

COMPETITIVENESS OF THE STEEL SECTOR IN POLAND

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Purpose: The aim of the work is to identify factors influencing the competitiveness of the steel sector in Poland and its characteristics, as well as to determine the level of competition intensity in it.

Design/methodology/approach: In order to achieve the objectives, the following research questions have been formulated: what factors affect the competitiveness of the steel sector in Poland, what is the structure of the steel sector in Poland and what is the level of competition intensity in the steel sector in Poland?

The research used the sector analysis according to M. Porter, the Herfindahl-Hirschman Index (HHI) as a measure of market concentration and a critical analysis of the literature.

Findings: The article presents an analysis of the steel sector in Poland. It describes in detail the structure of the sector, including the division of companies by size, legal form and PKD codes for 260 companies, and also characterizes the main steel producers in Poland.

Research limitations/implications: The research has been limited to the analysis of companies registered in the National Court Register that have codes related to metal production in their core business, narrowing them down to steel.

As a direction for further research, it is possible to indicate the extension of the scope of the analysis to include excluded non-ferrous metals, as well as the analysis of the entire value chain, taking into account basic fossil raw materials (iron ore, coking coal) and secondary raw materials (steel and non-ferrous scrap). The impact of technological transformation related to decarbonization on the future structure and competitiveness of the steel sector could be studied.

Practical implications: Practical implications for enterprises include the identification of factors influencing the competitiveness of the steel sector in Poland.

Originality/value: The article presents an analysis of the steel market concentration in Poland based HHI in 2023, which has not been previously published for such research assumptions of the sector. The article is intended for practitioners and researchers dealing with the subject of the steel sector in Poland and worldwide.

Keywords: Competitiveness, Steel sector, Green Deal, Poland, UE.

Category of the paper: Research paper, Viewpoint.

1. Introduction

The steel sector is one of the important pillars of the economy. In Poland, as in the entire European Union, this industry is undergoing a profound transformation. It is conditioned by both historical factors and contemporary regulatory and economic challenges.

The historical importance of the steel sector for European integration dates back to the beginnings of the European Coal and Steel Community (ECSC), established by the Treaty of Paris in 1951 (European Community, 1951). This pioneering form of economic cooperation between six European countries was the foundation on which the later structures of the European Union were built.

This Community was created not only as an economic project, but also as a political initiative aimed at preventing armed conflicts through the integration of key industrial sectors.

The coal and steel industries, which were the driving force of European industrialization, are currently in a phase of maturity or decline in highly developed countries. At the same time, they are developing dynamically in emerging economies such as China and India, which significantly affects the global structure of competition.

Competitiveness of the steel sector is defined as the ability to achieve and maintain an advantage in the market. It requires the identification of factors affecting the steel sector. The analysis of the literature shows that the issue of the steel sector in Poland has been addressed by various authors (Podsiadło, 2023; Bukowski, Bocian, 2024; Gajdzik, Wolniak, Grebski, 2023; Gajdzik et al., 2025). Based on the analyses, it is possible to indicate a research gap that is the subject of interest.

The article therefore addresses the research issues related to the competitiveness of the steel sector in Poland. It is an attempt to describe the structure of the steel sector in Poland, to determine the level of competition intensity in it and to identify factors influencing the competitiveness of this sector. With reference to the objectives of the article, the following research questions were formulated: what factors affect the competitiveness of the steel sector in Poland?; What is the structure of the steel sector in Poland?; What is the level of competition intensity in the steel sector in Poland?

In the European, but also in the Polish context, environmental regulations are currently of key importance, in particular the European Green Deal policy, which challenges steel producers to deeply decarbonise their production processes (Commission..., 2019; European Commission, 2025).

The Polish steel sector, despite the restructuring carried out in the 1990s, still struggles with problems typical of heavy industry, such as high energy costs, pressure from producers from countries with lower environmental standards and the need to adapt to increasingly restrictive requirements for reducing greenhouse gas emissions. At the same time, it has the potential for innovation, which, with appropriate support, can be the basis for building a new competitive

advantage. An important element in building a competitive advantage is the level of competition in the steel sector in Poland, as well as the global and European Union context.

In Poland, 6.4 million tons of crude steel were produced in 2023, which is 1 million tons less than in 2022, which is a decrease of 13.5%. Global crude steel production in 2023 reached 1 897.9 million tons. In 2023, Poland therefore had a 0.3% share in global crude steel production. The dominant producer was China with production of 1 022.5 million tons, which is about 54% of global production. Significant producers outside China were India (production of 140.8 million tons), Japan (87 million tons), the United States (81.4 million tons), Russia (76 million tons) and South Korea (66.7 million tons). Global crude steel production in 2024 reached 1 882.7 million tons. In Poland, 7.1 million tons of steel were produced in 2024 (World Steel Association, 2024a, 2025).

Table 1.

Crude steel production volume in 2023 and 2024 in individual regions of the world

World Region	2024 [Mt]	2023 [Mt]
European Union (27)	119.1	114.5
Other Europe	40.9	39.3
Russia, Other CIS, Ukraine	78.3	82.2
North America	105.4	110
South America	37.6	36.9
South Africa	4.7	5
Middle east	66.6	67.4
Asia	1382.8	1393.5
Australia	4.8	5.5
Others	42.5	43.6
Total of above countries	1882.7	1897.9

Source: Own study based on: <https://worldsteel.org/media/press-releases/2025/december-2024-crude-steel-production-and-2024-global-totals/>, 26.04.2025.

The actual production of raw steel should also be related to the production capacity of enterprises. For example, in 2022, 90 countries produced 1.88 billion tons of steel, and their production capacity amounted to almost 2.5 billion tons (Podsiadło, 2023).

The steel produced in 2023 was used at the level of 1.763 Mt in various sectors of the world economy. The method and degree of its use are presented in Figure 1.

As shown in Figure 3, between 2002 and 2023, imports of steel and iron to the EU from countries such as China, India and South Korea increased significantly.

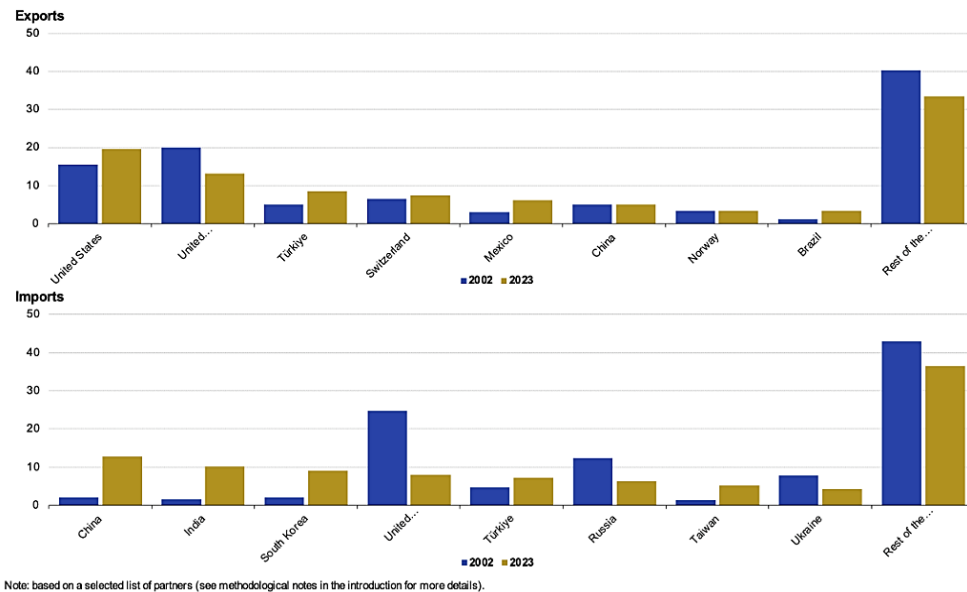


Figure 3. The EU's main trading partners for iron and steel (SITC 67) (% of EU total).

Source: Eurostat (online data code: DS-018995, 02.03.2025).

As the data shows, Poland exported steel and iron in 2023 for the amount of EUR 6.751 billion, and its main recipients were Germany within the EU and Ukraine outside the EU.

Table 2.
Iron and steel exports by EU countries in 2023. (SITC 67)

	Total exports (€ million)	Share of total goods exported (%)	Extra-EU exports (€ million)	Share of extra-EU exports (%)	Main intra EU partner	Value main intra EU partner (€ million)	Main extra EU partner	Value main extra EU partner (€ million)
EU (*)	41 000	1,6	41 000	100,0			United States	8 039
Belgium	18 977	3,6	3 182	7,8	Germany	5 467	United States	517
Bulgaria	984	2,2	191	0,5	Romania	254	Canada	51
Czechia	5 095	2,2	665	1,6	Germany	1 206	United	130
Denmark	1 561	1,2	334	0,8	Germany	348	Norway	97
Germany	33 757	2,1	9 815	23,9	France	3 442	United States	2 051
Estonia	266	1,5	33	0,1	Finland	81	Russia	13
Ireland	232	0,1	206	0,5	Germany	7	United	178
Greece	909	1,8	472	1,2	Bulgaria	104	Malaysia	79
Spain	10 507	2,7	3 080	7,5	France	1 878	United	633
France	13 869	2,3	3 493	8,5	Germany	3 395	United	581
Croatia	341	1,5	67	0,2	Italy	131	Türkiye	22
Italy	23 174	3,7	6 225	15,2	Germany	4 618	United States	1 296
Cyprus	7	0,2	6	0,0	Romania	1	Norway	0
Latvia	275	1,3	49	0,1	Estonia	45	United Arab	12
Lithuania	320	0,8	44	0,1	Latvia	93	Norway	16
Luxembourg	1 947	12,3	676	1,6	Germany	437	United States	165
Hungary	1 066	0,7	124	0,3	Austria	240	China	53
Malta	2	0,1	0	0,0	Cyprus	1	United Arab	0
Netherlands	13 969	1,6	2 584	6,3	Germany	4 651	United States	724
Austria	10 678	5,2	2 756	6,7	Germany	3 108	United States	703
Poland	6 751	1,9	806	2,0	Germany	1 730	Ukraine	200
Portugal	2 000	2,6	483	1,2	Spain	929	United	170
Romania	2 976	3,2	1 038	2,5	Germany	435	United States	373
Slovenia	1 898	2,8	384	0,9	Germany	287	United States	53
Slovakia	4 621	4,3	365	0,9	Czechia	1 030	Ukraine	145
Finland	5 506	7,2	795	1,9	Netherlands	1 654	United States	139
Sweden	7 688	4,2	3 128	7,6	Germany	1 385	United States	585

Note: main destination of exports is based on a selected list of partners (see methodological notes in the introduction for more details).

(*) Extra-EU trade only.

Source: Eurostat (online data code: DS-018995, 02.03.2025).

In 2023, Poland imported steel and iron worth EUR 13.810 billion, mainly from Germany within the EU and Ukraine outside the EU.

Table 3.

Imports of iron and steel by EU countries in 2023. (SITC 67)

	Total imports (€ million)	Share of total goods imported (%)	Extra-EU imports (€ million)	Share of extra-EU imports (%)	Main intra EU partner	Value main intra EU partner (€ million)	Main extra EU partner	Value main extra EU partner (€ million)
EU (*)	45 661	1,8	45 661	100,0			China	5 864
Belgium	12 210	2,4	6 224	13,6	Germany	1 966	China	846
Bulgaria	1 788	3,6	1 093	2,4	Romania	138	Ukraine	417
Czechia	8 180	3,8	841	1,8	Germany	2 131	Russia	265
Denmark	3 345	2,9	916	2,0	Germany	895	Russia	270
Germany	30 375	2,2	3 070	6,7	Belgium	4 335	Switzerland	652
Estonia	750	3,5	101	0,2	Finland	125	Türkiye	29
Ireland	1 169	0,8	745	1,6	Spain	102	United Kingdom	473
Greece	1 662	2,0	869	1,9	Italy	231	Türkiye	230
Spain	11 628	2,7	4 480	9,8	France	1 656	India	514
France	15 234	2,1	1 383	3,0	Belgium	3 915	United Kingdom	279
Croatia	1 123	2,8	218	0,5	Italy	410	Türkiye	38
Italy	22 914	3,9	10 989	24,1	Germany	2 822	China	2 013
Cyprus	271	2,1	66	0,1	Italy	86	Egypt	46
Latvia	612	2,4	138	0,3	Lithuania	93	Russia	70
Lithuania	984	2,2	195	0,4	Poland	321	Ukraine	28
Luxembourg	569	2,4	14	0,0	Germany	242	South Korea	8
Hungary	3 427	2,4	215	0,5	Germany	675	China	36
Malta	67	0,9	9	0,0	Italy	46	Türkiye	4
Netherlands	14 648	1,9	5 282	11,6	Germany	2 769	United Kingdom	868
Austria	5 274	2,5	516	1,1	Germany	2 070	Japan	118
Poland	13 810	13,2	2 670	5,8	Germany	3 626	Ukraine	820
Portugal	3 435	3,3	1 198	2,6	Spain	1 331	Taiwan	173
Romania	4 963	4,1	1 875	4,1	Italy	882	Türkiye	815
Slovenia	2 337	3,5	823	1,8	Italy	544	South Korea	527
Slovakia	3 566	3,4	168	0,4	Czechia	779	China	30
Finland	2 022	2,6	451	1,0	Germany	322	Norway	127
Sweden	5 632	3,2	1 112	2,4	Germany	1 086	United Kingdom	467

Note: main origin of imports is based on a selected list of partners (see methodological notes in the introduction for more details).

(*) Extra-EU trade only.

Source: Eurostat (online data code: DS-018995, 02.03.2025).

The chapter describing the context of the functioning of steel markets in the world and in the European Union is an introduction to the topic of the competitiveness of the steel sector in Poland. The following part of the article presents the methods used and indicates the factors influencing the competitiveness of the steel sector in Poland. The next chapter presents the results of the analysis of the steel sector in Poland along with a discussion and summary.

2. Methods

The research issues in the article concern the competitiveness of the steel sector in Poland. Among the objectives, the following are indicated:

1. Identification of factors affecting the competitiveness of the steel sector in Poland.
2. Characteristics of the steel sector in Poland.
3. Level of competition intensity in the steel sector in Poland.

In order to achieve the objectives, the following research questions were formulated:

1. What factors affect the competitiveness of the steel sector in Poland?
2. What is the structure of the steel sector in Poland?
3. What is the level of competition intensity in the steel sector in Poland?

The research used the sector analysis according to M. Porter, the Herfindahl-Hirschman Index (HHI) as a measure of market concentration and a critical analysis of the literature. An Excel spreadsheet was used for the calculations.

The authors, being participants in the steel sector, proposed methods of observation and inductive reasoning, which is situated in the narrative of management and quality sciences. The research also used quantitative analysis in determining the concentration of the steel market. The period under study concerns the year 2023. The analysis was conducted in the period February-April 2025.

The analysis was conducted on companies competing within the steel sector, which provided the following PKD codes as their main activity: 24.10.Z Production of pig iron, ferroalloys, cast iron and steel and metallurgical products, 24.20.Z Manufacture of pipes, tubes, closed sections and connectors, of steel, 24.3 Manufacture of other products of steel subjected to preliminary processing, 24.31 and 24.31.Z Production of cold-drawn bars, 24.32 24.32.Z Production of cold-rolled flat products, 24.33 and 24.33.Z Production of cold-formed products, 24.34 and 24.34.Z Wire production, 24.5 Metal casting, 24.51 and 24.51.Z Iron casting, 24.52 and 24.52.Z Steel casting. 326 such companies were identified. 66 companies were excluded from the analysis due to the lack of reporting data. Therefore, 260 companies were subject to the analysis.

Taking into account other PKD codes as main and other within the entire steel sector in Poland, we can list 3138 entities registered in the NCR (Polish: KRS) dealing with e.g. non-ferrous metals, steel processing, wholesale and retail trade.

In addition, a full analysis of the sector should also include entities conducting business activity and registered in the Central Register and Information on Business Activity (CEIDG). The scale of their activities in relation to entities operating based on the Commercial Companies Code is, however, negligible.

3. Factors influencing the competitiveness of the steel sector in Poland

The steel sector in Poland, as in the entire European Union, is facing a number of challenges resulting from global competition, climate policy and rising production costs.

One of the factors is the increase in steel imports to the EU and Poland. Steel imports to the EU have increased by 75% since 2013 and amounted to 46 million tons in 2023 (Eurostat, 2023; UN Comtrade, 2024). The share of imports in the EU market has reached 26% (for flat products

23%), approaching the level of the USA (30%), which is eroding the competitiveness of European producers. The main countries exporting steel to the EU are: India, China, Turkey, Taiwan, many of which benefit from cheap energy and less restrictive climate regulations.

On the other hand, there has been a decline in European steel exports. EU exports have fallen by 43% since 2013, from 31 million tonnes per year to 16 million tonnes (Eurofer, 2024). The EU has transformed from a net exporter (+11 million tonnes in 2013) to a net importer (-10 million tonnes from 2021). Important export markets such as Turkey, Russia, Algeria, India and China have stopped buying steel from the EU, opting for cheaper suppliers from Asia and Africa.

Factors include a decline in production and capacity utilization. Overcapacity is one of the biggest threats to the European steel industry. Globally, it exceeds 600 million tons (2022), and its further increase is expected until 2026. World steel production capacity is almost 2.5 billion tons, but capacity utilization has fallen to 74.3% (2022), which means that almost 600 million tons of steel are not being sold (World Steel Association, 2024a). In China, India, Vietnam, Turkey and ASEAN countries, steel plants are being expanded, often supported by state subsidies and a lack of environmental restrictions (OECD Steel Committee, 2023). Steel production in the EU decreased by 21% between 2012 and 2023, which means a reduction of 28 million tons per year. The share of European steelworks in global production is decreasing – competition from Asia is gradually reducing production capacity. The average capacity utilization in the EU has fallen to 65%, while the optimal level for steel industry profitability is 85-90%. In the EU, including Poland, steel mills are being forced to close production lines to adapt to falling demand and rising regulatory costs. Reductions in steel production may lead to reduced employment in the steel sector, especially if companies do not manage to adapt to the new conditions (Bartoszewicz, 2024). On the other hand, there is pressure to expand the arms sector, which may be an opportunity for the steel sector. Another pro-development opportunity is the introduction of the Industry 4.0 concept to the sector (Wolniak et al., 2020).

Another factor is the high production and energy costs. EU steel production costs are among the highest in the world. They are expected to increase by 25% by 2030, while in the US only by 15%, and even decrease in Asia. Energy costs in the EU steel industry increased by 350% between 2020 and 2022. In 2020, energy costs were 23 USD/t, and in 2022 they were already 104 USD/t. In comparison, in the US energy costs increased only from 11 to 16 USD/t (EEX & ARE, 2023). The EU climate policy ETS (Emissions Trading System) has increased the price of CO₂ emissions fivefold since 2018, which is further increasing costs and leading to a loss of competitiveness. Under the ETS, European steel mills are paying more and more for CO₂ emissions, which affects operating costs. From 2040, free emission allowances will be phased out completely, which means that Polish steelworks will have to pay the full price for CO₂ emissions (European Commission, 2023b). In the US, China or India, there are no such restrictions or they are much smaller, which gives a competitive advantage to local producers. Poland still produces steel mainly in blast furnace technology (BOF), which is high in emissions

and susceptible to ETS cost increases (Bukowski, Bocian, 2024). The energy sector in Poland is based on coal, which increases the energy costs for the steel industry (Gajdzik, Sujová, Biały, 2023). Polish steel will compete with countries that already offer cheaper renewable energy, e.g. Sweden, Norway (IEA, 2024). On the other hand, there are opportunities in the field of energy management systems for large enterprises (Gajdzik et al., 2024). One example, e.g. in Poland, is the possibility of reducing capacity in connection with participation in the capacity market. Another possibility was to use support within the framework of public aid for energy-intensive enterprises.

The factors influencing competitiveness are decarbonization and regulatory pressure related to the so-called Green Deal in the EU. The steel sector in the EU faces a huge challenge of adapting to climate regulations. The EU requires a 55% reduction in CO₂ emissions by 2030, which means the need to invest in new technologies (European Commission, 2023a). The transition to EAF (Electric Arc Furnaces) and DRI (Direct Reduced Iron) technologies using hydrogen requires billions of investments (Stroud et al., 2024). Private and public financing, e.g. Innovation Fund or Horizon Europe, can be crucial. The lack of sufficient sources of green hydrogen in Poland makes the technological transformation more difficult to carry out (Ziemacki, 2021). The EU aims to increase the share of steel produced in EAF from the current 40% to 60% by 2040 (Eurofer, 2023). Poland is largely dependent on blast furnace BOF production, which requires large investments in new technologies. Polish blast furnaces will be under pressure to transform to steel from electric furnaces fueled by renewable energy sources and hydrogen. Steel demand could fall by 15-17% by 2050, mainly due to increased recycling and more efficient use of raw materials (World Steel Association, 2024d). Reusing steel products could, on the other hand, create new jobs in a circular economy (Gajdzik, Wolniak, Grebski, 2023). Demand for critical raw materials such as lithium, copper, and cobalt is growing, which could have indirect effects on the steel industry.

CBAM (Carbon Border Adjustment Mechanism) (European Parliament and EU Council, 2023), as a factor influencing competitiveness, may additionally limit exports, as it introduces fees for non-EU countries, which may lead to trade retaliation. The CO₂ border adjustment mechanism imposes additional costs on non-EU steel importers, which is theoretically supposed to protect EU production (European Commission, 2021). Competitors from outside the EU (China, India, USA) do not incur similar costs, which additionally weakens the export position of European producers. Polish export steel will have to compete on the global market, where similar climate regulations do not apply everywhere.

4. Analysis of the steel sector in Poland – results

Within the steel sector in Poland, it is possible to identify entities competing within the sector, the bargaining power of suppliers, the bargaining power of buyers, the threat of the emergence of new competitors and the threat of the emergence of substitutes (Porter, 2008).

4.1. Companies competing within the sector

The analyzed 260 entities registered in Poland in the National Court Register (KRS) as of 31/12/2023 generated a total revenue of: PLN 59.931.878 thousand; and the total value of assets was: PLN 46 643 262 thousand. The share of the analyzed steel sector companies in Poland's GDP in 2023 was 1.37% (GUS, 2024). The percentage share indicating the type of legal form is presented in Figure 4.

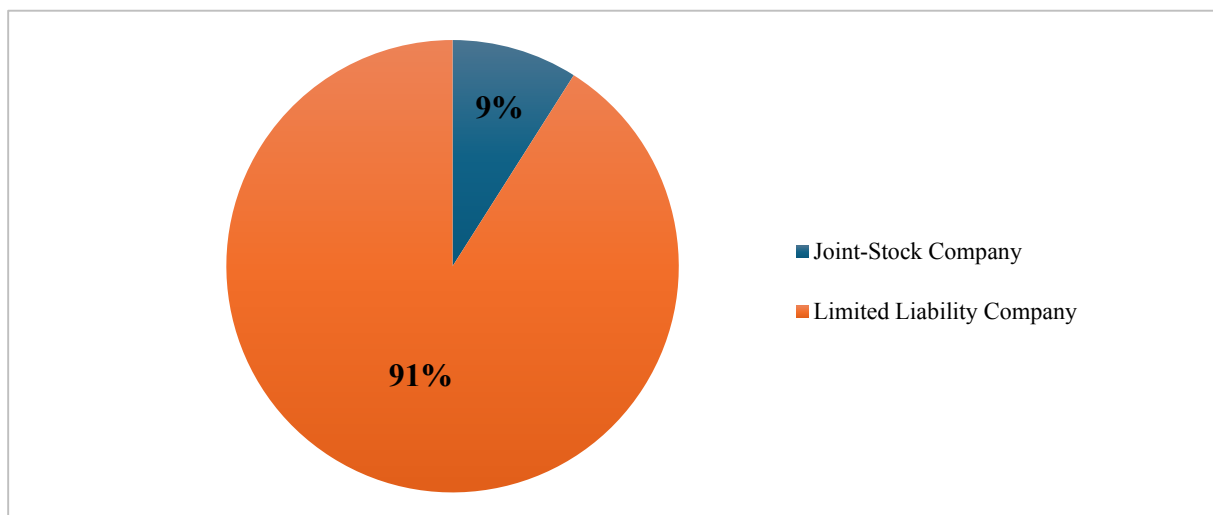


Figure 4. % share by legal form of steel sector companies in Poland.

Source: Own study based on (KRS) <https://wyszukiwarka-krs.ms.gov.pl/>

As many as 91% of the analysed entities are run as limited liability companies, the remaining 9% are joint-stock companies.

The following criteria for dividing companies were adopted in the analysis: net revenues and asset value. Data on the number of employees in companies were not included due to numerous gaps in information in this area.

The following criteria for dividing companies were adopted for the analysis, (Commission, 2003):

- Micro-entrepreneurs whose revenues or assets are $\leq$ €2m.
- Small-entrepreneurs whose revenues or assets are $\leq$ €10m.
- Medium-sized-entrepreneurs whose revenues or assets are $\leq$ €43m.
- Large-sized-entrepreneurs whose revenues or assets are $>$ €43m.

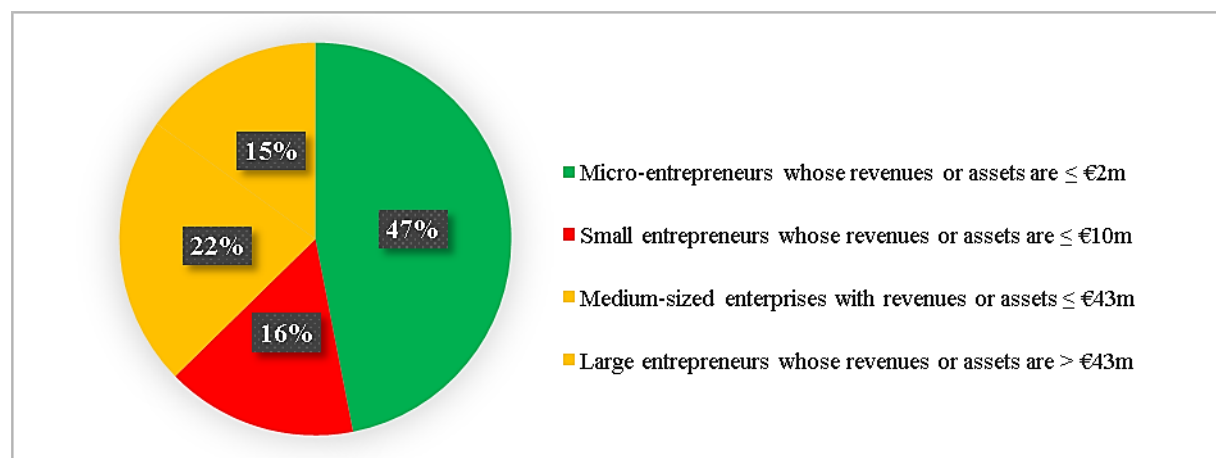
Table 4 presents the types of companies according to the criteria adopted.

Table 4.*Types of companies in the steel sector in Poland by revenue value and asset value*

Company size	Revenue volume	Asset Value
Large	39	39
Medium	58	58
Small	41	38
Micro	122	118

Source: Own work based on (KRS) <https://wyszukiwarka-krs.ms.gov.pl/>

Figure 5 presents the percentage share of companies by scale of activity in the steel sector in Poland.

**Figure 5.** % share of steel sector companies in Poland by scale of operations.Source: own work based on (KRS) https://ekrs.ms.gov.pl/rdf/pd/search_df

The largest number of companies, as many as 122 (47% of all analysed companies) were microenterprises, whose net revenues amounted to PLN 179,330 thousand, which was 0.3% of the total net revenues of the analysed steel sector. On the other hand, 39 companies (15%) were large (generated as much as PLN 54,119,181 thousand, which was 90.3% of the total net revenues. It was very similar in the case of the analysed assets, where microenterprises had 0.58% of the total value of assets of the steel sector. Large enterprises had as much as 90.76% of all assets of the steel sector. Medium-sized enterprises (22%) had an 8.03% share in net revenues and a 7.52% share in assets, respectively, and small entrepreneurs (16%) had a 1.37% share in revenues and a 1.13% share in assets.

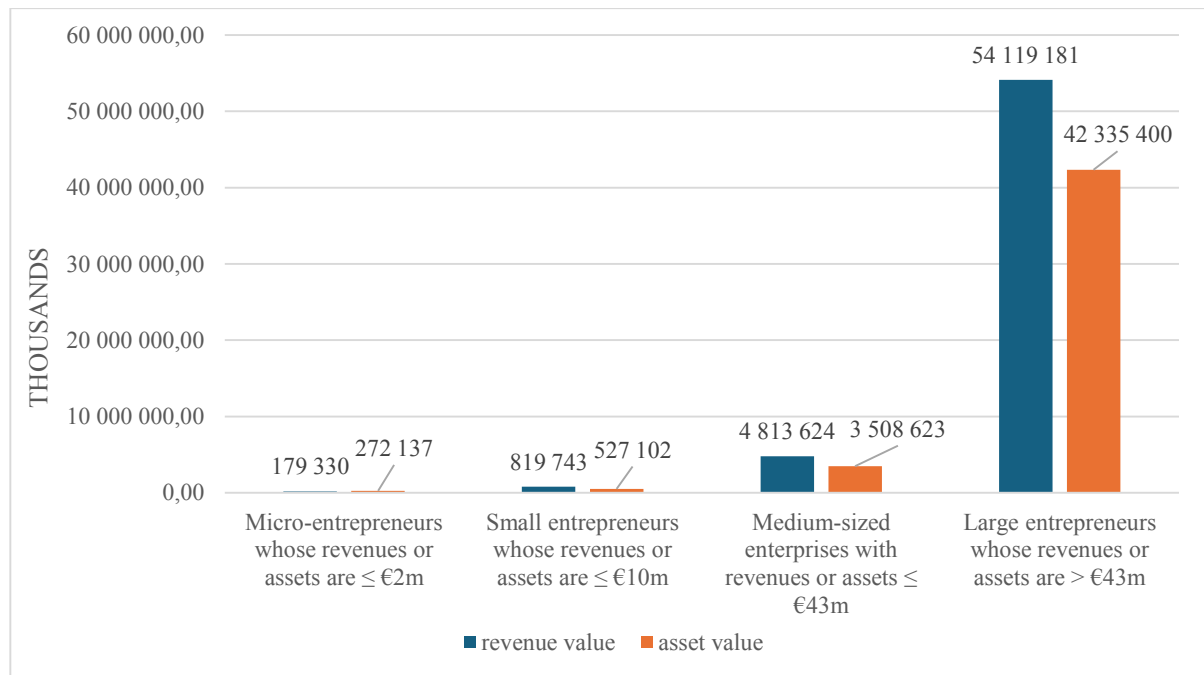


Figure 6. Value of companies' revenues and assets by scale of operations in the steel sector.

Source: Own work based on (KRS) https://ekrs.ms.gov.pl/rdf/pd/search_df

The companies were analyzed in turn in terms of the main PKD of their activity. The largest share in both revenues 73.88% and assets 75.24% were companies with the code - 24.10.Z Production of pig iron, ferroalloys, cast iron and steel and metallurgical products. Next were entities with the code 24.20.Z - Production of pipes, ducts, closed sections and connectors, of steel, where the share in net revenues was 9.31% and assets 8.97%, and companies with the code - 24.51.Z Iron foundry with a share in revenues 7.23% and a share in assets 7.88%.

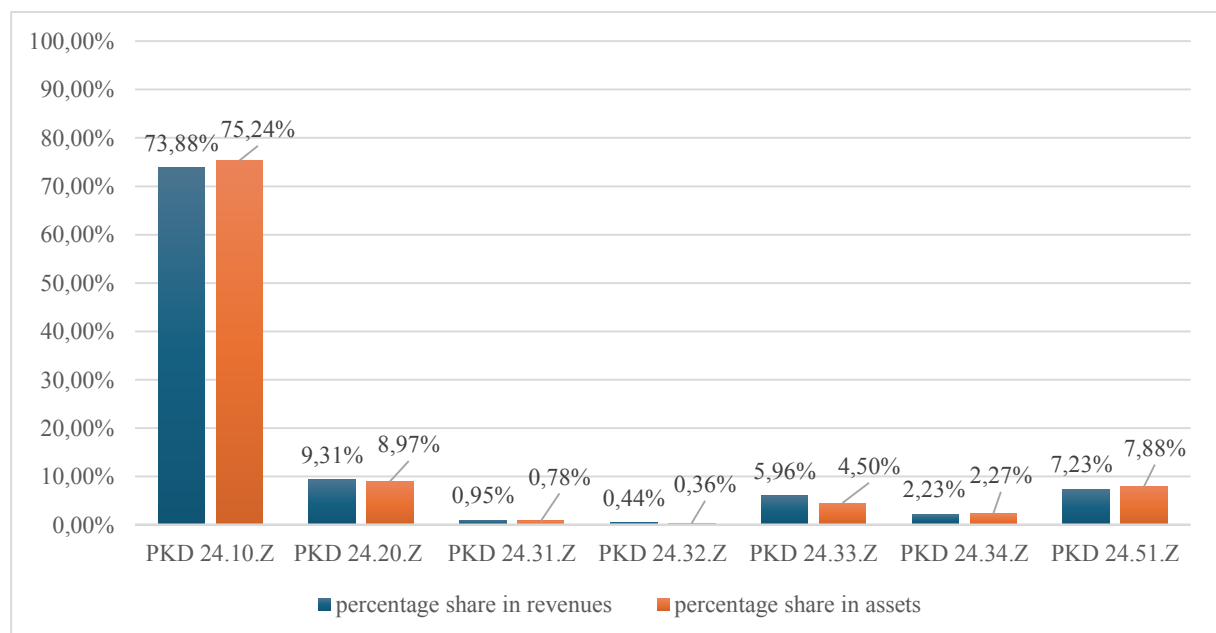


Figure 7. % share in revenues and assets of steel sector companies in Poland according to the PKD scale.

Source: Own study based on (KRS) https://ekrs.ms.gov.pl/rdf/pd/search_df

Despite the fact that code 24.10Z has the largest share in revenues and assets, it constituted only 16% of all companies in the sector. Code 24.20Z had 25% of all companies, and code 24.51Z had 20%. The largest percentage share, 27%, was held by companies with code 24.33Z, although their percentage share in revenues and assets was only fourth in order.

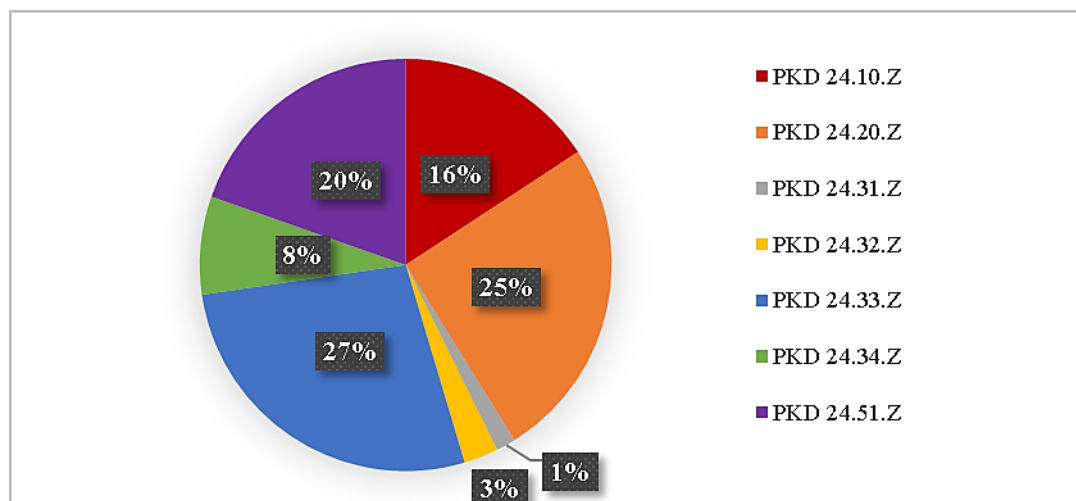


Figure 8. % share of steel sector companies in Poland according to the PKD scale.

Source: Own work based on (KRS) <https://wyszukiwarka-krs.ms.gov.pl/>

Among the entities in Poland accepted for analysis, there are 6 companies (6 plants) producing steel in industrial conditions:

1. Arcelor Mittal (Arcelor Mittal, branch in Krakow stopped the production of raw steel in the local blast furnace steelworks in 2019).
 - 1.1. Arcelor Mittal Dąbrowa Górnicza branch, where steel is produced in a blast furnace (BOF) system from iron ore.
 - 1.2. Arcelor Mittal Warszawa branch, where steel is produced in an electric arc furnace (EAF) from steel scrap.
2. CMC Poland in Zawiercie, where steel is produced in an electric arc furnace (EAF) from steel scrap.
3. Celsa Ostrowiec Steelworks, where steel is produced in an electric arc furnace (EAF) from steel scrap.
4. Cognor in Gliwice Łabędy, where steel is produced in an electric arc furnace (EAF) from steel scrap.
5. Częstochowa Steelworks, where steel is produced in an electric arc furnace (EAF) from steel scrap.

All 6 plants have rolling mills in their structure, where steel is processed into semi-finished or finished products. These plants are also suppliers of inputs for further processing, such as slabs. In further processes, e.g. rolling, they are used to produce so-called "long" sections, e.g. rails, ribbed bars, construction sections such as C-sections, I-sections, angles, V-sections or HEB sections. Next, there are slabs, from which, in further rolling processes, e.g. hot-rolled or cold-rolled sheets are produced, for structures, for the shipbuilding industry, for ship hulls,

and for the arms industry, armour plates. Then there are HRC hot-rolled sheets, from which in further processes, e.g. pipes and sections, wagon bodies, fuel and gas tanks, silos, hall structures, bridges, wind turbine masts are produced. One can also indicate flat and round bars, from which in further processes, e.g. construction elements, machine parts and structures, stirrup elements, bearings, ropes, wires, screws, fittings are produced.

Then there are cold-rolled CRC sheets, from which, in further processes, e.g. car bodies, parts of household appliances (washing machines, refrigerators, ovens, gas and electric cookers), cold-bent sections, trapezoidal sheets, steel doors and gates are produced.

The Polish steel sector uses about 65-70% of nominal production capacity. Steel production is characterized by a high share of fixed costs. According to estimates for electric steel plants, fixed costs constitute 30-40% of total production costs in the Polish steel sector. This encourages producers to maximize capacity utilization, even at the expense of margins. Table 5 presents steel sector companies in Poland producing steel in industrial conditions.

Table 5.

Steel sector companies in Poland producing steel in industrial conditions (as of December 31, 2023)

Item	Company name	Revenue volume [thousand PLN]	Asset value [PLN thousand]	Number of employees
1	Arcelor Mittal Poland S.A.	23 484 147	16 320 951	8185
2	Arcelor Mittal Warszawa sp. z o.o.	1 666 000	1 380 776	548
3	CMC Poland sp. z o.o.	5 694 552	3 786 316	2688
4	Celsa Huta Ostrowiec sp. z o.o.	3 372 466	4 067 590	1321
5	Cognor Holding S.A.	2 594 044	2 321 903	1854
6	Huta Częstochowa *	-	-	1235
	Total	36 811 209	27 877 536	15 970

*Częstochowa Steelworks * - (in 2023 owned by Liberty S.A. in bankruptcy, in 2024 the trustee leased the production assets to Węglokoks S.A.).*

Source: Own work based on (KRS).

Among the companies that make up the steel sector in Poland, excluding non-ferrous metallurgy, some of them are public and listed on the Warsaw Stock Exchange (WSE). These include Cognor Holding S.A. (COG), Odlewnie Polskie S.A. (ODL), Stalprodukt S.A. (STP).

Table 6.

Metallurgy and steel companies listed on the Warsaw Stock Exchange (as of December 31, 2023)

Item	Company name	Number of employees	Sales revenues [thousand PLN]	Asset value [PLN thousand]
1	Cognor Holding S.A.	1 854	2 594 044	2 321 903
2	Odlewnie Polskie S.A.	549	267 295	184 429
3	Stalprodukt S.A.	1 298	1 968 741	2 705 274
4	Ferrum S.A.*	316	534 696	361 024
	Total	4 017	4 830 080	5 572 630

*In connection with the decision of the Polish Financial Supervision Authority on granting FERRUM S.A. permission to withdraw the company's shares, marked with the code „PLFERUM00014”, from trading on the regulated market, as of 9 January 2025, these shares are withdrawn from trading on the WSE Main Market.

Source: Own study based on (KRS) https://ekrs.ms.gov.pl/rdf/pd/search_df

Poland, with several large steel mills on its territory, is a competitive market. There is pressure from cheaper producers from Asia, Turkey, the Middle East and Ukraine, which limits the margins of companies producing steel in Poland. This also applies to Russia, but sanctions have been introduced against it, some steel products, such as slabs, were not covered by sanctions. However, this does not completely exclude imports of Russian steel from third countries to the EU. Steel prices are susceptible to economic cycles, which leads to significant fluctuations in sales profitability.

In order to determine the level of competition intensity in the steel sector in Poland, the Herfindahl-Hirschman Index (HHI) was used. This indicator is a measure of market concentration, which shows how much market share the largest players have. It is used in the analysis of competition and assessment of the degree of market monopoly (Kwiatkowska, 2014).

HHI indicator formula:

$$HHI = \sum_{i=1}^n s_i^2 \quad (1)$$

where:

S_i – percentage share of the i -th company in the market (expressed as a percentage, but converted to decimal values or squared as a percentage),

n – number of companies on the market.

Shares can be given:

- as a number from 0 to 1 (e.g. 0.25 for 25%) → then the HHI score will be from 0 to 1, or as a percentage (e.g. 25%) → then the HHI score will be from 0 to 10,000.

According to the adopted assessment thresholds, the market can be defined as follows:

- $HHI < 1500$: unconcentrated market,
- $1500 \leq HHI \leq 2500$: moderately concentrated market,
- $HHI > 2500$: highly concentrated market (Kwiatkowska, 2014).

The indicator was calculated for the steel sector defined in this article according to previously adopted assumptions and for companies producing steel in industrial conditions in accordance with Table 5 (without taking into account data from Huta Częstochowa due to their absence).

The HHI index for companies producing steel in industrial conditions was 4464. It is higher than 2500, which indicates a highly concentrated market. The dominant position is held by Arcelor Mittal Poland S.A. with a 63.80% market share. If the shares of Arcelor Mittal Poland S.A. and Arcelor Mittal Warszawa sp. z o. o., which belong to the same capital group, are combined, their total share was 68.33%, which further increases market concentration. This HHI level indicates a highly oligopolistic market with a dominant leader.

Based on the collected data on net revenues of the 260 companies analyzed and the assumed total sales revenues of the steel sector in 2023, the Herfindahl-Hirschman Index (HHI) was calculated, which amounted to 1723.56. This indicates a moderate concentration of the steel sector in Poland. It is worth noting that, similarly to the previous calculations, a single entity (ArcelorMittal Poland S.A.) has a dominant market share of 39.18% this time, which significantly affects the HHI value. Additionally, as previously stated, ArcelorMittal also owns Arcelor Mittal Warszawa sp. z o.o. with revenues of PLN 1,666,000 thousand, which in total gives a 41.96% market share. The five largest entities control 61.93% of the market, which confirms significant concentration in the upper segment of the market, while the remaining part is fragmented.

The five companies with the largest share in the sector are:

1. ArcelorMittal Poland S.A. - PLN 23,484,147 thousand (39.18%).
2. CMC Poland Sp. z o.o. - PLN 5,694,552 thousand (9.50%).
3. Celsa "Huta Ostrowiec" Sp. z o.o. - PLN 3,372,466 thousand (5.63%).
2. Cognor S.A. - PLN 2,594,044 thousand (4.33%).
3. Stalprodukt S.A. - PLN 1,968,741 thousand (3.28%).

The 10 largest companies control 72.19% of the market. This market structure indicates the oligopolistic nature of the steel sector in Poland, with one dominant leader and a group of several significant players, as well as a large number of smaller entities with small market shares.

4.2. Suppliers' bargaining power

The main raw materials in the steel (blast furnace) industry are iron ore and coking coal.

Poland relies heavily on ore imports (including from Australia, Brazil, and Ukraine). According to data from the Central Statistical Office, iron ore imports to Poland in 2022 amounted to 5.2 million tons (GUS, 2022). Analyses indicate that the concentration of the global iron ore market, where the 4 largest producers control about 68% of global trade, gives suppliers significant bargaining power (Caixin Global, 2021).

Poland has its own coking coal resources. Coking coal is mainly supplied from the mines of Jastrzębska Spółka Węglowa (JSW S.A.) and processed in a coking plant, e.g. Zdzeszowice. Coking coal is included on the EU list of critical raw materials. Fluctuations in the prices of coking coal on world markets have a significant impact on the profitability of steel production in Poland.

For electric steelworks, the main raw material is steel scrap. Poland has scrap from internal resources and from EU countries, while at the same time being an exporter of this raw material, among others, to the Far East and Turkey. In the years 2019 Q2 - 2024 Q3 scrap consumption in the Polish steel industry amounted to 3558 kt, export of this raw material amounted to 2040 kt and import was at the level of 664 kt (HIPH, 2024). In recent years, Poland has transformed from a net exporter of scrap to a net importer. Attention is drawn to the rising prices of scrap and the limited availability of high-quality scrap on the domestic market. The import of scrap to Poland, but also to the EU in light of its limited resources, is increasingly regulated in the world by export bans, export quotas, export tax, fiscal tax on export or the obligation of the domestic market.

In Poland, as previously indicated, there are 6 plants that are suppliers of feedstock for further processing, such as: blooms, slabs, cold-rolled CRC and hot-rolled HRC sheets, flat and round bars. The limited number of suppliers of key raw materials means that they have a stronger negotiating position. Increases in energy prices and environmental regulations increase the production costs of suppliers.

The steel sector is energy intensive, which makes energy costs a key factor in competitiveness. The steel industry in Poland consumes about 4-5% of the total electricity in the industrial sector. Energy prices for industry in Poland are among the highest in the EU.

4.3. Buyers' bargaining power

The buyers of steel and steel products are wholesalers and retailers. Steel is a versatile and one of the most important engineering materials, because it combines high strength, durability and wear resistance, which makes it irreplaceable in many sectors of the economy. Steel is also a material that is used for complete recycling. Steel is a material used by many buyers (customers) from various industrial sectors. Among the most important are:

- **Construction and infrastructure** – used for the production of steel structures, bridges, tunnels, skyscrapers, stadiums, as well as concrete reinforcements; according to HIPH data, in 2022 the construction sector used about 5.2 million tons of steel (HIPH, 2023). A strong correlation is indicated between the economic situation in construction and the condition of the steel sector.
- **Automotive** – used for the production of car bodies, chassis, engines, exhaust systems and other vehicle components; the increasing quality requirements and price pressure from automotive concerns are emphasized.
- **Machinery** – used to build industrial machines, tools, agricultural equipment and production facilities; it is characterized by a high fragmentation of recipients, which limits their bargaining power.
- **Shipbuilding** – used in the construction of ships, vessels, submarines and drilling platforms.
- **Energy** – used in power plants (e.g. wind turbine structures, coal-fired power plant boilers), pipelines and oil and gas infrastructure.
- **Aerospace** – some steel alloys are used to make components for aircraft, rockets and satellites.
- **Railway** – steel is used to build tracks, wagons, locomotives and railway infrastructure.
- **Chemical and petrochemical** – used to manufacture pressure vessels, chemical reactors, pipelines and corrosion-resistant installations.
- **Food** – Stainless steel is commonly used in the production of food processing machinery, tanks and kitchenware.
- **Medical Equipment** – stainless steel is used to manufacture surgical instruments, implants and hospital equipment;
- **Household appliances** – steel is used here, among others, for the housings of washing machines, refrigerators, ovens, drums of washing machines and dryers, elements of gas and electric cookers, parts of kitchen appliances and robots.
- **Armaments** – used to build aircraft, tanks, armored vehicles, shelters, fortifications, weapons, ammunition and other equipment of military importance.

The recipients of steel to a lesser extent include forges.

Customers can import steel from cheaper markets (such as China or Turkey), which limits the ability of domestic producers to raise prices. Competition between producers forces them to offer better price and quality conditions.

4.4. The threat of new competitors emerging

The Polish steel sector is characterized by high entry barriers, which limits the threat of new competitors. Entering the market requires huge capital investments (steels, production lines, technologies). The estimated cost of building a modern steel plant with a production capacity

of 1-2 million tons per year is EUR 1-2 billion. Efficient steel production requires large scale, which puts new players at a cost disadvantage. Existing producers achieve economies of scale in raw material purchases, logistics and distribution. Production of high-quality steel requires specialist knowledge and experience. Patents and intellectual property protect many innovative solutions. However, new steel production technologies can change the market and create space for new players. There are high requirements related to the EU ETS system (CO₂ emission allowance trading). Implementation of low-emission technologies, on the other hand, requires additional investment outlays.

4.5. The threat of substitutes emerging

Steel is difficult to replace in many sectors, but alternatives such as aluminum, composites or plastics are becoming increasingly competitive, e.g. in automotive (bumpers, wheel arches), aviation, packaging, construction, transmission infrastructure - pipelines, gas pipelines, water pipelines. There is growing competition between steel and aluminum alloys in applications requiring lightweight construction. The high recycling potential of steel remains its competitive advantage.

5. Discussion

The article presents an up-to-date analysis of the steel sector in Poland. It describes in detail the structure of the sector, including the division of companies by size, legal form and PKD codes for 260 companies, and also characterizes the main steel producers in Poland.

The calculated Herfindahl-Hirschman Index (HHI) for companies producing steel in industrial conditions is 4464, while for the steel sector, with the assumptions adopted in the article, it is 1723.56. In the first case, it indicates a highly concentrated market, while in the second, it indicates a moderate concentration of the steel sector in Poland. It presents an up-to-date analysis of the concentration of the steel market in Poland, which has not been previously published for the latest data from the sector.

The research identifies the exact structure of entities in the steel sector, where large enterprises (39 companies) generate as much as 90.3% of the sector's revenues, while microenterprises (122 companies) account for only 0.3% of revenues.

Research indicates that companies with the PKD code 24.10.Z (Production of pig iron, ferroalloys, cast iron and steel and metallurgical products) have the largest share in revenues (73.88%) and assets (75.24%), even though they constitute only 16% of all companies in the sector.

The Polish steel sector is characterized by an oligopolistic structure, with the five largest entities controlling 61.93% of the market and the ten largest 72.19% of the market. The dominant leader (ArcelorMittal) controls almost 42% of the market.

In Poland, there are 6 plants producing steel in industrial conditions, of which only one (ArcelorMittal in Dąbrowa Górnicza) uses the blast furnace technology (BOF), while the remaining five use the electric arc furnace technology (EAF).

Poland's share in global crude steel production was only 0.3% in 2023, which shows the country's limited position in the global market.

M. Porter's five forces analysis for the steel sector in Poland indicates that:

- The bargaining power of suppliers is significant (among others due to the concentration of the iron ore market).
- The bargaining power of buyers is moderate (fragmentation of customers).
- The threat of new competitors in the production of steel in industrial conditions is low (high entry barriers).
- The threat of substitutes is selective and growing in some sectors.

The research presents a number of factors influencing the competitiveness of the steel sector in Poland, such as: an increase in steel imports to the EU and Poland, a decrease in production and capacity utilisation, high production and energy costs, decarbonisation requirements and regulatory pressure, and the CBAM mechanism.

The sector faces serious competitive challenges resulting from the pressure of global competition (especially from Asia), EU climate policy and rising production and energy costs.

The Polish steel sector is characterised by the dominance of large enterprises - only 39 companies generate over 90% of the revenues of the entire sector, while the rest of the market is fragmented.

The key challenge for the steel sector is the technological transformation associated with decarbonization, which requires significant investments in new production technologies (e.g. electric furnaces powered by renewable energy sources and hydrogen). There is a need for investment in production capacities in Poland with new technological solutions.

Steel imports to Poland (EUR 13.810 billion) significantly exceed exports (EUR 6.751 billion), which indicates competitive problems of domestic producers.

Among the actions that should be taken to increase the competitiveness of the steel sector in Poland, one can point to the optimization of feedstock sources. Cooperation in the supply of feedstock with a low carbon footprint, i.e. purchases of semi-finished products from DRI or EAF technology and the use of metallurgical scrap, would be important. Establishing a strategic partnership in the supply chain by negotiating long-term contracts for the supply of low-emission feedstock, e.g. from production powered by renewable energy sources (Islam, 2024).

It is important to increase the energy efficiency of rolling mills by investing in energy-saving charge heating furnaces and heat recovery systems.

The next step is to implement Industry 4.0 technologies that optimize the consumption of energy and raw materials, as well as to sign PPAs (Power Purchase Agreements) for the supply of energy from renewable sources (RES).

Attention should be paid to increasing access to cheap green energy through investments in wind energy, photovoltaics and nuclear power plants and the development of production and infrastructure for green hydrogen as key to the decarbonization of the steel industry (European Environment Agency, 2023).

As Eurofer points out, it would be important to implement EPD (Environmental Product Declaration) certificates for customers in the mining and construction sectors. Environmental certificates for steel products could be a market standard (World Steel Association, 2024b). The production of "green" steel could be offered with the "low-carbon" mark, and the positioning of "green steel" suppliers emphasizing the compliance of products with the Green Deal regulations could increase competitiveness on the global market (Eurofer, 2023).

In the framework of financing the steel sector, it would be important to use EU funds (Innovation Fund, KPO, Modernization Fund, Horizon Europe) offering assistance for projects related to decarbonization of production (Innovation Fund, 2024).

Establishing partnerships with research institutes – e.g. cooperation with the Łukasiewicz Research Network may also enable the development of innovative steel production technologies (Sieć Badawcza Łukasiewicz, 2024).

6. Summary

The Polish steel sector faces many challenges, including high competition, dependence on raw material imports and environmental regulations. However, it remains key to the economy, and innovations in the production of greener steel can open up new opportunities.

The research confirms the usefulness of Porter's five forces model and HHI index for the analysis of market concentration and competitiveness of the steel sector. The results indicate the significant role of environmental regulations and climate policy as factors shaping the competitiveness of the sector.

Among the practical implications for companies, one can point out the need to invest in low-emission steel production technologies (EAF, DRI using hydrogen) in order to adapt to regulatory requirements and maintain competitiveness. There is a need to support the transformation of the steel sector through aid programs, financing research on new technologies and ensuring access to clean and cheap energy. From the point of view of investors, it is important to identify risks and opportunities related to investments in the steel sector, especially in the context of energy transformation. Among them is a possible increase in steel

prices as a result of rising production costs and regulatory pressure, which may affect industries using steel.

The conducted research has its limitations. The analyses were limited to companies registered in the National Court Register (S.A. and sp. z o.o.), omitting entities registered in the CEIDG. 66 companies were excluded from the analysis due to the lack of reporting data, which could have affected the accuracy of the HHI calculation. The research sample was selected in accordance with the PKD 2007 classification scheme, section C - Industrial processing, division 24 - Metal production. The analysis focused on entities that have PKD codes related to metal production in their core business, narrowing it down to steel, therefore, precious metals, aluminum, copper, zinc, lead or other non-ferrous metals were not taken into account in further considerations. Data on the number of employees in many companies were not included in the analysis due to lack of information, which made it impossible to classify companies according to this criterion. The focus is mainly on data from 2023, which gives an up-to-date but static picture of the sector, without taking into account the dynamics of changes in the longer term.

As part of the directions for further research on the research problem, it is possible to extend the scope of the analysis to include excluded non-ferrous metals, which would enable a comprehensive study of the entire metallurgy and metal processing industry in Poland.

It would also be interesting to analyze the entire value chain, taking into account basic fossil raw materials (iron ore, coking coal) and secondary raw materials (steel and non-ferrous scrap). The impact of technological transformation related to decarbonization on the future structure and competitiveness of the steel sector could be studied.

A long-term comparative analysis of the competitiveness of the Polish steel sector in relation to other EU countries and global producers would also be useful. A detailed analysis of the impact of new regulations (CBAM, ETS) on the profitability and development prospects of the Polish steel sector is also becoming a challenge. It would also be interesting to study the possibilities of developing low-emission steel production technologies in Polish conditions, taking into account the availability of resources and infrastructure.

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