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Contents

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Music Genre Classification using Lyric Mining Based on tf-Idf

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ABSTRACT

With the advancement in the internet technologies, music domain has flourished with better access to various music libraries. In the present times, we are able to access music files over the internet with ease. Nowadays, the lyrics sets are categorised into different genres which cater to various listener moods. Users prefer to listen to music that best suits their mood. Thus considering the need for such classification, research works are being carried out to develop methodologies that can distinguish the music based on individual mood. In this research, instead of using the traditional method of audio feature analysis, we propose to develop a system which analyses the lyrics dataset of the songs based on the features extracted from the training phase and we can predict the mood of the song that is presented to the system at the validation stage. The proposed system is considering five moods containing one hundred songs each, for the validation purpose. The system is capable of predicting the mood of the song based on the analysis of the lyric text.

Keywords:classification, Lyric mining, Music Genre Cassification, , tf-idf,

I. INTRODUCTION

With the growth of technology, a large amount of music related data are generated and these data are stored in using efficient storage technologies which make possible for the faster retrieval of data. These data can be the metadata of the songs, the audio files, the video files and the lyrics. The music is generally categorized based on genres and moods for the people who have selective preference in music. Due to easy accessibility of music in the present time, people choose to listen to music that specifically caters to their mood of the moment such as happy, sad, angry, relaxed, calm, romantic, gloomy, energetic, confident etc. Thus advancement is being made to develop Music Information Retrieval (MIR) techniques to derive information from the lyrics and categories the music according to the mood.

In the proposed system, tf-idf and tf*tf-idf weighing schemes are used to determine the importance of the words in the lyric text with the corresponding moods. Heretf and idf stand for term and inverse document frequencies respectively and are the metrics used to determine the usefulness of the words in determining the mood of the songs. Then to improve upon the existing algorithm, a new weighing scheme tf*tf-idf is introduced whose sole purpose is to improve the existing weights of the words in the lyric text. Thus on comparing both algorithms, it is found that the existing tf-idf values have given better

performance and also there is a slight improvement observed in the accuracy for the correct prediction of lyric text.

II. RELATED WORKS

Menno van Zaanen, Pieter Kanters[1] in their study focuses on using features extracted from the lyrics to classify the lyrics in various moods and genres. They used various measures like K-Nearest Neighbour (KNN), Naïve Bayes (NB) and Support Vector Machine (SVM) to compare the accuracies of genres and other moods. In their study, they had found that happy and sad had better accuracies than calm and aggressive moods.

VipinKumar, and SonajhariaMinz [2] in their study used the Sentiword net to extract features related to sentiments of the words in the lyrics. They used three sentiment features i.e., ratio of the positive and negative scores, normalized ratio, and average of the positive and negative scores. Through their study, they were able to achieve an accuracy of 72% using Naïve Bayes classifier.

Teh Chao Ying, ShyamalaDoraisamy and LiliNurliyana Abdullah [3] have studied as how to determine the mood of the song by utilizing the lyrical features of the songs. In this study they have used another feature known as Part-Of- Speech (POS) for the classification of the collection of the songs. They calculated various classification parameter values for the genres and moods. From their study they found out that mood classification was better than genre classification for POS. The traditional method of determining the mood or genre of the song was through audio analysis. But with a lot of research works that were being carried out, many researchers tried to use both lyrics and audio to improve the accuracy of the mood prediction. One such study has been done by X. Hu, and J.S. Downie [4].Xiao Hu J. Stephen Downie developed the work on multi modal mood classification. They combined both audio and video classification. [5]. X. Hu, J.S. Downie and A.F. Ehmann examined the purpose of lyric text. They developed model that classify a song from the large ground truth set of 5,585 songs and 18 mood categories based on social tags [6]. R. Mayer, R. Neumayer, and A. Rauber were propsed the song classification based on frequency of certain rhyme patterns, POS features and static features such as Words per minute (wpm) [7].

The n-gram framework model was used for extracting the semantic features from lyric text. And the classification accuracy was compared by supervised learning approach (Naïve Bayes, Support vector machine and maximum entropy) [8]. Fuzzy clustering technique was used to detect the emotions of songs based on lyrics. The approach determine the emotion of Chinese lyrics by using emotion lexicon, called ANCW [9]..Teh Chao Ying, ShyamalaDoraisamy and LiliNurliyana Abdullah [10] in their study used the method of analysis of the lyrics and based on the analysis, they tried to observe interdependency

between genre and mood. They studied many weighing schemes and compared the results to determine the most efficient weighing algorithm. The Tamil Lyrics were classified by using tf-idf score by Kanchana et.al.[11]. In their study , the lyrics are categorized in two genres. Vishnpryaet.al., classifies the music into various genres by extracting the feature vector and Mel Frequency Cepstral Coefficient (MFCC) is used as a feature vector for sound sample. [12]

III. METHDOLOGY

The basic approach for the classification of songs based onlyrics involves the following steps or phases.

1. Data collection phase
2. Training phase
3. Validation phase

A. Data collection

1. Test Dataset collection: In the process of music information retrieval, the first step is raw data collection. There are a number of mood categories according to which the songs can be classified and they range from ten to twenty moods. For our system, we have chosen basically five mood categories namely happy, sad, romantic, angry and spiritual as other categories can be broadly classified under these five major categories. Under every mood, we have selected a dataset of 100 songs.

For the classification of the songs into different moods, we selected two online sources which offer song preferences based on mood. For each song in the dataset, mood labels isarecompared in both the sources and then classified them into their corresponding moods. Thus, a total of 500 songs are placed in text file for training the system and 50 songs are set aside for the validation phase.

2.Data preprocessing: The data preprocessing step basically involved the sampling of data i.e. making our test dataset ready for the training phase. Every song that we had downloaded, involved phrases such as "[Intro:]" "[Verse:]","[Chorus:]" and "[Bridge:]" which were insignificant and had to be removed manually. A Java program was used to remove all the punctuation marks that our text files consisted. The data cleaning process is done manually.

B. Training phase

1. Data pre-processing for training: Once the data has been removed of any irregularities as given in the data preprocessing step, the next step involves the pre processing step for the training phase. This step basically involves three major processes:-

2. Tokenization: Tokenization process involves breaking the string of the lyrics into tokens. This can be carried out based on a space, a character or by a string. This step is necessary because in the reading process, the wordsare read word by word. The process is done through a program written in Java.

Example: "This is an example string" can be tokenized into 'This', 'is', 'an', 'example' and string"

3. Stop word removal: Function words such as 'a', 'the', 'that', 'and' etc., do not carry any meanings thus are of little help in determining the tf-idf values and eventually in the classification. Thus, they had to be removed. This removal is carried out by a stop word removal program written in Java.Example: "The heart is a bloom Shootsup through the stony ground There's no room No space to rent in this town". The italicized words are stop words thus can be removed. Thus the result we have after removing the stop words is "heart bloom Shoots stony ground room space rent town".

4. Morphological analysis: The morphological analysis process also called as stemming process reduces the words onto their root form. For the tf-idf value calculation, the nouns are more significant than the verbs. For the process of stemming, we had used the Lancaster algorithm. For example 'swimming' reduces to 'swim'.

C. tf-idf weighing scheme algorithm

Bag of Words (BOG) method is used for tf-idf calculation. In this method, after stemming the words in the lyric, dataset are put into a single text document. This document acts as a bag of words helps further in the calculation of the tf. In our proposed system five BOG documents are available corresponding to the five moods. In the tf-idfweighing scheme, the relative importance of the words are studied with respect to a particular mood. The tf-idf is calculated for each word.

Let the BOG document be denoted by d. The term frequency (tf) of the term t gives the value which tells about how frequent the term occurs in the document d. tf is defined as the number of occurrences (n) of the term t in the document d divided by the total number of the occurrences of all the terms (N) in the document d.

$$tf_{(t,d)} = \frac{n}{N}(1)$$

where

n = number of occurrences of the term t in the docd

and

N = the total number of the occurrences of all the terms in the document d.

idf stands for inverse document frequency.

idf of the term t is defined as the logarithm of the value obtained by dividing the total number of documents (ND) by the number of documents (NT) in which the term t has appeared. i.e.,

$$idf_{(t,d)} = \log\left(\frac{N_D}{N_T}\right)(2)$$

where

N_D= the total number of documents and

N_T= the number of documents in which the term t has appeared.

Once we have obtained the tf and idf values of the term t, then tf-idf weight can be obtained by multiplying both the values tf and idf using Equation (3)

$$w(tf\text{-}idf) = tf * tf\text{-}idf(3)$$

Thus we have tf-idf weights for each term in the BOG document corresponding to each mood. If we have higher value of a term for a mood, which implies that the word holds higher importance to that particular mood. For some words, the value is zero too. That basically implies that the word is common among all the documents and thus the idf value becomes zero. The tf-idf values for the terms corresponding to their mood are copied and pasted on to separate text files. These text files are manipulated later in the validation phase using Java programs to determine the tf-idf values of the terms of the test lyric file and thus determining the mood of the lyrics.

Dtf *tf-idf weighing scheme algorithm

In the tf * tf-idf weighing scheme algorithm, we attempt to improve our values corresponding to the terms that hold importance to the moods. In this method, we first calculate the term frequencies of the terms of the test lyrics. Then for each term we extract the tf-idfvalues of the terms from the tf-idf documents corresponding to each mood. We compare the values and determine the greatest amongst all of them. Then corresponding to the mood to which the greatest value belongs, we multiply the tf by the tf-idf and update the value. These updated values are used in the calculation of the result. The values obtained after updating are added and summed up. Average value with respect to the five moods is calculated and the mood with highest value is declared to be the mood of the test lyrics. For validation, let t1 be a term that exists in the file and its term frequency tfin the file be 10. Corresponding to the term t1 the respective tf-idf values are extracted from the tf-idf documents. Suppose the values for the term t1 are:

{$tf\text{-}idf_{(happy)}$= 0.014934,

$tf\text{-}idf_{(sad)}$ = 0.0179584,

$tf\text{-}idf_{(romantic)}$= 0.073479,

$tf\text{-}idf_{(angry)}$ = 0.0156002 and

$tf\text{-}idf_{(spiritual)}$ = 0.01034}

It is observed that tf-idf$_{(romantic)}$ has the highest value. The highest value tf-idf$_{(romantic)}$ is multiplied by the term frequency tf of t1 (10).Thus, tf-idf$_{(romantic)}$ value * tf= 0.073479 * 10 = 0.73479. This value alone is updated in the existing tf-idf values in the document. {tf-idf(happy)= 0.014934, tf-idf$_{(sad)}$ = 0.0179584 , tf-idf$_{(romantic)}$= 0.73479,tf-idf(angry) = 0.0156002 and tf-idf$_{(spiritual)}$ = 0.01034 }. The same method is applied for the rest of the terms in the test lyric file.

Then the normal validation process is implemented to determine the mood of the song.

E. Validation phase

For the validation of a test lyric file, a Java program is used which would read the words one by one and would extract the corresponding tf-idf value of the word for every mood. These values are added and the total value of the tf-idf of the terms in the test document is calculated. For example, t_1, t_2, t_3…….. , t_n are the terms in our test document. Thus for every mood the sum of the tf-idf values of the terms is calculated by extracting the tf-idf values from the corresponding tf-idf document of the mood.

For happy mood:

$$\text{Total}_{\text{happy}} = tf\text{-}idf_{(t_1)} + tf\text{-}idf_{(t_2)} + tf\text{-}idf_{(t_3)} + \ldots\ldots + tf\text{-}idf_{(t_n)}$$

Similarly Total sad, Total$_{romantic}$, Total$_{angry}$ and Total spiritual are calculated. The Total$_{mood}$ value is then divided by the count of the number of moods (Nm) i.e., five for this system to calculate the average value.

$$Average_{mood} = \frac{Total_{mood}}{Number of moods}$$

Thus we get an average value of tf-idf weights for every mood as Average happy, Average sad, Average romantic, Average spiritual and Average angry. These average values are compared and the mood which has the highest average value is assigned to the mood of the test document.

IV. EXPERIMENTS AND RESULTS

To predict the mood of the song based on tf-idf values, a Java program was utilized. The experiments were done on the 500 training songs dataset. The system was tested using tf-idf and tf*tf-idf values for both the algorithms. The results are given in the Tables 1 and 2.

Table I.tf-idf weighing scheme algorithm

Song	Happy	Sad	Angry	Spiritual	Romantic	Acc %
Happy	55	0	0	0	49	53
Sad	10	23	0	0	68	23
Angry	8	4	50	1	38	50
Romantic	1	0	0	0	95	96
Spiritual	1	2	0	71	28	70

Table II.tf*tf-idf weighing scheme algorithm

Song	Happy	Sad	Angry	Spiritual	Romantic	Acc%
Happy	65	2	0	0	36	64
Sad	16	25	0	0	54	27
Angry	15	3	51	2	28	52
Romantic	5	1	0	0	91	93
Spiritual	7	1	0	66	23	68

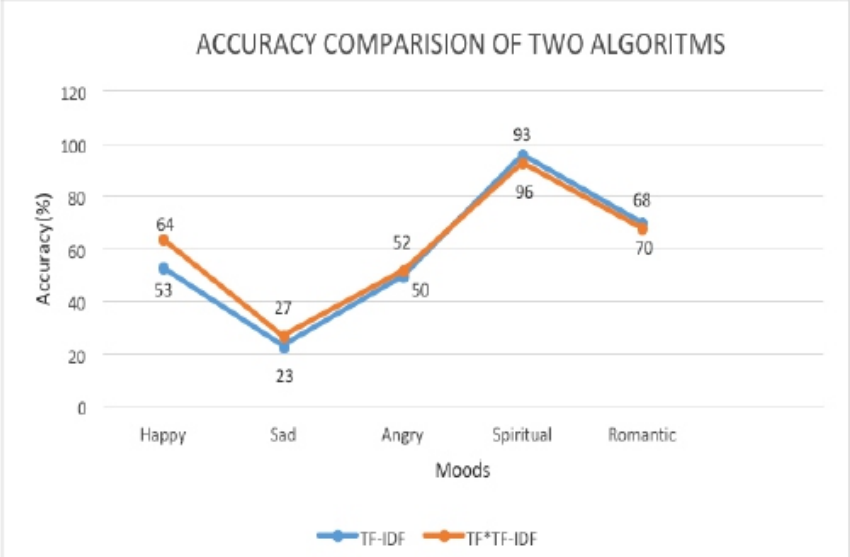

Fig 1. Line graph for algorithm comparison of tf-idf and tf*tf-idf in terms of accuracy

Fig.1. gives the good accuracy percentages for the moods happy, angry, spiritual and romantic were observed except for sad mood. The accuracy for romantic and happy are too good, because they consistof a lot of mood specific words such as "happy", "good", "feel","sunshine". Similarly for spiritual also accuracy is good using the specific words like "god", "lord", "holy" and "Jesus". The words that hold more importance to the mood has higher value. Comparing the results obtained from the two weighing scheme algorithms, the accuracy percentage obtained for tf*tf-idf is slightly higher than that of the tf-idf. For example for happy mood, the accuracy percentage is 53% in tf-idf which improves up to 65% intf*tf-idf. The similar trends were observed for other moods too. Thus, the results show that tf*tf-idf is comparatively better than tf-idf.Table 4 contains the confusion matrix of tf-idf results; this will help us in determining the performance of the algorithms. The confusion matrix is a very important theoretical concept in predictive analysis. It reports the number of false positives (f_p), false negative (f_n),true positives (t_p) and true negatives (t_n). Using these values, Precision, Recall and F-measure can be calculated which are basically measure of relevance. Precision (also called positive predictive value) is the fraction of retrieved instances that are relevant. i.e.,

$$\text{Precision} = \frac{tp}{tp + fp}$$

While recall (also known as sensitivity) is the fraction of relevant instances that are retrieved.

$$\text{Recall} = \frac{tp}{tp + fn}$$

F-measure can be defined as the harmonic mean of precision and recall.

$$F = 2 \cdot \frac{\text{precision} \cdot \text{recall}}{\text{precision} + \text{recall}}$$

Table III. Precision, Recall and F-Measure Results of tf-idf

Mood	Precision	Recall	F-Measure
Happy	73.33	52.88	61.44
Sad	79.31	22.77	35.38
Angry	100	49.5	66.22
Spiritual	98.61	69.61	81.61
Romantic	34.17	98.96	50.8

Table III lists Precision, Recall and F-Measure for various moods of the algorithm tf-idf.Table IV lists Precision, Recall and F-Measure for various moods of the algorithm tf*tf-idf

Table IV. Precision, Recall and F-Measure Results of tf*tf-idf

Mood	Precision	Recall	F-Measure
Happy	60.18	63.10	62.88
Sad	78.12	26.32	39.42
Angry	100	51.51	68.42
Spiritual	97.05	68.04	80
Romantic	39.22	93.81	54.88

The precision values for the spiritual and angry moods are considerably very high. This high precision value of the moods can be attributed to the high weights and high frequencies of the relevant words related to the respective moods. Figure 2 shows the Precision, Recall and F-measure of tf-idf

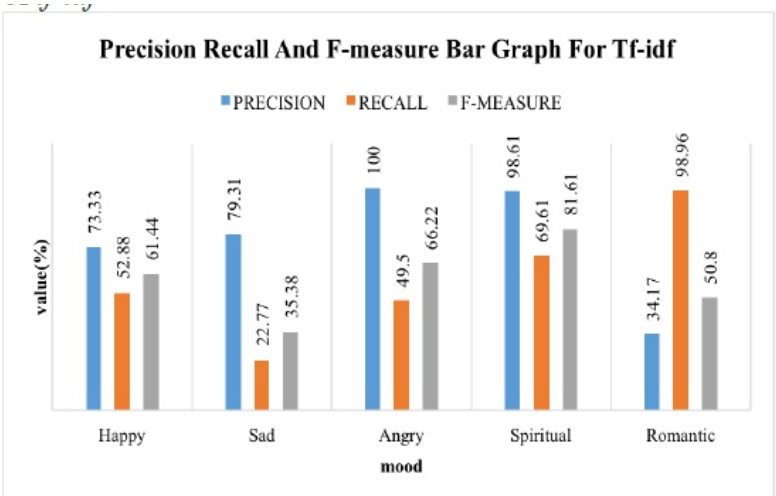

Fig 2. Precision recall and F-Measure bar graph for tf-idf

Figure 3 shows the precision, recall and f-measure of tf*tf-idf

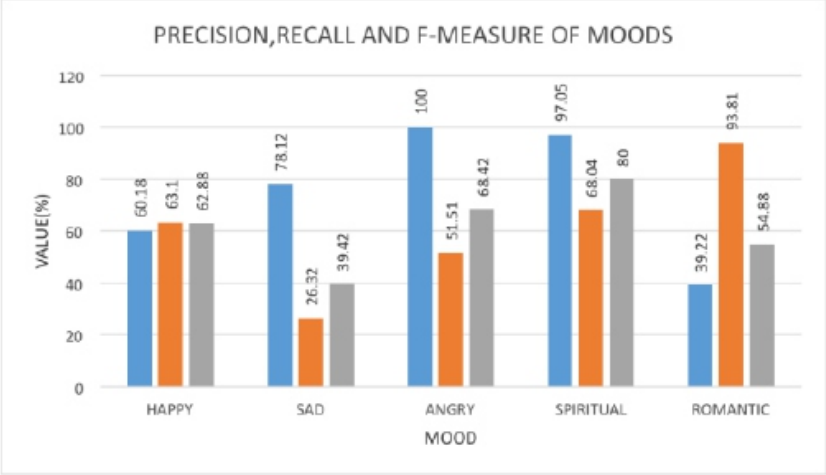

Fig 3. Precision Recall and F-Measure Bar Graph For tf*tf-idf

V. CONCLUSION

Research works are being carried out to develop methodologies that can distinguish the music based on individual mood. In this research, instead of using the traditional method of audio feature analysis, we had proposed a system which analyses the lyrics dataset of the songs based on the features extracted from the training phase and from which we can predict the mood of the song that is presented to the system at the validation stage. The proposed system had considered five moods such as happy, angry, sad, romantic and spiritual and each containing one hundred songs each, for the Validation purpose. The system is able to predict the mood of the song based on the analysis of the lyric text.

In this paper, the system was trained using the data set, which contained 500 songs. Based on the results obtained from the training phase, the system had predicted the mood of the song in the validation phase. The system was tested with two algorithms which are tf-idf and tf*tf-idf. The overall accuracy achieved was about 59% in the case of the tf-idf weighing scheme and about 63% through using tf*tf-idfalgorithm. In future, the experiment can be extended a large sized dataset of songs in order to train the system better and improve the accuracy of prediction. The proposed method can be extended to implement a system for mood classification for other languages. This paper can be extended to further improve the system and its accuracy by including hybrid features such as audio and lyric text.

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Modeling Volatility in the Stock Market for Accuracy in Forecasting

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ABSTRACT

In this paper, the best GARCH type model was selected and compared with the machine learning models, such as Extreme Learning Machine (ELM) and Multilayer Perceptron Neural Network (MLP-NN) models in modeling and forecasting monthly return of the financial market data. The objective of the study was to compare the best model in forecasting New York and Shanghai Stock Composite indices, for the period 01.01.1996 to 01.09.2019. The GJR-GARCH model outperformed other GARCH type models based on the Schwarz Bayesian Information Criterion (SSBIC). The Monte Carlo simulation carried at 1000, 2000, 3000, 4000 and 5000 finite sample (window) sizes to test the consistency of the GJR-GARCH model parameters has shown perfect results between true and the simulated coefficients. Finally, the GJR-GARCH model was compared with the MLP-NN and ELM machine learning models. The monthly return forecasting of two years (24 months) was done starting from period 01.09.2019 to 01.09.2021. The study found the MLP-NN model as the best in the modeling and forecasting monthly returns of the two composite stock indices for the two years by considering the Root Mean Square Error (RMSE).The study recommends that further research should focus on the formulation of the hybrid model that combines machine learning and the GJR-GARCH models in forecasting stock market volatility.

Keywords: GARCH type models, GJR-GARCH, Extreme Learning Machine (ELM), Multilayer Perceptron Neural Network (MLP-NN), MSE, RMSE.

I. INTRODUCTION

Modeling and forecasting Financial Time Series have become a hot cake almost in all organizations that work with quantifiable data. Financial markets have been affected daily by ongoing social, Economic, Political and other related factors on a day-to-day basis. Statistical models are very essential in solving forecasting problems. In this perspective, the prediction of the volatility with the best precision is significant for stock markets and for the economy of the world in general. The classical method for modeling and forecasting volatility known as Generalized Autoregressive Conditional Heteroscedasticity (GARCH) has been deployed by many researchers, nevertheless, the prediction based on the method often is quite not higher. Furthermore, limitations in modeling methods resulted in greater inadequacies in the financial market.

Currently, financial time series modeling forecasting using GARCH type models have been combined with Machine learning models to produce the exciting accuracy in forecasting with minimum

forecasting error. Thus, improved modeling and forecasting methods are continuously required to reduce investment risks and increase the efficiency of the markets. This study will innovate focus on changing the models to improve the capability of the future forecast of the stock volatility. The study by [1] tested a hybrid Neural Networks-GARCH model in forecasting the volatility of the three Latin-American stock indexes. Further, the outcomes of the ANN model revealed an improved performance of the GARCH model for the three stock markets with robust and consistent results at different volatility measures and specifications.

The accuracy in forecasting performance still is an important subject in stock market volatility. The ensemble system of EGARCH-BPNN depicted a wonderful performance in the stock volatility forecasting based on Mean Squared and Mean absolute errors. The results from the experiment proposed that the ensemble model captured the skewness, kurtosis, and normality of the intra-day forecasting of the S&P 500 data [2]. The rest of the work portioned into four further sections. The brief review of literature on modeling and forecasting models with numerous applications evidenced from world-leading stock markets found in China and U.S.A will be done, since recently arguments pertaining bilateral business relationship has brought a huge discussion. The following section will include the detailed methodology and the data used for the analysis. The results will then presented and interpreted. Eventually, summarization and the main conclusions and recommendations will be made.

II. LITERATURE REVIEW

There is a number of researchers who tried their best in the field of financial time series. Researchers such as [3] and [4] developed Autoregressive Conditional Heteroscedasticity (ARCH) and Generalized ARCH symmetric models for stock market modeling and prediction. Furthermore, Exponential GARCH [5], Threshold GARCH [6] and GARCH-M [7] were developed later as an extension that incorporates alternative specifications to the two aforementioned models to capture the asymmetric characteristics in the financial data. These increasing complexity and uncertainty of the financial time series forecasting have resulted in the improvement and modification of the GARCH-type models for accurate forecasting of financial volatility. The Realized GARCH combined returns modeling and measures volatility. Many features were found in the linear or log-linear Realized GARCH models. Simple Realized GARCH applied to two indices has shown improvement in the standard GARCH models [8]. The EGARCH and Artificial Neural Networks were combined to form a hybrid model for forecasting S&P 500 index volatility. Hybrid forecasts were compared with the EGARCH model. The study found that the best volatility forecasts were provided by the hybrid model [9]. The study by [10] has shown improvements in forecasting volatility of the oil price using a hybrid model that incorporates financial variables. It further concluded that the hybrid model has increased accuracy in the volatility

forecasting by 30% based on Heteroscedasticity Adjusted Mean Squared Error (HMSE). The Simulation made to assess the performance of the finite-sample approach concluded that the estimation conditional quantile on the portfolio returns still an open problem for future further studies[11]. The GARCH model with the student's Innovation was found to perform best on the SSE380 volatility predictions. The bootstrap simulation model has shown that Model Confidence Set (MCS) captures the range of significance levels of the superior models[12]. The performance of the hybrid model that combines GARCH type and Machine learning (Artificial Neural Networks) models in the modeling and forecasting daily log return of the Kenyan Stock Markets. The study found that the ANN-EGARCH hybrid model effectively performs the modeling and forecasting of the stock market price volatility [13].

Over decades now, machine learning has gained momentum in the modeling and forecasting of the financial times series. This provides a platform for researchers to focus on the development of the most performing hybrid models that captures effectively the stock market volatility.

III. METHODOLOGY

A. ARCH-GARCH Models

1. Autoregressive Conditional Heteroscedasticity (ARCH) Model

The introduced ARCH (p) model [14], which is a classical model for stochastic variance modeling. The model changes the assumptions of the variation in the error terms from $var(r_t) = \sigma_t^2$ ıdom sequence which only depends on the past square values of the time series. Furthermore, r_t can be expressed as a parametric form of σ_t^2 as $r_t = \sigma_t v_t$, where $v_t \sim iid(0,1)$.

Therefore, the ARCH (p)model is given by:-

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{p} \alpha_i r_{t-i}^2 \qquad (1)$$

Where $\alpha_0 > 0$, $\alpha_i \geq 0$, and $i > 0$. To ensure $\{\sigma_t^2\}$ an asymptotically stationary random sequence $\alpha_1 + \alpha_2 + \alpha_3 + ... + \alpha_p < 1$.

Apart from its useful applications in financial time series forecasting, the introduction of the conditional variance to the ARCH model instead of only considering conditional mean was still useful.

2. Generalized-ARCH (GARCH) model

The drawbacks and limitations of the ARCH model resulted in the development of another model called the Generalized ARCH (GARCH) model. The developed model added a lagged conditional variance $\{\sigma_{t-j}^2\}$ to the ARCH model as the new term in the GARCH model which eventually reduces the

estimated number of parameters. The conditional variance in the GARCH model is the linear function of the square its own lags and past observations [15]. The developed GRAPH (p , q) model can be written as:

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{p} \alpha_i r_{t-i}^2 + \sum_{j=1}^{q} \beta_j \sigma_{t-j}^2 \qquad (2)$$

Where p and q represents the order of r_t^2 *and* σ_t^2 respectively, the sufficient condition $\alpha_0, \alpha_i, \beta_j > 0$ *for* $i = 1,2,3,\ldots,p \;\&\; j = 1,2,3,\ldots,q$ must be achieved.

The $GARCH(p,q)$ process is weakly stationary if and only if $\sum_{i=1}^{p} \alpha_i + \sum_{j=1}^{q} \beta_j < 1$, and the model keeps not only the conditions of the ARCH model but also the condition of the linear function of the lagged conditional variance.

3. Exponential GARCH (EGARCH) Model

The asymmetric EGARCH model expresses the conditional variance as the natural logarithm that varies over time as a function of the logarithm of the lagged conditional variance instead lagged of its squares[16]. The EGARCH(p,q) model can be expressed as:-

$$\log \sigma_t^2 = \alpha_0 + \sum_{i=1}^{p} \alpha_i \left[\frac{|v_{t-i}|}{\sigma_{t-i}} \right] + \sum_{i=1}^{p} \gamma_i \left[\frac{|v_{t-i}|}{\sigma_{t-i}} - E\left\{ \frac{|v_{t-i}|}{\sigma_{t-i}} \right\} \right] + \sum_{j=1}^{q} \beta_j \log(\sigma_{t-j}^2) \qquad (3)$$

Where γ and α measures the leverage effects and volatility clustering respectively. The σ^2_t always is positive irrespective of the parameters sign and non negativity constraints. If $\gamma < 1$ it indicates a leverage effect, then the asymmetric effect exponential and not quadratic. The EGARCH model shows volatility impacts on the stock market which can either be good or bad news.

4. Threshold GARCH(TGARCH) Model

The TGARCH model measures the asymmetric effect by augmenting the dichotomous dummy variable into the GARCH model [17]. The TGARCH (p, q) model is given by:-

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{p} \alpha_i r_{t-i}^2 + \sum_{j=1}^{q} \beta_i \sigma_{t-j}^2 + \sum_{i=1}^{p} \gamma_i \psi_{t-i}\, y^2_{t-i} \qquad (4)$$

Where

$$\psi_{t-i} = \begin{cases} 1 & if\ r_{t-i} < 0 \quad \rightarrow Negative\ news \\ 0 & if\ r_{t-i} \geq 0 \quad \rightarrow Positive\ News \end{cases}$$

The parameter ψ (.) stands for the indicator function. This can either indicate negative or positive stock market news. The leverage effects exist if $\gamma > 0$, this is equivalent to the GARCH (p, q) model. The other important required conditions are $\alpha;\beta;\alpha+\gamma \geq 0$.

B. Machine learning Models

1. Multilayer Perceptron Neural Network (MPL-NN)

The MLP-NN has become a famous Artificial Neural Network (ANN) model in forecasting [18]. The single hidden layer was used in the modeling and forecasting of the two giant stock market returns by Market capitalization found in China and the USA.

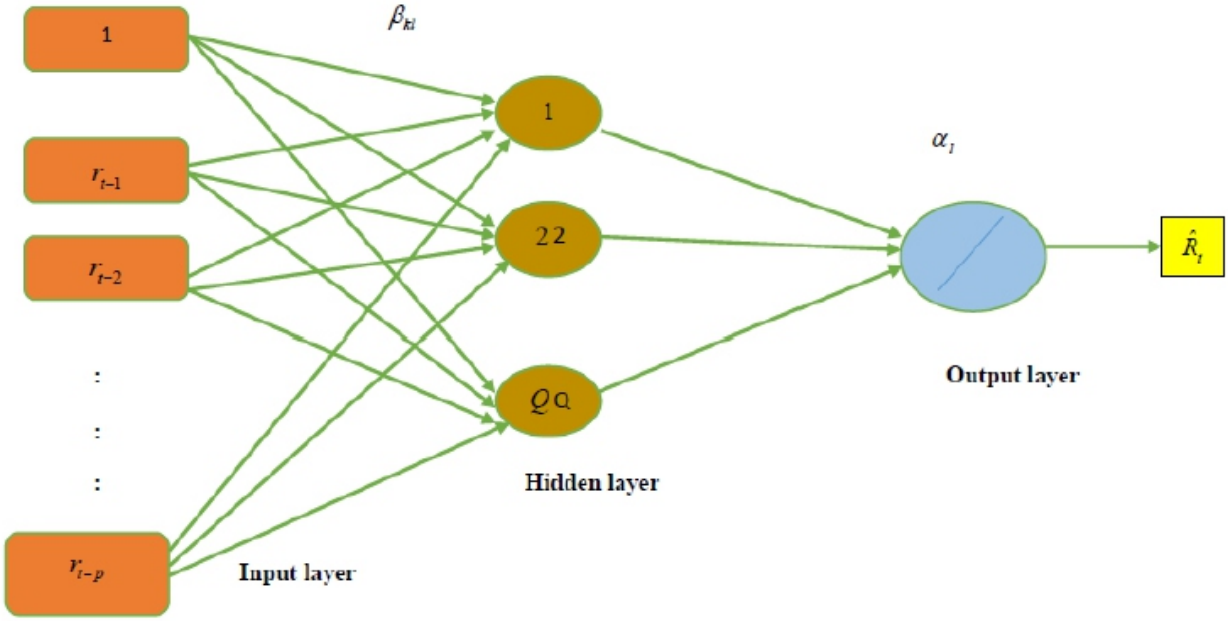

Figure 1: The Architecture of MLP-NN

Mathematically, the MLP-NN model can be expressed by the following:-

$$r_t = \alpha_0 + \sum_{l=1}^{q} \alpha_l f\left(\beta_{0l} + \sum_{k=1}^{p} \beta_{kl} r_{t-k}\right) + \varepsilon_t \qquad (5)$$

Where Q are the hidden layers, while r_{t-k} and $\hat{R}_t$ are the inputs output layers respectively. The p and q are the inputs and hidden layers respectively. $\alpha_l (l = 0,1,2,...,q)$ and $\beta_{kl} (\kappa = 0,1,2,..., p; l = 0,1, 2, ... ,q)$ are the connection weights and ε_t is the error term; f is the transfer function, it is applied as the nonlinear activation function, the sigmoid transfer function employed is given by $f(x) = \frac{1}{1+e^{-x}}$; α_0 *and* β_{0j} are the bias terms.

2. Extreme Machine Learning (ELM)

The ELM model has been purposely introduced to improve the learning speed of the feedforward neural networks[19]. The ELM with Single hidden Layer Feedforward Neural Networks (SLFNs) selects randomly the number of hidden nodes and eventually the SLFNs output weights. Then, arbitrary

$$(r_k, v_k),\ 1 \le k \le N,$$
$$r_k = [r_{k1}, r_{k2}, r_{k3}, \ldots, r_{km}]^T \in \mathbb{R}^N;$$

$v_k = [v_{k1}, v_{k2}, v_{k3}, \ldots, v_{km}]^t \in \mathbb{R}^m$; Mathematical formula for the activation function $f(r)$ and $\tilde{N}$ hidden nodes is written as:-

$$\sum_{k=1}^{\tilde{N}} \pi_k f_k \left(\phi_k \bullet r_l + c_k\right) = 0_l \ , l = 1, 2, 3, \ldots, N \qquad (6)$$

Where $\phi_i \bullet r_j$ is the inner product of ϕ_k *and* r_l; $\phi_k = [\phi_{k1}, \phi_{k2}, \phi_{k3}, \ldots, \phi_{kn}]^T$ is the weight vectors connecting the i^{th} hidden and the input nodes; $\pi_k = [\pi_{k1}, \pi_{k2}, \pi_{k3}, \ldots, \pi_{kn}]^T$ is the weight vectors connecting the k^{th} hidden and the output nodes and c_k is the threshold for the k^{th} hidden node.

C. Performance Measure

Numerous statistical measures stand to be used to estimate model accuracy with the lowest error [20]. The most famous measures for forecasting performance employed in the study are MSE and RMSE. Based on the aforementioned, let $r_1, r_2, r_3, \ldots, r_n$ represents the time series observations, then the $\hat{y}_i$ represents the k^{th} predicted values, where $k \le n$. For $k \le n$, the k^{th} error e^k is then given by $e_k = r_k - \hat{r}$.

Now,

$$MSE = \frac{1}{n}\sum_{i=1}^{n} e_k^2 \qquad (7)$$

$$RMSE = \sqrt{MSE}$$

D. Data Description and Process Flow Diagram

In order to perform modeling and forecasting on financial time series data, historical financial time series monthly data of twenty-three years from http://www.yahoofinance.com was extracted starting from January 1996 to August 2019. The stock indices employed are the New York Stock Exchange (NYSE) in the U.S.A and Shanghai Stock Exchange (SSE) in China. The selected stock markets are among the top ten stock markets and globally dominates in terms of market capitalization. Thus, there is a need to make a critical statistical analysis of the two countries' financial markets to see if there are impacts in bilateral trading. The extracted dataset is partitioned into training (80%) and testing (20%) datasets. The raw data is normalized using a normalization equation in which each sample value of data is divided by maximum value among all data samples. Normalization is a technique that is applied as part of data preparation for machine learning techniques. The monthly stock returns transformed into monthly log returns as follows:-

$$r_t = \log(\mathrm{P}_t) - l\,\mathrm{og}(\mathrm{P}_{t-1}) \qquad (8)$$

Where, r_t is the monthly log return, while P_t *and* P_{t-1} are the stock prices for time t *and* $t-1$ respectively.

Process flow Diagram

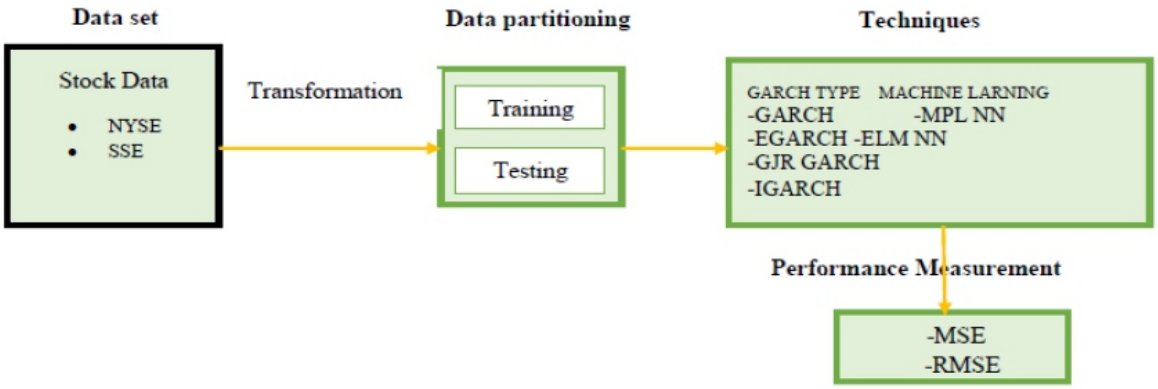

Figure 2: Modeling process flow

IV. EMPIRICAL RESULTS AND DISCUSSIONS

Table I below shows log-returns summary statistics for NYSE and SSE stock indices. An upward shift of the monthly return shows a negative loss. Besides, it shows that the indices faced a negative shock. The excess kurtosis for the two indices indicates a fat tail for return distribution. The J-B test (p-value<0.05) provides strong evidence that the returns of the closing stock prices for the two indices are non-normally distributed. Based on the result the study opted for in the GARCH model the student's t innovations.

Table I: Summary Statistics

Statistics	Log return for closing Prices	
	New York Stock Index	Shanghai Stock Index
Size	284	284
Mean	0.0054	0.006063
Min	-0.22303	-0.282782
Max	0.12878	0.278057
SD	0.04656449	0.07858687
Skewness	-0.8269198	-0.1936297
Kurtosis	5.759658	4.789212
JB Statistic	122.49	39.656
JB(P-value)	< 2.2e-16	<2.447e-09

Figure 3 below shows the plot for both original and log return series for the NYSE and SSE stock indices respectively.

The plot has evidenced that for the two indices there is sharp decline and upward movements of the stock indices evidencing the existence of the volatility.

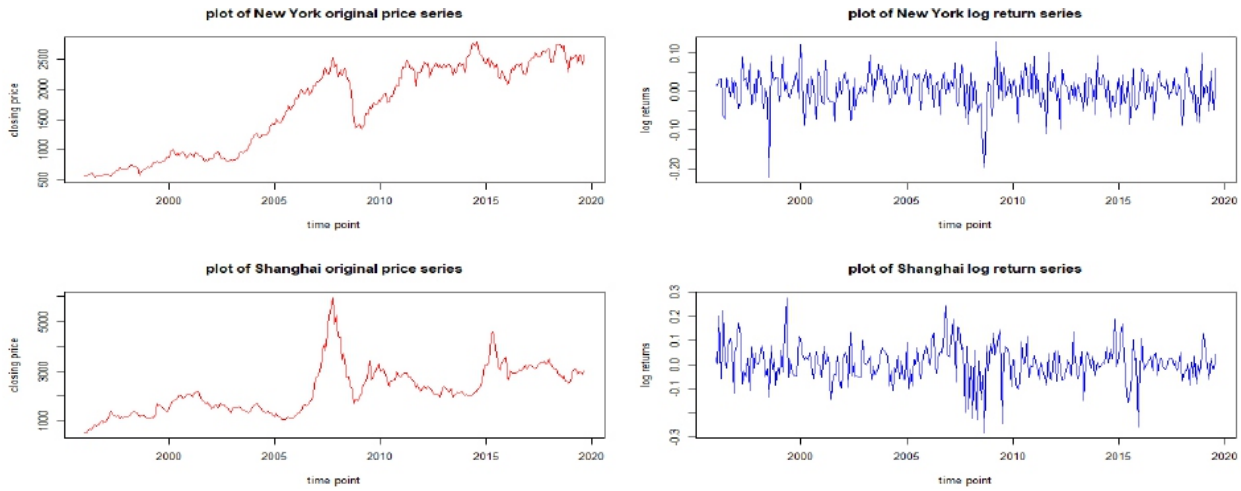

Figure 3: Plots of the Original and the return series

Table II below presents the optimal variance GARCH (1, 1) type models for the stock price return for the two stock indices. The optimal model selection was made based on the Minimum value of the SBIC. The optimal selected GARCH type model for both indices is the GJR-GARCH (1, 1) model with the student's t innovations.

Table II: SBIC Results for GARCH type models

GARCH MODEL	NYSE-SBIC	SSE-SBIC
GARCH(1,1)	-3.2678	-2.299
EGARCH(1,1)	-3.2937	-2.299
GJR-GARCH(1,1)	-3.2497	-2.2912

This results in table III below confirms the existence of the volatility in the two market indices since $\alpha + \beta + \gamma < 1$.

However, the negative sign in the GJRGARCH model implies that there exist no leverage effects.

Table III: GJR-GARCH Model Summary

Stock Index	Optimal Parameter	Estimator	p-value
NYSE	μ	0.0078	0.000649
	ω	0.00001	0.00000
	$\alpha 1$	0.0000	0.999636
	$\beta 1$	1	0.00000
	$\gamma 1$	-0.007081	0.00000
	Shape	6.35737	0.000159
	Volatility persistence	0.4964595	
SSE	μ	0.003269	0.401732
	ω	0.000391	0.05154
	$\alpha 1$	0.1958	0.030474
	$\beta 1$	0.806456	0.00000
	$\gamma 1$	-0.1321	0.08363
	Shape	7.523359	0.029511
	Volatility persistence	0.4350635	

E. Monte Carlo Simulation of Parameter Distribution

It is important after the model identification to see the consistency estimated model parameters using the underlying density. The ugarchdistribution function enables the performance of the Monte Carlo experiment. This method enables the simulation and fitting multiple times a model at different sample (window) sizes. In this paper, we tried to use 1000, 2000, 3000, 4000 and 5000 sample (window) sizes to test the consistency of the GJR-GARCH model parameters. The results at different windows were approximately the same as the true coefficients of the model. This implies that the Monte Carlo simulation has reflected the true parameters of the fitted GJR-GARCH model. Table IV below shows the results of the true versus Monte Carlo simulated GJR-GARCH model parameters.

Table IV: True Vs Monte Carlo Simulation parameters

Stock Index	Coefficients	μ	ω	α1	β1	γ1	Shape
NYSE	True-Coefficient	0.0078431	9.56E-06	8.83E-09	1	-0.00708	6.3574
	Window-1000	0.007996	1.2E-05	0.001658	0.99891	-0.00986	6.7512
	Window-2000	0.0078261	8.96E-06	0.001327	0.99946	-0.00819	6.4883
	Window-3000	0.0078697	8.87E-06	0.001235	0.99942	-0.0079	6.4075
	window-4000	0.0077843	8.19E-06	0.001304	0.99924	-0.00716	6.4078
	window-5000	0.0078306	8.18E-06	0.001154	0.99932	-0.00699	6.3555
SSE	True-Coefficient	0.0032693	0.000391	0.19577	0.80646	-0.1322	7.5234
	Window-1000	0.0034506	0.000424	0.18645	0.80548	-0.12654	8.4503
	Window-2000	0.0032778	0.000413	0.19803	0.80083	-0.13494	7.8605
	Window-3000	0.0030309	0.000416	0.19736	0.80066	-0.13335	7.6074
	window-4000	0.0033828	0.000404	0.19024	0.80721	-0.1296	7.6037
	window-5000	0.0031951	0.000409	0.19679	0.80305	-0.13201	7.5827

F. Stock Market Data Partitioning into Training and Testing Sets

Table V below, two composite stock data were partitioned into 227(80%) training and 57(20%) testing set respectively. The MSE for both the train and test data was obtained by getting MSE between fitted and actual values and the forecast and the test values respectively. The MSE for both training and testing data is acceptable.

Table V: The MSE for the Training and Testing data

Forecasting Method	Stock Index	Layers		MSE
MLP-NN	NYSE	Number of inputs	10	Total Train=0.0011
		Number of hidden layers	1	
		Number of Neurons	5	Total Test=0.0023
		Number of outputs layer	1	
	SSE	Number of inputslayers	8	Total Train =0.0030
		Number of hidden layers	1	
		Number of Neurons	5	Total Test =0.0188
		Number of the output layer	1	

ELM	NYSE	Number of input layers	10	Total Train =0.0029
		Number of hidden layers	1	
		Number of Neurons	100	Total Test =0.0020
		Number of the output layer	1	
	SSE	Number of input layers	8	Total Train =0.0072
		Number of hidden layers	1	
		Number of Neurons	100	Total Test =0.0194
		Number of the output layer	1	

G. Modeling and Forecasting Comparisons

The forecasting comparison of different models was used in this paper. The machine learning MLP-NN and ELM and statistical GARCH model performance were compared. Based on the previous findings, the combined EGARCH and ANNs hybrid model was found to provide the best forecasting of stock market volatility[21]. In addition, the ANN-GJR-GARCH model found to outperform other GARCH type models in volatility forecasting[22]. For the case of the two stock indices, the RMSE was used in the forecasting performance assessment. In the two stock indices, the MLP-NN model performed the best compared to ELM and GJR-GARCH models. Table VI below evidenced MLP-NN has the minimum RMSE in both NYSE and SSE stock indices.

Table VI1: RMSE for the two Stock Indices

Stock Index	Forecasting Method	RMSE
NYSE	MLP-NN	0.035741
	ELM	0.051179
	GJR-GARCH	0.041942
SSE	MLP-NN	0.035854
	ELM	0.051171
	GJR-GARCH	0.066964

Figure 4 below presents the MLP-NN with 9 input nodes, 1 hidden layer with 5 neurons and 1 output layer. Likewise, figure 5 shows the forecasting two years (24 months) for the SSE stock index from September 2019 to September 2021. The forecasting results show an upward shift in the NYSE stock index in the next two years.

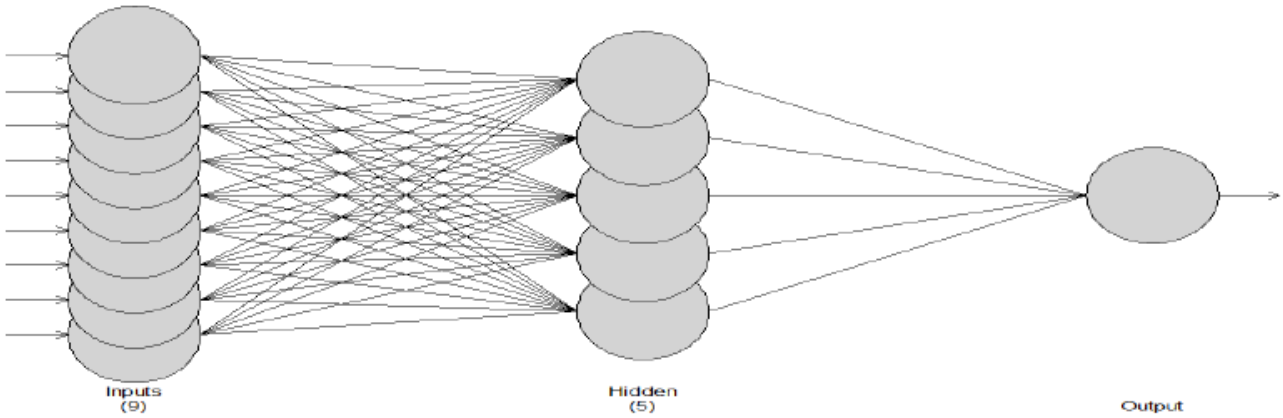

Figure 4: MLP-NN Plot for NYSE Index

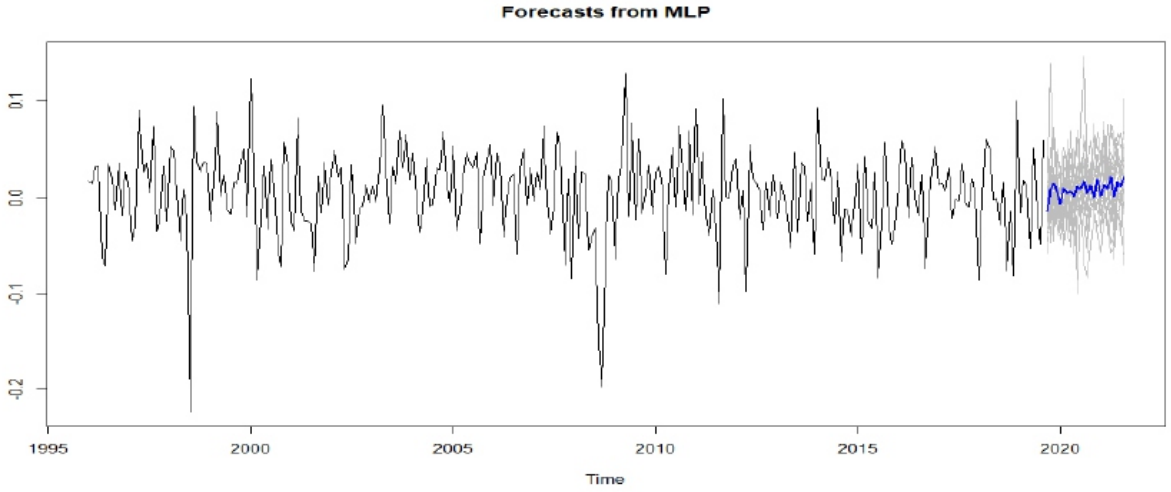

Figure 5: MLP-NN Forecasting for NYSE Index

Figure 6 below presents the MLP-NN with 9 input nodes, 1 hidden layer with 5 neurons and 1 output layer. Figure 7 shows the forecasting of two years (24 months) for the SSE stock index from September 2019 to September 2021. The forecasting results show a stable stock index for SSE in the next two years.

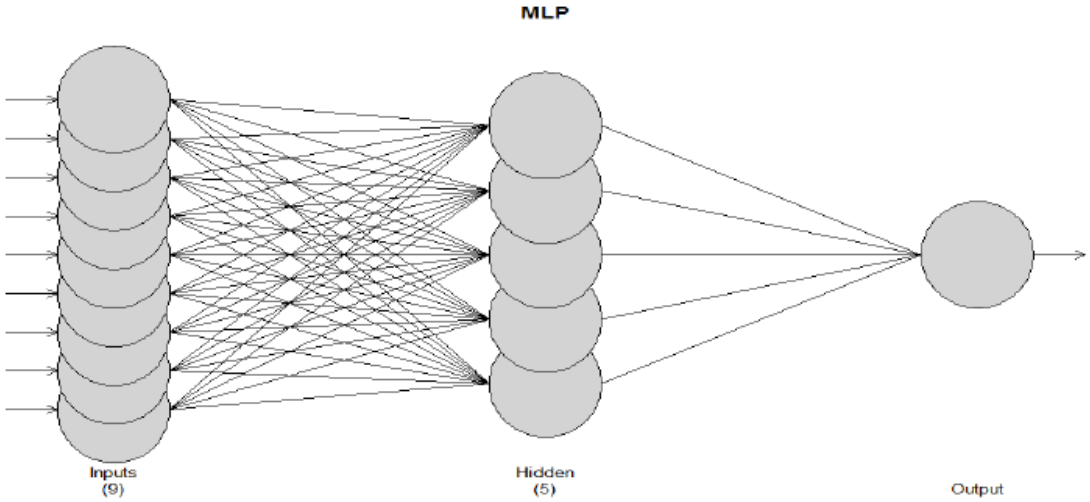

Figure 6: MLP-NN plot for SSE Index

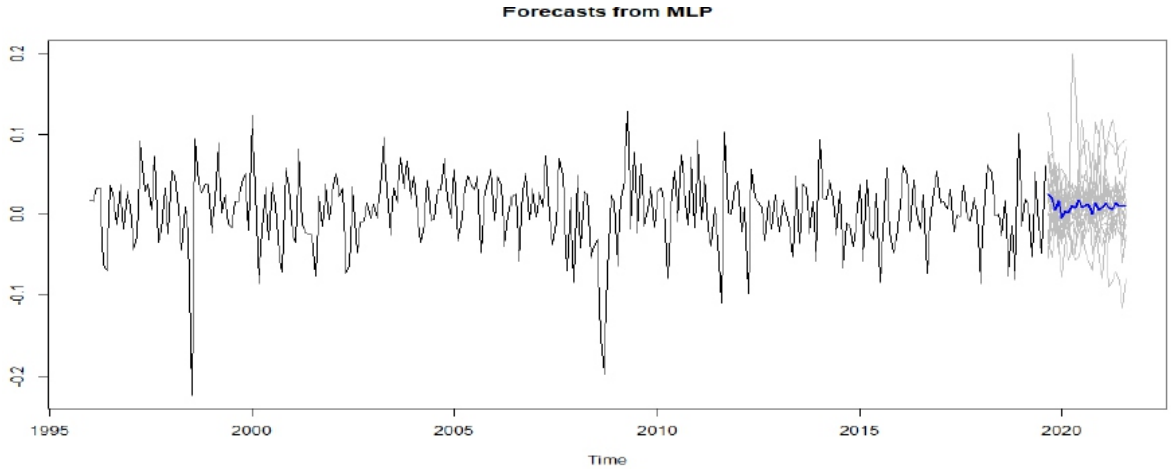

Figure 7: MLP-NN Forecasting for SSE Index

V. CONCLUSION AND RECOMMENDATIONS

The purpose of the paper was to come up with the best GARCH type model and then compare it with the Machine Learning models. The GJR-GARCH Model was found to outperform other GARCH models in modeling NYSE and SSE composite monthly stock returns. The Monte Carlo simulation is done at 1,000, 2,000, 3,000, 4,000 and 5,000 finite sample (window) sizes have shown consistency in the estimated GJR-GARCH model parameters. Then, the modeling and forecasting comparison was made between GJR-GARCH, MLP-NN, and ELM. The study found the MLP-NN model to be the best performing model in both estimating and forecasting volatility for the NYSE and SSE composite stock market indices. Moreover, the forecasting results for the two stock markets for the next two years have shown price volatility in NYSE which is found in the U.S.A compared to SSE which in China. This has great implications in the economic stability and competition of these global leading stock markets and countries in terms of economy. Further research should focus on the formulation of the hybrid model that combines machine learning and GARCH type models in forecasting stock market volatility.

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What Factors Do Influence Islamic Social Reporting (ISR) Disclosure? Evidence from Indonesia

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ABSTRACT

This research was aimed to identify factors affecting disclosure quality of Islamic Social Reporting (ISR) disclosure. ISR is an index that measures the level of social disclosure following the sharia principles conveyed by the company in its annual report. To assess corporate social disclosure following Islamic sharia, an index is known as Islamic Social Reporting (ISR). There are four factors believed to influence disclosure ISR quality, i.e. the board of independent commissioners, liquidity, company growth, the age of the company and the size of the company. The data used are secondary data taken from the website of the Indonesia Stock Exchange (see: www.idx.co.id). The population of this study was the Jakarta Islamic Index company listed in Indonesia Stock Exchange during 2014-2016 period. The samples in this study were taken by using purposive sampling technique to obtain 16 companies. Data analysis techniques used are multiple regression analysis methods. The results showed that liquidity and the size of the firm significantly affect the quality of Islamic social reporting disclosure. While for the board of independent commissioner, company growth and the age of the company has no significant effect on quality of Islamic social reporting disclosure.

Keywords: age; company growth; liquidity; size; Islamic social reporting disclosure.

I. INTRODUCTION

Sharia's economic development in Indonesia continues to increase every year. This is driven by increasing public awareness of Islamic economics and supported by the fact that 87% of Indonesia's population is Muslim, therefore the potential for sharia economic development in Indonesia is still very large. One of the sharia economic products that continue to grow in Indonesia is the Islamic capital market. Reporting from kompas.com in 2013, the number of sharia capital market investors in Indonesia was only 803 people. In 2014 the number of sharia capital market investors increased to 2,705 people or increased to 237% from 2013. Then the number of sharia capital market investors continued to increase to 4,908 people in 2015. And in 2016 the number of sharia capital market investors continued to increase to 12,283 people or increased 150% from 2015 [1].

Conventionally, social responsibility disclosures for users of company reports, including investors, are things that can be considered to make investment decisions because from these disclosures the users of company reports can find out what actions the company is taking to improve the quality of life of the community and the surrounding environment. Muslim investors and users of other Muslim companies' reports want sharia social disclosure, which is about whether the company's operations are following Islamic sharia. If the company where they invest or related to business activities by the sharia, they can get spiritual satisfaction because it is following what is believed to be Muslim investors [2].

To assess corporate social disclosure following Islamic sharia, an index is known as Islamic Social Reporting (ISR). ISR is an index that measures the level of social disclosure following the sharia principles conveyed by the company in its annual report [2]. ISR was first introduced by [3] which was later developed by [4]. [3] pointed out that many limitations in the social reporting framework carried out by conventional institutions so that he proposed a conceptual framework of Islamic social reporting based on sharia provisions that not only helped decision-making for Muslims but also to assist companies in fulfilling obligations to God and society.

Several studies on ISR disclosure show inconsistencies in results. Research conducted by [5], [6] shows that independent commissioners influence the disclosure of corporate social responsibility. While the research conducted by [7] shows that independent commissioners have negative relations with social responsibility disclosure. While the research conducted by [8], [9], [10] shows that there is no influence of independent commissioners on disclosure of social responsibility.

Next, the effect of liquidity also shows inconsistent results. Research conducted by [11] shows that liquidity has a significant effect on the disclosure of social responsibility. Meanwhile, research conducted by [12], [13] shows that there is no influence of liquidity ratios on disclosure of social responsibility.

Then the company's growth variable also shows inconsistencies in results [13], [14], [10] are some researchers who research the influence of corporate growth on the disclosure of corporate social responsibility. The results of [13] show that the growth of companies influences the disclosure of corporate social responsibility. While the research conducted by [14], [10] showed that the growth variables of the company did not affect the disclosure of corporate social responsibility.

The relationship between company age and ISR disclosure also experienced inconsistencies in results. Research conducted by [15], [14], [10] shows the influence of firm age on ISR disclosure. Meanwhile,the research conducted by [8] shows that there is no influence on the company's age on ISR disclosure.

Next, the effect of company size also shows mixed results. Research conducted by [4], [5], [8], [14], [10] found the influence of firm size on disclosure of social responsibility. Meanwhile, research conducted by [12], [16] shows no influence from these variables.

Based on the results of the above research which shows inconsistency in Islamic social responsibility disclosure, this study will re-examine the effect of independent board size, liquidity, company growth and firm age on the quality of ISR disclosure. In contrast to previous research, this study will measure ISR disclosure based on the quality of disclosure derived from [17] research. So that the results of ISR measurements in this study are not taken into account the quantity of ISR disclosures but take into account the quality of disclosure.

II. LITERATURE REVIEW

A. Size of Independent Commissioner and Islamic Social Reporting

From an agency theoretical perspective, boards with a high proportion of independent directors are presumed to be more effective in monitoring and controlling management. They are, therefore, expected to be more successful in directing management towards long-term firm value-enhancing activities and a high degree of transparency [6]. It is generally believed that the independent commissioner will strengthen the board by monitoring the activities of the management and ensure the interests of the investors are protected [5] and [10]. Research conducted by [5], [6] shows the influence of independent commissioners on disclosure of social responsibility.

H1: The size of independent commissioners influences the quality of Islamic social reporting disclosure

B. Liquidity and Islamic Social Reporting

According to [18], liquidity ratios are used to measure a company's ability to meet its short-term liabilities. Liquidity is an important factor in company evaluation by interested parties such as investors, creditors and local government [19]. High liquidity ratios are expected to be related to the extent of voluntary disclosure, this is based on the expectation that for companies that have good liquidity, they are more willing to disclose information than companies with low liquidity [20]. Research conducted by [11] shows that liquidity affects the disclosure of social responsibility.

H2: Liquidity influences the quality of Islamic social reporting disclosure

C. Company Growth and Islamic Social Reporting

The company's growth is an illustration of the company's strength to survive [21]. Firm growth indicates an increase in corporate financial performance, so it is one of the considerations in investment decisions [14]. With the guarantee of the company's economic activities, according to the expectations of the stakeholders, the company will increase attention to the social activities of its environment. Research conducted by [13] shows the influence of the company's growth on the disclosure of social responsibility.

H3: Company growth influences the quality of Islamic social reporting disclosure

D. Company Age and Islamic Social Reporting

Older companies have more experience with information about the company. The age of the company shows the company's ability to overcome difficulties and obstacles that can threaten the life of the company so that the longer the company stands, the more capable the company can increase investor confidence. Companies with older ages will tend to disclose more information in their annual reports to increase the company's reputation and image in the market [22]. Research conducted by [5], [14], [10] shows the influence of firm age on disclosure of social responsibility.

H4. Company age influences the quality of Islamic social reporting disclosure

E. Company Size and Islamic Social Reporting

The effect has been identified as positive as a firm size is expected to increase is its information reporting level [16]. Bigger firms tend to have a more complex connection with their stakeholders. According to stakeholders theory, all decisions of stakeholders and the firm's business activities are affected and affecting its stakeholders. Thus, a firm that has a more complex connection will face more requirements [11]. Besides, larger companies tend to have higher public demand for information than smaller companies. The number of shareholders indicates if the company needs more disclosure due to demands from shareholders and capital market analysis. Research conducted by [4], [5], [8], [14], [10] showed the influence of firm size on disclosure of social responsibility.

H5: Company size influences the quality of Islamic social reporting disclosure

III. RESEARCH METHODS

A. Population and Sample

The population in this study are companies listed in the Jakarta Islamic Index. The sampling technique used a purposive sampling technique with the following criteria: (1) The company is consistently registered in the Jakarta Islamic Index during 2014-2016; (2) The company presents annual reports during the research period; (3) The company's financial statements are presented in rupiah. So that the researchers obtained 16 companies that were used as research samples. The type of data used in this study is secondary data obtained from the official website of the Indonesia Stock Exchange at www.idx.co.id and the website of each company.

B. Definition of Variable Operations

Islamic Social Reporting

The dependent variable in this study is the quality of Islamic Social Reporting (ISR) disclosure. The ISR index in this study consists of 43 items of disclosure arranged in six themes following the research of [4]. The data analysis used in the assessment of the quality of ISR disclosure is content analysis with a scoring or weighting approach.

The quality of ISR disclosure in this study was measured using scoring or weighting methods, as developed by [17] by giving a score of 0 (zero) to a score of 4 (four) with the following conditions. A score of zero (0) indicates the reports do not disclose anything. One (1) indicates the reports just disclose qualitative information only, without an explanation. Two (2) indicate the reports just disclose qualitative information and provide some evidence. Three (3) indicate the reports disclose qualitative and quantitative information with the evidence in figure or number. While four (4) indicates the reports disclose information qualitatively and quantitatively with following the benchmarking against the best practices as stated by the ISR guidelines index.

Size of Independent Board of Commissioners

The size of the Independent Board of Commissioners is measured by using the number of independent commissioners divided by the total members of the board of commissioners [8], [7].

Liquidity

The liquidity in this study is proxied by the current ratio. The current ratio in this study is formulated as follows [11]:

$$Current\ Ratio = \frac{Current\ Assets}{Current\ Debts}$$

Company Growth

To measure the company's growth in this study by comparing sales of the current year with the previous year [10].

$$Growth = \frac{Net\ Sales_t - Net\ Sales_{t-1}}{Net\ Sales_{t-1}}$$

Company age

The age of the company in this study is calculated from the establishment of the company until the annual report year [8].

Company Size

Company size is the size of a company that can be calculated by several methods. This study uses proxy LN total assets obtained from the statement of financial position at the end of the period in the company's annual report [4].

C. Data Technique Analysis

The Descriptive statistical analysis was used to provide an overview of the variables in this study. To analyze the data in this study is multiple linear regression analysis. However, before carrying out linear regression multiple regression, a classical assumption test is first carried out. Testing the hypothesis in this study will be analyzed by statistical test F, statistical test t and test coefficient of determination (R2).

IV. RESULT AND DISCUSSION

A. Descriptive Statistical Analysis

The mean value of the Islamic social reporting variable is 33.33%; the minimum value of 10% and the maximum value of 51%. The mean value in the variable size of the independent board of commissioners is 43.29%; the minimum value of 29% and the maximum value of 83%. The mean value of the liquidity variable is 2.19; the minimum value is 0.58 and the maximum value is 6.91.

The mean value in the company's growth variable is 4.77%; the minimum value of -24% and the maximum value of 75%. The mean value in the variable age of the company is 47.13 years; the minimum value of 5 years and a maximum value of 132 years. The average value in the company size variable is 31.13; the minimum value of 28.79 and a maximum value of 33.20. This is can be seen in the following table 1:

Table 1 : Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Board of Ind. Comm.	48	.29	.83	.4329	.13823
Liquidity	48	.58	6.91	2.1919	1.14508
Com. Growth	48	-.24	.75	.0477	.15672
Com. Age	48	5.00	132.00	47.1250	28.20866
Com. Size	48	27.79	33.20	31.1309	.89675
ISR	48	.10	.51	.3333	.09231
Valid N	48				

Source: Research Data

B. Classic assumption test

Normality Test

Normality testing in this study used the Kolmogorov Smirnov test. Based on the data, it indicated that to be normally distributed if the Kolmogorov-Smirnov significance value is more than 0.05 so that it can be said that the data has a residual that is normally distributed.

Multicollinearity Test

The multicollinearity test aims to determine whether there is a strong correlation between independent variables. The test was done by looking at the tolerance value with the resulting VIF. In this study, the tolerance value of all independent variables obtained > 0.1 with the overall VIF value <10, so it can be said that there is no strong correlation between independent variables or it can be said that it is free of multicollinearity.

Heteroscedasticity Test

The data show that the probability value on all independent variables is greater than the significance level of 5% or 0.05 so that it can be concluded that there is no heteroscedasticity disorder in the regression model.

Autocorrelation Test Autocorrelation Test

From research data, the results of the Dw test (Durbin Watson test) were 0.784. This means that the regression model above has no autocorrelation because the number is between 0 and +2. Therefore this regression model is considered feasible to be used as research forecasting.

C. Hypothesis Test Results

F Test (Simultaneous)

Based on testing with SPSS, ANOVA output is obtained in the following table 2:

Table 2

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	,113	5	,023	3,300	,013[b]
	Residual	,288	42	,007		
	Total	,400	47			

Source: Research Data

From table 2 above, it is known that the F statistics is greater than F table which is 3.298> 2.44 and the significant number is 0.013 smaller than the significance level of 0.05, meaning the Size of the Independent Board of Commissioners, Liquidity, Company Growth, Company Age and Company Size simultaneously have a significant effect on the quality of ISR disclosure.

t-Test Results (Partial)

Based on testing with SPSS, partial test output is obtained in table 3 below:

Table 3

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-,786	,451		-1,745	,088
	Board of Independent Commisioner	-,024	,098	-,036	-,247	,806
	Liquidity	-,022	,010	-,349	-2,340	,024
	Company Growth	-,111	,081	-,189	-1,368	,179
	Company Age	-,001	,001	-,155	-1,014	,316
	Company Size	,039	,014	,377	2,683	,010

Source: Research Data

Based on table 3 above, the effect of the size of the Independent Board of Commissioners, Liquidity, Company Growth, Company Age and Company Size partially on the quality of ISR disclosure can be explained as follows:

1. The size of independent commissioners (X1), P-Value (0.806) > 0.05 then H0 is accepted
2. Liquidity (X2), PValue (0.024) > 0.05 then H0 is rejected
3. Company Growth (X3), PValue (0.179) > 0.05 then H0 is accepted
4. Company Age (X4), PValue (0.316) > 0.05, H0 is accepted
5. Company Size (X5), PValue (0.010)> 0.05 then H0 is rejected.

Determination Coefficient

The coefficient of determination measures how far the ability of the model to the independent variables together in explaining the variation of the dependent variable.

Table 4. Determination Coefficient

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,531[a]	,282	,197	,08274

Source: Research Data

D. Discussion

The size of the independent commissioner has t-statistic that is greater than t-table, namely -0.247> -2.018 and p-value 0.806> 0.05 (α = 5%), it can be concluded that H2 is rejected. This means that the size of the independent board does not affect the quality of ISR disclosure. Independent commissioners do not have shares in the company, do not have business relationships and affiliate relationships with the company so that the independent commissioner has enough space to act independently and objectively. However, some regulations require companies to have independent commissioners of at least 30% of the existing board of commissioners. This allows the company to establish an independent board of directors only to comply with regulations. The results of this study support the results of research by [8], [9], [10] and contrary to the results of [5], [6].

Liquidity has t-statistics that is smaller than t-table, namely -2.333 <-2.018 and p-value 0.024 <0.05 (α = 5%), it can be concluded that H3 is accepted. This means that liquidity has a significant effect on the quality of ISR disclosure. Financial performance as indicated by the strong liquidity ratio of a company is closely related to the extent of disclosure of social responsibility. Companies with a high level of liquidity will signal to other companies to show a company better than other companies. The signal is given by the company by disclosing sufficient information through its annual report. The results of this study are consistent with the research of [11] and contradict the research of [12], [13].

The company growth has t-statistics that is smaller than t-table, that is -1,367> -2,018 and p-value 0,179> 0,05 (α = 5%) it can be concluded that H4 is rejected. This means that company growth does not affect the quality of ISR disclosure. Companies that grow are more attractive to investors than companies that only disclose year reports which are an obligation for the company. The results of this study support the results of [13] research and contradict the research of [14], [10].

Then the age of the company has t-statistics greater than t-table, namely -1.014> -2.018 and p-value 0.316> 0.05 (α = 5%) so it can be concluded that H5 is rejected. This means that the age of the company does not affect the quality of ISR disclosure. Older companies have integrated with the social system of the community and already have a reputation in the eyes of the community. So that the company already knows and seeks to implement harmonious relationships with stakeholders. So that the age of the company will not affect the quality of ISR disclosure. The results of this study support the results of [8] research and are contrary to the results of [15], [14], [10].

The size of the company has t-statistics that is greater than t-table that is 2.618> 2.018 and the p-value is 0.010> 0.05 (α = 5%) it can be concluded that H6 is accepted. This means that the size of the company has a significant effect on the quality of ISR disclosure. This result is following agency theory which states that the larger the company, the higher the agency costs. To reduce agency costs, companies will tend to disclose broader information. Besides, large companies are the most highlighted issuers of stakeholders, the greater disclosure is a reduction in political costs as a form of corporate social responsibility [23]. The results of this study support the results of [4], [5], [8], [14], [10]. However, it shows different results from the research of [12], [16].

V. CONCLUSIONS

Based on the results of the tests that have been carried out, it can be concluded that the size of the independent board of commissioners, liquidity, company growth, and company age simultaneously have a significant effect on the quality of ISR disclosure. While partially the company's liquidity and size have a significant effect on the quality of ISR disclosure while the size of the independent board of commissioners, company growth, and company age partially does not affect the quality of ISR disclosure. To reduce agency costs, companies will tend to disclose broader information. Besides, large companies are the most highlighted issuers of stakeholders, the greater disclosure is a reduction in political costs as a form of corporate social responsibility.

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The Construction Market Monopolization: Identification of the Threats to the Economic Security of Ukraine

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A B S T R A C T

The degree of the construction market monopolization of Ukraine is assesed. Threats to the economic security of the state are identified, considering that monopolization causes significant public losses related to the establishment of monopoly prices, the slowdown in scientific and technological progress, the irrational allocation of resources. According to data on the net income of enterprises in the construction industry of Ukraine, the authors calculated Market concentration ratio, Herfindahl-Hirschman index, Dispersion of market shares, Coefficient of variation, Gini index, Entropy of market shares, that indicate a low level of the construction industry monopolization in Ukraine. Defined indicators allowed to form a matrix, which characterize the level of market concentration and its dynamics. According to the values of the variation index and the Gini index, the market studied belongs to highly monopolized, and due to the tendency of the Gini index to increase, it falls into the "red zone".

This means the emergence of threats to national economic security associated with a decrease in GDP, increased income differentiation, reduced state budget revenues, and the like and indicates the need for macroeconomic measures that would restrain the development of monopoly phenomena in the construction market. This approach to identifying economic security threats resulting from market monopolization will allow the state to respond to negative trends in a timely manner, counteracting the threatening factors.

Keywords: construction, competition, concentration level, economic security, monopolization.

I. INTRODUCTION

The problems of maintaining the economic security of a state are quite acute for all countries of the world, without exception, regardless of their size and level of development.

In modern conditions of military-political instability in Ukraine, each component of economic security is heavy and is influenced by a significant number of factors that may create threats to economic security or increase its level.

The basis of the economic development of any national economy is production in the context of various types of economic activity. One of the indicators of the directions of economic processes in the state is the development of the construction market. The intensity of construction processes in Ukraine has increased significantly in recent years. To a wide extent, it depends on the type of competition in the construction market, which affects pricing, real estate sales, and through a chain reaction affects other economic and social indicators. Despite this, the construction market monopolization can create direct and indirect threats to the economic security of the state. Therefore, along with the study of the main indicators of economic security, attention should be paid to indicators that characterize the level of monopolization of markets, and in the case of threats, macroeconomic management decisions in the field of antitrust regulation can be made.

II. THEORY/CALCULATION/METHODOLOGY

A. Literature review

The risk for the ensuring the economic security of the country is not only in increasing the tendencies of de-industrialization of the national economy, but also in the lack of formation of new competitive, innovative drivers of its development. An additional factor is the deterioration of the conditions of competition and access to foreign financial markets. The traditional dominance of foreign investment in the financial sector and real estate markets is currently limited to the objective problems of development of such sectors of the economy and does not meet the interests of the state in the modernization of the national economy [1].

The study of the American economist M. Porter showed that the intensity of internal competition is of paramount importance among all factors of the national business environment for the competitiveness of companies on the world market [2]. As Jeremy I. Bulow say, the monopolist is led to producing goods less durable than those produced by either competitive firms or monopolist returns. A reverse Averch-Johnson result--that monopolist sellers may invest less in fixed costs (including plant modernization and research and development) than would the renters--is shown. It is also shown that, even though sellers have less monopoly power than renters and nondurable-goods monopolists, it is possible that the seller will cause a greater deadweight loss than the other types of monopolies [3].

In the ranking of global competitiveness for 2018, Ukraine ranked 83rd among 140 countries studied in the world [4]. According to indicators characterizing the level of competition in the Ukrainian markets, in particular, such as: "Distorting impact of taxes and subsidies on competition", "Market dominance", and "Competition in the service sector", Ukraine ranked 114; 110; 80 places. This indicates the existence of threatening phenomena in the economy that require careful analysis and adequate macroeconomic management decisions.

Rash and wide build-in of the world-commercial connections into the global network might bring damage for economic security and suppress "growing points" of any homeland industry. The problem of harmonization of relations between foreign and domestic commodity producers in the absence of macroeconomic procedure for their settlement is barely decidable with sufficient reliability. The theory of systems and commercial practice suggest that in order to save competitive advantages and to protect a perspective commodity producers facing coming out of transnational companies' threats can protect themselves with the help of deliberate policy, which integrates the state support of the enterprises (protectionism, state orders, custom duties, tax concessions, investments etc.) and the collaboration with foreign corporations, which possess scientific and innovative potential [5].

As Filyuk (2015) rightly points out, "... the monopolization of the domestic economy negatively influences stability and economic growth in the country, creates obstacles for increasing national competitiveness. The negative influences of monopolization include: significant loss of society from monopoly power; reduction of state budget revenues from monopolistic industries due to the use of shadow schemes, transfer pricing, political influence, etc. by monopolists limits the growth of the country's GDP; growth of the economy's corruption due to the desire to retain monopoly power at any cost or to increase it; deterrence of innovation and investment development of the Ukrainian economy; conservation of environmentally hazardous industries (instead of modernizing production, investing in replacing worn-out and outdated equipment of enterprises, oligarchs manage to get super-profits in spite of high material intensity and energy intensity of production by reducing wage costs of an employee); facilitating capital outflows from the national economy through the use of transfer pricing schemes; significant impact on the course of the national currency; interest of individual monopolists in the destabilization of the Ukrainian economy" [6].

Among the most negative features of the influence of monopoly on economic security the researchers Babich and Kasianova distinguish such: positive features of free competition can not fully manifest themselves; there is a deformation of competitive relations (flexibility changes, adaptability to the market), the stability of reproduction mechanisms decreases, and it can lead to a severance of economic

ties; prices lose market flexibility, react insufficiently to fluctuations in supply and demand, are characterized by low elasticity; monopoly suppresses the impulses that go from demand to production, which disorients investment flows, while consumer needs remain unmet [7]. Andrienko considers the monopolization of the market by large construction enterprises to be one of the threats to the economic security of construction enterprises. Large construction enterprises due to lower output, compared with medium and small business entities, can offer lower prices for their services, and therefore have a better chance of receiving an order. Such situation is a threat to the existence of small and medium enterprises [8].

Miniaylo and Burian analyze the monopolization of the construction market using indicators such as market concentration ratio; Herfindahl-Hirschman index; dispersion of market shares; entropy of market shares; Gini index [9]. These coefficients are used by scientists Kunhui Ye, Weisheng Lu & Weiyan Jiang [10] and to assess the level of market concentration of the international construction market, Pulaj (Brakaj) and Kume [11] - to assess the monopolization of the Albanian construction market. However, the authors have not analyzed exactly what consequences this or that level of monopolization may entail according to the results of calculating the reduced coefficients. A detailed analysis of competition in the primary residential construction market in Ukraine was conducted in the monograph by Pavlov [12].

As evidenced by the results obtained in an empirical study by Cosman and Quintero, a higher degree of concentration in local housing construction markets leads to a decrease in housing production volume, a decrease in construction speed and greater price volatility. Construction markets are a central component of macroeconomic cycles [13]. The authors [13], based on their own research, demonstrate the influence of the concentration of the local housing market on the dynamics of the housing market cycle. Chalenko and Riabchun [14] pay attention to unfair competition as a threat to the economic security of enterprises and argue that in order to effectively protect the interests of business entities from unfair competition, it is necessary not only to deal with it with regulatory and administrative methods, but to create conditions under which it would be unprofitable to break the rules of fair competition.

Research by British scholars led them to conclude that construction remains a highly competitive sector in United Kingdom and there is little to be gained by regulation other than the work currently being undertaken on collusion in bidding, and on mergers and acquisitions. The key point is to ensure that competitive bidding is free from collusion [15].

The core dilemma is whether the effects of the economic concentration were perceived to be a loss of social equality or a loss of economic efficiency. Obviously, different policy makers put a different accent and had a particular focus but we could still wonder which the dominant perspective was. Modern antitrust literature still intensely debate the reasons and the motivations of the political and economic actors that lead to the adoption of the Sherman Act in 1890, the first competition policy in the world [16]. We will analyze the concentration of construction enterprises in Ukraine using statistical data on the volume of net income and profits for 2015-2017, which allow us to numerically assess the degree of concentration and intensity of competition in construction.

B. Methods

For a long period of time, different economic schools have been analyzing the phenomena of market monopolization using both quantitative and qualitative methods, some of which are officially approved at the level of national legislation of the states. Modern economic modeling allows to measure the levels of market concentration, in particular, using the following indicators: market concentration ratio; the Herfindahl-Hirschman index; dispersion of market shares; entropy of market shares; the Gini index. The indicated indices successfully characterize the level of monopolization of different markets - from financial [17] to the markets of the real sector of the economy to the markets of the real sector of the economy [18].

The paper calculated the market concentration ratio CRn for three, four, five and seven largest enterprises, which defined as the sum of market shares of the largest enterprises operating in the market. It characterizes the share of several largest enterprises in the total market volume, however, does not take into account the activities of enterprises remaining in the number of the largest [19]. This indicator is calculated by the ratio:

$$CR_n = \sum_{i=1}^{n} S_i, i = 1,2,\ldots,n \qquad (1.1)$$

where n – the number of largest enterprises in the industry for which the indicator is calculated; Si – the share of the i-enterprise in the industry; the values of Si are sorted by descending.

In order to assess the ratio between the largest enterprises that belong to the "core" of the primary real estate market, the Linda Index (IL) is calculated, which, unlike the concentration index, allows to assess the differences in the "core" of the market and allows to determine what number of enterprises dominate in the market. For this, the Linda index is calculated in stages: first for the two largest firms, then for the three, and so on, until the condition of monotony of the function is violated (the tendency for the index to decrease is followed by a tendency to increase). This change in tendency shows that the company that was added to the calculation last, has a significantly smaller market share than all previous ones.

In order to assess the distribution of "market power" among all the subjects of the construction market in Ukraine, we calculated the Herfindahl-Hirschman index (HHI), which is also a concentration index, but does not characterize the market share controlled by several major enterprises, but the distribution of "market power" between all subjects of this market. The indicator is calculated as the sum of squares of market shares (in percent) of all market participants in its total volume:

$$HHI = \sum_{i=1}^{n} S_i^2, \qquad (1.2)$$

where Si – the share of the i-firm in the industry, %; n – the number of firms in the industry.

The higher the value of the Herfindahl-Hirschman index is, the higher the concentration of sellers in the market becomes, and vice versa, a decrease in the value of the Herfindahl-Hirschman index means increased competition in the market, a decrease in the concentration and market power of enterprises [19].

The indicator of the dispersion of market shares assesses the degree of deviation of the market share of each developer from the average market share. The dispersion of market shares is calculated by the formula (1.3).

$$\sigma^2 = \frac{1}{n}\sum_{i=1}^{n}\left(S_i - \frac{1}{n}\right)^2, \qquad (1.3)$$

where S_i – the share of the i-firm, n – the total number of firms in the market.

The lower the indicator of dispersion of market shares σ^2 is, the more homogeneous the sizes of enterprises and the shares of economic entities in the market are, and the level of concentration is lower. And vice versa - the higher the dispersion value is, the more uneven the market becomes, the weaker the competition and the stronger the power of large firms are [20]. The value of the HHI index is related to the indicator of the dispersion of the company's shares on the market by the ratio:

$$HHI = n\sigma^2 + 1/n\,. \qquad (1.4)$$

In otder to determine the degree of uneven distribution of market shares among market participants, the coefficient of variation is also used:

$$v = \frac{\sigma}{\overline{S}} \cdot 100\% \cdot \qquad (1.5)$$

where $\overline{S} = \frac{1}{n}$ – an average market share of the enterprise.

The higher the uneven distribution of market shares is, the more concentrated the market, with other things being equal, is considered to be. The value of the coefficient of variation indicates the intensity of

the variation signs and, accordingly, the homogeneity of the composition of totalities that is being studied.

If the coefficient of variation is less than 30%, the totality is considered to be homogeneous, if it is in the range of 30%-70% - of medium homogeneity, a value greater than 70% - the totality is heterogeneous.

The entropy index shows the average value of the logarithm of the reciprocal of the market share, mesured by the market shares of the firms:

$$E = \sum_{i=1}^{n} S_i \ln\left(\frac{1}{S_i}\right). \qquad (1.6)$$

The entropy index is an indicator reciprocal of the concentration: the higher its value is, the lower the concentration of sellers in the market and the lower their ability to influence the market price become.

In order to determine the level of monopoly power of enterprises, we use such tools as: the Gini index and the Lorentz curve. The basis of the Gini index, which is calculated using the Lorenz curve, is the idea that the extreme positions in the distribution of incomes or benefits between groups of individuals are egalitarian (everyone who participates in the distribution receives equal shares) and antiegalitarian (one participant in the distribution receives all benefits). In order to depict the Lorenz curve on the coordinate axes, the cumulative (accumulated) results of the distributions are plotted on a percentage scale from 0 to 100: on the horizontal axis - quantiles of income received by persons, on the vertical axis - quantiles of income received [21].

In construction, the low Gini index indicates a high homogeneity of market shares and high competition in the market and vice versa. The Gini index is the ratio of the area of the segment A created by the Lorenz curve and the line of uniform distribution to the area of triangle A + B below the line of uniform distribution: G = A / (A + B). In order to calculate the area of the lower segment B, we can use the approximate trapezoid method.

The Lorenz curve is a traditional tool for measuring the degree of inequality in income distribution or wealth distribution. Over time, this tool began to be used to assess the degree of concentration of various markets. The Lorenz curve shows which share of the total output falls on a certain share of enterprises, which are distributed in different groups depending on the size of income.

Like all economic characteristics, the company's net income is the basis for determining market shares, is a random variable, the prevailing characteristic of which is the law of distribution.

In order to verify the conformity of the logarithmic income values to the normal distribution law, we used the Kolmogorov-Smirnov criterion and the Jacques-Beer's test.

Output data for the calculation of the above indicators was generated according to the financial statements of 100 enterprises, which make a sample of the total population of 27468 construction enterprises of Ukraine. The statistical error of this sample is 0,098.

The idea of the article is that the calculated indicators of concentration and their dynamics are ranked in order to form a matrix divided into 9 quadrants, which depending on the level of monopolization and the value of the growth rate of the concentration indexes are divided into the green, yellow and red zones.

The "red zone" of the threat map implies an immediate response in the form of antimonopoly regulation in order to limit the market power of monopolists or oligopolists and restrain its growth. If the market is in the "yellow zone", this indicates the average level of threats and requires in-depth analysis and a situational reaction to the evidences of the deterioration of the competitive environment. If according to the concentration indicators, the market is referred to the "green zone" of the quadrangle, then the threats associated with monopolization do not require increased attention from the government, depending on the permissible limits of risk.

III. RESULT

Analysis of the concentration of the construction market of Ukraine in order to identify the availability of threats to the economic security of the state was carried out on the basis of information on the total income of enterprises in the industry.

The share of the company in the market is assessed by us as the ratio of its annual income to the total income of all analyzed enterprises. The total number of enterprises analyzed is 100 units.

The calculation of the concentration indexes on the construction market according to the ration (1.1) allowed the following values to be obtained:

$$Cr3 = 43.1\%;\ CR4 = 47.5\%;\ CR5 = 51.5\%;\ CR7 = 59\%.$$

The value of CR3 = 43.1% means that the market share of 43.1% is occupied by the three largest construction companies – Kyivmiskbud Private Joint Stock Holding Company, Trust Zhytlobud-1 Private Joint Stock Company, House-building Combine No. 4 Private Joint Stock Company.

The five largest enterprises occupy 51.5% of the market, and seven - 59% of the Ukrainian construction market. Since the condition of 40% <CR4 <60% is fulfilled, according to the classification of Shepherd [22], this indicates the absence of a monopoly and a high level of competition in this market.

For the two largest enterprises, the Linda index is equal to the percentage of their market shares (Li):

$$IL_2 = \frac{S_1}{S_2} x100\% \quad . \qquad (1.10)$$

If $S_1 = 50\%$, $S_2 = 25\%$, then $IL_2 = 200\%$.

For the three largest enterprises, the Linda index is determined by the formula:

$$IL_3 = \frac{1}{2}\left[\frac{S_1}{(S_2 + S_3)/2} + \frac{(S_1 + S_2)/2}{S_3}\right] x100\% \qquad (1.11)$$

For four enterprises, the Linda index is:

$$IL_4 = \frac{1}{3}\left[\frac{S_1}{(S_2 + S_3 + S_4)/3} + \frac{(S_1 + S_2)/2}{(S_3 + S_4)/2} + \frac{(S_1 + S_2 + S_3)/3}{S_4}\right] x100\% \quad . \qquad (1.12)$$

The decrease in the Lind index when adding enterprises means that the core has not yet been formed. According to ratios (1.10) - (1.12), we get:

$$IL_2 = 286{,}2\%; \quad IL_3 = 145{,}3\%; \quad IL_4 = 214.4\%.$$

Since the addition of the fourth enterprise causes a break in the descending tendency, thus it can be argued that the three largest enterprises form the “core” of the construction market of Ukraine: Kyivmiskbud Private Joint Stock Holding Company, Trust Zhytlobud-1 Private Joint Stock Company, House-building Combine No. 4 Private Joint Stock Company.

Using the HHI value calculated for each construction company when determining the Herfindahl-Hirschman index, we will get the values: HHI = 963. Since the index is less than 1500, the market is considered to be a low-concentrated, therefore, the construction market under study is a market of perfect competition.

Using the ratio (1.3) and the value of the dispersion index, calculated for each construction company, we will get the value σ^2 =0,00086. The result suggests that the construction market in Ukraine is low dispersed. This means tough competition and the absence of one or two firms dominating.

The higher the value of the coefficient of variation is, the more varied the value of the indication around the mean value and the higher the heterogeneity of the totality become. The coefficient of variation for this market is: V = 294%.

The obtained coefficient of variation indicates a high heterogeneity of construction: there are both large leading enterprises and small ones that serve one or two objects. It should be noted that the number of such small enterprises is 75 (75%) out of 100 enterprises analyzed by us (Fig. 1). That is, three-quarters of enterprises are small, 21 enterprises are large, four are particularly large.

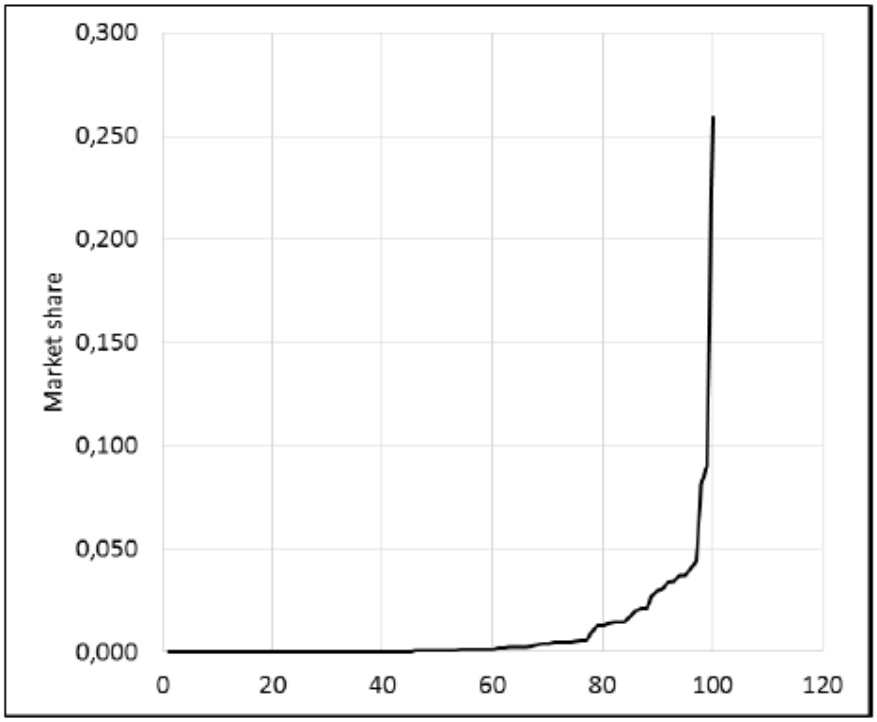

Fig 1. Distribution of enterprises by the share of participation in the construction market Source: calculated by the authors based on their own sample of net income of construction enterprises

Using the ration (1.6) and the values of Sn, calculated for each construction company, we calculate the entropies of market shares of construction companies. On the basis of the calculations we will get: E = 3,03 . According to the classification given above, the result obtained indicates a high level of competition in the construction market. The Lorenz curve for the construction market of Ukraine is shown in Fig. 2.

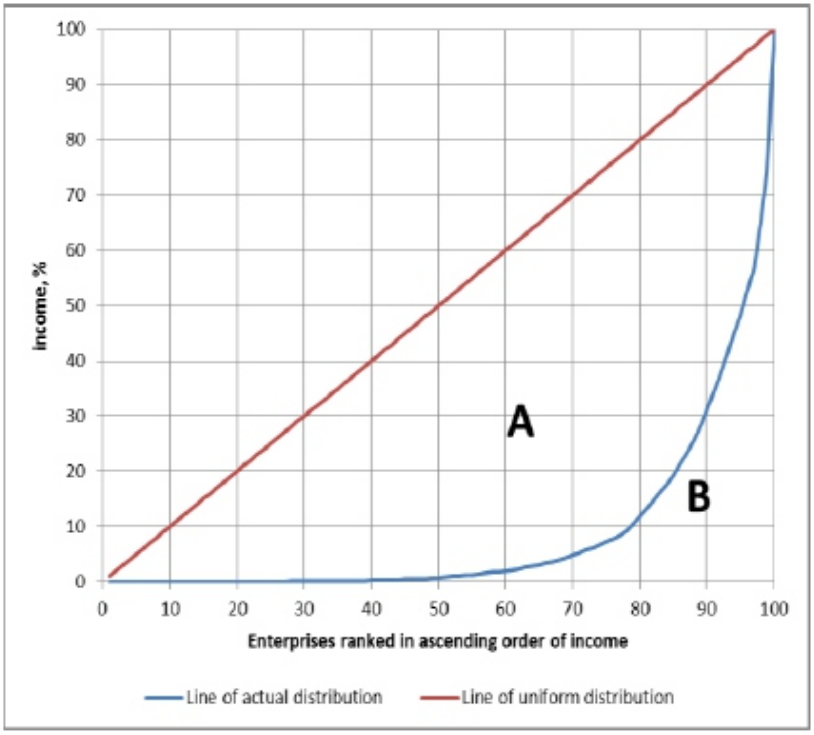

Fig. 2. Lorentz Curve for the Ukrainian Construction Market

Source: created by the authors based on their own sample of net income of construction enterprises

Using the available data and ratios (1.8), we obtain the value of the Gini index: G = 0,911.

Such a value of the Gini index indicates a very significant differentiation of market shares held by various enterprises in the construction industry and, accordingly, a significant differentiation in their incomes. In addition, it can be concluded that the average difference in the market shares of enterprises operating in this market is equal to the average value of this share.

The calculation of the concentration of the construction industry of Ukraine for 2017 is shown in Table I.

Table – I: Calculation of the concentration of the construction industry of Ukraine for 2017

No. in seq.	Enterprise	Si	HHI	Dispersion index	Entropy index	Sn	Fn	Gn
1.	Kyivmiskbud-1 PJSC	0,000000	0,000000	0,0001	0,0000	0,0000	0,010	0
2.	Specialized mechanized mobile carriage No.6 Ukrhmilbud PJSC	0,000000	0,000000	0,0001	0,0000	0,0000	0,020	0,0000

3.	Kyiv Specialized Repair and Construction Company PJSC	0,000000	0,00000 0	0,0001	0,0000	0,0000	0,03 0	0,000 0
4.	Construction and installation department number 20 PJSC	0,000000	0,00000 0	0,0001	0,0000	0,0000	0,04 0	0,000 0
5.	Ukrmiasomolmashtehremont Poltava Specialized Repair and Construction Department	0,000001	0,00000 0	0,0001	0,0000	0,0000	0,05 0	0,000 0
6.	...	...	...	...	...	...	...	...
95.	Interbudtonel PJSC	0,037295	0,00139 1	0,0007	0,1227	0,4845	0,95 0	0,030 6
96.	Zhytlobud – 2 ALC	0,040188	0,00161 5	0,0009	0,1292	0,5247	0,96 0	0,033 3
97.	Khmelnitsk Road Construction Department № 56 PJSC	0,044254	0,00195 8	0,0012	0,1380	0,5690	0,97 0	0,037 2
98.	Trust Zhytlobud - 1 PJSC	0,081284	0,00660 7	0,0051	0,2040	0,6503	0,98 0	0,073 2
99.	Domobudivny combine number 4 PJSC	0,090548	0,00819 9	0,0065	0,2175	0,7408	0,99 0	0,162 7
100.	Kyivmiskbud Private Joint Stock Holding Company	0,259189	0,06717 9	0,0621	0,3500	1,0000	1,00 0	0,249 2
Total		**1,000**	**0,09628**	**0,0863**	**3,0267**	**8,9929**	**50,5 0**	**0,910 6**

Source: calculated by the authors

Ensuring the completeness of the analysis is possible by studying the distribution of profitability of these enterprises. The basis for the analysis is the performance of construction companies for 2017 in the context of net income, net profit and profitability of their main activities, obtained from the officially published financial statements of the 100 largest enterprises in the industry. The value of net income the most fully describes the activities of the enterprise, which is closely related to the volume of construction product sales. We will conduct a statistical analysis of the income of construction companies in Ukraine (Table II).

Table – II: Results of the previous statistical analysis of the net income sample *

No. in seq.	Indicators	Value	Indicators	Value
1.	Sample volume	100	Minimum value	0
2.	Mean value	120599	Maximum value	3125808
3.	Median	11649,5	Asymmetry	6,59
4.	Standard deviation	356033	Pointedness	52,4

Source: calculated by the authors based on their own sample of net income of construction enterprises

The significant difference of the mean sample from the median, the large asymmetry and pointedness give reason to doubt the normal law of the distribution of profitability of the above enterprises. In order to check the hypothesis of the correspondence of the enterprise income to the normal distribution law, we used the Kolmogorov-Smirnov criterion, implemented in the Statistica 6.0 program (Fig. 3). Since the probability $p < 20.0$, the hypothesis about the normal distribution is rejected.

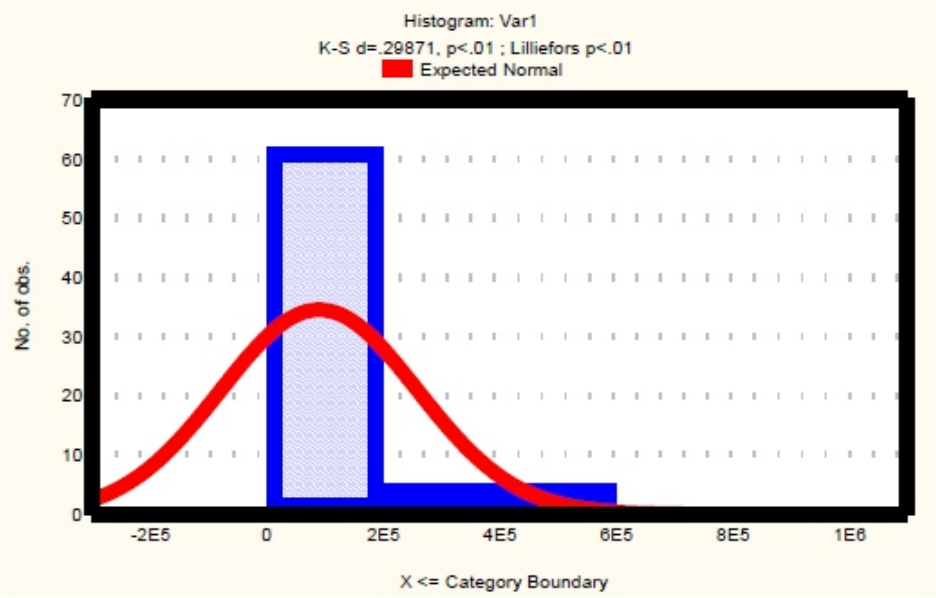

Fig. 3. Cheking the hypothesis of a normal distribution by the Kolmogorov-Smirnov criterion
Source: made by the author using the program "Statistica"

The asymmetric form of the distribution shown in Fig. 3 can correspond to a lognormal distribution law. By definition, a continuous inherent random variable r has a log-normal (log-normal) distribution if the value $X = \ln r$ has a normal distribution. In order to check the hypothesis of a log-normal distribution of enterprise income in the construction industry, it is necessary to log the value of income, and for logariphmic values, check the hypothesis of a normal distribution.

In order to apply the Jacques-Beer's criterion, it is necessary to calculate the distribution asymmetry k_3 and the pointedness of the distribution k_4 by ratios:

$$k_3 = \frac{\sum_{i=1}^{n}(x_i - \bar{x})^3}{n\sigma^3}, \quad k_4 = \frac{\sum_{i=1}^{n}(x_i - \bar{x})^4}{n\sigma^4} - 3. \qquad (1.13)$$

After that, we need to calculate the statistics of Jacques-Beer by the formula (1.14):

$$JB = n\left(\frac{k_3^2}{6} + \frac{k_4^2}{24}\right), \qquad (1.14)$$

It is advisable to compare it with a critical value $JBc(\alpha)$.

For the level of significance $\alpha = 0.05$ $JBc(\alpha) = 5.991$.

Thus, we have:

$$k_3 = -0{,}390;\ k_4 = -0{,}652;\ JB = 3{,}142.$$

Since JB ≤ JBc , the hypothesis of a normal distribution is not rejected. We make the same conclusion using the Kolmogorov-Smirnov criterion, which we implemented in the Statistica 6.0 program (Fig. 4).

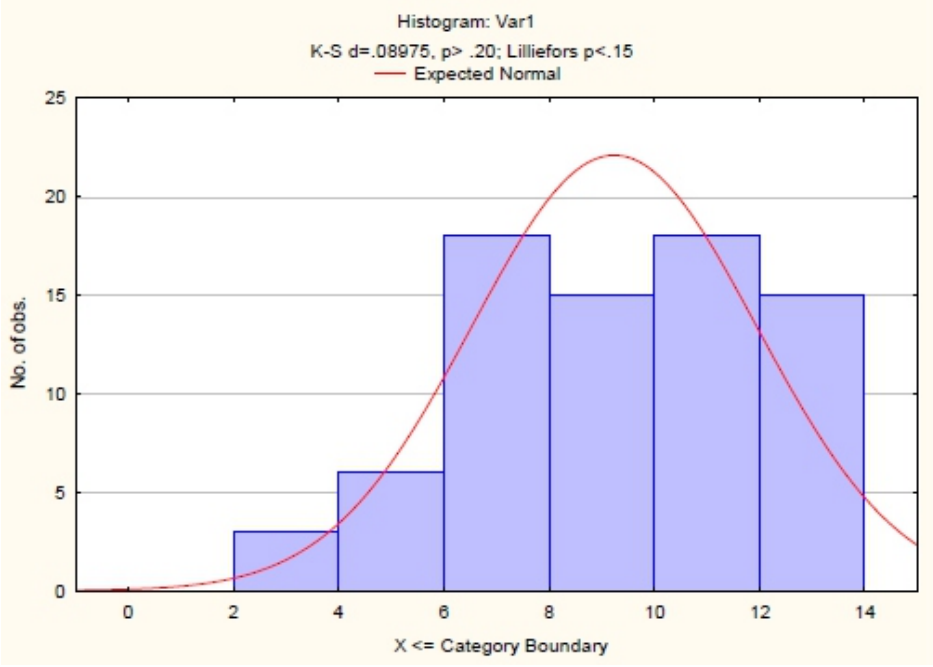

Fig. 4. Cheking the hypothesis of a normal distribution by the Kolmogorov-Smirnov criterion

Source: made by the author using the program "Statistica"

Since p > 0,20, the hypothesis of a normal distribution is not rejected. Thus, we have confirmed the hypothesis about the lognormal distribution of the values of profitability of enterprises of the construction industry. The density function of the distribution of logariphmic values of profitability has the following form:

$$f(x) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}, \qquad (1.15)$$

where $x = \ln r,\ \mu = 9{,}224,\ \sigma = 2{,}709$.

The law of income distribution we have constructed allows us to obtain several practically useful results:

1) the most likely value of the enterprise income is UAH 10.1 million;

2) 50% of enterprises have an income that is in the range from UAH 1.63 to UAH 63.0 million;

3) 90% of enterprises have an income that is in the range from UAH 0.12 to UAH 873 million.

A more detailed description of the income distribution of enterprises, obtained using the distribution function (1.15), is given in Table. III.

Table - III: Intervals of profitability of Ukrainian construction enterprises

No. in seq.	Indicators	Value									
1.	Reliability level	0,95	0,90	0,80	0,70	0,60	0,50	0,40	0,30	0,20	0,10
2.	Minimum limit, thousand UAH	50	118	315	612	1037	1631	2449	3570	5104	7213
3.	Maximum limit, thousand UAH	2049265	872785	326230	167947	99083	63007	41959	28788	20135	14248

Source: calculated by the authors

The lognormal distribution law we identified is quite close, and for large values of profitability almost coincides with the Pareto distribution law obtained for the distribution of personal incomes of citizens [24]. Both laws argue that most of the large revenues are concentrated in the hands of a small group of individuals. Sometimes this law is interpreted in the following simplified way:

– 80% of capital is concentrated in the hands of 20% of people. This is due to their extraordinary behavior, so that they could get rich from scratch;

– 80% of production is provided by 20% of the enterprises.

The above interpretation is called the Pareto principle (principle 20/80). This principle is often applied to the correct solution of various situations in the economic and social sphere. For example, one of the

principles of effective management sounds like this: 80% of the result is achieved at the expense of 20% of all spent efforts, and the remaining 80% of efforts yield only 20% of the total result.

Using the value of net income and net profit, we can calculate the profitability of the main activities of enterprises by the ratio:

$$R = \frac{P}{D - P} \cdot 100\% \quad (1.16)$$

Distribution of the calculated profitability values is shown in fig. 5.

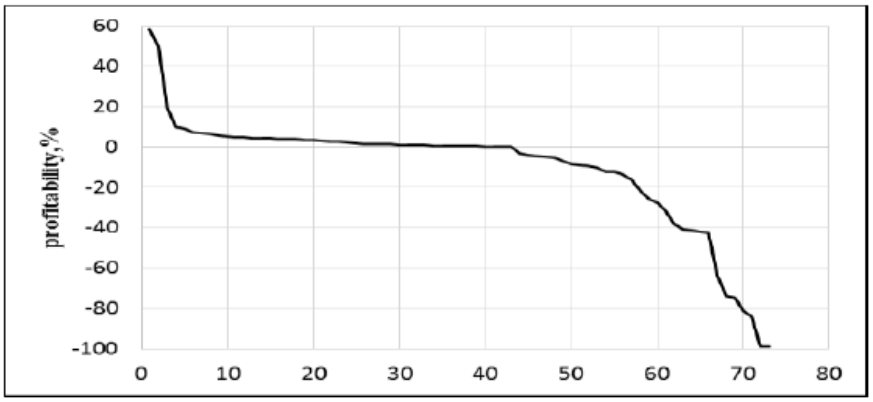

Fig. 5. Distribution of profitability values of the main activities of construction enterprises

Source: created by the authors

According to the profitability values all the enterprises studied by us can be divided into four groups:

1. Profitable enterprises with a profitability of 15% and above. This group includes the first five enterprises.
2. Profitable enterprises with profitability of 0%-15%. This group includes 48 enterprises.
3. Unprofitable enterprises with profitability of 0%-15%. This group includes 17 enterprises.
4. Unprofitable enterprises, the level of profitability of which is less than 15%. There are 30 such enterprises in the sample.

A large variation in profitability can be explained by the specifics of the construction industry. An enterprise can build a house for several years, and all these years its activity will be unprofitable. After construction is completed, the phase of the living space sale begins and the main activity becomes highly profitable. This cyclical profitability is typical for small enterprises that maintain one construction project. The economic stability of such enterprises is low, because unforeseen additional expenses during the construction period may become unacceptable for the enterprise and lead to its bankruptcy. The statistics of income confirms our considerations. The first two companies from the studied list and the last twenty (with a small exception) occupy the last posiyions in the list of enterprises grouped by

profitability. Consequently, a very high or very low value of profitability is a direct evidence of the low economic sustainability of the enterprise. Large-scale enterprises have somewhat diversified production due to the maintenance of several facilities. At the same time, the unprofitability of one object is covered by the profitability of another and, thanks to this, the profitability of the main activity ranges from + 10% to -20%. Such enterprises are more economically sustainable. Thus, a relatively low value of profitability (positive or negative) is evidence of the economic sustainability of the enterprise.

IV. DISCUSSION

The calculated concentration indicators for the period of 2015-2017 according to the methodology described in this study (with the exception of the coefficient of variation and the Gini index) indicate a low level of monopolization of the construction industry of Ukraine, and therefore, the monopolization of the specified market does not belong to significant threats to national economic security (Table IV).

Table – IV: Level of concentration of enterprises in the construction industry of Ukraine for 2015-2017

Coefficient name	Normative value	Indicators Value			Level of concentration depending on the actual value of the indicator	Growth rate		Average increase
		2015	2016	2017		2016/ 2015	2017/ 2016	
Market concentration ratio	1. Pure monopoly (CR4 ≈ 100%). 2. Dominant firms (50% <CR4 <90%) 3. Limited oligopoly (CR4> 60%) 4. Effective competition (CR4 <40%)	46,4	47,98	47,5	Average	103,41	99,00	1,20
Herfindahl-Hirschman index	1. HHI < 1000 weakly concentrated market; 2. 1000 < HHI < 1800 medium concentrated market; 3. HHI > 1800 – highly concentrated market	871	1075	963	Low	123,42	89,58	6,50
Dispersion of market shares	The higher the value of the dispersion is, the more uneven and, therefore, the more concentrated the market becomes.	0,00098	0,0001	0,00086	Low	10,20	860,00	335,10
Coefficient of variation	The coefficient is less than 30% - a homogeneous totality; 30% - 70% - a totality of average homogeneity; more than 70% - a totality is heterogeneous	276%	309%	294%	High	111,96	95,15	3,55
Entropy of market shares	Values from 0 to 0.5 - the market is monopolized; from 0.5 to 2, - oligopolistic market, the sole monopolization of which is unlikely; above 2 - quite high degree of market competitiveness	3,15	3,05	3,03	Low	96,83	99,34	-1,92
Gini index	The higher the Ginny index is, the higher the uneven distribution of market shares between sellers becomes and, therefore, with all other things being equal, the probability of concentration in the market is higher.	0,540	0,577	0,911	High	106,85	157,89	32,37

Source: calculated by the authors

The analysis of the level of concentration in the construction market of Ukraine, as well as statistical analysis of the distribution of income and profitability of enterprises of this type of economic activity allows to form the prerequisites for identifying threats to the national economic security of Ukraine. The urgency of taking economic measures as a response to identified threats can be assessed using a matrix, the idea of which is to rank the threats to economic security depending on the level of market concentration and its dynamics (Fig. 6).

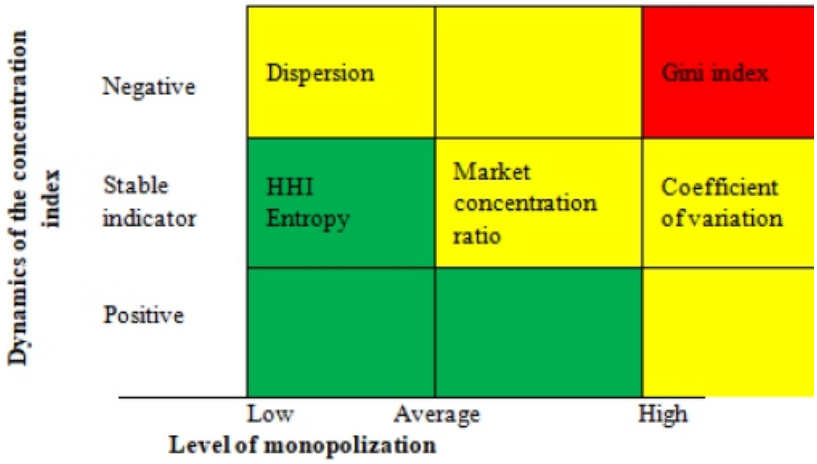

Fig. 6. Map of threats to the economic security of the state depending on the level and dynamics of indicators of monopolization of the construction market in Ukraine for 2015-2017
Source: created by the authors

The "red zone" of the threat map implies an immediate response in the form of antimonopoly regulation in order to limit the market power of monopolists or oligopolists and restrain its growth. If the market is in the "yellow zone", this indicates the average level of threats and requires in-depth analysis and a situational reaction to the evidences of the deterioration of the competitive environment. If according to the concentration indicators, the market is referred to the "green zone" of the quadrangle, then the threats associated with monopolization do not require increased attention from the government, depending on the permissible limits of risk.

According to the results of the analysis, it can be concluded that the values of the Herfindahl-Hirschman indices and the entropy of the market frequencies of the construction market of Ukraine indicate a high level of competition, and refer the market to the "green zone", do not pose a threat to the national economic security of Ukraine.

According to the market concentration ratio, the market has an average level of monopolization and is in the "yellow zone", which requires more detailed attention in terms of leveling threats to economic security. The value of the two coefficients — the coefficient of variation and the Gini index — attribute

the market under study to highly monopolized, and due to the tendency for the Gini index to increase, it falls into the "red zone". This means the emergence of threats to national economic security associated with a decrease in GDP, increased income differentiation, reduced state budget revenues, and the like. Such situation requires a more in-depth analysis of the reasons that led to such values of this coefficient, and in the case of the identification of potential threats to the development of a competitive market, the adoption of administrative and economic regulatory measures.

V. CONCLUSION

Analysis of indicators characterizing the level of monopolization of the construction market in Ukraine in the context of identifying threats to the state's economic security has led to the following conclusions.

1. Monopolization of individual markets in a country can have significant consequences for the economy and national security, which consist in reducing revenues to the budget, reducing the volume of national production with an increase in the price level, deepening income differentiation, restraining innovation and investment development. This poses the threats to national security, from minimal impact to substantial enough and requires the development of a clear methodology for identifying these threats.
2. Analysis of current market concentration indicators, such as: the market concentration ratio; the Herfindahl-Hirschman index; the Linda index, the dispersion of market shares; the coefficient of variation, the entropy of market shares; the Gini index applied to the construction market showed the existence of certain differences in determining the level of competition according to various indicators. In particular, the overwhelming majority of calculated indices indicate a fairly high level of competition in construction. However, the characteristic values of the coefficient of variation and the Gini index indicate the opposite situation, which requires a deeper analysis. In particular, the coefficient of variation indicates a high heterogeneity of construction: there are both large leading enterprises and small ones that serve one or two objects. A value of the Gini index indicates a very significant differentiation of market shares held by various enterprises in the construction industry. The average difference in the market shares of enterprises operating in this market is equal to the average value of this share.
3. The law of distribution of income of construction companies built in the work is sufficiently close to the law of distribution of Pareto, which allows us to make a conclusion that a very high or very low value of profitability is a direct evidence of the low economic stability of an enterprise. Large-scale enterprises have a more diversified production due to the maintenance of several objects. At the same time, the unprofitability of one object is covered by the profitability of another and, thanks to this, the profitability of the main activity ranges from + 10% to -20%. Such enterprises are more economically sustainable. Thus, a relatively low value of profitability (positive or negative) is evidence of the economic sustainability of the enterprise.

4. The identification of threats to the economic security of the state associated with monopolization can be carried out using a matrix, divided into "red", "yellow" and "green" zones depending on the level of market concentration and its dynamics. The results of the construction market positioning indicate that the Herfindahl-Hirschman index and the entropy of the market frequencies of the construction market of Ukraine are indicators of a high level of competition, and refer the market to the "green zone" that does not pose a threat to the national economic security of Ukraine. According to the market concentration ratio, the market has an average level of monopolization and is in the "yellow zone", which requires more detailed attention in terms of leveling threats to economic security. The value of the two coefficients — the coefficient of variation and the Gini index — attribute the market under study to highly monopolized, and due to the tendency for the Gini index to increase, it falls into the "red zone". This means the emergence of threats to national economic security. There is a need to take macroeconomic measures that would restrain the development of monopoly phenomena in the construction market.

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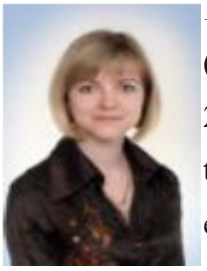

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