

ANALYSIS OF THE SIZE OF STEEL PRODUCTION IN POLISH STEEL INDUSTRY

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Abstract

The publication presents changes in the size of steel production in the Polish steel industry for the period 1990-2014. Poland started to transform the economic system in 1990 (the beginnings of a market economy). The notion of *transformation* was used as the change of organisation form of business activities of enterprises in given branches of industry which allows for development of a given system, its improvement and higher level of adaptability in the surrounding. Since 1990, the privatization of state enterprises and industrial restructuring has become a permanent part of the Polish economy. Changes in the Polish steel industry is an excerpt of the global change program in heavy industry. Global processes of change in the steel industry (to build strong capital groups, modernization of production technology, improve production efficiency, environmental protection requirements, etc.) influence the image of the Polish steel industry. The structure of the steel market in Poland form a strong capital groups: ArcelorMittal, CMC – Commercial Metals Company, ISD – Industrial Union of Donbass, Celsa. Steel production is adjusted to the existing global demand. The publication concentrates on crude steel production in Polish steel industry. On the base of statistic data prognoses of crude steel production until 2020 is realized.

Keywords: Crude steel production, Polish steel industry, transformation in economy

1. INTRODUCTION

In Poland, at the turn of 1989 and 1990 introduced radical reform of the system (elimination of subsidies for state-owned enterprises, privatization of enterprises, employment reduction, withdrawal uneconomic technology, deregulation of prices from administrative control, liquidation of unprofitable enterprises, reduction of production capacity on traditional industries). Transformational changes (improving business efficiency) were implemented in all sectors of industry [1]. Restructuring (systemic reconstruction of the companies) has enabled enterprises to adapt to market conditions. The restructuring of the steel industry in Poland started in 1992. It has been implemented a number of government recovery programs. Restructuring of metallurgical enterprises in Poland and in other countries in which transformation of economy took place, was understood as the process of adjustment of enterprises to new conditions of market economy. These were practical activities based on government and business repair programs. The range of restructuring included all areas of activities of enterprise. Changes had a deep and radical character. Restructuring was preceded by privatisation of state owned enterprises. Foreign capital became the owner of key steelworks in Poland (ArcelorMittal, CMC, Celsa, Selerstalat, ISD). Transformation restructuring allowed to achieve efficiency of functioning in enterprises in conditions of market economy. Finally, in 2006 (European Commission report) steel restructuring process has been completed [2 - 3].

2. CRUDE STEEL PRODUCTION IN POLISH STEEL INDUSTRY

Steel production in Poland in the last decades has changed and depending on the economic conditions and changes in demand for steel. In 1990, it has been produced 13.5 M mt steel. In 1990-1993 there was a downward production trend (8.9 M mt in 1993). In 1994-1997 it was produced more than 10 M mt of steel per year. The next two years is a renewed decline in steel production under 10 M mt. Levels above 10 M mt occurred again in 2000, 2004, 2007 years. After the economic crisis, steel production does not exceed 10 M mt

per year [4]. Steel production processes is carried out by: converters BOFs and EAFs. With the end of 2002 has been withdrawn hearth process (relatively late in comparison to the global steel industry). Currently, slightly more than half of the steel produced is produced in the process BOFs, and the rest in EAFs (**Figure 2**). In **Figure 1** shows the changes in steel production in Poland in the years 1990-2014. The main steel production plants in Poland are 2 BOF steel plants (primary production from iron ore), 7 steel EAF (secondary production from scrap), 10 rolling mill of flat products, 9 rolling mill of long products, 12 tube mill and cold formed sections. The biggest steel producer is ArcelorMittal Poland, with production of about 5 M mt per year. Production of crude steel and share of processes from 1990 to 2014 are summarized in **table 1**.

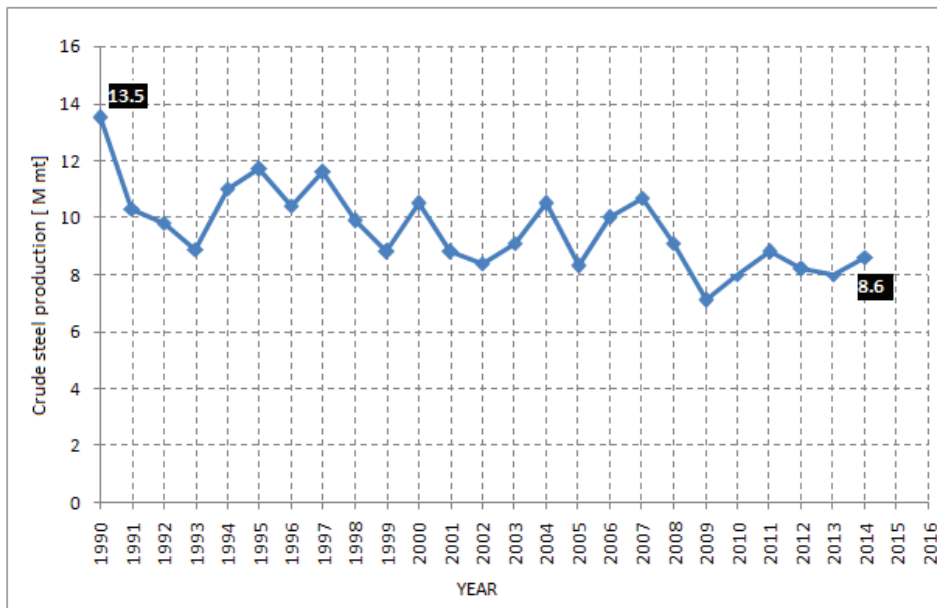


Figure 1 Crude steel production in Poland in 1999 - 2014 [M mt]

Source: On the base on statistic data.

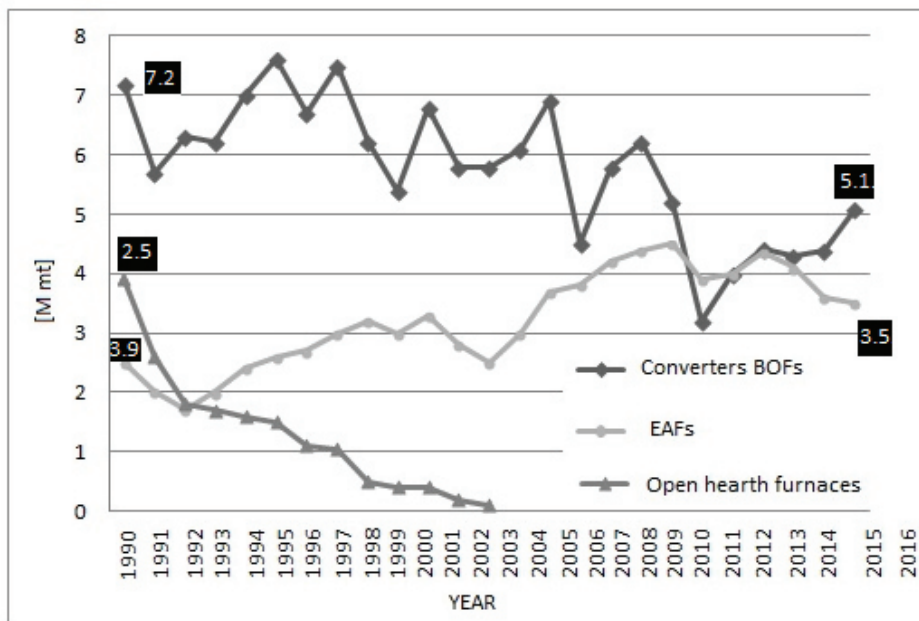


Figure 2 Manufacture of crude steel production by processes from 1990 to 2014

Source: On the base on statistic data.

Table 1 Crude steel production In Poland

Year	Crude steel production [M mt]	Share of processes [%]		
		BOFs	EAFs	Open Hearth Furnaces
1990	13 600	52.9	18.4	28.7
1991	10 300	55.1	19.6	25.3
1992	9 800	64.3	17.3	18.4
1993	8 900	63.0	20.0	17.0
1994	11 000	63.7	21.8	14.5
1995	11 700	65.0	22.2	12.8
1996	10 500	63.8	25.7	10.5
1997	11 450	64.6	26.2	9.2
1998	9 900	62.6	32.3	5.1
1999	8 800	61.4	34.1	4.5
2000	10 500	64.8	31.4	3.8
2001	8 800	65.9	31.8	2.3
2002	8 400	69.0	29.8	1.2
2003	9 100	67.0	33.0	0
2004	10 600	65.1	34.9	0
2005	8 300	54.2	45.8	0
2006	10 000	58.0	42.0	0
2007	10 600	60.8	39.2	0
2008	9 700	53.6	46.4	0
2009	7 100	45.1	54.9	0
2010	7 990	48.8	51.2	0
2011	8 770	50.4	49.6	0
2012	8 400	50.6	49.4	0
2013	8 000	55.0	45.0	0
2014	8 600	59.0	41.0	0

Source: On the base on statistic data.

3. PROGNOSIS OF CRUDE STEEL PRODUCTION UNTIL 2020 YEAR

To build a prognosis of size of the steel production for the years 2015-2020 uses the following methods of prognosis based on: a linear model, one-parameter exponential smoothing model Brown's two-parameter model Holt's exponential smoothing, autoregressive model AR (1) and autoregressive AR (1, 4) [5-8]. Particular prognoses were realized by the team: J. Szymshal, B. Gajdzik.

3.1 The method of prognosis based on linear model

Prognosis method allowed us to estimate coefficients of the linear model based on the method the smallest sum of squared residuals. Obtained model (1), the coefficient of determination: $R^2 = 0.4444$. The model was presented on **Figure 3**.

$$\text{The size of production of steel} = 271.86 - 0.131 \cdot \text{Year} \quad (1)$$

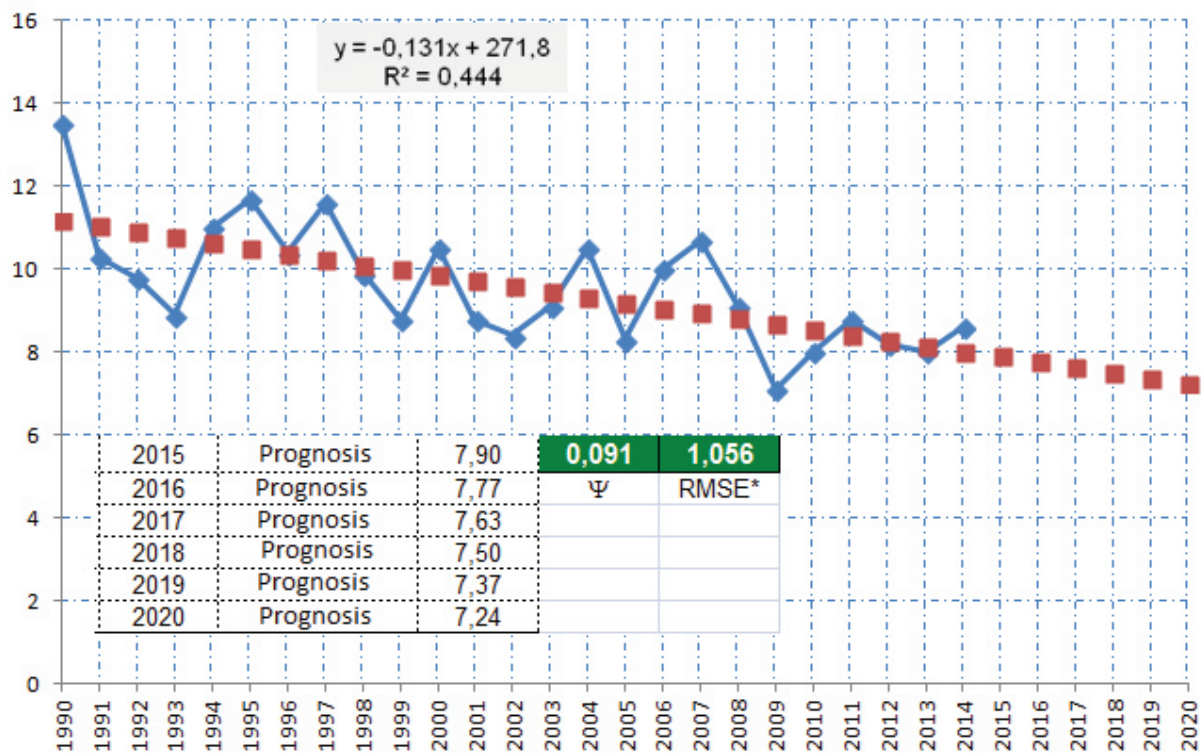


Figure 3 The linear model of prognisis of steel production

3.2. Prognisis method based on one-parameter exponential smoothing model by Brown

The minimum value of errors prognisis expired obtained for parameter alpha = 0.234 (Figure 4).

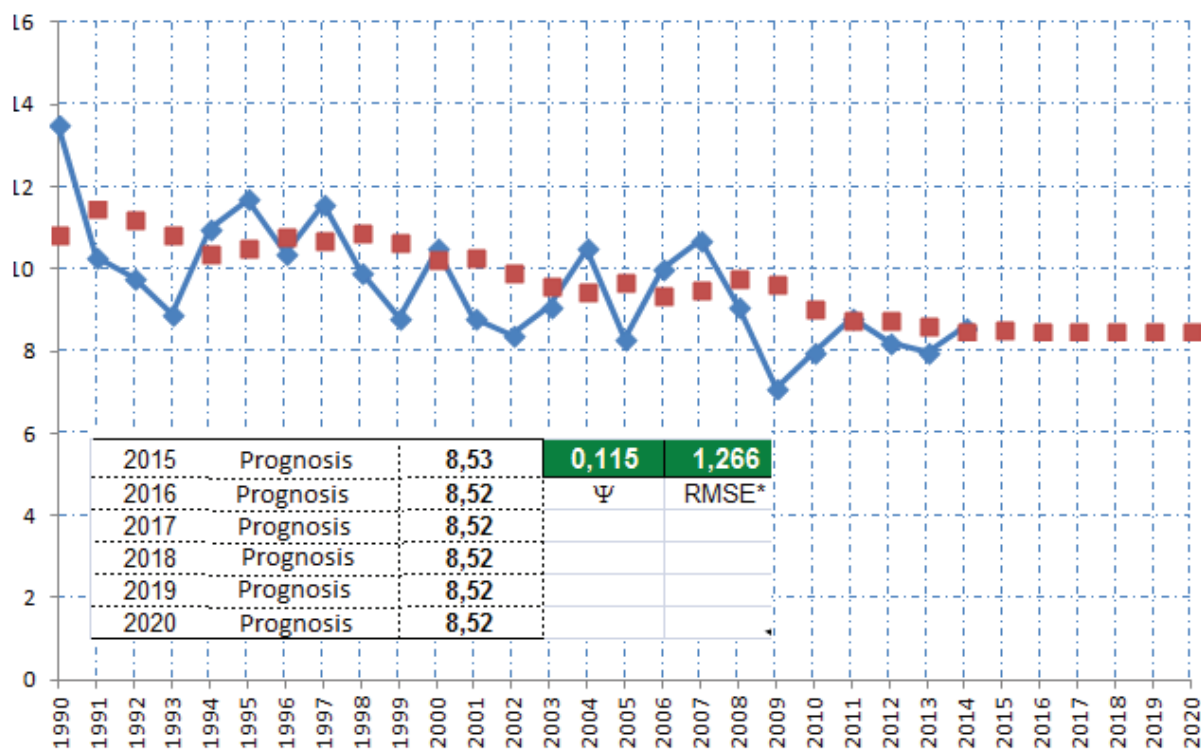


Figure 4 Prognosis by Brown model

3.3. Prognosis method based on two-parameter exponential smoothing model by Holt

The minimum value of errors prognosis expired obtained for parameter : alpha = 0.665 and beta = 0.457.

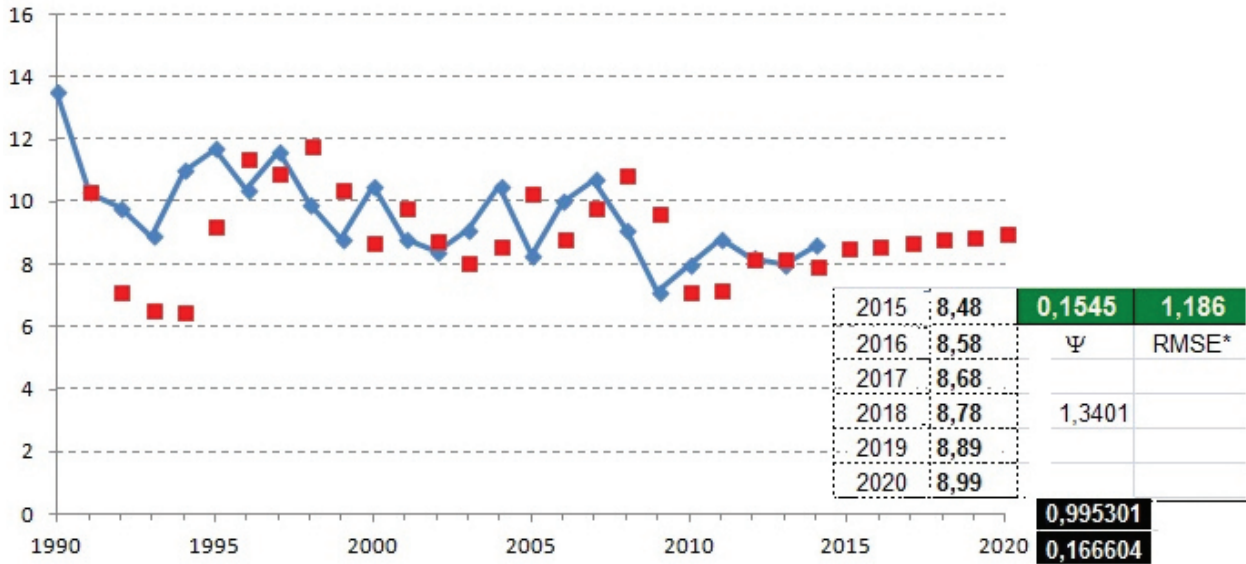


Figure 5 Two-parameter model of exponential smoothing by Holt

3.4. Prognosis method based on autoregressive model AR(1)

Estimation of the coefficients AR (1) based on the method of the smallest sum of squared residuals. Obtained model (2):

$$\text{The size of production of steel} = 5.936 + 0.363 \cdot \text{Previous}_1 \tag{2}$$

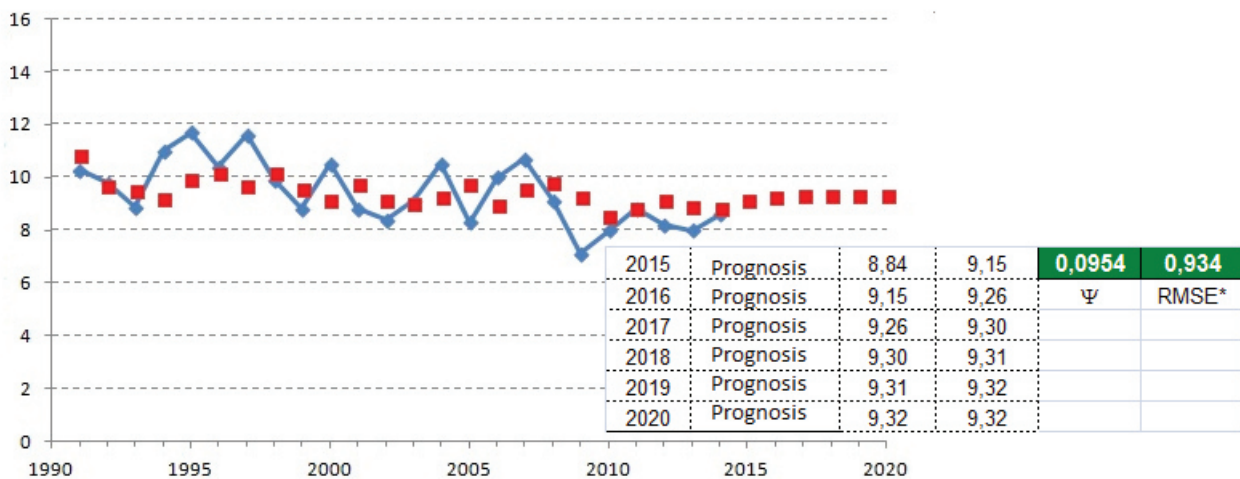


Figure 6 Autoregressive model AR (1)

3.5. Prognosis method based on autoregressive model AR(1,4)

Estimation of the coefficients AR (1,4) based on the method of the smallest sum of squared residuals. Obtained model (3):

$$\text{The size of production of steel} = 3.80 + 0.369 \cdot \text{Previous}_1 + 0.217 \cdot \text{Previous}_4 \tag{3}$$

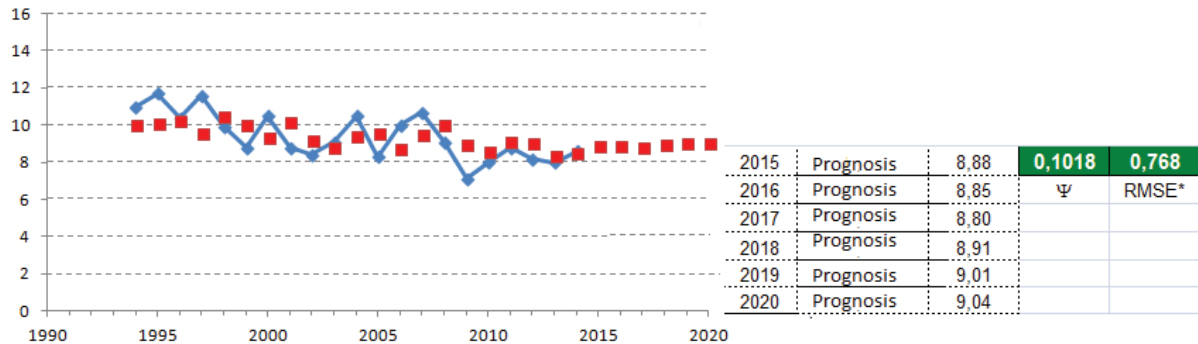


Figure 7 Autoregressive model AR (1,4)

4. CONCLUSION

Conclusions from the analysis:

In the years 1990-2014:

- The highest level of production 13.5 M mt of steel was in 1990,
- The lowest was 7.1 M mt in 2009,
- BOFs production process is now over 50% of the production (in 2014 produced 5.1 M mt of steel in this process) [8],
- electrical process EAFs is less than 50% of production, in 2014 produced 3.5 M mt of steel [8],
- a total in 2014 produced 8.6 M mt of steel [9],

Prognosis up to 2020: projected level of steel production in 2020 will be about 9 M mt.

Conclusions from the prognosis:

The best fit to the empirical data volume of steel production were characterized by prognosis based on: autoregressive model AR (1, 4) two-parameter exponential smoothing model by Holt. Ex-ante prognosis (for the period 2015-2010) obtained in these methods are very similar to each other and indicate that over the next 6 years (until 2020) should be an increase in steel production by approx 300 thousand tons. Steel production projected to Holt's model will range about 8.48 M mt to 8.99 M mt. On the other hand, according to the AR autoregression model (1.4) will be from 8.88 to 9.04 M mt. Estimate is optimistic, because of the higher production than the current level. The production volume will not exceed 10M mt of steel per year.

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