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MESOECONOMIC MARKET ANALYSIS BASED ON SELECTED BIG DATA TOOLS – THE CASE OF WOOD MARKET TRENDS IN POLAND UNDER ECONOMIC UNCERTAINTY

Key words: mesoeconomics, wood market, economic uncertainty, Big Data, e-commerce analysis, Poland

ABSTRACT. The paper discusses selected trend changes in the Polish wood-based products market under conditions of economic uncertainty. From a mesoeconomic approach, using Big Data resources and online e-commerce tools, the wood market was analyzed from the perspective of demand and online user activity. In terms of time scope, the research covered the period 2019-2021, including the pandemic year. Secondary data based on Google Ads and Google Analytics were analyzed. The study used selected open-source analytical tools, including Google Keyword Planner and Data Studio. The controversial hypothesis, which assumes that potential demand for wood and wood-based products shows a sustainable trend even under economic uncertainty, was verified. The findings were visualized and discussed. Finally, the rationale for confirming the assumed hypothesis was not obtained. However, the results of the research proved to be interesting, out of the box. It turned out that the popularity and multifaceted use of wood is not limited by typical boundaries. The consequence of the market situation is a growing demand for wood, but at the same time a supply deficit. This is a challenge for the wood market benchmarking and formulating practical recommendations for economic policy in the wood-based sector in Poland.

INTRODUCTION

In the natural economy, of which agriculture and forestry are a key part, wood is an important renewable resource. In many specific applications, wood can be reused, that is, recycled. It can also biodegrade and, in various forms, be a component of new products. Additionally, it can be a source of green energy, either directly or in the form of wooden biomass. Meanwhile, wood and wood fibers are the basis of many finished products. Thus, wood as a material, has functional and aesthetic qualities and is environmentally friendly. Popular final wood-based products include: wooden construction materials, interior decoration materials, furniture, kitchen accessories, toys, paper products, books, hygiene products and many others. Wood-based materials are also used for packaging (primary, secondary, transportation). In creating the forest-wood value chain, certification plays an important role [Czemko et al. 2017, Paluš et al. 2018]. It applies first to forests, then to the raw material (roundwood), and finally to processed materials, semi-finished and finaly wood-based products.

At the third decade of the twenty-first century, the economic situation is being verified by market uncertainties. First, in 2020 by a pandemic, then, in 2022, by the largest military conflict in Europe since the Second World War. It's clear that the entire market, including the wood-based sector, is in a state of emergency. It is a de facto economic uncertainty. At the pandemic's start, it was thought that economic activity in the wood industry would be severely curtailed. Meanwhile, the threat described as "lockdown" paradoxically became an opportunity to activate the wood-based sector [Mikołajczak et al. 2020]. This opportunity relates to various symbiosis factors used by market participants [Kusiak et al. 2018]. From economic, environmental, industrial, as well as social, behavioral factors [Potkański et al. 2011, Wanat, Potkański 2011, Paszkowski et al. 2019]. It formulates the question of trade-offs, the coexistence of multiple market players in a risk perspective [Chudobiecki et al. 2016]. It is worth asking whether there is a model of integral economy [Chirat 2021], taking into account the individual ability to develop under conditions of uncertainty? Against this background, assuming a longer than short-term course of the crisis, it is necessary to verify the importance of the sectoral market, created by wood and wood-based products [Wanat et al. 2021b].

In forestry, and subsequently in the wood market – economic and social, natural, ecological aspects intermingle [Ratajczak 2013]. It was the forest economy that gave rise to the idea of sustainable development [Von Carlowitz 1713, 2013]. This idea can be the starting point of a broader research perspective: integral economics [Chirat 2021, Słodowa-Hełpa 2013] and integral ecology [Wanat 2016, Kusiak et al. 2022]. A natural illustration of such a defined perspective is the forest [Nawrot, Wanat 2022]. We find that the principles of business remain essentially unchanged in all sectors. However, if one considers the challenges of the production chain (timber, wood materials, semi-finished products, final wood products) and related services (forest services) – it is no longer so obvious [Wanat

et al. 2022]. The specific "territory" of forestry economic activity in Poland is determined by the structure of forest ownership. It is a natural, resource-based monopoly. Moreover, it is managed by the State Forests National Forest Holding (Państwowe Gospodarstwo Leśne Lasy Państwowe).. Private, local government and other forest resources have a small share in the economic settlement. Thus, the Polish wood market is also specific [Wanat 2009, Wanat, Klus 2015]. For these reasons, it is justifiable to study market trends, determined by wood-based products, precisely under conditions of economic uncertainty.

MATERIAL AND METHODS

The research was planned in an attempt to assess the "popularity" of wood and wood-based products under the uncertainty initiated by the pandemic time. A mapping of the wood market in an electronic economy was used, the importance of which was recognized by entrepreneurs and consumers [Sujová, Hajdúchová 2015]. Under these special conditions, market participants sought an opportunity to operate primarily in the digital world. The study project included the following elements:

1. The research background was the demand perspective of the wood market [Wanat et al. 2021a]. The level of interest of potential customers in wood-based products was analyzed (subject scope). Specific measures of the "popularity" of wood were determined by Internet users, potential customers (subject scope) [Wiśniewski 2018]. The volume of requests was limited to the territory of Poland and the Polish language (spatial scope). The period of 2019-2021 (and in these years the months: from March to April) was selected for analysis.
2. Data for the research was obtained from open Big Data resources available to Internet users [Buhalis, Volchek 2021]. Thus, the main source of data became the information available on the Internet, but limited to the territory of Poland (location of users), and, as already mentioned, to the Polish language group. The data was downloaded and aggregated using the Google search engine and its free analytical tools: Google Ads, Google Analytics and Data Studio [Giraldo-Romero et al. 2021, Saluja et al. 2021]. Thus, the condition of representativeness of the research sample was waived. It was assumed that the secondary data made available in Google applications from a sufficient set of recorded activity (search traces over a defined period of time, by selected keywords).
3. Next, keyword search conditions were developed. A substantive criterion was applied. Based on the state of the art, a targeted selection of product groups was made. These groups were mapped as query patterns, built on the basis of keywords (in Polish, of course), synonyms of the word: wood. The following groups were selected: wood, sawmill wood, paneling wood, exotic wood, firewood and construction timber. The analysis was carried out in the area of the identified groups – for 180 related keywords [Keyword Tool API 2022].

4. In the next step, the data was collected. In preparing the analysis of the number of queries for each group of keywords, a conventional measure (CM) was used. This measure (CM) corresponds to the average monthly number of search results. Then, for each examined keyword and its derivatives (synonyms), a matrix of results (MR) was compiled. The matrix consists of data collected in consecutive months of research, according to the location and search network settings (language: Polish, country: Poland). Subsequently, the data were cleaned of outliers. Finally, they were compiled into separate sub-bases. Data matrixes for each product group were selected.
5. Tools used in Big Data and e-commerce analysis on the Internet were selected for the research. Data was collected using the Google Keyword Planner application. This application is a module of the free Google Ads service for registered Google users. The average monthly number of search results (CM) for selected keywords and aggregated product groups was analyzed. The research covered a two-year period (from March 1, 2019 to March 31, 2021). The queries registered by Google, directed from the territory of Poland and in the Polish language, were verified. Search terms were selected according to the content criterion. The initial selection of trends made it possible to select product groups, aggregate them and analyze them again over the same period.

Of course, one may formulate the question, why the classical approach of data analysis was not used? Then correct sampling (representativeness) would have been necessary, as well as statistical verification of the results obtained. In the presented case study, these elements were intentionally excluded. The Big Data approach, and therefore working on a complete set of input data (all information saved in Google Ads databases was downloaded), does not need additional "forecasting" and "standardization" of the data used. This is because the research takes into account all the information recorded in the database [Buhalis, Volchek 2021].

Therefore, there is no need for "data representation". All data is analyzed. This is sufficient for substantive (qualitative) trends assessment [Saluja et al. 2021]. If probabilistic models and their verification (that is, future trend design) were planned, statistical analysis would be necessary. This is where the appeal and "advantage" of Big Data analytics resides. Therefore, the proposed approach facilitates the identification of ex-post trends and inferences based on such a prepared, "complete" data structure.

The research scenario, which was carried out according to the assumptions, had ten stages [Wanat et al. 2021a]:

– content analysis and keyword selection (stage 1),
– collected data from the Internet/Google (stage 2),
– preparation of IT tools: auxiliary application for data aggregation and verification and outliers elimination (stage 3),
– aggregation and cleaning of data (stage 4),
– selection of keywords for product groups (stage 5),

– re-analysis of search results, for aggregated data (stage 6),
– compilation and discussion of the results (stage 7),
– visualization of the results in Google Keyword Planner (stage 8),
– formulating conclusions (stage 9),
– recommendations (stage 10).

The obtained results were collated, visualized and discussed.

WOOD MARKET TRENDS – RESULTS AND DISCUSSION

In proceeding to identify trends in the Polish wood market under conditions of economic uncertainty, a review of the supply background was done. In this perspective, the frequency of professional keyword searches based on wood – already in demand – was analyzed.

The supply background is illustrated primarily by the situation of wood-based enterprises during the analyzed period, especially in the pandemic (Figures 1 and 2).

With some surprise, a relative stabilization in the number of active enterprises in the wood-based sector was identified. This was especially true for companies (SMEs). In contrast, the activity of individual entrepreneurs was in line with the general sentiment during the pandemic period. However, the balance of active companies (comparing the number of closures and new businesses in the industry) makes it possible to indicate an optimistic upward trend at the end of the examined period.

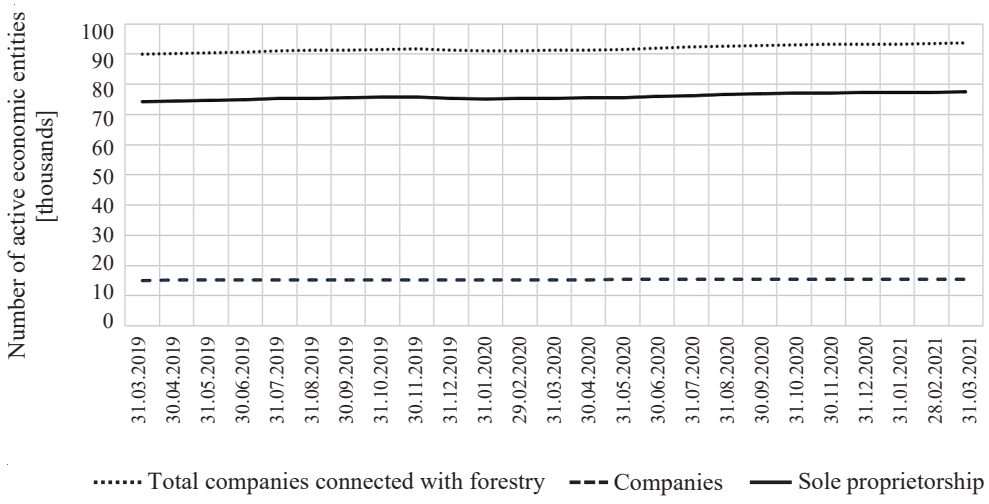

Figure 1. Active enterprises in forestry and wood-based sector in Poland in 2019-2021 (quantity in thousands, in monthly ranges)

Source: own elaboration based on [https://stat.gov.pl, GUS 2021, GUS, BDL 2022]

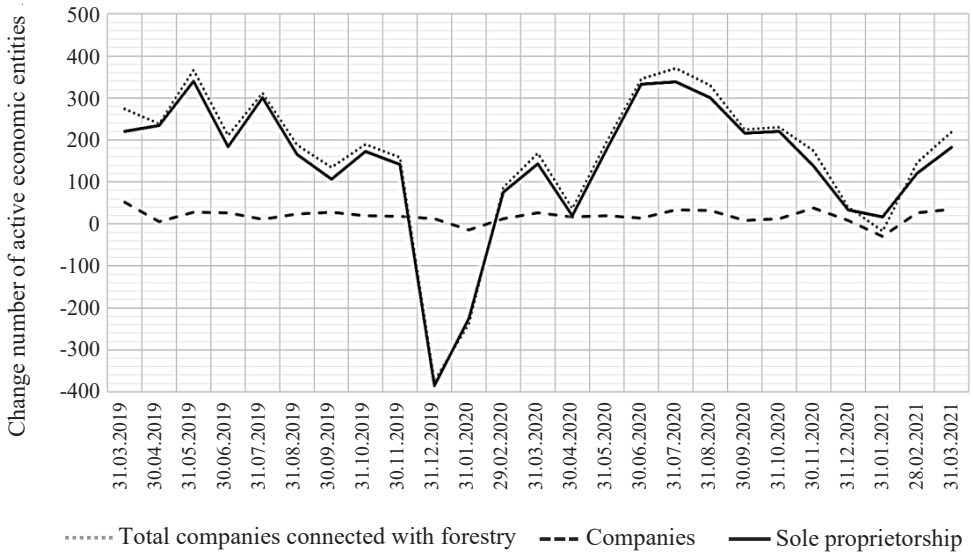

Figure 2. Changes in the share of active enterprises (on/off balance) in forestry and wood-based sector in Poland in the period 2019-2021 (quantity in thousands, changes in monthly ranges)

Source: own elaboration based on [https://stat.gov.pl, GUS 2021, GUS, BDL 2022]

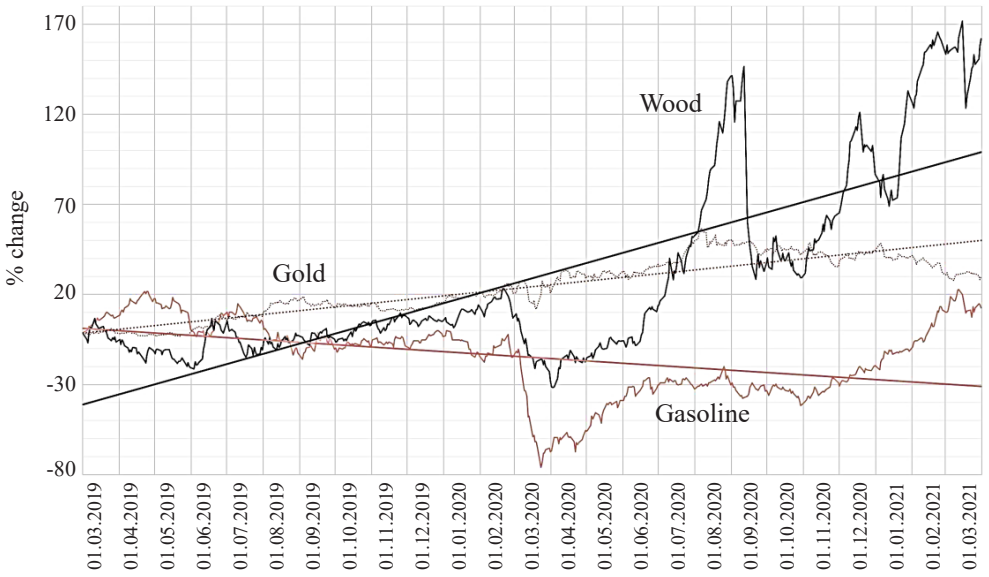

Figure 3. Changes in aggregate indices for the average wood price (in USD/1000 board feet) against the price of gold (in USD/ounce) and gasoline (in USD/gallon) period from 2019-2021 (% change, in monthly ranges)

Source: own elaboration based on [bankier.pl 2022]

The average unified price of wood – determined, of course, over the same period – also turned out to be an important market indicator [Klus et al, 2021, Wieruszewski et al. 2022], and described well the competitive situation [Wanat, Sarniak 2022]. The price of wood was compared with the prices of selected commodities: gold and gasoline (Figure 3). A marked increase in the average, aggregated wood price was noted.

In the next step, the level of interest in wood and wood-based products was analyzed against other popular consumer queries on the Internet. Web users' inquired about traveling, homemade food production and the use of a vegetarian diet were selected. Comparing the results, a relatively constant high average monthly rate of inquiries was noted, with an upward trend during the pandemic period (Figure 4).

In the same area, the dynamics of change (% change) in interest in wooden products was also verified. During the examined period, the highest percentage increase in inquiries about wood and wood-based products was noted. In addition, the growing trend has been stable (Figure 5).

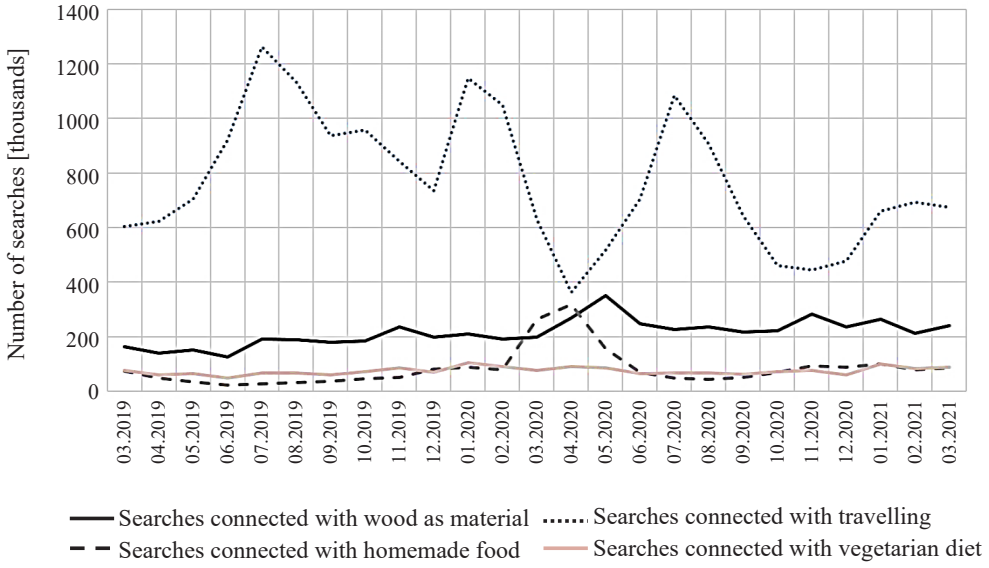

Figure 4. Level of interest in wood and wood-based products against other online queries (traveling, homemade foods, vegetarian diet) in the period 2019-2021 [a rounded measure of the number of online queries, recorded monthly]

Source: own elaboration based on Google Keyword Planner and [https://keywordtool.io/api, Keyword Tool API 2022]

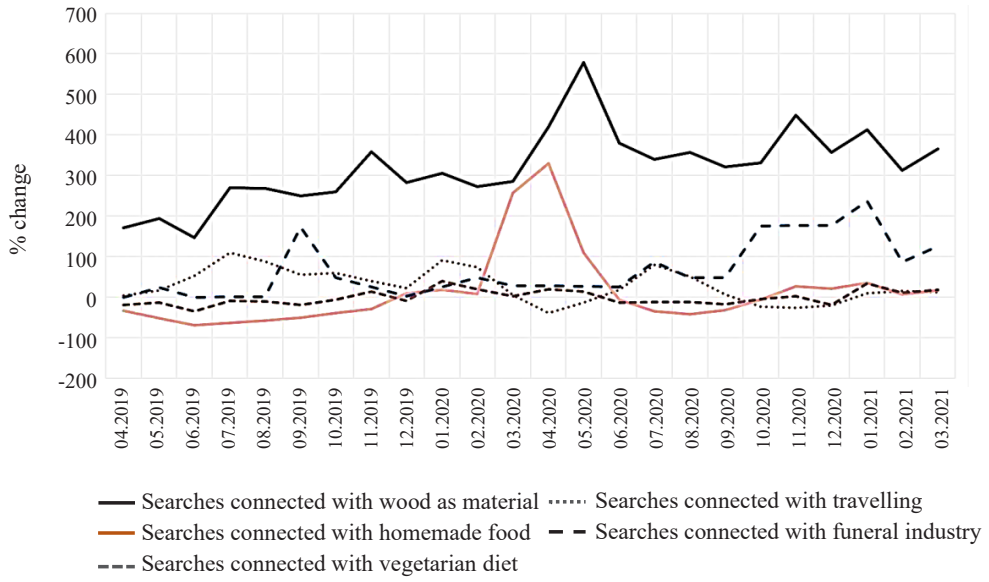

Figure 5. Dynamics of change of web users' interest to wood-based products in the period from 2019-2021 (% change for average monthly inquiries)

Source: own elaboration based on Google Keyword Planner and [https://keywordtool.io/api, Keyword Tool API 2022]

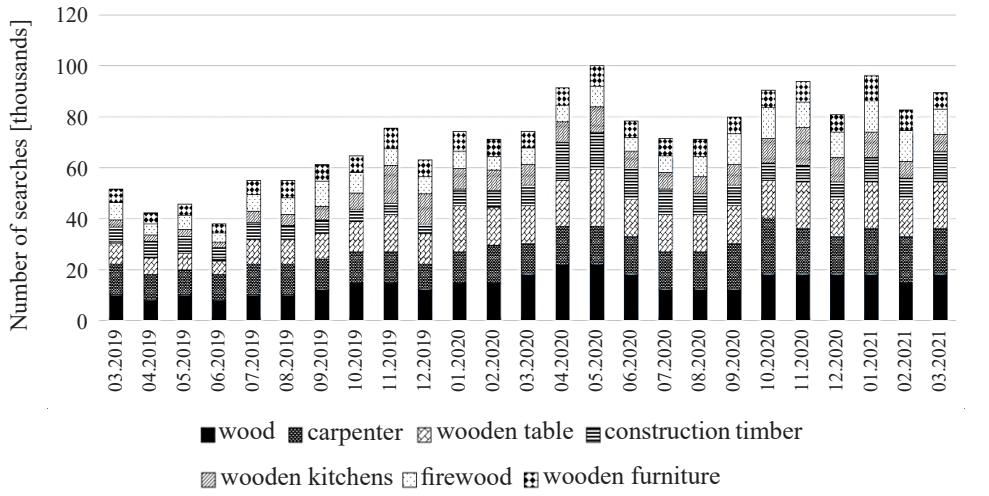

Figure 6. Changes in web user interest for selected wood-based product groups in the 2019-2021 period (% change for average monthly inquiries)

Source: own elaboration based on Google Keyword Planner and [https://keywordtool.io/api, Keyword Tool API 2022]

Analyzing the dynamics of interest changes in individual wood-based product groups, a dominant upward trend was noted. The results were ranked according to the average monthly number of online inquiries, for the same period as in other cases, i.e. from March 2019 to April 2021. Within the product groups, the highest level of interest was noted for wood furniture, firewood, as well as solid wood kitchens (kitchen furniture) and construction wood (Figure 6).

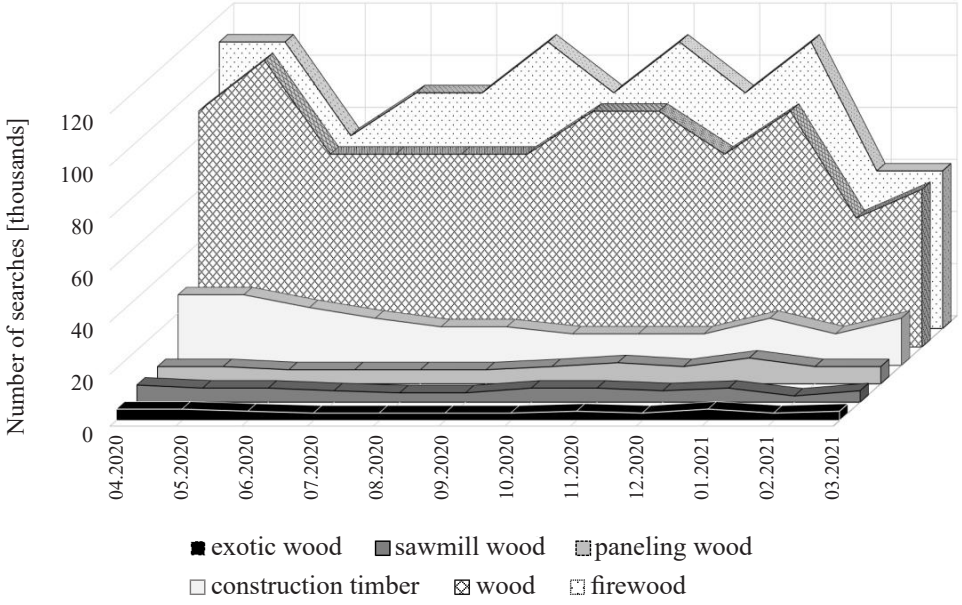

Figure 7. Dynamics of changes in consumer/web users› interest for selected wood-based product groups in the period 2019-2021 (monthly average quantity of requests, in thousands)
Source: own elaboration based on Google Keyword Planner and [https://keywordtool.io/api, Keyword Tool API 2022]

Then, analyzing the aggregated product groups (Figure 7), the dominance of queries for the keywords "wood" (in general) and "firewood" was noted. During the examined period and in this subject area – consumer interest averaged 100 thousand queries per month. A slight decreasing trend was also shown. For the other groups, where "construction timber" was the most popular, a balanced trend was noted. The trend was relatively stable (as shown for "sawmill wood", "paneling wood" and "exotic wood"). Finally, using the case of the pandemic period, it was noted that the level of interest in wood and wood products is not decreasing.

Moreover, during the examined period of economic uncertainty (2020-2021), despite a significant increase in prices, customer interest – and therefore demand for wood – showed an upward trend.

CONCLUSIONS

Based on the research results, their discussion, and descriptive analysis, the following conclusions and recommendations were formulated:

1. In the examined period, from March 2019 to April 2021, pandemic time played a special part. A period of economic uncertainty began, which unfortunately continues. The war in Europe, as a result of the Russian Federation's aggression against Ukraine, as well as high inflation and rising prices for many key products are shaping not only a picture of uncertainty, but of increasing risk. Against this background, the mesoeconomic supply outlook for the wood market (timber deficit and rising prices) is unclear, unstable and difficult to predict.
2. Despite these definitively negative macroeconomic conditions, interest in wood and wood-based products is not decreasing. Of course, this has so far been demonstrated only from the initial pandemic period. However, a noticeable change in consumer preferences, a greater interest in the household (including its renovations and home furnishings), seems to be maintaining the trend of greater wood interest.
3. Thus, the hypothesis formulated at the start was verified negatively. It assumed that under conditions of economic uncertainty, potential demand for wood and wood-based products is sustainable. It was verified whether this stable trend is also matched by adequate, sustainable consumer interest. After research, it was shown otherwise. Wood does not „succumb" to negative trends, and demand for wood-based products exceeds stereotypes and typical barriers.
4. However, a relative level of stability (sustainability) was identified in the wood-based business sector. Larger changes occurred in the group of individual entrepreneurs. Whether this trend will continue remains to be seen. However, the real problem for the sector and the wood market is becoming a growing deficit of wood and uncontrolled price increases. The supply imbalance could lead to a collapse of the market, despite very positive trends on the demand side.

It is worth noting that under conditions of economic uncertainty and even crisis, the popularity of wood (raw material, material and final product) has not diminished. Paradoxically, the universal use of wood and wood materials has been "rediscovered". Does this mean a return to wood as a universal natural resource? It is difficult to say unequivocally. Perhaps the key to the use of at least some of the resources of the natural economy is the ancient Greek origin of the key word "economy" (gr. *οικονομία*) [Sedláček 2014]. The word›s content refers to the observance of laws (gr. *νόμος, nomos*) and principles aimed at taking care of the home (gr. *οἰκος*, *oikos*) [Słodowa-Hełpa 2015]. It is this motivation that best manages risk, especially in times of economic uncertainty [Potkański, Wanat 2017, Paszkowski et al. 2018, Wanat et al. 2018]. In this context, it seems necessary to permanently monitoring the wood market and formulate recommendations for economic policy in the wood-based sector in Poland.

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MEZOEKONOMICZNA ANALIZA BRANŻY Z WYKORZYSTANIEM WYBRANYCH NARZĘDZI BIG DATA – PRZYKŁAD RYNKU DRZEWNEGO W POLSCE W WARUNKACH NIEPEWNOŚCI GOSPODARCZEJ

Słowa kluczowe: mezoekonomia, rynek drzewny, niepewność gospodarcza, Big Data, analiza e-commerce, Polska

ABSTRAKT

W artykule podjęto próbę identyfikacji trendów popularności wybranych produktów bazujących na drewnie – w warunkach niepewności gospodarczej na rynku polskim. W ujęciu mezoekonomicznym, wykorzystując zasoby Big Data i internetowe narzędzia e-commerce, analizowano rynek drzewny z perspektywy popytowej, poprzez pomiar aktywności użytkowników Internetu. W zakresie czasowym badaniem objęto okres 2019-2021, w tym rok pandemii. Analizie poddano dane wtórne, pozyskane za pośrednictwem aplikacji Google Ads i Google Analytics. Wykorzystano wybrane narzędzia analityczne typu *open-source*, w tym Google Keyword Planner oraz Data Studio. Do weryfikacji przyjęto kontrowersyjną hipotezę, w której założono, że potencjalny popyt na drewno i produkty drewnopochodne wykazuje trend zrównoważony nawet w warunkach niepewności gospodarczej. Uzyskane wyniki zwizualizowano i poddano dyskusji. W efekcie nie uzyskano wprawdzie przesłanek do potwierdzenia założonej hipotezy, jednak wyniki okazały się interesujące, nieszablonowe. Zauważono, że popularność drewna i jego wieloaspektowe zastosowanie nie poddaje się prostym ograniczeniom niepewności gospodarczej. Odzwierciedleniem sytuacji rynkowej okazał się rosnący popyt na drewno, ale równocześnie deficyt jego podaży. W tym kontekście konieczne wydaje się monitorowanie rynku drzewnego oraz sformułowanie rekomendacji praktycznych dla polityki gospodarczej w sektorze leśno-drzewnym w Polsce.

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