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Rozprawa doktorska

Modele prognozowania produkcji wyrobów do określania kierunków rozwoju rynku stalowego

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Abstract of the doctoral dissertation pt. „ Models of forecasting the output of products for determining the directions of development of the steel market”

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Production engineering is a very broad concept and includes, among others, the issues of planning, designing, implementing and managing manufacturing systems. Forecasting models for determining the directions of market development support the decision-making processes of manufacturing companies. In this study, various econometric methods were applied, building integrated models that capture many factors influencing the volume of product production.

The scope of the research covered the metallurgical sector and identified key users of the steel market, i.e. construction, production of finished metal goods, production of machinery and equipment, production of vehicles, production of other transport equipment, production of household appliances. For selected sectors, the volume of use (level of demand and steel consumption) of individual groups of steel products was analysed, including: hot-rolled flat products, cold-rolled flat products, galvanized sheets, reinforcing bars, wire rod, heavy sections and pipes. Such an analysis of the market situation and forecasting the manufacturing of these products in a sectoral system may be used by steel companies and other entities in the steel users market at the stage of investment planning.

Justification for the choice of topic was, inter alia, too low level of domestic production of steel products in relation to the demand of steel market users. It results from the limited production capacity and the mismatch in the production structure in Poland. Moreover, there was a lack of specialized analyzes of the consumption of steel products broken down by users of the steel market in the economy. The main purpose of the work was to develop a comprehensive methodology for market research of individual steel products in the field of demand and production of steel users in Poland, as a method of determining the directions of steel market development.

The first part of the paper presents information on the situation and importance of the steel sector in the economy, presents an overview of the existing steel sector research in the area of restructuring, and analyzes publications on production forecasting in relation to a specific industry sector.

The steel industry as a sector is an important part of the national economy - with an average share of approx. 3% in the total value of industrial production and approx. 0.3% in the creation of added value. The indirect impact of the sector is even greater, considering its

connection with the economic environment through the demand for materials, energy and services: for each unit of value added produced in the domestic steel industry, 5.7 units of value added are generated by the activity of the sector in other parts of the economy. The importance of the steel sector is even greater in terms of its products, used in many branches of the economy for production and construction. Apparent consumption calculated as domestic steel production reduced by exports and increased by imports in the last ten years amounted to an average of 11.65 million tonnes, and its trend was increasing with an average growth dynamics of 6.9% annually. In the same period, the average annual steel production was approx. 8.75 million tonnes.

The first analytical part of the work presents a gradual methodology for determining the sectoral steel consumption for 6 main steel users. The sectoral classification was made in accordance with: the guidelines of steel associations, the statistical classification in force in the country and the EU, and taking into account input-output flows Based on the developed unified database, an approximate, but highly realistic structure of the steel market was established in relation to the standard adopted form that functions in national statistics. When building the database, inter-industry flows were taken into account and the missing data were supplemented using statistical methods. In total, a database of apparent consumption of thirteen assortments of steel products was developed in eight market segments over a period of fifteen years, which was used for further research.

The most representative product was selected for the presentation of the research method, i.e. galvanized sheets from the group of flat products, due to the significant amount of apparent consumption, high added value of the product, wide application and growing demand from market users. The model building process started with trend models for each of the market segments, from which the trend with the highest match to real data was selected for forecasting. The next stage was the selection of variables describing the activities of key steel users, i.e. factors influencing the volume of demand for steel products, describing production activities in individual sectors, including: sold production, production of more important products, employment, investments, consumption of materials and energy. The designated database became the basis for the development of one-, two- and three-factor models with linear and power functions taking into account the specificity of the application of a given product and a high level of correlation with the dependent variable. The models were subjected to full statistical verification, and then, using statistically significant models, consumption forecasts for the tested steel product on individual user markets were determined until 2025.

On the basis of the developed models, a cumulative forecast was also prepared according to pessimistic scenarios - with minimum values, central - with average values, optimistic - with maximum values and models with the highest level of fit. The collective analysis made it possible to check the level of matching of estimated values with full real data. All lists showed a very good fit (R2 index> 0.9). The aggregated selected models with the highest level of fit and meeting all criteria showed the highest R2, which means compliance with the actual values at the level of 97.5%. It was therefore judged that they would be the best to draw conclusions for producers of steel products. On their basis, the size and directions of market development for the selected product were determined.

In the forecast period, the apparent consumption of galvanized sheets, after a decrease in 2020, will recover to a level higher by 1% than in 2019. However, from 2022, a declining upward trend of dynamics will continue from + 5.8% to + 1.7% in 2025. In 2022, an increase in demand for galvanized sheets should be expected, especially in the segment: construction (approx. 40 thousand tonnes), finished metal products industry (approx. 33 thousand tonnes), automotive (15 thousand tonnes) and other sectors (10,000 tonnes). In the next three years, the highest increase in demand is forecast for the market: production of finished metal products (75 thousand tonnes), construction (62 thousand tonnes) and automotive (23 thousand tonnes). Then making assumptions about the selection of markets in which the producer could increase its share. it was estimated that the domestic production of galvanized sheets may increase in the next five years by 233 thousand. tonnes in relation to 2020, i.e. to the level of 985 thous. tonnes in 2025

The adopted methodology was consistent with the specific objectives of this work and the research hypotheses. The main research question was: is it possible to forecast the demand for individual assortments of steel products on the basis of data describing the production activities in the main steel processing industries? The conducted analysis with the verification of models and forecasts is the basis for stating that the developed methodology is correct and useful. The hypothesis was also confirmed that the use of statistical models, taking into account selected factors and changes in steel consumption, enables comprehensive analysis and forecasting of the demand for steel products.