

STEEL PRODUCTION IN POLAND WITH PESSIMISTIC FORECASTS IN COVID-19 CRISIS

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The publication consists on the situation in Polish steel industry after the start of COVID-19 pandemic. The aim of the publication is to present the impact of the COVID-19 crisis on steel production in Poland. The analysis of the volume of steel production in Poland was carried out between January 2020 and June 2020 and compared to the production in the same period in 2019. In order to deepen the analysis of the situation in the Polish steel industry data about apparent steel use and situation in steel consuming sectors were presented. The paper ends pessimistic forecasts for steel production in Poland.

Keywords: steel industry, forecast, COVID-19, Poland

INTRODUCTION

The situation of the Polish steel industry in the first months of 2020 changed to worse, due to restrictions on the reduction of the increase in SARS-CoV-2 infection in the country and worldwide. The first cases of infection were in December 2019 among the inhabitants of Chinese city of Wuhan (city with population 11 million). The first cases of Covid-19 outside China were recorded on January 13, 2020 in Thailand. The first European country to report infections was France (January 24, 2020). In Poland, the Ministry of Health confirmed the first cases on March 4, 2020. On 30th January the World Health Organisation declared the new virus an international threat for people [1]. The SARS-CoV-2 virus pandemic has become a challenge for all countries in the world. The health threat has evolved into a threat to economies, industries, businesses and jobs. Particular supply chains have been broken and demand has decreased, there has been an economic crisis. This crisis has caused the biggest drop in steel demand since the global financial crisis in 2008. In 2020 worldsteel forecasts that steel demand will contract by 6,4 %, dropping to 1 654 million tonnes due to the COVID-19 crisis (the forecast was published in June 2020 by worldsteel) [2]. Steel demand in the developed economies was expected to decline by 17,1 % in 2020 [2]. In developing countries steel demand (excluding China - Chinese steel demand was expected to increase by 1,0 % in 2020) was expected to fall by 11,6 % in 2020. EU steel demand suffered a contraction of 5,6 % in 2019 due to the sustained manufacturing recession [3]. In Poland, in March 2020, 658 000 tonnes of crude steel were produced, 28 % decrease from March 2019. In the period January-March 2020, steel production in Poland amounted to 2 million tonnes of crude steel (decrease

steel production compared to the previous year was 19 %) [4]. In the second quarter of 2020, production was also at 2 million tonnes (decrease steel production compared to the quarter of previous year was 14 %). If there were no crisis, in 2020 steel production in Poland would be above 9 million tonnes or 10 million tonnes in the best-case scenario [5-6]. In the COVID-19 crisis, the optimistic forecasts are not realistic. The paper presents the situation in the Polish steel sector in COVID-19 crisis with forecasts of steel production for coming years.

THE SITUATION IN POLISH STEEL INDUSTRY IN COVID-19 CRISIS

The development of SARS-CoV2 worldwide has been a lockdown for several weeks. The return to economic activity takes place slowly (defrosting of the economy). The economic situation in the country has affected the situation of all industry. The Polish steel industry has reduced production and introduced economic downtime (some employees do not work in full readiness for work and receive lower wages). Demand for steel fell and the steel mills had lower financial results. In Poland, raw steel production in the period from January to June 2020 amounted to 4 044 thousand tonnes (decrease of 16 % as compared to the same period of the previous year). In addition to steel production, the decrease was also recorded for many steel products: hot-rolled products – a decrease of 10 % (compared to the same period of the previous year), pipes – a decrease of 11 % (compared to the same period of the previous year). The decrease was also in the production of cold-rolled sheets and tapes (by 2 % compared to the same period of previous year). Exports of steel products from Poland in the period from January to June 2020 amounted to 2 605 thousand tonnes (decrease of 17 %). Imports of steel products in the first half of 2020 amounted to 5 110 thousand tonnes (decrease of 10

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% compared to the same period of the previous year). The apparent steel use of finished steel products in Poland in the period January to June 2020 amounted to 6 254 thousand (a decrease of 10 % compared to the first half of 2019). The share of imports in the apparent steel use of finished steel products in Poland between January and June 2020 was 74 %. The high level of imports is a barrier for Polish industry, particularly in the difficult time. Production sold of the industry in Poland decreased by 6 % in analyzed period. The decrease in steel production was influenced by the decrease in demand for steel products in other industries in Poland. The largest decrease in production was recorded in the automotive industry (decrease by 30 % compared to the same period of the previous year). There was also a significant decrease in the production of machinery and equipment (decrease of 15 %). In other steel consuming sectors in Poland, declines were lower and even there was an increase by 2 % in construction and building [4]. The decrease in demand for steel has led to the exclusion of unnecessary capacity (including the blast furnace in Cracow). The wrong situation has also increased due to many years of unused capacity of steel mills. In recent years (2000-2018), steel mills have started 71,79 % of production capacity on an average annual basis with an average steel production of 9 million tonnes. The collapse in the steel industry – a decline in production – could lead to plant closures and job losses. Currently, out of 24 000 employees in the Polish steel industry, there are 150 000 employees on the secondary market (including a large part of employed in the automotive sector). Unfortunately, this sector has the biggest problems in the market during COVID-19 crisis. In individual months, the decrease in car production was very large in Poland, e.g. 80 % in April 2020 compared to April 2019. In the coming years (2-3 years), demand for cars is not expected to increase (in opinion of experts), there will be a decrease in sales by about 20-30 %. Since July 2020, manufacturers no longer used from the “anti-crisis shield” (the government program was completed). Other problems of Polish steel industry are related to industry energy intensity and decarbonisation policy according to European Green Deal and Carbon Border Adjustment (CBA) - continuous changes in Polish steel industry towards sustainability. The build-up of disadvantages for producers, employees, suppliers, customers is called the “COVID-19 crisis”.

THE ANALYSIS OF STEEL PRODUCTION IN POLAND IN COVID-19 CRISIS

The decrease in raw steel production in Poland between January and June 2020 is shown in Figure 1. In addition, Figure 1 shows the dynamics of changes in steel production as compared to monthly steel production in Poland 2019. During the Covid-19 crisis (the period from January to June 2020), monthly steel production in the first half of 2020 had a decline.

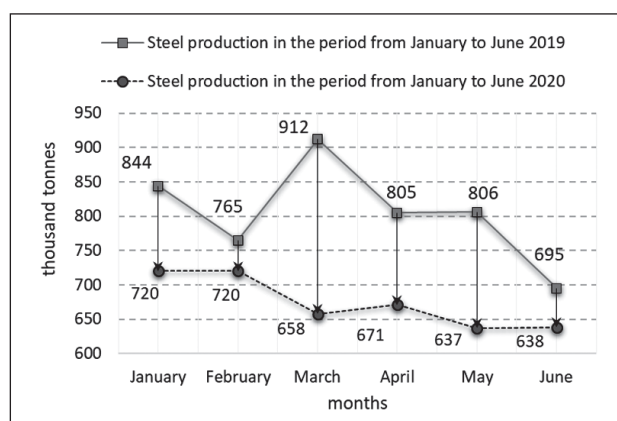


Figure 1 Steel production in Poland in the period from January to June 2020 and compared to 2019 [own study based on data from Polish Steel Association]

Table 1 Dynamics of steel production in Poland: monthly, quarterly and half-yearly in 2020 compared to 2019

	2019	2020	Dynamics
	/thousand tonnes		/ %
January	844	720	-14,69
February	765	720	- 5,88
March	912	658	-27,85
April	805	671	-16,65
May	806	637	-20,97
June	695	638	-3,19
first quarter	2 521	2 098	-16,78
second quarter	2 306	1 946	-14,31
first half-year	4 794	4 044	-15,65

Table 1 shows the dynamics of steel production in the layout: month-on-month; quarter-on-quarter and half-on-half in 2020 compared to 2019.

Formula for dynamics:

$$D_p = \frac{(P_t - P_{t-1})}{P_{t-1}} \cdot 100 \% \quad (1)$$

where: D_p - dynamics of steel production in analysed period 2020 compared to the same period 2019; P_t - steel production in the current period (2020); P_{t-1} - steel production in the previous period (2019).

In order to deepen the analysis of the situation in the Polish steel industry, the production of finished products was summarised in Table 2. During the analysed period, there was also a decrease in apparent steel use (with the exception of the volume of apparent steel consumption in February 2020) – Figure 2. Between April and June, the decrease is very large above 20 % each month.

Formula for apparent steel use:

$$A_u = P_s + I_s - E_s \quad (2)$$

where: A_u - Apparent steel use; I_s - Imports; E_s - Exports.

THE REVISION OF STEEL PRODUCTION FORECASTS FOR POLAND

In my steel production forecasts for Poland for the coming years, I pointed mainly to an optimistic scenario

Table 2 **Production and dynamics in finished steel products in Poland in the period from January to June 2020 and dynamics of the same period 2019 [3]**

Products	Production half-year 2020	Dynamics to half-year 2019
	/thousand tonnes	/ %
Hot-rolled products	3 756	10,1
including long	2 508	-2,8
including flat	1 248	-21,9
Cold-rolled sheets and strips	491	-2,4
Galvanized sheets and tapes	387	-10,8
Tubes & Pipes, incl.:	363	-10,7
including seamless	55	-8,3
including welded	308	-11,1

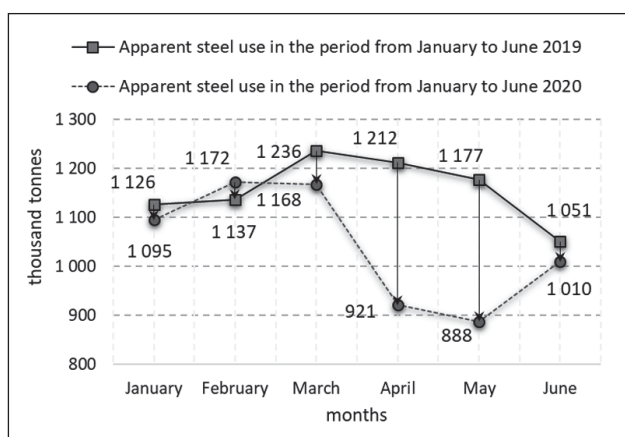


Figure 2 Apparent steel use in Poland in the period from January to June 2020 compared to 2019 [own study based on data from Polish Steel Association]

(the best-case scenario) with an average annual forecast production from 9 to 10 million tonnes [5-6]. In the COVID-19 crisis, the steel production forecasts for Poland will be lower. In 2020, steel production in Poland compared to the previous year (steel production in 2019 was 9 million tonnes) will be below 9 million tonnes. It can expect the greater drop in steel production in Poland in 2020 compared to 2018 or 2017, then production was above 10 million tonnes. In COVID-19, the pessimistic forecasts (the worst-case scenario) for steel production for Poland will be. The pessimistic forecasts (own study) are characterised by a sharp downward trend in the coming years. The worst-case scenario begins when the steel production in Poland falls below 9 million tonnes. Such predictions were obtained using an advanced exponential-autoregressive time series model (AdExpAR*) (for: $k = 3, l = 2, \alpha = 0,1488 (\Psi)$ or $\alpha = 0,1553 (RSME^*), \beta_1 = 0,1; \beta_2 = 0,2; \beta_3 = 0,7; \delta_1 = 0,4; \delta_2 = 0,6$, where: k – smoothing constant, l – forecast smoothing constant, α – smoothing parameter from the range $(0,1] \rightarrow (\alpha \neq 0)$, β_i – rang weight given to the (i) assessment of the smoothed value, δ_j – weights given to the increase in smooth value ratings). This model is an autoregative form with amplitude-dependent factors, so estimating parameters is a nonlinear optimization problem. The estimation method is carried out according to

the steps presented in the book on econometrics [7-9]. Formulas (3 and 4) have been used to evaluate forecasts (ex post forecast errors: root mean square error $RMSE^*$ (3) and mean error Ψ (4)) [7]:

$$\Psi = \frac{1}{n - m} \sum_{t=m+1}^n \frac{|y_t - y_t^*|}{y_t} \quad (3)$$

$$RMSE^* = \sqrt{\frac{1}{n - m} \sum_{t=m+1}^n (y_t - y_t^*)^2} \quad (4)$$

where: n – number of elements of the time series; m – number of initial time moments t ; y_t – empirical data; y_t^* – forecasts value.

Ex post forecasts describes mathematical dependencies (5):

$$\begin{cases} G_t = y_t \text{ for } t = 1, \dots, k \\ G_t = \alpha \cdot y_t + (1 - \alpha) \cdot \sum_{i=1}^k (\beta_i \cdot G_{t-i}) \text{ for } t > k \\ y_t^* = G_{t-1} + \sum_{j=1}^l \delta_j \cdot (G_{t-j} - G_{t-j-1}) \text{ for } t = l + 2, \dots, n \end{cases} \quad (5)$$

where: G_t – evaluation of smooth series value (smoothing operator).

Ex ante forecasts describes mathematical dependencies (6):

$$y_T^* = G_n + (T - n) \cdot \sum_{j=1}^l \delta_j \cdot (G_{n-j+1} - G_{n-j}) \text{ for } T = n + 1, \dots, \tau \quad (6)$$

For obtained model (AdExpAR*) such errors were obtained: $\Psi = 0,088$; $RMSE^* = 0,964$. The results of the calculations are presented in Table 3, and the trends of ex post and ex ante forecasts are shown in Figure 3.

In COVID-19 crisis the steel mills can produce between 8,9 and 8,7 million tonnes of steel. In the very strong pessimistic scenario we can expect the production below 8 million tonnes. Such predictions were ob-

Table 3 **Results of the calculations using advanced exponential-autoregressive time series model**

No.	Year	Steel production	G_t	y_t^*	$\frac{ y_t - y_t^* }{y_t}$	$(y_t - y_t^*)^2$
1	2000	10,498	10,498			
2	2001	8,809	8,809			
3	2002	8,367	8,367			
4	2003	9,107	9,822	7,177		
5	2004	10,578	9,084	10,139	0,042	0,193
6	2005	8,336	8,671	9,661	0,159	1,756
7	2006	9,992	9,624	8,063	0,193	3,719
8	2007	10,631	9,290	9,757	0,082	0,763
9	2008	9,727	9,043	9,727	0,000	0,000
10	2009	7,128	9,146	8,744	0,227	2,611
11	2010	7,993	9,043	9,040	0,131	1,095
12	2011	8,776	9,021	9,063	0,033	0,082
13	2012	8,348	8,999	8,950	0,072	0,362
14	2013	7,950	8,873	8,977	0,129	1,055
15	2014	8,558	8,936	8,809	0,029	0,063
16	2015	9,202	9,002	8,885	0,034	0,101
17	2016	9,000	8,913	9,067	0,007	0,004
18	2017	10,333	9,153	8,918	0,137	2,003
19	2018	10,165	9,173	9,196	0,095	0,940
20	2019	8,956	8,983	9,325	0,041	0,136
21	2020			8,918	0,088	0,964
22	2021			8,854	Ψ	$RMSE^*$
23	2022			8,790		
24	2023			8,726		
25	2024			8,662		

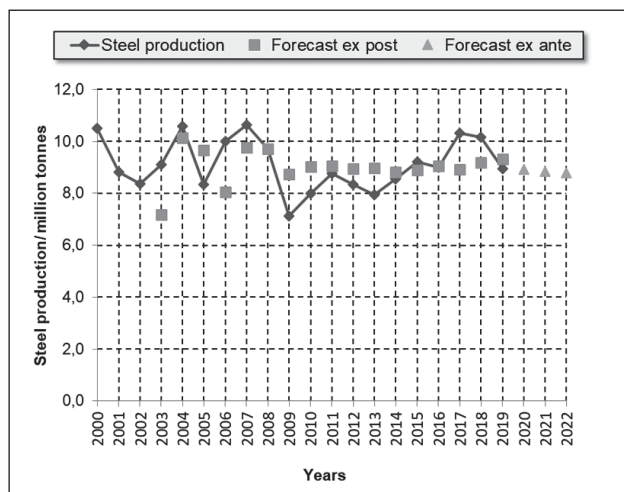


Figure 3 Forecasts for steel production for Poland using (AdExpAR*) [own study]

tained using the naïve method in multiplication terms for a time series with a development trend. Assumption of the prognostic method (formulas: 7 and 8):

for ex post forecasts:

$$y_t^* = y_{t-1} \cdot \left(\frac{y_{t-1}}{y_{t-2}} \right) \quad (\text{for: } t=3...20) \quad (7);$$

for ex ante forecasts:

$$y_T^* = y_{T-1} \cdot \left(\frac{y_{T-1}}{y_{T-2}} \right)^{(T-n)} \quad (\text{for } T=21 \dots 22) \quad (8).$$

The results of the calculations are presented in Table 4, and the trends of forecasts are shown in Figure 4. In 2020, the forecast of steel production for Poland was 7,891 million tonnes, and in 2021, assuming the crisis and its deepening even 6,932 million tonnes. In the model forecast errors were high: $\Psi=0,157$, $RMSE^*=1,748$ but it is worth considering such a scenario for the Polish metallurgy.

CONCLUSION

Based on the analysis of the situation in Polish steel industry the following conclusion was drawn: • the Polish steel sector reduced steel production during the COVID-19 crisis (decline of 16 % compared to the first half of 2019) • forecasts for steel production in Poland are pessimistic with production 8,7 million tonnes in coming years or below 8 million tonnes when the COVID-19 crisis will be more strong then up to now.

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Table 4 Results of the calculations using naïve method in multiplication terms for a time series with a development trend

No.	Year	Steel production	y_t^*	$\frac{ y_t - y_t^* }{y_t}$	$(y_t - y_t^*)^2$
1	2000	10,498			
2	2001	8,809			
3	2002	8,367	7,392	0,117	0,952
4	2003	9,107	7,948	0,127	1,345
5	2004	10,578	9,943	0,063	0,443
6	2005	8,336	12,287	0,474	15,613
7	2006	9,992	6,569	0,343	11,716
8	2007	10,631	11,976	0,127	1,810
9	2008	9,727	11,311	0,163	2,507
10	2009	7,128	8,901	0,249	3,141
11	2010	7,993	5,224	0,346	7,668
12	2011	8,776	8,962	0,021	0,035
13	2012	8,348	9,637	0,154	1,660
14	2013	7,950	7,941	0,001	0,000
15	2014	8,558	7,571	0,115	0,974
16	2015	9,202	9,213	0,001	0,000
17	2016	9,000	9,895	0,099	0,800
18	2017	10,333	8,802	0,148	2,344
19	2018	10,165	11,863	0,167	2,885
20	2019	8,956	10,000	0,117	1,089
21	2020		7,891	0,157	1,748
22	2021		6,952	Ψ	RMSE*

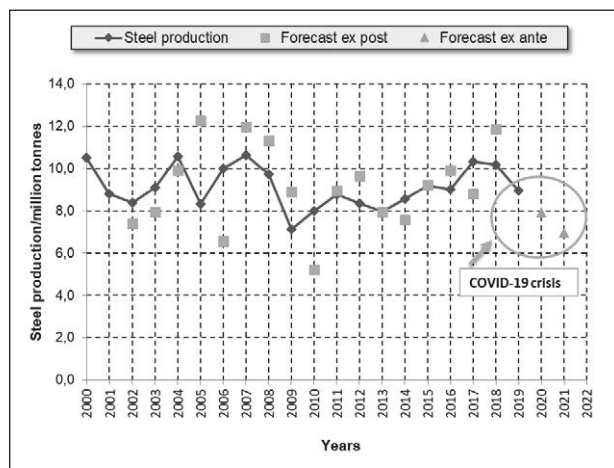


Figure 4 Forecasts for steel production for Poland using naïve method [own study]

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Note: B. Gajdzik is responsible for English language, Katowice, Poland.