

Wavelet Methodology for Analyzing Internet Marketing Metrics in Managing the Product Policy of the Business Entity

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Abstract: *The formation and development of economic relations requires a change in the approach to the disclosure of such ties. At the heart of this lies the need to pay attention to individual business entities. This is due to the fact that in the modern world it is economic agents (enterprises, firms, companies) that determine the overall economic development. Their effective functioning is directly related to the proper implementation of the relevant commodity policy. It is important to use various tools to achieve your goals. Among such tools in the work is Internet marketing. This tool allows you to evaluate the promotion of goods and services on the market, take into account the interests of buyers, assess the dynamics of demand, and attract new potential customers. One of the conditions for the implementation of this approach is the evaluation of Internet marketing in the management of product policy. The paper reveals research directions in related studies, considers metrics for analyzing economic dynamics. The author's understanding of the Internet marketing metrics from the point of view of achieving the necessary conditions for the implementation of the product policy is proposed. To do this, we use the wavelet methodology, in particular wavelet coherence. A specific example of the proposed approach is considered. The work uses visualization to present empirical data and the results obtained. It is based on the use of graphs and charts. The results obtained can be used in the development of strategies for the implementation of commodity policy for any business entity.*

Keywords—metrics; Internet; marketing; control; comparison; grade; commodity policy; business entity; wavelet analysis; wavelet coherence

1. INTRODUCTION

Modern economic systems are more focused on the sustainable functioning and development of individual business entities. This is based on the concept of state non-intervention in the activities of economic agents, reducing the state's share in the ownership of business entities, and developing private business [1]-[3]. Based on this, it is possible to develop the necessary strategies for behavior in the market, to evaluate the use of such approaches.

In most cases, the effectiveness of individual enterprises, companies, firms is determined by the conditions and proper provision of their product policy. At the same time, in a broad sense, commodity policy should be understood as an activity that ensures the expansion of the range due to the efficiency of production and sales of products [4], [5].

The latter in modern economic conditions is achieved through the use of new approaches, technologies and tools.

Thus, the process of commodity policy management becomes the basis for effective functioning for any business entity. This allows us to say that an effective commodity policy is the key to achieving the set goals.

Ultimately, this determines the interest in this research topic, determines its significance and the need for further consideration.

Among the tools for promoting goods and services to consumer markets, their successful implementation, the Internet is used. This approach allows you to organize marketing research, study the target audience, attract potential buyers, monitor market trends, and ensure product promotion and much more [6], [7]. For these purposes, you can use various techniques and algorithms [8]-[20]. However, one way of such analysis and research can be the use of Internet marketing metrics [21]-[25]. This ensures the promptness of obtaining the results necessary for the implementation of the planned strategy for promoting the commodity policy.

The presentation of Internet marketing metrics can be based on various principles. Due attention in this aspect is given to information content, accuracy, reliability. This makes it necessary to use new tools for analysis and implementation of relevant metrics.

Thus, the main goal of this study is: to consider the features of the implementation of the product policy, the possibility of using Internet marketing for this purpose and the development of a new approach for constructing metrics for such an analysis. The disclosure of the tasks set requires a preliminary study of related literature sources.

2. RELATED WORKS

The analysis of literary sources on the subject of this study involves the consideration of works that relate to both product policy and metrics for the analysis of economic processes, in

particular Internet marketing. In this vein, we will construct our consideration.

P. Tecchi, C. McAlister, F. Mathieux and F. Ardente explore the general issues of product policy implementation [26]. In particular, the authors consider the impact of such a policy on the sustainable development of all elements of the economic system. Directions for efficient use of resources and reduction of unproductive costs are determined. For their implementation, a matrix approach is used. A method has been developed to determine the key components of the effective use of funds to promote commodity policy. This approach takes into account the views of all stakeholders.

B. Boardman's study is aimed at studying the directions for achieving energy efficiency in the case of the implementation of a sound product policy [27]. The study was conducted on data from the UK. For these purposes, the possibility of introducing minimum standards is being considered. The developed approaches allow achieving energy efficiency and energy saving.

X. Xie, J. Huo and H. Zou explore product policy issues based on innovations in green products, energy and processes [28]. For this, the content analysis method is used for a number of financial indicators. The authors conduct an analysis based on data on 209 companies. The paper shows that such innovations have a significant impact on all processes of product policy. However, this influence is positive. Recommendations are proposed that allow for the development of an innovative direction in commodity policy, taking into account "green" solutions.

G. Albora, L. Pietronero, A. Tacchella and A. Zaccaria are studying the possibilities of developing a product policy [29]. This is done based on machine learning for the purposes of industrial upgrading. The authors also note a number of areas of economic complexity when considering such an issue. For this, forecasting methods are used. At the same time, it is important to predict the emergence of new products, the development of their life cycle, and promotion on the market. An important element of such an analysis is the cross-validation of data, which involves the study of the mutual dynamics of all parameters. This approach allows us to introduce a measure of the possibility of introducing a new product, to justify the directions for the development of commodity policy.

A. Arundel, C. Bloch and B. Ferguson explore the role of innovations and their consistency with the policy in the field of production of goods, their logistics and sales [30]. Such an analysis was carried out for data from Sweden. For these purposes, the possibility of using cognitive testing is considered. At the same time, it is noted that the approach to innovations affects the types of their implementation and implementation. Therefore, it is important to take into account the subject area for such innovations. This ultimately determines the appropriate commodity policy.

D. W. Stewart and Q. Zhao analyze the relationship between Internet marketing, business models and government commodity policy [31]. At the same time, the special role of promoting goods on the Internet is emphasized. The paper gives an assessment of the economic necessity of the relations under consideration in the context of the formation of strategies to support the commodity policy. Particular attention is paid to the formation of new market relations based on Internet trading. Various business models are being explored, where such trade is a priority. The issues of state support of relevant models of Internet business, the formation of the necessary strategies and policies for their management are considered.

The work [32] discusses the strategy of actions in the implementation of product policy based on marketing research. For these purposes, an approach is proposed based on a two-vector coordinate system - the needs of the buyer and the communication environment. The possibility of using crowd technology to assess the capabilities of an enterprise, company, firm in the field of communication with the consumer is also considered. This allows you to evaluate the various strategies of the commodity policy of a business entity.

M. Omar, I. Bathgate and S. Nwankwo explore the processes of attracting buyers to the goods market using Internet marketing [33]. Such a study is carried out on the example of emerging markets. The authors consider the satisfaction of online buyers. For this, a special evaluation measure is used. The analysis is based on a survey of respondents. The authors classify the results of the survey and divide buyers into several groups. This made it possible to identify factors influencing the satisfaction of Internet customers. This is important for the development of various strategies for the implementation of commodity policy.

M. Bahorka, L. Kurbatska and L. Kvasova analyze the possibilities of using marketing reserves to change the competitive positions of a business entity [34]. The paper summarizes theoretical and empirical approaches to marketing research management. It is shown that with the help of marketing reserves it is possible to increase the competitiveness of various enterprises, companies, firms. For these purposes, such a measure as price-originality is used. On its basis, it is possible to develop a strategy and general principles of commodity policy in each specific case. This will allow you to freely navigate in the ever-changing business environment.

Thus, we see different approaches to the study and analysis of commodity policy. At the same time, the possibility of developing strategies for the implementation of such a policy in the conditions of a changing decision-making environment is important. In this context, it is advisable to use Internet marketing. At the same time, metrics are needed to evaluate actions in the Internet environment. These metrics should also take into account the specifics of emerging economic relations. Based on this, we will conduct a brief analysis of the specifics of using metrics to assess economic relations.

3. SPECIFICS OF METRICS IN ASSESSING ECONOMIC RELATIONSHIPS

In this section, we will give examples of several works where metrics are used to assess the relationships that arise in the process of economic dynamics.

In [35], various metrics are studied in assessing the stability of a product system. Among these approaches, the life cycle assessment method is considered. At the same time, to take into account many factors, it is necessary to use integral indicators. To form a new metric, it is proposed to use the adaptation method. It is also advisable to use generalized indicators of metrics in combination with traditional indicators. This allows you to expand the results of the assessment, to obtain new conclusions.

M. Genero, G. Poels and M. Piattini build metrics based on the analysis of the entity-relationship relationship [36]. This allows you to understand what factors are decisive in database models, including economic series for different parameters. Thus, as a metric, one can consider some relationship between the data presented in the form of a diagram. These metrics make it possible to understand the structural properties of the processed variables. The authors also note the importance of building metrics that contribute to forecasting, building models for such purposes.

In [37], the results of the assessment of relations in the sphere of agricultural production are summarized. The authors focus their attention on the development of generalizing indicators for evaluating data on various agricultural commodities. The authors note the existence of various metrics, each of which draws its own conclusions. Therefore, it is important to find typing for individual approaches and find a common approach for building a complex metric. This, for example, can be done on the basis of data from the stock market and comparing such data with each other.

A. Parchomenko, D. Nelen, J. Gillabel and H. Rechberger also emphasize the plurality of metrics in assessing economic dynamics [38]. The authors conduct a compliance analysis for 63 different indicators. The paper summarizes such metrics and shows the relationship between them. This is done based on the clustering methodology. As a result, the main groups of metrics are identified, which makes it possible to generalize a single integral indicator for data analysis. A standardized visualization of metrics is also proposed, which allows you to better understand the results. Visualization also contributes to the consideration of complementary indicators, their mutual replacement.

In [39], the possibility of choosing the most appropriate indicators for assessing economic relations is considered. For these purposes the Delphi method is used. Thus, a generalization of various metrics and the conclusion of the most appropriate for further data analysis is achieved.

We see that the key specificity of the use of metrics for the analysis of economic dynamics is the presence of a whole

variety of indicators and data. The second specific feature can be considered the need to visualize metrics to understand the results obtained and make optimal decisions.

4. WAVELET COHERENCE AS A TOOL FOR CONSTRUCTING METRICS FOR ANALYSIS

Any comparison involves finding a solution that is acceptable in a given situation. This fully applies to the consideration of metrics in the management of product policy. At the same time, the basis of such an analysis is data obtained, in particular, on the basis of Internet marketing data. However, any data can also be considered here. This is based on the fact that any set of data can be considered as some specific measure of comparison. So the time series can be interpreted as a metric in the space of time, on which you can define, set and build more complex comparisons in the form of special metrics.

To achieve the goals of the study, it is proposed to use the wavelet methodology. Among its tools, one should single out the construction of wavelet coherence estimates. These estimates have found wide application in the study of economic data [40]-[45]. So if we have two time series, then using wavelet coherence estimates, we can build an estimate of the strength of the relationship between such data. Such a diagram can be some kind of visual metric in assessing the dynamics of data. To implement this concept, we use the following formulas [46], [47]:

$$M^2(a, b) = \frac{|\Theta(a^{-1}W_{g(t)z(t)}(a, b))|^2}{\Theta(a^{-1}|W_{g(t)}(a, b)|^2)\Theta(a^{-1}|W_{z(t)}(a, b)|^2)},$$

where:

$W(a, b)$ – is a values of cross wavelet spectra;

a, b – is a scale and center of time localization, that determine the scale of the wavelet transform;

$g(t), z(t)$ – is a data series that we explore;

Θ – is a smoothing operator;

$M^2(a, b)$ – is a squared wavelet coherency coefficient.

$0 \leq M^2(a, b) \leq 1$. $M^2(a, b)$ – presented in the form of color characteristics that display the strength of the relationship between the data. Each color is characterized by its strength of connections, which is also displayed on the diagram.

Thus, $M^2(a, b)$ it is a measure of the connection between data, which is some generalized metric for two time series. This metric allows you to assess the situation and make a decision in the field of commodity policy.

A generalized procedure for such a comparison can be presented in accordance with Fig. 1.

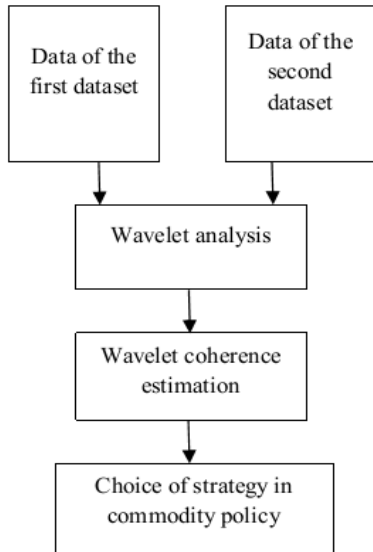


Figure 1: Metric formalization procedure based on wavelet coherence estimates for strategy selection in commodity policy

The second approach for the formation of metrics when choosing product strategies is based on comparison with the standard. A diagram of such a procedure is shown in Fig. 2.

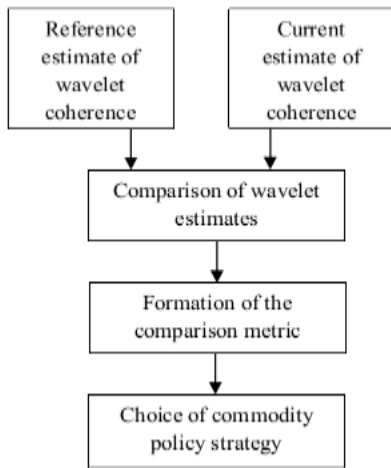


Figure 2: Formalization of the metric based on comparison with the benchmark

For these purposes, a standard is formed that corresponds, for example, to a certain situation on the market. Further, this reference is compared with the current value of the wavelet coherence estimate. Thus, a new comparison is obtained. In this case, it suffices to implement an element-by-element comparison of two wavelet coherence estimates. In this way, it is also possible to compare with each other the estimates that reflect the situation, for example, under different conditions.

5. RESULTS AND DISCUSSION

Below are examples of metrics calculations based on wavelet coherence estimates to determine strategies in the commodity policy of a certain business entity. As such a subject, we consider an agricultural enterprise. Therefore, we will evaluate the metrics based on market quotes for oats, corn, pig meat and cattle meat. All data are considered in the period 01.19.2020-05.14.2023 (investing.com).

We see that the dynamics of prices for oats and corn differ from each other.

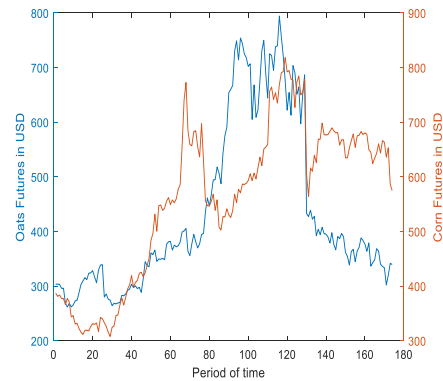


Figure 3: Dynamics of quotations for oats and corn

Also different is the dynamics of quotations for the meat of pigs and cattle.

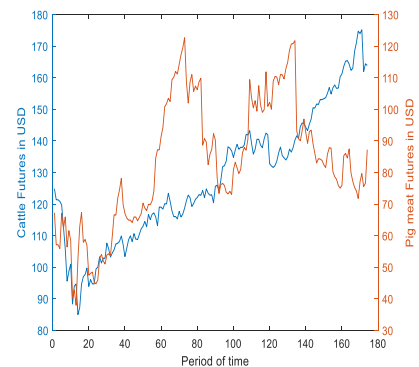


Figure 4: Meat prices for pigs and cattle

The dynamics of prices for oats and corn is characterized by the presence of price peaks in different periods of time. Prices for cattle meat are constantly rising, and prices for pig meat have different trends.

We see that the metric for oat and cattle meat prices reflects the fragmented strength of the relationship between such data.

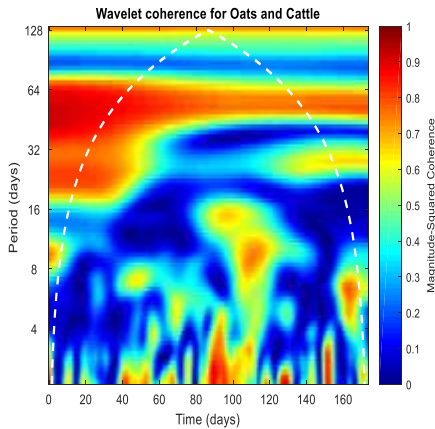


Figure 5: Metric for assessing the relationship between quotations for oats and cattle meat

The most significant assessment of the relationship between the dynamics of prices for oats and cattle was in the period 10.10.2021-02.20.2022. This must be taken into account when choosing a strategy in the implementation of commodity policy, taking into account various factors of influence.

For the oats and hog data, we see an even weaker relationship, as reflected by the corresponding metric.

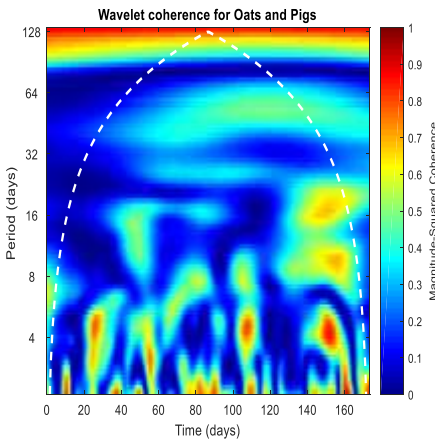


Figure 6: Relationship between oat and pig meat prices

This representation of the strength of the relationship in metrics characterizes the difference in the diets of each animal species. Therefore, from the point of view of product policy formation, it is also important to compare the relevant metrics with each other (formation of a metric based on comparison - Fig. 2, before that we considered metrics based on Fig. 1).

In general, the metric for oats and cattle is comparable to that for oats and pig meat.

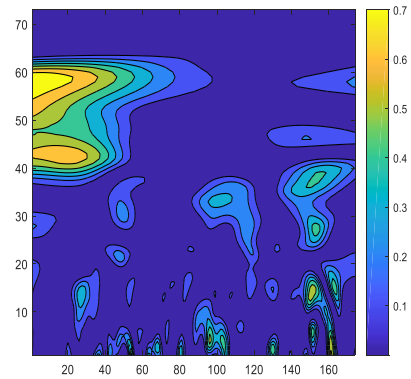


Figure 7: Comparison for metrics for oats, bovine meat and pigs

This conclusion is based on the fact that we practically do not observe significant differences in the pairwise comparison of their wavelet coherence estimates. There are small differences over the entire time horizon (highlighted by contour lines). But such differences are fragmentary and weak. There are also more significant differences in the depth of relationships, which are typical for the period 01.19.202-12.20.2020. This is important to take into account when developing long-term strategies in product policy planning.

Consider similar metrics with corn data.

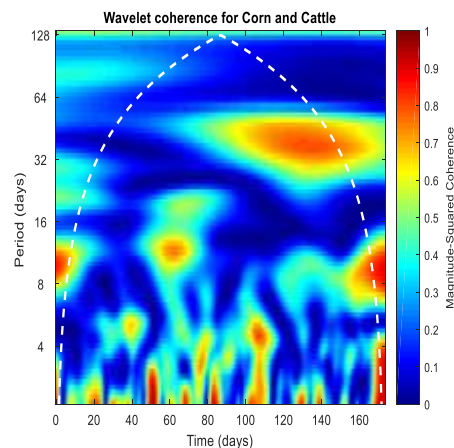


Figure 8: Comparison of data for corn and bovine meat

It should be noted that the metric for corn and cattle is more significant, but also fragmentary. But this fragmentation is denser, which, most likely, reflects the peculiarities of trading. The depth of relationships is also more clearly expressed. This allows you to make clearer forecasts in the development of commodity policy.

The metric for corn and hog meat prices is more pronounced.

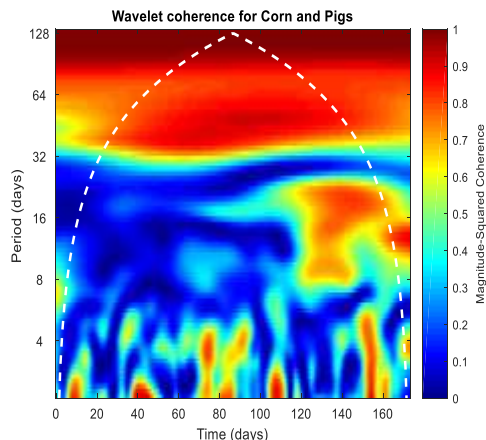


Figure 9: Metrics of links between quotations for corn and hog meat

There is also a more significant depth of interconnections, which should be taken into account when developing a predictive commodity policy.

Comparison of the corresponding metrics is shown in Fig. 10.

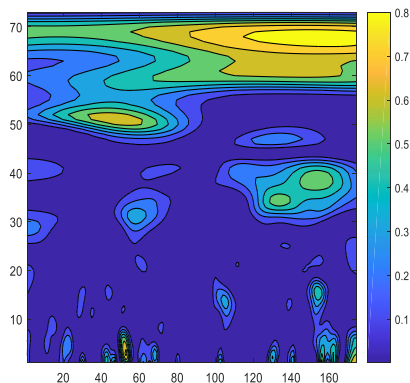


Figure 10: Comparison of metric data for corn, pig meat and cattle

Fig. 10 shows the comparability of metrics for corn – pig meat and corn – cattle meat. However, unlike the data in Fig. 7 we can observe a more significant depth of connections. Thus, we can build more reliable forecasts. We also note that corn is a more significant factor in the diet of livestock and pigs than oats.

6. CONCLUSION

The paper substantiates the necessity and possibility of using the wavelet methodology for constructing metrics in data analysis to manage the commodity policy of a business entity. This conclusion is made on the basis of the analysis of various literary sources.

Individual examples of using wavelet coherence estimates for constructing metrics are considered. Two procedures for obtaining such metric estimates are proposed. Specific examples are given from the point of view of trade in agricultural products. The results of the obtained metrics to refine the strategies for the formation of commodity policy are considered.

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