

The Application Of Automatic Linear Programming To Determine The Optimal Financial Structure

Ali Hindi Al-Ali

Faculty of Administration and Economics, University of Kufa, Iraq.

Email: alih.alali@uokufa.edu.iq

Sarah Salam Sarhan

Faculty of Administration and Economics, University of Kufa, Iraq. Email:

sarhs.alruaziq@student.uokufa.edu.iq

Abstract

Purpose- The paper aims to know the role of automatic linear programming in determining the optimal financial structure.

Design/ methodology/ approach- The current study is an applied study. The paper utilizes different indicators (measurements) for the financial structure, including financing with ordinary shares, financing with retained earnings, financing with loans, and financing with deposits. The optimal financing structure was also determined using automatic linear programming. Data were gathered from 20 Iraq Stock Exchange-listed banks. The study used 44 banks as a sample from 2015 to 2020, and it also adopted a financial hypothesis that the study sample banks rely on balanced financial structures in their operational operations.

Findings - We conclude that the optimal combination that banks can use to fund their assets must rely primarily on finances with ordinary shares.

Originality/value - To create profit and prevent future financial risks, the study sample banks must depend on an optimal financing mix indicated by funding with ordinary shares.

Keywords: automatic linear programming, optimal financial structure, balanced financial structures, the optimal combination

1. INTRODUCTION:

The banking sector is one of the sectors that play a significant role in Iraqi reality, leading to economic growth. It is an important financial origin for this expansion, and it contributes to economic stability and the resolution of problems and difficulties. This interest in financing the activities of the banking sector has increased significantly in recent years because it is a double-edged sword that can be a major consideration in the bank's success or failure. The financial structure is depicted on the balance sheet's left side of the financial statements.

In the latest practices to manage and reduce investment risk, banks seek to achieve a

balance between internal and external sources of funding and to achieve the optimal level of funding that aids to make effective decisions to achieve the maximum amount of profits in return for the minimum amount of risks, thus enhancing and strengthening the bank's performance using automatic linear programming through the statistical program SPSS to reach the optimal financing

The study is significant because it assists in identifying the sources of financing for Iraqi banks, allowing the optimal combination to be determined, thereby avoiding the risks that may be encountered. The following questions represented the study's problem: Do the banks in the study sample rely on a diverse financing mix? What role does linear programming play

in determining the best financing structure? As a result, this research presents appropriate solutions to avoid such risks and confront the financial imbalances and problems it faces by stabilizing the funding sources. The solutions reflect a mix of owned and borrowed funds to achieve the best combination for increasing revenue while avoiding risks and financial problems.

2. LITERATURE REVIEW

Before delving into the optimal financial structure, it is necessary to define some related terms, such as capital structure and financial structure. According to (Morsink, 2018) capital structure is defined as how an organization finances its operations through equity and debt. While (Oyedokun, et al., 2018) defined it as the total sources of financing that the institution uses to finance its assets and operations, including retained earnings, equity, and long-term debts. He expressed his viewpoint (Marimuthu, 2019) which he defined as the debt-to-equity ratio used in financing business operations.

Based on the preceding, the researchers conclude that the capital structure consists of a mix of long-term debt and equity. The capital structure is only used to finance long-term assets, distinguishing it from the financial structure defined by him (Hui, et al., 2017) a mixture of capital and debt at different rates. While (Darmawan, 2019) indicated that the source of financing used to finance the institution's assets is represented in the total liabilities on the balance sheet. (Zakaria & Salawa, 2020) It should be added that the financial structure is nothing more than a mix of debt and equity used to fund the institution's activities and investments.

Relying on the above, it is clear that the financial structure is represented on the balance sheet's left side, through which the institution's assets are financed. In terms of the optimal financial structure, (Bertuah & Budiati, 2020) stated that the ratio of debt to equity could increase the institution's share price. While (Himmah & Dianty, 2020) stated that the optimal financing structure maximizes value for the institution while assuming a certain level of risk. He went on to say (Adhegaonkar & Khedkar, 2021) that the optimal financing structure is a well-balanced

mix of debt interest and debt cost. The researchers believe that balancing the financial structure of any financial institution can only be done by adopting that harmonious mixture of financial sources in which the cost of financing is at its lowest and, in return, the value of the institution is at its highest as a result of its profitable operations.

There are numerous theories dealing with the structure of finance, the most important of which are Modigliani and Miller's theories. However, according to (Nguyen, 2020) Modigliani and Miller's theory is inappropriate for the financing structure because it assumes homogeneous expectations, ideal capital markets, the absence of taxes or bankruptcy costs, and financial leverage does not affect the market value of the institution.

According to (Bodie, et al., 2013) the agency theory arises from a conflict of interest between shareholders and managers appointed as their agents who pursue their interests and goals at the expense of the shareholders' interests. In terms of the trade-off theory, (Abdul Aziz, 2019) stated that the optimal financing structure could be determined by balancing the benefits and costs associated with debt financing, which may reduce agency costs. While also (Pinto, et al., 2020) appended that the ownership structure is a tool to facilitate agency conflicts in corporate governance, as shareholders can regulate and manage their businesses by deciding on the capital structure choice.

According to (Ehrhardt & Brigham, 2011) managers have information to forecast the organization's cash flow better than investors. This discrepancy in information between managers and investors is referred to as information asymmetry. In contrast, he added (Nawi, 2015) that the signal theory was developed because its financing structure refers to information about the institution and its investors.

According to the two researchers, many theories deal with financing structure. However, each theory is based on assumptions, such as the Modigliani and Miller theory, which assumed the absence of taxes or bankruptcy costs. As a result, owners and managers are at odds. The linear programming method can be used in conjunction with the SPSS statistical program to determine the optimal financing structure that will assist the institution in improving its

number	Bank of Name	Ordinary stocks finance	retained earnings finance	debt finance	Deposit finance	Average
1	Ashur	46.94%	1.19%	29.44%	22.43%	100%
2	AL-Atta	34.73%	0.47%	43.43%	21.37%	100%
3	Baghdad	12.20%	0.67%	46.28%	40.85%	100%
4	Commercial	42.91%	3.28%	29.34%	24.48%	100%
5	Credit	36.81%	5.06%	31.92%	26.21%	100%
6	Elaf	55.97%	0.72%	27.65%	15.67%	100%
7	Gulf Commercial	33.98%	1.13%	34.88%	30.01%	100%
8	International development	22.23%	1.33%	41.98%	34.47%	100%
9	Investment	31.37%	1.48%	36.47%	30.68%	100%
10	Iraqi Islamic	35.39%	1.47%	39.13%	24.02%	100%
11	Kurdistan	28.00%	4.25%	38.89%	28.86%	100%
12	AL-Mansour	11.38%	0.24%	45.06%	43.31%	100%
13	Middle East	22.65%	12.19%	37.47%	27.69%	100%
14	AL-Mosul	51.63%	0.75%	27.12%	20.50%	100%
15	National	29.83%	1.34%	41.24%	27.60%	100%
16	National Islamic	34.26%	1.66%	44.47%	19.61%	100%
17	Region Trade	37.84%	2.87%	58.84%	0.45%	100%
18	Sumer	58.22%	1.92%	22.96%	16.91%	100%
19	Trans Iraq	63.73%	0.37%	20.66%	15.23%	100%
20	The United	43.06%	0.22%	37.18%	19.55%	100%
	Average	36.66%	2.13%	36.72%	24.49%	100%

performance, increasing its ability to generate profits, and dealing with future risks.

3. DATA AND METHODOLOGY:

For the independent variable, the measurement tools are shown in table (1) will be used (financing structure)

Table (1) Funding Structure Budget Metrics

The measure	Mathematical equation	Reliable sources for determining the measure
Ordinary stocks finance(equity)	$\frac{\text{paid Capital}}{\text{total assets}}$	& (Ezeoha, 2011) (AbuTawahina, 2015) & (Brigham & Houston, 2020)
Retained earnings finance	$\frac{\text{Retained earnings}}{\text{total assets}}$	
Debt finance	$\frac{\text{total liabilities}}{\text{total assets}}$	
Deposit finance	$\frac{\text{deposit}}{\text{Total Liabilities and Equity}}$	

Source: Prepared by the researchers based on the sources mentioned therein

4. RESULTS AND DISCUSSION

Table (2) shows us the percentage of the ownership structure of the banks in the study sample. We note that most of the banks preferred to rely mainly on financing with ordinary shares and then rely on Financial with debts and then deposits and finally relying on self-financing; these banks are: (Trans Iraq, Ashur, Commercial Bank, Al-Credit, Elaf, Sumer, and The United). The second section

of banks preferred relying on debt finance, then financing with ordinary shares (equity), finance with deposits, and self-financing such as (National, Iraqi Islamic, Al- Investment, Al-Atta, Al-Gulf Commercial, and Al-National Islamic). Finally, some other banks prefer to rely on debt finance and then rely on self-finance, and the last source is relying on deposit finance. Basing on the preceding results of the financial structures financial analysis adopted by the banks within the

current study sample, the first main hypothesis, which states (that the banks of the study sample depend in their operational actions on balanced financial structures), is rejected due to their reliance on different combinations of financial structures according to its investment plans and financial policies.

Table (2) Ownership Structure Rat

Source: Prepared by the researchers based on the annual reports of banks

Table (3) depicts the optimal solution of the study of selected banks as extracted through the indicators of net current assets, employment of accumulated profits, real productive capacity, and expected bankruptcy value to determine the optimal financing structure using the method of automatic linear programming via the SPSS statistical program to assist the surveyed banks in improving their banking work and performance. Increasing its ability to confront potential future risks to achieve a sound financial reality. The following table will help to clarify this:

Table (3) The objective function of the study sample banks

Number	Bank of Name	objective function
1	Ashur	6.15
2	AL-Atta	1.32
3	Baghdad	1.72
4	Commercial	6.55
5	Credit	5.99
6	Elaf	6.64
7	Gulf Commercial	1.23
8	International development	2.49
9	Investment	3.69
10	Iraqi Islamic	3.94
11	Kurdistan	4.60
12	AL-Mansour	1.82
13	Middle East	3.05
14	AL-Mosul	5.30
15	National	3.49
16	National Islamic	4.06
17	Region Trade	2.91
18	Sumer	7.40
19	Trans Iraq	8.89
20	The United	4.13
	Average	4.27

Source: Prepared by the researchers based on the annual reports of banks

The financial statements of the study selected banks were analyzed using automatic linear programming via the (SPSS) program to determine the optimal combination that the

(lagging) banks can guide to apply to advance their banking reality and achieve financial stability. The table below summarizes the current study model (4).

Table (4) Summary of the model

type	V3	V4
Target		Z
Automatic Data Preparation		On
Model Selection		Forward

Method		Stepwise
Information Criterion	Akaike Information Criterion Corrected (AICC)	9.321

Source: Prepared by the researchers based on the outputs of the SPSS program.

The table above shows the data that was entered and that belongs to the banks of the study sample, the method in which it was analyzed, and the criterion for comparison between the indicators of the financing structure appearing in the table (4) amounting

to (9.321), and the coefficient of determination for this model amounted to (72 percent), indicating that the percentage of what was interpreted by the model is very high. The analysis of coefficients can also be illustrated in Figure (1) below:

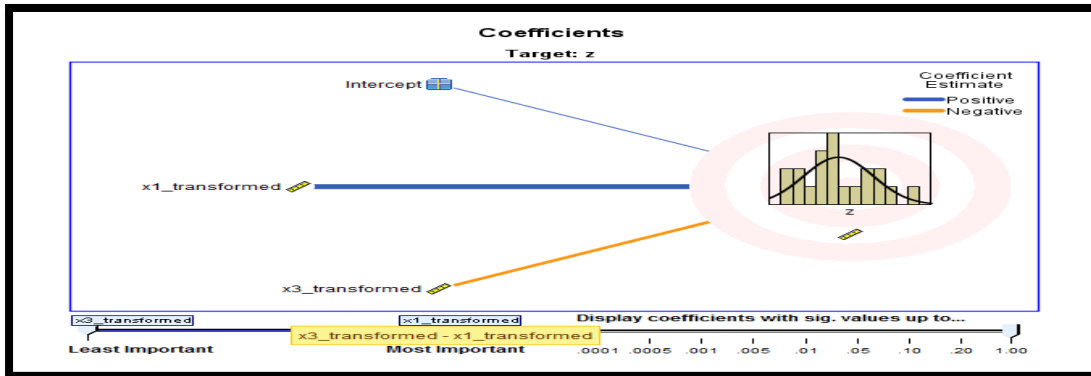


Figure (1) Transaction analysis

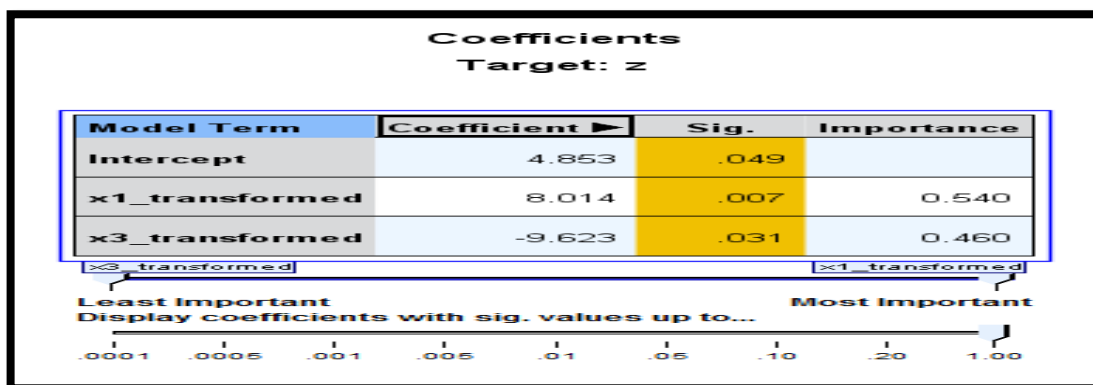
Source: Prepared by the researchers based on the outputs of the SPSS program.

The Figure above depicts an analysis of the transactions represented by the financing structure indicators to determine which indicator plays a significant role in achieving the optimal combination of the study sample banks, which can assist the study sample banks in overcoming crises and achieving a state of financial stability, which can ultimately lead to achieving financial safety. As shown in figure (1), financing with ordinary shares has a significant impact on

achieving the optimal combination; that is, banks can obtain the optimal combination and achieve financial soundness if they finance their financial assets by issuing ordinary shares at a rate of (54 percent), and in return, their adoption of debt in financing their assets at a rate of (46 percent), as the latter had the least influence on achieving the optimal combination, and Figure (2) below shows the results achieved by each

Figure (2) shows the relative importance of

Source: Prepared by the researchers based on



transactions

the outputs of the SPSS program.

The importance of each of the common stocks and debt in achieving the optimum combination of banks in the study's sample is clear from the figure (2), as we note that funding with common stocks achieved good results, as the value of transactions for this indicator reached (8.014) at a significant level (0.007), which is much lower than the test statistic which is (Sig > 0.05). Its relative importance reached (54 percent), indicating that banks can achieve the optimum combination (54 percent). If the debt is excessive, it produces the opposite results in terms of optimal financing. The transaction value for this indicator was (-9.623) at a significant level (0.031), which was less than the test statistic of (Sig > 0.05), but the debt financing indicator was the least influential. Compared to ordinary share financing, its

relative importance reached (46 percent), so banks must approve debts up to a certain amount (46 percent).

Concerning the automatic linear programming of study data: once the source of the financing structure that can achieve the optimal combination for the (lagging) study sample banks to adopt in financing their assets has been identified, the comparison process between banks will be conducted in this paragraph through the mechanism they have adopted in the structure Financing it, to know which bank of them can represent the optimal combination that other banks that suffer from financial problems can use and advance their banking situation to reach financial safety, and this will be clarified according to the table (5), which includes a summary of building the model for the current study.

Table (5) is a summary of the model construction

	Model									
	1	2	3	4	5	6	7	8	9	10
Information Criterion	0.434	-0.629								
Effect										
b5_transformed	✓		✓	✓	✓	✓	✓	✓	✓	✓
b7_transformed	✓		✓	✓	✓	✓				
b6_transformed		✓	✓	✓	✓	✓	✓	✓	✓	✓
b1_transformed			✓	✓	✓	✓	✓	✓	✓	✓
b2_transformed			✓	✓	✓	✓	✓	✓	✓	✓
b3_transformed			✓	✓	✓	✓	✓	✓	✓	✓
b4_transformed			✓	✓	✓	✓	✓	✓	✓	✓
b8_transformed			✓	✓			✓	✓		
b9_transformed			✓	✓	✓	✓	✓	✓	✓	✓
b10_transformed			✓		✓		✓		✓	

The model building method is Best Subsets using the Information Criterion.
A checkmark means the effect is in the model.

Source: Prepared by the researchers based on the outputs of the SPSS program.

According to the table (5), the banks that achieved the most optimal combination while also enjoying a good financial situation were represented by the following banks (Ashur Bank, Mosul, Iraqi Credit, Trans-Iraq, Sumer), which relied primarily on common shares, then debt financing, deposit financing, and finally relying on retained earnings to finance its assets. The sources of its financing

structure represented the optimal combination on which banks in financial distress could rely to improve their financial system, advance their banking activities, boost their competitiveness, and increase their ability to generate profits as well as strengthen their ability to deal with the risks and crises that it faces. As for the final five banks, their funding structure and the combination adopted by the

least influential among the banks as mentioned above, even though these banks enjoy good financial condition, namely, Elaf, Commercial, Kurdistan, United, National Banks, and these banks differed in their financing structures on which it relied to finance its assets, some of which relied primarily on debts, then ordinary shares, then deposits, and later retained earnings, and other. Based on the aforementioned, banks experiencing financial difficulties must select from among the

various combinations offered by the current study, emphasizing that the optimal combination that we have reached to achieve financial stability is the combination previously mentioned, and a summary of the ten combinations that were chosen to achieve financial stability. Figure (3) depicts the optimal financing structure, showing which bank had the most influence in achieving the optimal combination.

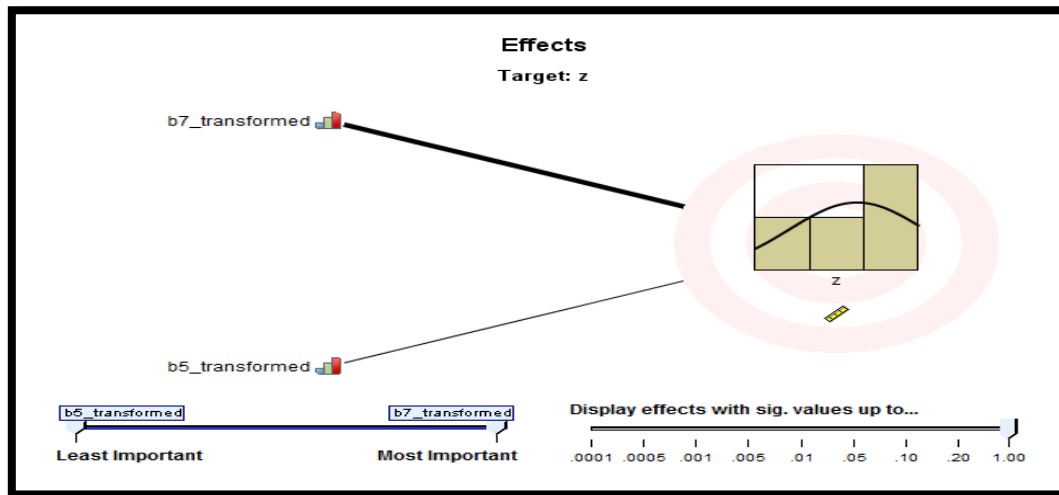


Figure (3) The combination of banks that achieve the optimal combination

Source: Prepared by the researchers based on the outputs of the SPSS program.

Figure (3) clearly shows that the bank carrying the seventh sequence, represented Mosul Bank, is the most influential bank. The combination that it has adopted in the structure of financing its assets can be considered the optimal combination that banks can adopt, given the relative importance that is achieved (51 percent), whereas the bank carrying the sequence The fifth, represented by the Ashur Bank, was less influential than the previous bank, with a relative importance of less than 1%. (49 percent). The outcomes of the automatic linear programming of balancing the financing structure of the study sample banks can be summarized based on the preceding. The results of this process can be summarized in the following points: Banks in financial distress can improve their financial situation by using the optimal combination of financing with ordinary shares, debt financing, deposits financing, and finally, retained earnings financing to finance their assets. Reluctant

banks can also follow the policy adopted by Mosul Bank, which was the most influential bank in financing its assets compared to other banks, to advance their banking activities and increase their ability to face the risks to which they are exposed.

5. CONCLUSIONS

We conclude from the automatic linear programming analysis results that the best combination that banks can use to fund their assets must rely primarily on equity financing. As a result, the study sample banks must rely on an optimal financing mix, primarily financing with ordinary shares, to help them advance their banking activities and confront future risks.

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Competing interests

The author has no conflicts of interest to declare that are relevant to the content of this article

Availability of data and materials

The datasets generated and/or analyzed during the current study are available in the Figshare repository,

<http://www.isxiq.net/isxportal/portal/uploaded/FilesList.html?currLanguage=en>

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