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Presenting Evolutionary Model of Borrowing Sales Using Collective Intelligence and Bird Flight Algorithm

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Abstract
The purpose of this article is to present the evolutionary model of loan sales using collective intelligence and meta-heuristic algorithms (bird flight algorithm). In terms of method, this research is in the category of quantitative research, and in terms of purpose, it is included in the category of applied research. The statistical population includes all active companies admitted to the Tehran Stock Exchange. This research has been investigated between ۲۰۱۱ and ۲۰۱۹ for active companies admitted to the Tehran Stock Exchange. The method of data collection is through library study and financial data of companies admitted to the stock exchange by referring to the financial statements and explanatory notes with the financial statements, and it has also been compiled using the Rahavard Novin software. Also, with the help of EViews ۹ and MATLAB software, he presented a borrowing sales model, and in the next step, with the help of MATLAB software and the flight of bird's algorithm, he presented an evolutionary model of borrowing sales, in the end, by comparing the step-by-step regression model and the borrowing sales model. The findings showed that the borrowing sales model with the help of the bird flight algorithm has a higher efficiency.
Keywords: *Meta-heuristic algorithms, Bird flight algorithm, Loan sales, Evolutionary model of loan sales, Collective intelligence*

Introduction

One of the motivations of the activists of the securities lending industry is the sale of securities, the contradiction of which with some Islamic principles has made the financial experts to think of finding Sharia solutions to replace the aforementioned trading instruments in order to make the Islamic markets benefit from its benefits (Mehri et al., ۲۰۲۳). Borrowing is one of the main types of transactions in mature stock markets of the world. For example, in more than ۴۰٪ of all transactions made in the New York market, sellers have borrowing on the supply side (Han, ۲۰۲۲). Obviously, this huge amount of transactions cannot be caused by the activity of small shareholders. Leading academic studies show that leveraged sellers are more adept at detecting negative information about corporate stocks than other investors. Therefore, this group plays a fundamental role in bringing the market price to the intrinsic value of each share. On the other hand, another very important feature of other borrowing sellers is participation in creating liquidity and generality in the market. In the absence of this tool, liquidity is often from the stock offered by the current

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stock owners and some brokers (Annan Abakah, ۲۰۲۳).

While borrowing sellers can increase the liquidity supply by borrowing from owners who are currently unwilling to sell (Dalvand et al., ۲۰۲۳). In simpler terms, with the presence of short sellers, more shares will be offered for sale at any given moment of time, and as a result, buyers will be able to trade with more sellers. In fact, many brokerage companies in mature markets borrow (part of) the shares they own from their subsidiary investors after obtaining permission and gain the possibility of exchanging with more buyers (Eugenia et al., ۲۰۲۳). In this way, more transactions per unit of time will be possible. Serious academic studies have also been conducted in this field, which generally confirm the role of debt sellers in improving liquidity and depth. The scope of influence of loan sellers goes beyond the level of market exchanges, to the extent that the existence of loan sellers even affects the way companies are managed. Although these sellers do not have voting rights, the potential threat of selling a company's shares from them will cause managers to avoid decisions that will harm the intrinsic value of the stock even in the short term, because they are aware of the skill of debt sellers in discovering negative information. In addition to showing this mechanism, academic research has found findings such as improving contracts between companies and managers, reducing administrative and financial corruption, as well as increasing accounting transparency as a result of the threat of debt sellers (Ejigu & Desalegn, ۲۰۲۳).

One of the new topics of the capital markets is that the investor sells the assets that he does not have in the market and invests the proceeds in other assets (Heidari et al., ۲۰۲۲). In other words, he borrows the asset in the hope of lowering the price and returns the asset to the lender when the price drops and makes a profit in this way. This approach is called borrowing sales, which will be discussed more widely in the following (Carletti et al., ۲۰۲۳). Like any other financial institution, it is necessary to strictly regulate the rules governing the sale of debt to prevent destructive and unfair profit-seeking behaviors and also to prevent excessive risk-taking by investors. In mature financial markets, people who, because of access to informational rents, can obtain negative information about companies or the market without costly expert reviews, are discouraged from short selling (Thapa et al., ۲۰۲۰). For example, company managers, board members, tax inspectors, etc. are not allowed to sell on credit of the companies they work for or are related to. Similarly, leveraged selling is prohibited for individuals who have access to information rents because of their political positions. Also, investment funds and banks that invest in the stock market from micro capital or customer deposits are prohibited from borrowing sales because they may expose their customers and depositors to high risk due to calculation errors. In addition, different markets impose other special and general restrictions on borrowing sales. In general, although financial market experts recommend borrowing sales as an important tool for market efficiency, they also emphasize strict monitoring and application of rules regarding fair, non-rental exchanges that imply market stability (Augsburg et al., ۲۰۲۳).

Considering the complexities involved in the implementation of these alternative models, it is not clear that these models have the necessary agility to help correct prices. For this reason, in this article, we will present the evolutionary model of borrowing sales with the help of collective intelligence and the bird flight algorithm so that we can give a reasoned answer to the main issue of whether the borrowing sales model with the help of the bird flight algorithm has a higher efficiency. and to convince In this direction and in order to provide a better model for predicting loan sales using a data mining approach, it will be investigated by applying the meta-heuristic algorithm of the flight of birds. In the following, comparing the results with the linear regression method obtained

from the same variables will also help to understand the best model. In fact, the research gap of this research is that a comprehensive research has not been done on the modeling and presentation of the evolutionary model of loan sales, and in the meantime, the role of loan sales has been neglected.

Literature Review

The borrowing sale process leads to acceleration in the price correction of overvalued securities or corrects the abnormal buying pressure that leads to inflation of securities prices. Based on this authority's belief, the leveraged selling function can increasingly lead to the superiority of index-based investment funds and investors with a longer-term perspective compared to other investors. According to this authority, loan sales may potentially contain important information that, if made public, could help users make decisions (Davis et al., ۲۰۲۳). Borrowing sellers seek to reduce prices, try to maintain their positions in borrowed stocks or try to increase the number of borrowed shares, these results are in line with the view of critics who believe that borrowing sales aggravates the price reduction process. When the researchers limited their analysis to the fundamental value of the stock, they found no credible evidence of short sellers attempting to trade below the fundamental value of the stock and found that a significant proportion of short seller's short sold stocks that were more than their fundamental value is priced in (Nishihara et al., ۲۰۲۳). In addition, the researchers found that while following a decline in the stock price, the borrowed sellers tend to reduce the number of borrowed shares, in stocks whose price is still more than the fundamental value, there is a tendency to increase the number of borrowed shares sold (Ardehi et al., ۲۰۲۳). Increase the results of these researchers indicate the fact that borrowing sellers use a variety of strategies. While all the people who sell stocks by borrowing do not use the fundamental values of the stocks, but a large number of these people, with their actions, cause the convergence of the stock market price with the fundamental value and do not intensify the downward trend of the stock price (Cashman et al., ۲۰۲۲). Short selling is usually done on stocks that appear to be overvalued and are expected to fall in price. Speculators typically seek to use these opportunities to sell short. On the other hand, risk hedgers, in order to cover the risk of their purchase positions in the derivative market, sell the base share on credit (Yan et al., ۲۰۲۳). Data mining is the process of finding relationships, patterns, meaningful rules and new trends by digging in large amounts of data stored in data warehouses, using artificial intelligence and mathematical and statistical techniques. One of the methods of data mining is the use of meta-heuristic intelligent algorithms. A data mining solution is more than just a set of powerful data structures and techniques. This technique should be used in the right place and with correct data (Sachan & Swarnkar, ۲۰۲۳).

-The results of Akkoyun et al (۲۰۲۳) article titled "Crowded out from the beginning: Impact of government debt on corporate financing" dedicated that Using hand-collected data on corporate bond and stock offerings, we identify the impact of government debt on corporate financing during World War I. The early twentieth century provides a unique opportunity to identify the impact of government debt on private financing because during this period (۱) firms announced the amount they wanted to raise before each security offering and (۲) the Treasury issued debt in discrete intervals. We identify the impact of Treasury issues by comparing differences in the amount firms offered to the amount they actually raised when the Treasury was borrowing to when the Treasury was not in the market. We find that long-term government bond offerings negatively affect both amount of long-term corporate bonds and dividend paying stocks issued. In contrast, we find no effect on short-term debt issue. Our findings suggest that investors view stable dividend paying stocks

a close substitute for relatively safe long-term bonds.

-The results of Agarwal & Singhvi (۲۰۲۳) article titled "Creditor-controlled insolvency and firm financing– Evidence from India" showed that Using the 'Insolvency and Bankruptcy Code' (IBC) in India, we show that, despite an increase in the supply of credit, IBC led to a higher reduction in the secured debt of the high tangibility firms compared to the low tangibility firms. We also find that secured debt was substituted with other sources like equity, retained earnings, and accounts payable; more cash was held back. Our findings suggest that managers' expected cost of bankruptcy obstructed the expected increase in supply of credit after IBC. We add to the mixed evidence on the impact of creditor rights on firm's financing decisions.

-The results of Wu (۲۰۲۳) research titled "Impacts of digital inclusive finance on household entrepreneurship" showed that analyses the impact of inclusive digital finance on household entrepreneurship. Through a mediating effects model, we explore the association between inclusive digital finance and household entrepreneurship performance. Selecting data from the China Household Finance Survey (CHFS) in ۲۰۱۷, ۲۰۱۹ and ۲۰۲۱ as the research sample. The study finds that: digital inclusive finance can facilitate household entrepreneurial decisions; digital inclusive finance can enhance entrepreneurial performance through two mechanisms: promoting innovative behavior and alleviating financing constraints, and digital inclusive finance can promote household entrepreneurship by reducing financing constraints.

-The results of Nanda & Gordon (۲۰۲۳) article titled" Small firm financing: Sources, frictions, and policy implications" dedicated that bank and credit card-based borrowing by the business and its owners account for the overwhelming share of external finance. Second, we highlight that there is growing evidence of heterogeneity in financing frictions facing small firms: a substantial share of firms may not even seek external finance or benefit from relaxed constraints because they do not wish to grow; on the other hand, relaxing constraints has large measured effects on investment and employment for certain subpopulations of small firms. This heterogeneity has important implications for how average effects are interpreted in academic studies, as well as for how policy is enacted. We conclude by noting the greater availability of microdata on small firm financing in recent years. This has the potential to generate substantial insight on the degree to which the rise of financial technology can overcome traditional financing frictions, as well as enhance our understanding of the effectiveness of different types of government interventions on small business financing and growth.

-The results of Guedes & Pinto (۲۰۲۳) article titled" Pricing of project finance bonds: A comparative analysis of primary market spreads" showed that a comparative analysis of project finance (PF) and traditional corporate finance (CF) bond spreads and pricing. Using a cross-section of ٤٧،١٩٦ bonds issued worldwide in the ١٩٩٣–٢٠٢٠ period, we show that PF and CF bonds are differently priced, PF bonds have higher spreads than comparable CF bonds, and although ratings are the most important pricing determinant for PF and CF bonds at issuance, investors rely on other contractual, macroeconomic, and firms' characteristics beyond these ratings. Our results do not support the hypothesis of PF transactions as mechanisms of reducing sponsoring firms' funding costs: the cost of borrowing affects financing choices and PF transactions' weighted average spread is higher than that of comparable CF bond deals. We also find that economies of scale, risk management, and information asymmetry arguments affect sponsoring firms' choice between PF and CF transactions.

-The results of Nishihara et al (۲۰۲۳) article titled" Corporate investment, financing, and exit model with an earnings-based borrowing constraint" showed that develops a real options model to study the

effects of an earnings-based borrowing constraint (EBC) on a firm's investment, financing, and exit decisions. We highlight how EBC affects the decisions and values differently than a liquidation value-based borrowing constraint (LBC). Unlike LBC, the firm with EBC delays investment to increase the cap of debt. Investment reversibility (or equivalently, liquidation value) does not largely affect the firm with EBC, although it greatly affects the firm with LBC. Unlike LBC, EBC loosens with higher volatility because higher volatility delays investment, which increases the cap of debt. With low investment reversibility and high volatility, EBC is preferable to LBC from a firm value perspective, and in case of financial distress, the firm will go into reorganization bankruptcy rather than liquidation bankruptcy. This also implies a positive relation between EBC and reorganization bankruptcy. Our results are largely consistent with empirical observations.

The results of Lathiya et al (۲۰۲۳) article titled"A systematic review of decentralized finance protocols" showed that Decentralized finance (DeFi) has revolutionized the financial industry in recent years. Industries such as banking, insurance, and investment are experiencing a significant shift due to the growth of DeFi. The decentralized finance market is expanding exponentially, emphasizing the potential of digital currencies and decentralized platforms in providing an alternative to the traditional finance paradigm. It eliminates the need for costly intermediaries, reduces transaction fees, and increases accessibility to financial services for everyone, regardless of their geographic location or economic status. With the enormous increase in cryptocurrency investment, individuals and institutions have started to use DeFi. In this context, understanding the architecture and working mechanisms of different DeFi protocols becomes crucial in creating new and innovative products. This review paper explores various DeFi protocols, including derivatives, decentralized exchanges (DEX), lending and borrowing, asset management, and stablecoins. It analyses their internal structure and composability, providing insights into how these protocols can be combined to create new and innovative DeFi products and explore the potential of DeFi in providing an alternative to the traditional finance paradigm.

The use of artificial intelligence and meta-heuristic algorithms in providing borrowing sales modeling can help shareholders to make the necessary improvements in the process of selling shares when the stock price is decreasing by using meta-heuristic algorithms and machine learning. For this purpose, we need to create a database to accurately predict the price of shares for sale and the rate of return of share profits and the shares themselves, and apply the necessary improvements in the above model using the meta-heuristic algorithm of the flight of birds.

The most important innovations of this article are:

- ✓ Examining the most important challenges of loan sales;
- ✓ The effect of collective intelligence on loan sales;
- ✓ Presenting the evolutionary model of loan sales with the help of collective intelligence and bird flight algorithm;
- ✓ Investigating the effectiveness of the borrowing sales model with the help of the bird flight algorithm.

Research Methodology

This article is an in terms of the type of quantitative research and based on the objective. Also, due to the fact that in the current research, the variables happened in the past, it is a type of post-event research. On the other hand, in terms of theory, it is of the type of affirmative research and in terms of reasoning, it is also of the type of inductive research. Also, this research is a type of quasi-experimental research in the field of financial accounting research. Finally, in this research, based on the test of the proposed hypotheses by following the previous researches, the models related to the research topic are presented in the form of the final models of the research. The financial

information related to the companies admitted to the Tehran Stock Exchange has been used, and for this purpose, the time period of the research is between ۲۰۱۱ and ۲۰۱۹. All the companies that meet the requirements of the statistical population have been checked in full and there will be no sampling. Also, the accepted companies in different industries with the following conditions form the statistical population of this article:

- According to the time period of information access (۱۳۹۰-۱۳۹۸), the company must have been admitted to the stock exchange before ۲۰۱۱ and its name has not been removed from the list of mentioned companies until the end of ۲۰۱۹
- Due to the difference in the time period, the effects of macro variables such as inflation, exchange rate, etc. will not be comparable. Therefore, in order to increase the power of equalization and equalize the conditions of the selected companies, the financial year of the companies should end at the end of March every year. Because the companies whose information was incomplete to calculate the primary variables of the financial statements are removed from the sample. The companies should not stop their activities and change their activity period.

Table ۱.
Selection of the companies studied in the research

Companies Type	**Qty**
The total number of companies admitted to the stock exchange at the end of ۲۰۱۹	٥٧٠
The number of companies that were not active in the stock market during the period ۲۰۱۱-۲۰۱۹	۱۷۱
The number of companies admitted to the stock market after ۲۰۱۱	٤٦
The number of companies that have changed their financial year in the time period of the research, or their financial year does not end at the end of March	۷۳
The number of companies that were other than holding, investments, financial intermediaries, banks or leasing	٥۱
The number of companies whose information is not available in the time period of the research	٦٦
Number of sample companies	١٦٣

The data collection tool in this research is library method and using foreign and domestic articles as well as financial data of listed companies by referring to financial statements and explanatory notes.

The methodology of the collective intelligence algorithm should be carried out based on the following five steps in order:

۱- Data selection;
۲- Data cleaning;
۳- Dividing the data into training and evaluation sets;
٤- Pattern training process;
٥- Evaluating the trained pattern with the evaluation data not yet viewed by templates.

In the first stage, by reviewing the literature and the background of the research, all the variables introduced in the research are identified. The second step is to clear the data. In this research, to implement the second part, step-by-step regression is used in the selection of input variables. Selection of inputs is one of the most important goals in data preprocessing. This problem includes the process of determining relevant inputs and removing attributes that are redundant and provide little information. Carrying out the process of selecting inputs before applying a learning algorithm has many advantages. By removing a large number of irrelevant inputs, learning methods incur less computational cost and time. Also, the model obtained becomes simpler, which often makes its interpretation easier and is more useful and beneficial in practice. Also, simple models have better generality when used for prediction. The third step is to divide the data. One of the criteria used for evaluation is the error rate, which has different types, in general, it is not possible to make a proper judgment about the capabilities of the algorithms by comparing the calculated error on the learning data. Usually, the error rate of the learner of the learning data is lower than the error rate of the data that has not been seen

in the learning process. With this reasoning, learning error cannot be used to compare patterns. The reason is that for more complex patterns, estimators that usually have more parameters have more complex bounds. This complex boundary reduces the error on the learning data compared to simpler models; therefore, in addition to the learning data set, a set of data is needed for evaluation. The fourth and fifth stages: training data is used to learn the pattern and evaluation data is used to calculate the error rate of patterns for events that have not been observed so far. Of course, for the evaluation to be appropriate, the number of model implementations is not enough. This is possible by repeatedly implementing the learning and evaluation process; therefore, when a data set is provided, a part of it should be set aside for the final evaluation and the rest used for learning, and again the two sets should be Table ۲.

changed and the model evaluated again (Makanda et al., ۲۰۲۳).

Findings

Descriptive analysis

The descriptive statistics table shows the mean value, standard deviation, minimum and maximum of each of the independent, dependent and control variables. In this table, the main central index is the mean, which indicates the balance point and the center of gravity of the distribution, and is a good index to show the center of the data. In descriptive analysis, the researcher describes the collected research data using descriptive statistics tables and indices such as central and dispersion indices. This helps a lot to clarify and explain the researcher's data. A descriptive analysis of the data is presented in Table ۲.

Descriptive statistics of quantitative variables used in the study

Variable	AVE	Min	Max	standard deviation	Observations
EA	۰,۱۹۳	-۰,۰۳٤	۰,۹٦۱	۰,۲۱۷	۱۱٤۱
ROA	۰,۱۱۷	-۰,۷۱۸	۰,۷۱٤	۰,۱۳۹	۱۱٤۱
ROE	۰,۳۳۱	-٥,۳۸۷	۰,۷۳٦	۰,٤۱۹	۱۱٤۱
EM	۰,۰۸۹	۰,۰۰۰۱	۰,۸۸۹	۰,۰۹٦	۱۱٤۱
As	۰,٤٥۷	۰,۰٤۲	۰,٦۰۷	۰,٤۱٦	۱۱٤۱
CFO	۰,۸٥۸	۰,۱٤۰	۰,۹۸۹	۰,٦۸۲	۱۱٤۱
LEV	۰,٦۱٦	۰,۰۰۲	۰,۷۱٥	۰,۲٥۳	۱۱٤۱
RO	۰,٦۳٥	۰,۰۱۷	۰,۷۲۳	۰,۲۸۸	۱۱٤۱
ERM	۰,۰٥۳	۰,۰۰۹	۰,۰۸۲	۰,۰۰٤	۱۱٤۱
REM	۰,۰۹٤	۰,۰۰٦	۰,۱۷۳	۰,۰۰۱	۱۱٤۱
AEM	۰,۰۷۳	۰,۰٦۳	۰,۲۰۷	۰,٤۲۱	۱۱٤۱
DEBT	۰,۹۹٥	۰,۰٦٥	۱,۰۲۹	۰,٦٥٤	۱۱٤۱
SIZE	۱۳,٥۲٥	۱۰,۳۰۳	۱۹,۲۷۷	۱,٥۸۰	۱۱٤۱
MB	۰,۸٥٤	۰,٥۳٦	۱,۸۲٦	۰,۹٦۳	۱۱٤۱
Culib	٤,۸۱۷	۱,٥۳٥	٥,۹٦۳	۰,٤۲۳	۱۱٤۱
ltdebt	۰,۹۰۹	۰,۱۸۲	۱,۱۷۸	۰,۱۰۷	۱۱٤۱
Sokok	۱,٥۹٦	۰,۰۲۸	۲,۰۳۷	۰,٥۲٥	۱۱٤۱
CD	۱,۱٦۲	۰,۹۲۳	۱,۲٤٦	۰,۱۸٤	۱۱٤۱
Ld	۰,۹۰۲	۰,۰۰۸	۰,۹۹۳	۰,٤۰۳	۱۱٤۱

According to the descriptive statistics table, the average related to the borrowing sales of the sample companies is ۰,۰۹٤ and the sales for the sample companies is ۰,۰۷۳. Also, the average risk management for sample companies is ۰,۰٥۳ (the debt ratio is obtained by dividing total debt by total assets, and long-term and current liabilities are divided by assets due to balancing the figure).

The results of the research hypotheses test based on regression

In the present study, the model estimation method is based on panel data. This method is a combination of time series data (۲۰۱۱-

۲۰۱۹) and cross-sectional data of ۱٦۳ companies admitted to the stock exchange. All the calculated figures for each of the variables of the model are in millions of Rials. The software program used in this research is Evioz[۹] software program. The estimated models according to the presented hypotheses are presented as multivariable regression models.

The results of the first main hypothesis test and model. The first main hypothesis: the financing method that companies choose will have a significant effect on the use of loan sales. The current hypothesis consists of two parts:

The first sub-hypothesis: the financing method that companies choose will not have a significant effect on the use of sales.

The second sub-hypothesis: the financing method that companies choose will have a significant effect on the use of sales.

Therefore, the regression models for the first hypothesis (current debt, long-term debt and Sukuk bonds related to foreign financing) have been developed as follows:

$$AEM_{it} = \beta_0 + \beta_1 culib_{it} + \beta_2 ltdebt_{it} + \beta_3 Sakok_{it} + \beta_4 CD_{it} + \beta_5 LD_{it} + \beta_6 ROA_{it} + \beta_7 DEBT_{it} + \beta_8 SIZE_{it} + \beta_9 MB_{it} + \varepsilon_{it}$$

The first sub-hypothesis:

H۰: The financing method that companies choose will not have a significant effect on the use of sales

H۱: The financing method that companies choose will have a significant effect on the use of sales.

Table ۳.

The result of the first sub-hypothesis test

	Dependent variable: sales		
Variable	**Coefficient**	**t statistic**	**Prob**
C	۰,٦۰۱	٤,۱۹۸	۰,۰۰۰
Culib	-۰,۰۲۹	-۲,۳۰۸	۰,۰۲۱
ltdebt	۰,۲٥۳	۷,۲٥۳	۰,۰۰۰
Sakok	۰,۰۰۳	۲,۹۸۲	۰,۰۱۸
ld	۰,۱۱٥	۱,٥٤٤	۰,۰۲۰
cd	-۰,۰۹۷	-۲,۳۰٤	۰,۰۲۱
Roa	-۰,۰۰٥	-۲,٦۷۷	۰,۰۰۷
Debt	۰,۰۰۰۲	۰,۰۳۰	۰,۹۷٥
Size	-۰,۰۰٦	-۰,۱٥۸	۰,۸۷۳
MB	-۰,۰٥۳	-٦,۹۱٦	۰,۰۰۰
F statistic	۲,۷۰٥	R۲	۰,٥۹
F(Prob)	۰,۰۲۹	R۲A	۰,٥۸٦
		D.W	۲,۰۱٦

The first step: to determine the homogeneity or heterogeneity of the data using the Chow Test

According to the significance level of Chow's test statistic, which is higher than the acceptable error level. A pooled data model is selected for fitting. Therefore, it is not appropriate to use the panel data method, also, due to the non-significance of Chow's test, there is no need for Hausman's test. The coefficient of determination of the model is equal to (۰,٥۹), which shows that ٥۹٪ of the changes in the sales variable can be explained by internal and external financing methods and other control variables. In regression analysis, especially when the variables are studied over a period of time, the change of data over time may follow a certain pattern, Durbin Watson test is used to characterize this pattern. The concept of independence means that the result of one observation does not affect the result of other observations. In regression, when the behavior of the dependent variable is studied over a period of time, the problem of non-independence of errors may be encountered. This type of relationship in data is called autocorrelation. If there is autocorrelation in errors, linear regression cannot be used. To check this assumption intuitively, you can use variable sequence graphing. But the safer way is to use the Durbin Watson between ۰ and ٤. If there is no sequential correlation between the residuals, it indicates a negative correlation. In general, if this coefficient is between ۱,٥ and ۲,٥, there is no need to worry, since the Durbin Watson statistic is equal to (۲,۰۱٦), this coefficient is between ۱,٥ and ۲,٥, so it shows correlation There is no error between components of the model. The significance level of F statistic is equal to (۰,۰۲۹) less than the accepted error level (٥٪) and the whole regression model is significant.

The second step: verifying or rejecting the hypothesis: The results of Table ٤ show that current debt with a coefficient of ۰,۰۲۹ and a

significance of ۰,۰۲۱, long-term debt with a coefficient of ۰,۲۵۳ and a significance of ۰,۰۰۰, Sukuk bonds with a coefficient of ۰,۰۰۳ and a significance of ۰,۱۸ from domestic financing methods, and cash receipts with a significance of ۰,۰۲۰ and Retained earnings have a significant effect on sales with a significance of ۰,۰۲۱. Also, among the control variables included in the model, asset return rate and growth opportunity have an effect on sales. Therefore, the research hypothesis that the financing method chosen by the companies will have a significant effect on the use of sales is accepted and confirmed. And the results show that no matter how much the financing company does, there will be a possibility of sales.

The second sub-hypothesis: the financing method that companies choose will have a significant effect on the use of loan sales. The regression model of the present hypothesis is as follows.

$$REM_{it} = \beta_0 + \beta_1 culib_{it} + \beta_2 ltdebt_{it} + \beta_3 Sakok_{it} + \beta_4 CD_{it} + \beta_5 LD_{it} + +\beta_6 ROA_{it} + \beta_7 DEBT_{it} + \beta_8 SIZE_{it} + \beta_9 MB_{it} + \varepsilon_{it}$$

H۰: The financing method that companies choose will not have a significant effect on the use of borrowing sales.

H۱: The financing method that companies choose will have a significant effect on the use of credit sales.

Table ٤.

The result of the second sub-hypothesis test

Dependent variable: Loan sales			
Variable	**Coefficient**	**t statistic**	**Prob**
C	۰,۲۹۰	٤,٤١٤	۰,۰۰۰
Culib	-۰,۰٤۱	-۲,۹۷۹	۰,۰۰۳
ltdebt	۰,٦۰۷	٥,۱۳٦	۰,۰۰۰
Sakok	-۰,۱۰۷	-۱,۹٥۱	۰,۰٥۱
ld	-۰,۰۱۷	-۰,۹٥٤	۰,۰٤۰
cd	-۰,۰۰۹	-۱,۲۱۲	۰,۰۲۸
Roa	-۰,۰۰٦	-۱,٤۲۷	۰,۱٥۳
Debt	۰,۰۰٥	۰,۲٦۰	۰,۷۹٤
Size	۰,۰۳۳	۰,٤۲٦	۰,٦۷٤
MB	-۰,۰۲٦	-۰,٦۸۳	۰,٤۹٤
F statistic	۲,٦۲٦	R۲	۰,۷۹۱
F(Prob)	۰,۰۲۳	R۲A	۰,۷۸۲
		D.W	۱,۹۸۹

The first step: to determine the homogeneity or heterogeneity of the data using the Chow test

According to the significance level of the Chow test statistic, which is higher than the acceptable error level. A pooled data model is selected for fitting. Therefore, it is not appropriate to use panel data method, also, due to the non-significance of Chow's test, there is no need for Hausman's test. The coefficient of determination of the model is equal to (.۰,۷۹۱), which shows that ۷۹٪ of the changes in the borrowing sales variable can be explained by internal and external financing methods and other control variables. Since Durbin Watson's statistic is equal to (۱,۹۸۹), this coefficient is between ۱,٥ and ۲,٥, so it shows that there is no correlation between the error components of the model. The significance level of F statistic (۰,۰۲۳) is less than the accepted error level (٥٪) and the whole regression model is significant.

The second step: Checking the confirmation or rejection of the hypothesis

The results of Table ٤ show that current debt with a coefficient of -۰,۰٤۱ and a significance of ۰,۰۰۳, long-term debt with a coefficient of ۰,٦۰۷ and a significance of ۰,۰۰۰, Sukuk bonds with a coefficient of -۰,۱۰۷ and a significance of ۰,۰٥۱ from domestic financing methods, and cash receipts with a significance of ۰,۰٤۰ and Accumulated interest with a significance of ۰,۰۲۸ has a significant effect on borrowing sales. Also, among the control variables entered into the model, none of them showed a significant effect on loan sales. Therefore, the research hypothesis that the financing method chosen by companies will have a significant effect on the use of loan sales is accepted and confirmed. . And the results show that no matter how much the financing company does, there will be a possibility of borrowing sales. The findings of this study are line with the results of Akkoyun et al.

(۲۰۲۳), Wu (۲۰۲۳), Nanda & Gordon (۲۰۲۳), Lathiya et al. (۲۰۲۳), Guedes & Pinto (۲۰۲۳), and Agarwal & Singhvi (۲۰۲۳).

Nanda & Gordon (۲۰۲۳) showed that profit smoothing through real accounting items does not increase firm value. In fact, profit manipulation can reduce the value of the business unit because the actions of Tah return before the management itself. Because borrowing sales in the year of dividend release causes future profits to decrease or made in the current period to increase profitability, it can have a negative effect on the cash flows of future periods. According to the results obtained from the test of the first and second sub-hypotheses, it can be said that in both cases, internal and external financing methods have an effect on both types of borrowing and accrual sales. Therefore, with this explanation, it can be said that if there are internal financing methods, they have the opposite effect on borrowing and accrual sales.

The results of the second main hypothesis test and model.

The second main hypothesis states: corporate risk management will have a significant effect on reducing the occurrence of sales.

This hypothesis consists of two sub-hypotheses:

The third sub-hypothesis: corporate risk management will have a significant effect on reducing the occurrence of sales.

The regression models of the present hypothesis are in the opposite form.

$$AEM_{it} = \beta_{۰} + \beta_{۱}ERM_{it} + \beta_{۲}ROA_{it} + \beta_{۳}DEBT_{it} + \beta_{۴}SIZE_{it} + \beta_{۵}MB_{it} + \varepsilon_{it}$$

H۰: Corporate risk management will not have a significant effect on reducing the occurrence of sales.

H۱: Corporate risk management will have a significant effect on reducing the occurrence of sales.

Table ٥.

Statistical significance of the research model

Model	Coefficient of determination	Adjusted coefficient of determination	F statistic	Significant level
Seventh	۰,۵۹	۰,۵۱	۷,۹۲۷	۰,۰۰۰

The most important goal of this table is to provide a statistic to measure the goodness of fit, which is done by the coefficient of determination. The coefficient of determination is a measure to measure the intensity of the relationship between x and y, the value of which is ۰,۵۹. That is, the coefficient of determination is able to explain ۵۹٪ of changes in the dependent variable (sales). The sequential correlation between the residuals means that the observations influence each other. Now, after the initial check and that the significance of the whole model has been accepted using the F statistic, we will check the significance of the coefficients obtained from the t-test. The significance table of the regression model coefficients is as follows.

Table ٦.

Coefficients and value of t statistic

Variables	Coefficient of	T statistic	Significant level
C	۰,۰۱٤	۰,٤۸۷	۰,٦۲٦
ERM	۰,۰۰۱	۰,۰۷۹	۰,۰۳۷
MB	۰,۰۰٥	۱,۰٥۱	۰,۰۰۳
DEBT	۰,۰۱۲	٤,۳۲٦	۰,۰۰۰
ROA	-۰,۱۳۲	-۱۱,۸٦۸	۰,۰۰۰
SIZE	-۹,٥۳	-۰,۱۳٤	۰,۸۹۰

Test result

According to the test results of the first research model, the significance level of the F statistic (۰,۰۰۰) is less than the acceptable error level (٥٪) and the whole regression model is significant. Considering the low (P-Value) of the t statistic from the accepted error level for the coefficient of β۱, the test results show that corporate risk management has an effect on borrowing sales. Therefore, the H۰ hypothesis of the research can be rejected at the error level of ٥٪. Also, the results of the research show that the entered control variables of asset return rate and debt ratio and market value to book value have a

significant effect in identifying borrowing sales.

The fourth sub-hypothesis: corporate risk management will have a significant effect on reducing the occurrence of borrowed sales.

$$REM_{it} = \beta_{.} + \beta_{۱} ERM_{it} + \beta_{۲} ROA_{it} + \beta_{۳} DEBT_{it} + \beta_{۴} SIZE_{it} + \beta_{۵} MB_{it} + \varepsilon_{it}$$

H۰: Corporate risk management will not have a significant effect on reducing the occurrence of borrowed sales.

H۱: Corporate risk management will have a significant effect on reducing the occurrence of borrowed sales.

Table ۷.

Statistical significance of the research model

Model	Coefficient of determination	Adjusted coefficient of determination	F statistic	Significant level
Eighth	۰,٦٤	۰,٥٦	۸,٥٥٤	۰,۰۰۰

The most important goal of this table is to provide a statistic to measure the goodness of fit, which is done by the coefficient of determination. The coefficient of determination is a measure to measure the intensity of the relationship between x and y, which is ۰,٦٤ That is, the coefficient of determination is able to explain ٦٤٪ of changes in the dependent variable (borrowed sales). The sequential correlation between the residuals means that the observations influence each other. Now, after the initial check and that the significance of the whole model has been accepted using the F statistic, we will check the significance of the coefficients obtained from the t-test. The significance table of the regression model coefficients is as follows.

Table ۸.

Coefficients and value of t statistic

Variables	Coefficient of	T statistic	Significant level
C	۰,۰٤۸	۱,٦۱٤	۰,۱۰٦
ERM	۰,۰۳۷	٤,٤۰٦	۰,۰۰۰
MB	۰,۰۰٦	۰,۳۷۳	۰,۰۰۸
DEBT	۰,۰۰۱	۰,٤٦٦	۰,٦٤۰
ROA	۰,۰۰۸	۳,٥۹٥	۰,۰۰۰
SIZE	-۰,۱۳۷	-۱۲,۳۷۸	۰,۰۰

Test result:

According to the test results of the first research model, the significance level of the F statistic (۰,۰۰۰) is less than the acceptable error level (٥٪) and the whole regression model is significant. Considering the low (P-Value) of the t statistic from the accepted error level for the coefficient of β۱, the test results show that corporate risk management has an effect on borrowing sales. Therefore, the H۰ hypothesis of the research can be rejected at the error level of ٥٪. Also, the results of the research show that the input control variables of asset return rate, company size and market value have a significant effect on book value in identifying borrowing sales. Borrowing occurs when a manager uses personal judgment for financial reporting. On the one hand, profit accrual items allow the managers to calculate the profit in a way that reflects the true value of the economic enterprise, and on the other hand, these items allow the managers to use the flexibility of the accepted accounting principles and methods and change the information content of the profit. Distort Financial risk not only affects the development of the company itself, but also affects the economic development of the whole society. However, many of the existing methods are neither integrated fuzzy sets with quantitative analysis, nor considered as historical data in the past few years. Considering the partial use of information in evaluation, it is appropriate to use historical financial information and fuzzy theory to describe the evaluation information about financial risk for companies. Establishing regulations and subsequently promulgating them to reduce credit risk leads to unwanted volatility in income statements. Regardless of the specific information considered, there is still a subjective aspect to a financial institution's assessment of financing risk, but it is important for any company to have a

sound modeling framework. Because loss provisions affect income statements, accurate evaluation of these amounts is essential for each reporting period. However, creating regulations and their subsequent promulgation to reduce financing risk leads to unwanted volatility in income statements.The results of thi article are in line with the research results of Nishihara et al. (۲۰۲۳), Eugenia et al (۲۰۲۳), Akkoyun et al (۲۰۲۳), Cashman et al (۲۰۲۲).

The Algorithm-based research hypothesis test results

The third hypothesis: the accuracy of the sales forecast by the bird flight optimization model is higher than the linear regression.

$$AEM_{it} = \beta_{.} + \beta_{۱} ERM_{it} + \beta_{۲} ROA_{it} + \beta_{۳} EA_{it} + \beta_{۴} EM_{it} + \beta_{۵} CFO_{it} + \beta_{۶} culib_{it} + \beta_{۸} ltdebt_{it} + \beta_{۸} CD_{it} + \varepsilon_{it}$$

The fifth sub-hypothesis: the accuracy of the sales forecast by the bird flight optimization model is higher than the linear regression.

H۰: The accuracy of the sales forecast by the bird flight optimization model is not higher than the linear regression

H۱: The accuracy of the sales forecast by the bird flight optimization model is higher than the linear regression.

Table ۹.

The result of the fifth sub-hypothesis test

Dependent variable: Sales			
Variable	**Coefficient**	**t statistic**	**Prob**
C	۸,٦۱٦۷	۳,۲٦۱٤	۰,۰۰۸
ERM	۸,۸۳۹٦	۳,۷۸۵۵	۰,۰۲۰
Roa	-۸,٤۹٦۱	۱,۷٦٤۵	۰,۰۰۰
EA	۰,۰۰۰۹٦	۰,۰۰۹۳	۰,۰۱۸
EM	-۲,۰۳۸۹	۰,٤۰۸۷	۰,۰۰۰
CFO	-۱۱,۳۸۹۰	۲٦,۵۷۷	۰,۰۰۰
Culib	۱۸,۳٤۷۱	۷,۳٤۲۳	۰,۰۱۳
Ltdebt	-۱,۹۸٦٦	۳٤,۲۲۵	۰,۵٦۲
CD	-۰,۰۰۵۷۵۷	۰,۰۱۸۱	۰,۷۵۲
F statistic	۳۰,۸۵۲	R۲	۰,۰۵٤
F(Prob)	۰,۰۰۰	R۲A	۰,۵۳٦
		D.W	۱,۸٤٤

The first step: to determine the homogeneity or heterogeneity of the data using the Chow test

According to Table ۹ and the significance level of Chow's test statistic, which is higher than the acceptable error level, the consolidated data model is selected for fitting. The coefficient of determination of the model is equal to (۰,۵٤), which shows that ۵٤٪ of sales changes can be explained with the help of the bird flight algorithm. Since the Durbin Watson statistic is equal to (۱,۸٤٤), this coefficient is between ۱,۵ is up to ۲,۵, so it shows that there is no correlation between the error components of the model. The significance level of F statistic is (۰,۰۰۰) less than the accepted error level (۵٪) and the whole regression model is significant.

The second step: Checking the confirmation or rejection of the hypothesis

The results of Table ۹ show that the accuracy of sales forecasting by the bird flight optimization model is higher than that of linear regression. Based on the obtained model, the predicted sales model by the bird algorithm has the required efficiency.

The sixth sub-hypothesis: the accuracy of forecasting of borrowing sales by the bird flight optimization model is higher than linear regression.

The regression model of the present hypothesis is as follows.

$$REM_{it} = \beta_{.} + \beta_{۱} ERM_{it} + \beta_{۲} ROA_{it} + \beta_{۳} EA_{it} + \beta_{۴} EM_{it} + \beta_{۵} CFO_{it} + \beta_{۶} culib_{it} + \beta_{۸} ltdebt_{it} + \beta_{۸} CD_{it} + \varepsilon_{it}$$

H۰: The accuracy of the prediction of borrowing sales by the bird flight optimization model is not higher than linear regression

H۱: The accuracy of forecasting borrowing sales by the bird flight optimization model is higher than linear regression.

Table ۱۰.

The result of the sixth sub-hypothesis test

Dependent variable: Loan sales			
Variable	**Coefficient**	**t statistic**	**Prob**
C	۱۷,٤۸۰۹	۷,۳۱۵۳	۰,۰۱۷

Dependent variable: Loan sales			
Variable	**Coefficient**	**t statistic**	**Prob**
ERM	-۱,۸۷۰۹	۳,٤۲٥۸	۰,۰۰٥
Roa	-۰,۰۰٦۹٦	۰,۱۸۲۱۳	۰,۰۰۲
EA	۱,۲٥۹٥	۰,۷۹۱٦	۰,۰۰۰
EM	-۱۲,٥۲٦۸	٥,۱٦۲۰	۰,۰۱۲
CFO	-۸,٤۰۰٤	۱,۷۷۷۸	۰,۱۲۰
Culib	۰,۰۰۰٤٥	۰,۰۰۹٤	۰,۰۸٥
Ltdebt	-۲,۱۷۸۱۹	۰,٤۱۰۸	۰,۰٦۳
CD	-۱۱,۱۹٤۱	۲,٦۷۸۸	۰,۰۱٥۷
F statistic	۱۳,۰۱٥۰	R۲	۰,۰٦۸
F(Prob)	۰,۰۰۰	R۲A	۰,٦۷۱
		D.W	۱,۹۰۳

According to Table ۱۰ and the significance level of Chow's test statistic, which is higher than the acceptable error level, the consolidated data model is selected for fitting. The coefficient of determination of the model is equal to (۰,٦۸), which shows that ٦۸٪ of the changes in loan sales can be explained with the help of the bird flight optimization algorithm. Since the Durbin Watson statistic is equal to (۱,۹۰۳), this coefficient is between It is located from ۱,٥ to ۲,٥, so it shows that there is no correlation between the error components of the model. The significance level of F statistic is (۰,۰۰۰) less than the accepted error level (٥٪) and the whole regression model is significant.

The second step: Checking the confirmation or rejection of the hypothesis

The results of Table ۱۰ show that the accuracy of the prediction of borrowing sales by the flight pattern of birds is higher than that of linear regression. Based on the obtained model, the predicted model of borrowing sales by the bird optimization algorithm has the necessary efficiency.

Tests related to collective intelligence method

Table ۱۱.

Borrowing sales prediction error

	Test		**Validation**		**Train**	
MSE	۰,۰۰٦ ۸	۰,۰۰٥ ۹	۰,۰۰ ۹	۰,۰۷ ۹	۰,۰۲ ٥	۰,۰٥ ٥
MAE	۰,۰۰۷	۰,۰۱۹	۰,۱٥ ۰	۰,۰٦ ۷	۰,۰٤ ۳	۰,۰۰ ۹
SMAPE	۰,٤٥۳	۰,۲٥۷	۰,٦۰ ۹	۰,٤۳ ۱	۰,٥۱ ۳	۰,٦۰ ۲
R۲	۰,٥۰۷	۰,٤۱۸	۰,٤۱ ٤	۰,٥٥ ۱	۰,۷٤ ۷	۰,٥٦ ٤

The following table shows the selected variables and the weight of each of them with the accuracy of ۳ decimal places for model (۱). The proposed algorithm has selected ۸ variables out of ۱۲ variables. The performance results of different research models indicate that the combination of algorithms can provide better and more favorable results.

Table ۱۲.

Selected variables of loan sales

Row	**Variable**	**Variable weight (actual)**	**variable weight (mandatory)**
۱	EA	۰,٤۱۷	۰,٥۱٥
۲	ROA	۱,۳٥۷	۰,۹۸٥
۳	ROE	۰,۰۰۰	۰,۰۰۰۰
٤	EM	۰,۰۹۷	۰,۱۱۳
٥	As	۰,۰۰۰	۰,٥۰۳
٦	CFO	۱,۰۷۳	۰,۸۸٥
۷	LEV	۰,۰۰۰	۰,۰۰۰
۸	RO	۰,۰۰۰	۰,٥٦۸
۹	CL	۰,۸٦۲	۰,۷۷۱
۱۰	Long-term debt	۰,۹۲۹	۰,۰۸٦
۱۱	Cash	۱,۲٥٦	۱,۰۲۹
۱۲	Accumulated profit	۰,۰۰۰	۰,۰۰۰
۱۳	ERM	۱,۰۱٦	۰,۹٤۷

It is given according to the results of the weight of each of the selected variables. As can be seen, the above ۸ variables of gross profit margin, return on assets, changes in profit, operating cash to assets, current debt, long-term debt, cash flow and risk management have been approved to enter the model due to their weight. Other variables are not included in the model because they have no weight in the model. On the other hand, in order to introduce and identify the most effective key inputs in predicting loan sales, the flight pattern of birds has been used. Therefore, a value of ۱ means considering this parameter as a network input, and a value of zero means that this parameter is not possible. As it is known, the six variables of gross profit margin, return on assets, and operating cash to assets, current liabilities, cash flow and corporate risk management are

considered as the main parameters in the model in both models and have the greatest impact in predicting sales. Borrowing and commitment.

Conclusion

Borrowing is defined as an intentional attempt by management to convey specific information to users of financial statements. Accurate and timely forecasts of profit management improve the decision-making of users of accounting reports. If investors use the past as a basis for the future, they can guess what the company's situation will be like in the future using past information, but this is only a guess based on past information; while the future may be very different from the past. In this regard, agency theory based on the assumption of conflict of interests can explain the reasons for borrowing sales. Due to the conflict of interest, which is one of the results of the creation of large joint-stock companies, the owner-agent relationship and the theory of agency have been formed, and the existence of an effective supervisory mechanism on management is necessary to ensure that proper management is applied in the interests of shareholders. In the current business structure, the separation of ownership from management is inevitable, and the absence of an effective monitoring mechanism on management in such companies increases the possibility of inefficient allocation of resources and the spread of organizational problems, and this often leads to the issuance of non-transparent and misleading reports to hide Problems are seen from the perspective of shareholders. The possibility of making loan sales is higher compared to other companies. Using the ownership percentage of institutional shareholders, debt ratio, company size, income tax, sales variability, profit variability, cash from operating activities, profit quality ratio, total assets turnover, return on sales, return on investment and return on equity model by using a decision tree, which had ۷٤٪ accuracy in predicting loan sales.

Suggestions

- Forming and optimizing the borrowing sales model using other innovative algorithms;
- Forming and optimizing the borrowing sales model using input information except for what came in this research. For example, measuring the performance of other market indicators and their impact on the borrowing sales model;
- Presenting a new borrowing sales model using multi-criteria optimizers;
- Presenting a new model of borrowing sales by considering other statistical communities;
- Expanding information and trying to include international markets;
- Presenting a new model of borrowing sales with an emphasis on financial behavior issues and how to influence investors.

Research limitations

- The asymmetry of information between all stakeholders is considered as a limiting factor in the accurate prediction of information in this model;
- The lack of knowledge of the shareholders with the concepts of capital market and borrowed sales and the meta-heuristic algorithms of the flight of birds and artificial intelligence can be a limitation for this model;
- The intervention of capital market executives and manipulation of capital market symbols can be an inhibiting factor in the functioning and forecasting of this model.
- As an artificial intelligence, borrowing sales modeling also faces obstacles. One of these obstacles is access to sufficient and high quality data. To build an accurate forecasting model, comprehensive and accurate data on past sales and return rates are required. But in many cases, sufficient data are not available or their quality is low.
- Other limitations include the complexity of the loan sales process and changes in the market. The loan sales process includes many dynamic and complex variables in which many changes

occur. Also, with changes and competition in the market

- The forecasting model must be updated and respond to market changes and competition.
- Finally, the limitation in borrowing sales modeling with artificial intelligence is the need for expertise and technical knowledge. Building an accurate prediction model requires expertise and technical knowledge in the field of artificial intelligence, machine learning, statistics and mathematics. To build an accurate forecasting model, expertise and strong technical knowledge are needed in these fields.

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