequently low value added. By contrast, high energy prices coincide with specialisation in many heterogeneous products.
2. Low energy prices often coincide with energy exports while high energy prices coincide with energy imports. Energy-importing countries need to earn a higher value added in their manufacturing exports in order to be able to afford the imports.
3. High energy prices might be a result of specialisation in successful sectors. High export productivity might make investments in energy generation more expensive, thus increasing energy prices.

Consequently, we refrain from the incorrect interpretation that *"high energy prices encourage specialisation in more productive sectors"*. We, however, assert that there is no evidence that energy prices above the global average undermine in the long-term the productivity of export sectors.

Figure 7: Box plots for *value added* of all sectors whose specialization is (1) significantly negative, (2) not significant and (3) significantly positively correlated with the energy price

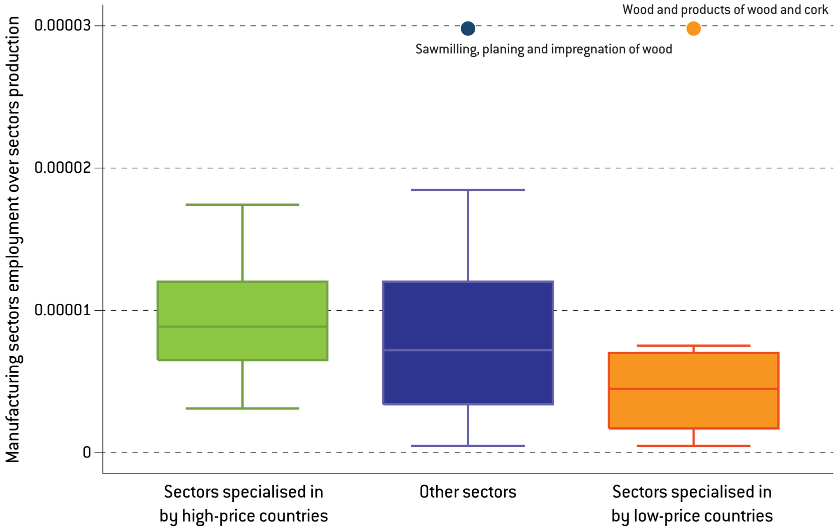


Source: Bruegel. Note: The coloured boxes contain 50 percent of the sectors in each category, the band inside the box represents the median of each category, 90 percent of all sectors in each category have a value-added over production value that lies between the upper and the lower bars.

Figure 8 shows that sectors in which countries with high energy prices are more likely to specialise have significantly higher employment relative to their production value than sectors in which countries with low energy prices specialise. **This indicates that countries with high energy prices tend to specialise in sectors with higher employment per production value than countries with low energy prices.** Again, causality is difficult to establish but we find no evidence that high energy prices lead to lower employment in the manufacturing export sector.

The effect of relative energy prices on manufacturing value added and employment depends on the sectoral composition in each country. Figure 9 shows that in European countries, value added is highest in those manufacturing sectors that neither significantly coincide with high nor low energy prices. Only Greece, Norway, Sweden and the UK have a higher share of manufacturing value added in sectors that coincide

Figure 8: Box plots for *employment* of all sectors whose specialisation is (1) significantly negative, (2) not significant and (3) significantly positively correlated with the energy price



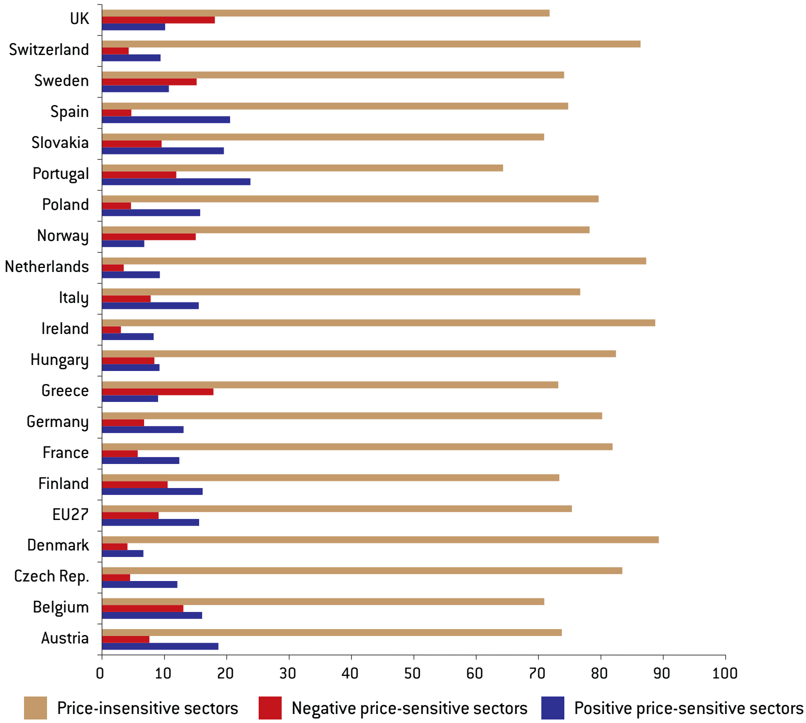
Source: Bruegel. Note: The coloured boxes contain 50 percent of the sectors in each category, the band inside the box represents the median of each category, 90 percent of all sectors in each category have a value-added over production value that lies between the upper and the lower bars.

with low energy prices. All other countries already specialise in sectors that are above-proportionally present in high-energy price countries[16].

For employment (Figure 10) the picture is similar. In all countries, the highest employment share is in sectors that do not coincide with low or high energy prices. Belgium, Finland, Hungary, Norway and Sweden have the highest employment shares in sectors that coincide with low energy prices. All other countries have higher employment shares in sectors that coincide with high energy prices. But overall in the countries covered, more people (130,000) are employed in sectors that coincide with low energy prices than in sectors that coincide with high energy prices (90,000).

16. To clarify, we note that this argumentation is not circular. We identify products that are above-proportionally exported by countries with low energy prices and aggregate those into sectors. In Figure 6 we do not, however, check which countries export most of these products (the answer would be the countries with the lowest energy prices), but we check which share of value added in a country is produced by the sectors that we find to coincide with low energy prices.

Figure 9: Share of value added within a country, grouped according to the energy-sensitivity of the sectors



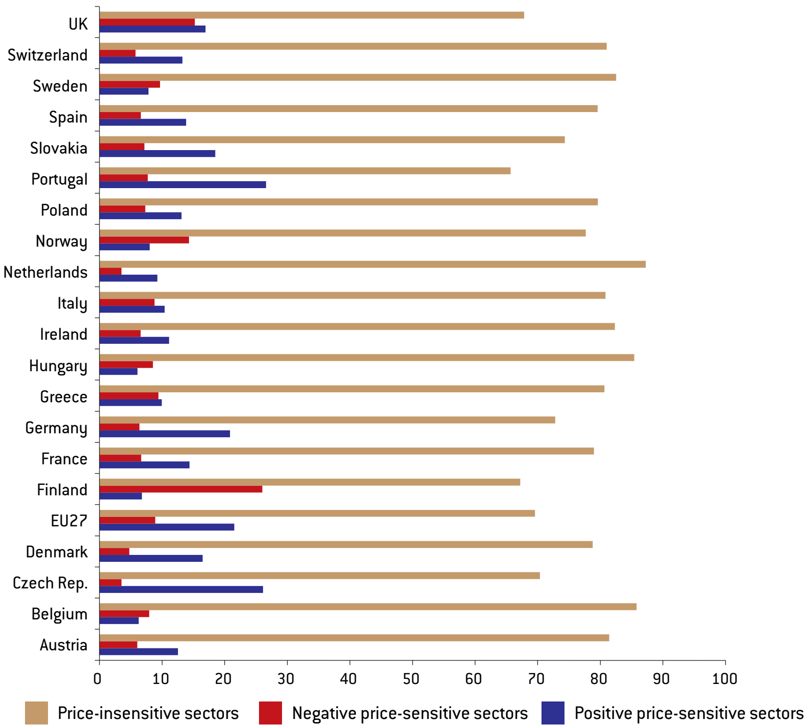
Source: Bruegel. Note: Based on the sectoral value added data by country from Eurostat.

6.5 Conclusion

We have shown that whether a country has low or high energy prices does not determine whether it is a competitive exporter of manufactured products, but it does influence in which sectors a country becomes competitive.

Obviously, a country can neither specialise in all manufacturing sectors nor can it have a relative competitive advantage in all production factors. Nevertheless, subsidising individual production factors through direct state aid, favourable regulations or tax exemptions for certain sectors is commonplace in global competition. The costs of these subsidies are borne by other parts of the economy. If they are levied by putting higher taxes on capital or labour, the competitiveness gain of the energy-intensive

Figure 10: Share of employment within a country, grouped according to the energy-sensitivity of the sectors



Source: Bruegel. Note: Based on the sectoral employment data by country from Eurostat.

sector might not be enough to compensate for the competitiveness loss of the 'naturally' competitive sectors, because the energy-intensive sectors contribute relatively less to employment and value added.

With our analysis we also challenge the view that certain energy-intensive sectors are central to the competitiveness of other sectors. One might think, for example, that the competitiveness of the car industry – one of the largest manufacturing sectors in terms of employment and value added in Europe – depends on the competitiveness of the steel and aluminium industry. We, however, find that while the aluminium industry is indeed concentrating in countries with below-average energy prices, the car industry is not.

There are at least three more reasons to refrain from subsidising energy prices:

First, government intervention in energy pricing (eg regulations) does not create the necessary stable investment framework for energy consumers, and can destroy incentives for energy producers. Investment in energy efficiency and domestic energy supply will be reduced, causing the price disadvantage to increase.

Second, volatile energy prices attract very specific industries that tend to leave as soon as energy prices are lower elsewhere. Other sectors, which invest in human-capital formation, knowledge and complex supply chains form a more sustainable basis for competitiveness.

And third, short-term political intervention might actually prevent structural convergence of energy prices. If large (and potentially even inefficient) consumers are given an incentive to stay by subsidised energy prices, energy consumption cannot react to the differences in resource availability. Other consumers will have to pay more and suppliers will be under no pressure to price energy more competitively.

Europe will be better able to maintain its competitiveness in manufacturing sectors by refraining from unsustainable measures such as subsidies to energy consumers. That said, structural measures for reducing the cost of energy to the economy are of course a sensible economic policy. Most prominently, making the European internal market for energy work could significantly reduce the cost of energy.

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