

Asset and Liability Optimal Management Mathematical Modeling for Bank

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ABSTRACT

This research with using data from the years 2010 and 2011 to design a mathematical model in order to manage the optimal assets and liabilities in Bank Mellat. Therefore, management of this process is regarded as the most important topic at strategic planning of bank. Therefore, it is required to obtain quantitative techniques for optimum management of assets and liabilities. One of the quantitative models for management of asset and liability in bank is Goal Programming model. While modeling all legal and operational considerations, compulsory limitations and considerations related to goals of managers and priorities are observed.

This model has structural and ideal limitation and decision making variable divides into two groups including: principal variable and diversion variable. Result of this study showed that it was possible to design model of optimum management of assets and liabilities at this bank and it is possible to determine suitable structure for items of balance sheet and extend it to management of asset items in all banks and also it is possible to extend it to all banks.

KEYWORDS: Asset and liability Management, Asset, liability, Goal Programming

INTRODUCTION

The techniques of asset and liability management occurred for strategic programming, revenues, income and modeling prediction based on balance sheet which is display of bank's sources and uses.

According to the definition the techniques of asset and liability management are targeted the volume, composition, date, sensitivity's rate, quality and liquidity of assets and liabilities for achieving the proportion of risk to predetermined return. Actually the purpose of assets and liabilities management is supporting the quality and quantity of assets with considering the risky of assets and liabilities for future management. To gain this purpose banks should search a suitable technique for achieving to this target.

In fact, the asset and liabilities management is design an appropriate strategy's management of investment in various assets with considering the liabilities of financial institution and output flows related to it with using the available financial resources in institution.

In this research, the used quantitative model is Goal Programming which is defined as ultimate goal of minimizing the deviations and determined necessities. Different necessities with goals are as form of constraints, the main variables of model, assets and liabilities items of balance sheet also deviations all are defined as goals.

2. Theoretical Foundations and Research Background

As was mentioned asset and liability management has special place for all institutions, especially financial institutions and among them, especially banks. Managers constantly seek to know what technique can maximize the return and control the risk also totally can maximize the shareholder wealth. In this regard, try to propose the techniques and models until identify the best solutions and possible answers and help the managers in the decision process.

With review of previous studies understand that the first mathematical models were in the field of bank's management. Totally the presented model in the field of asset and liabilities management can be divided into two general group's deterministic or probabilistic. Deterministic models is used of linear programming and are considered a certain amount (Constant) for random events and the calculated amounts for big problems then probabilistic model by considering the volatility of variables and the existing uncertainties in future so will provide the consistent models with these changes in the future (Habibi, 2002, Thesis).

2-1-Deterministic models

Chambers & Charnes (1961) introduced the first model of assets and liabilities as deterministic linear programming model. Their model was studied on determining an optimal portfolio for a bank over several periods that the level of existing risk in bank's portfolio was mentioned as constraints in the model.

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The Chambers & Charnes's researches continued by Cohen & Hammer(1967), Robertson(1972), Lifson & LoBlackman(1973), Filitz & Loeffler(1979). Although it was thought that their model in facing with disaggregation also unreliability and lack of dynamism is treated differently but all of them has a common feature, all of them are specifically consider the profitability in target function and used of constraints as linear form.

Eatman & Sealey are used of a multi-objective linear programming's model while three objectives (Net profit, capital adequacy ratio and the ratio of risk assets to capital) were considered.

Giokas & Vassiloglou (1991) presented a Goal Programming model in a case study of Greek relatively large banks. They believed that management in addition to trying to maximize the revenues also should try for involved risks in capital allocation and other bank's goals such as market share and increasing the amount of loans and deposits.

Antti Korhonen was presented a practical application from Goal Programming including of three stages in one of the Finland Bank as programming model of bank's dynamic portfolio with several scenarios and multiple purpose also priorities changing. He include the goals as expected profit, liquidity risk, capital adequacy, grow of customer relationships and so on also two groups of variables, deterministic variables and probabilistic variables have been surveyed in the model. Making scenario based on probabilistic volatility of probabilistic variables is reviewed in twenty-one scenario and according to economic conditions and probable changes also possible changes in priorities is the best combination of portfolio.

One of the applied research is a research with this title "A multicriteria methodology for bank's asset and liability management" which this research is done by Kyriaki Kosmidou and Constantin Zopounidi in a Greek bank. With examining the 2000 year's balance sheet with the helping of Goal Programming is offered a balance sheet for 2001 and based on three interest rate (Bond, deposits and facilities rates) is done some simulations until according to the most probable economic condition is selected the best combination with highest return.

Also Forston & Dimce used of a Goal Programming approach while were considered the four purposes (Profitability, capital adequacy and the proportion of loan to deposit and liquidity).

2-2- Probabilistic models

With a general overview, the presented approaches based on probabilistic models can be divided into eight approaches.

2-2-1- Probabilistic Simulation Models

Derwa (1973), Robinson (1973) and Grubmann (1987) expressed that using of probabilistic simulation models for solving the financial problems. Despite the ease of understanding these models by bank's managers and the controlling of limited number of variables by these models are limited the practical using of these models.

2-2-2- Modeling according to Markowitz Theory

The second approach of probabilistic modeling is admonishing of Markowitz Theory (1959) that provided the portfolio selection while the risk is measured by deviation in a period programming. This model is lacking of an essential aspect of bank's asset and liability management it means the balance of asset and liability.

He just considered the portfolio risk without considering the other possible uncertainty. Brodt transformed the Markowitz theory and he presented a program about efficient dynamic balance sheet management which maximizes the benefits for a certain amount of risk over a multi-period. However the problem of these studies it was that they were not considered the multi-stage nature and multi-objective of issue.

2-2-3- Chance Constrained Programming

The third approach of probabilistic modeling is the random constraints programming which at first time was presented by Thore & Charnes and Littlechild (1968). Pogu & Bussard (1972) were formulated a model of random constraints which was twelve periods that there was just the amount of future's cash uncertain necessities. The most important problem of random constraints programming it is that there were not any various fines about small and large volatility in constraints.

2-2-4 Sequential Decision theoretic

The sequential decision theoretic for the first time was presented by Wolf (1969) that used of consecutive decision's analysis for finding an optimal decision trough using of implicit enumeration. This technique did not present a clear optimal solution for solving the problems with a time more than a period. For solving this problem,

Wolf stated that the solution of a period model is the same with provided solution for solving the n period model. Also this model ignored the concurrency of assets and liabilities date.

Bradly & Crane (1972) used of approach for bond portfolio management model. Their model was similar to Wolf's model conceptually and to overcome the computational problems re-formulated the assets and liabilities issues and presented an algorithms of total analysis programming for minimizing the computational problems.

2-2-5- Probable Dynamic Programming

Eppen & Fama(1971) with using the probable dynamic programming approach they modeling the second and third types of assets although the aspects of uncertainty and dynamic of Bank's balance sheet was managing successfully but this approach because of computational problems especially at the time of assets and liabilities increasing was not too successful. Also Cohen and et al (1981) have done studies in this area.

2-2-6- Probable Linear Programming with Simple Recourse

The model of probable linear programming with simple recourse also is called the linear programming under uncertainty. In this approach the analysis of each random variable is reviewed by a constraint. Difficulty of structure understanding and the model's philosophy also inability to compute creates some barriers in applying this model in the 60's and 70's.

For example Thore and Cohen (1970) presented their model as a tool for analysis the sensitivity in various periods as a prescriptive tool.

Crane (1971) & Booth (1972) used of this approach with a limited number of possible results and two periods.

Kallberg and et al, be formulated the short-term financial programming of a company as linear programming model with simple flow while anticipation of cash necessity as discrete random variables.

Ziemba & Kusy (1986) used of multi-period's probable linear programming with simple recourse for the assets and liabilities management's model. Model's solutions with using of specific codes was obtained by Kallberg and Kusy(1976). They used of their model in Saving funds of Vancouver city for five years programming. Their results show that ALM probable model as theoretical and operational has provided better results in compared to deterministic linear programming model.

Carinol and et al (1994) used of multi-stage probable programming with the goal of maximizing long-term company's wealth at the same time with creation of incomes return (With creation of high income return) with presentation a large number of scenarios and uncertainties then for solving computational problems of presented model- Russell-WYasuda Kasai Model Was used of parallel computer.

2-2-7- Dynamic Generalized Networks

Mulvey & Vladimirov (1992) applied the dynamic generalized networks to design the financial issues in uncertainty condition and under various fragment time. Their model presented the some scenarios, basic indicators in financial variety issues including risk management. Finally Mulvey and Ziemba presented the wider measures and more comprehensive from assets and liabilities structure's modeling techniques for individuals and financial institutions such as banks and insurance companies about the risk controlling. However their model was appropriate for solving the small problems and was not suitable for solving the large problems.

2-2-8- Stochastic Dedication Model

Hiller & Eckstein (1993) applied the probable programming models for managing the stock exchange with constant income.

Computational problems and ignoring of a series financial implications Reduces the efficiency and applicability of some presented techniques' groups. But in using of quantitative models should be noted to several points :

1. Multi-period model which to combine the changes of return distance in during the time, transfer costs associated with the Selling of assets before date and synchronize of entrance cash flows in during the time with adaptation of assets date with expected output cash flows.
2. Simulations with considering the assets and liabilities should be done for ensuring from basic principles of accounting and adaptation of assets and liabilities liquidity.
3. Transmission costs to enter the broker costs (Wage) and other costs which occur in buying and selling of securities.
4. Should enter the uncertainty of cash flows, hidden uncertainty in commitments and savings exiting.
5. The uncertainty combination in interest rates in the decision-making process for avoiding of lending and borrowing decisions that finally it is possible lead to insolvency of bank.

6. Constraints, legal necessities and the policy existing be considered in model in operating environment of bank.

3. The estimation of model

It should be noted that in order to prioritizing and determining the importance degree of goals is used of AHP standard questionnaire and this questionnaire has been solved with using of Expert Choice software. So the results are placed in objective function of Goal Programming model and have been solved by lingo10 software.

3-1- Prioritization of goals

Because the importance level of defined goals is different the goals were divided into three groups in the first stage through interview with some heads of banks:

-The main group (Group I):

Capital adequacy

Liquidity risk

-The More important group (Group II):

Growth of total assets

-The Important group (Group III):

Receivables from banks and credit institutions

Constant assets and other assets

After dividing the goals into three general groups for determining the degree of importance within each group a questionnaire was designed and was completed by Bank's managers. After collecting the questionnaires the results was solved with using of Expert Choice software and the degree of priority and adaptation rate for different goals in proportion to themselves was obtained.

Priority level	Criterion	Degree of priority
p1: The main group	Capital adequacy	0.857
	Liquidity risk	0.143
p2: The more important group	The growth of total assets	1
p3: The important group	Receivables from banks and credit institutions	0.125
	Constant assets and other assets	0.875

3-2- Goal Programming

3-2-1- Decision variables

The decision variables are divided into two groups, the main and deviation variables. Model has 24 decision variables which 14 variables are main variables (Relating to the balance sheet elements) and 10 variables are deviation variables (5Positive deviation variables and 5negative deviation variables).

The first group of decision variables: According to balance sheet structure the following definitions are provided for decision variables.

Assets	X_i	Liabilities and Equity	Y_i
Cash	X_1	Demand deposits	Y_1
Receivables from central bank	X_2	Savings deposits and similar	Y_2
Receivables from banks and credit institutions	X_3	Term investment deposit	Y_3
Granted Facilities	X_4	Other deposit	Y_4
Bond	X_5	Payable stock's profit	Y_5
Investments and partnerships	X_6	Equity	Y_6
Constant assets and other assets	X_7		
Underline main items			
Guarantees	X_8		

The second group of decision variables: The deviations amount in gold programming model is expressed the level of achievement to goals.

Determined goal	The creation of positive deviations from goals	The creation of negative deviations from goals
Receivables from banks and credit institutions	d1+	d1-
Constant assets and other assets	d2+	d2-
Capital adequacy	d3+	d3-
Liquidity risk	d4+	d4-
Growth of total assets	d5+	d5-

3-2-2-Constraints

As was said constraints are divided into two groups structural and gold constraints. The presented model has 18 constraints that 13 of them are structural constraints and 5 are gold constraints. From 13 structural constraints the 5 constraints are considered as constant form in two periods.

3-2-2-1-Structural constraints

- Receivables from central bank:

The ratio of legal deposit is stated in balance sheet with this title "receivables from central bank". The ratio of legal deposit is in determined necessities group for the banking system and its rate for years 2010, 2011 is 14.5%.

$$x_2 = 14.5\% \sum_{j=1}^4 y_j$$

- Bond and other similar

Bond because of tax benefit and the capability of high liquidity is as assets without any risks which in needed times converted to cash quickly and is allocated to other groups of asset. From the managers and experts's opinion of bank Mellat the minimum amount of this variable is a percentage of deposit.

$$x_5 \geq 1\% \sum_{j=1}^4 y_j$$

- Investments and partnerships

Bank's investment basket is including investment in stock of accepted companies in stock exchange, rights partnerships, direct investments and the investments of outside the country that this amount should be at least 1% of total deposits. Also the instruction of credit institutions' investment the subject paragraph 3 matter 34 law of country's monetary and banking the total investment of every credit institution should not be 40% more than of mentioned credit institution's equity.

$$x_6 \geq 1\% \sum_{j=1}^4 y_j \quad \text{and} \quad x_6 \leq 40\% y_6$$

- Facilities

According to Nature of banking which is attracting the deposit and facility's granting, facility is formed the most important number of banks' assets. The credit limit of resources that is calculated in each year also is presented it to bank network in order to awareness of facilities granting limit is indicated the allocating between 70% to 80% of total deposits to facilities granting.

$$x_4 \geq 70\% \sum_{j=1}^4 y_j, \quad x_4 \leq 80\% \sum_{j=1}^4 y_j$$

- Cash

The optimal amount of cash should be such that in case of deposits' possible exit the banks does not face with major problems and does not make liquidity risk for bank. With regard to the determined necessity by the central bank the amount of stored cash at least should be equal to 2% of resources including legal deposit (deposits). According to experts' opinion in Bank Mellat this amount should be at least 1% of total deposits.

$$x_1 \geq 1\% \sum_{j=1}^4 y_j, \quad x_1 \leq 2\% \sum_{j=1}^4 y_j$$

- Guarantee

In some banking services such as issuance of guarantees because no money is exchanged so these transactions are called out-balance sheet transactions.

In the defined necessity by the Islamic Republic of Iran Central Bank so for the issuance level of guarantee is expressed that the maximum amount of guarantee issuance is equal to 30% of deposits amount plus equity plus cash amount of guarantee issuance.

$$x_8 \leq 30\% \sum_{j=1}^4 y_j + y_6 + 0.1x_8$$

- Profit

The main sources of bank's income is three main groups of assets are such as facilities, investments, bond and income from guarantee wage also the main sources of bank's costs are such as the profit of investment deposits and the costs of doubtful receivables. Income of assets which has return minus the cost of liabilities which have cost is determined equal to total return (R).

Formula of total return for years 2010 and 2011 is as follows:

$$2010: 18\%x_5 + 25\%x_6 + 1.5\%x_8 - 14\%y_3 - 1.2\%x_4 = R$$

$$2011: 18\%x_5 + 25\%x_6 + 1.5\%x_8 - 16\%y_3 - 1.3\%x_4 = R$$

- Demand Deposits

Customers deposits are formed the commercial bank's major part of financial resources. So they are as model input in model and about time aspect are in two below sections:

Real amount of demand deposits in 2010(Million Rials): $y_1=155,878,268$

Real amount of demand deposits in 2011(Million Rials): $y_1=162,312,603$

- Savings deposits and similar

This type of deposit is as bank's without any costs sources and is surveyed in two periods:

Real amount of savings free interest deposits in 2010(Million Rials): $y_2=41,654,278$

Real amount of savings free interest deposits in 2011(Million Rials): $y_2=40,600,569$

- Term investment deposits

Investment deposits have highest rate of deposit interest and is as high stretch deposit in compared to interest rate.

Real amount of term investment deposits in 2010(Million Rials): $y_3=258,901,811$

Real amount of Term investment deposits in 2011(Million Rials): $y_3=321,864,835$

- Other Deposits

Other deposits are including advance receipts for documentary credits that in two periods are as follows:

Real amount of other deposits in 2010(Million Rials): $y_4=30,891,975$

Real amount of other deposits in 2011(Million Rials): $y_4=43,280,946$

- Payable Dividends

Shareholders should be supported because of time value they give the funds to bank also for accepting the potential risk of losses through dividends. In investigated research based on decision of shareholders convention averagely in years 2010 and 2011 respectively 48% and 75% of profit is divided between shareholders.

Year 2010: $y_5 = 48\%R$

Year 2011: $y_5 = 75\%R$

- Equity

Bankroll is as a barrier for protecting of creditors in front of losses that it is possible occur because the lack of appropriate measures in risk management.

Real amount of equity in 2010(Million Rials): $y_6=27,659,463$

Real amount of equity in 2011(Million Rials): $y_6=46,658,058$

3-2-2-2-Gold Constraints

- Receivables from banks and credit institutions

According to needing for exchange also interbank needs approximately a constant value of assets is in other banks and credit institutions that generally this number is at least 14,5 % of total deposits.

$$x_3 - 14.5\% \sum_{j=1}^4 y_j + d_1^- - d_1^+ = 0$$

- Tangible and intangible constant assets and other assets

Based on defined necessity by the Central Bank $\bar{c}.1$ for private banks 70% of equity is allocated to this group of assets.

$$x_7 - 70\%y_6 + d_2^- - d_2^+ = 0$$

- Capital adequacy ratio

Capital adequacy ratio is result of bank's capital base division to weighted assets based on the risk that according to the approved of Basel committee I about banks this ratio should be at least 8%.The mentioned ratio is as the most important analysis ratios of bank's financial statements which represents the bank's power in front of unpredictable losses, so for each item of asset is defined a risk coefficient.

$$y_6 - 8\%(0 \times x_1 + 0 \times x_2 + 20\% \times x_3 + 100\% \times x_4 + 0 \times x_5 + 100\% \times x_6 + 100\% \times x_7 + 50\% \times x_8) + d_3^- - d_3^+ = 0$$

- Liquidity Risk

Liquidity risk is occurring because of a bank's inability to reduce the liabilities or providing resources for increasing the assets. One of the most important goals of banks' managers is controlling the liquidity risk which in studied bank for controlling the liquidity risk 17% of total deposits to assets is allocated with high degree of liquidity.

$$x_1 + x_3 + x_5 - 17\% \sum_{j=1}^4 y_j + d_4^- - d_4^+ = 0$$

- The growth of total assets

In using of optimizer model for determining the optimal combination for future condition should be considered the items' growth. So the growth of total assets is applied as following constraints for years 2010 and 2011:

$$2010: \sum_{i=1}^4 x_i + d_5^- - d_5^+ = 640000000$$

$$2011: \sum_{i=1}^4 x_i + d_5^- - d_5^+ = 760000000$$

3-2-3- The objective function

The objective function according to gold constraints and priority coefficient of each goal is as follows in goal groups:

$$\text{Min}Z = P_1 (0.857d_3^+ + 0.143d_4^-) + P_2 (d_5^-) + P_3 (0.125d_1^- + 0.875d_2^+)$$

The designed model was solved after identifying the constraints with using the LINGO10 software.

4-RESULT

Study on the bank's real balance sheet in year 2010 and year 2011 and its comparison with the results of model is as follows:

4-1-Year 2010

Amounts: Million Rials

Assets	xi variable	Real	Model	Deviation
Cash	X ₁	7,887,133	14,619,790	6,732,657
Receivables from central bank	X ₂	69,3814,101	83,820,130	14,439,029
Receivables from banks and credit institutions	X ₃	69,899,059	70,662,320	763,261
Granted Facilities	X ₄	379,335,620	389,861,100	10,525,480
Bond	X ₅	12,075,204	29,239,580	17,164,376
Investments and partnerships	X ₆	7,813,551	11,616,970	3,803,419
Constant assets and other assets	X ₇	40,192,307	40,190,280	-2,027
Sum		586,583,975	640,0140,170	53,426,195
Guarantees	X ₈	77,693,878	77,593,880	-99,998

4-2- Year 2011

Amounts: Million Rials

Assets	xi variable	Real	Model	Deviation
Cash	X ₁	10,043,167	22,722,360	12,679,193
Receivables from central bank	X ₂	62,173,334	81,232,430	19,059,096
Receivables from banks and credit institutions	X ₃	62,860,785	81,232,430	18,371,645
Granted Facilities	X ₄	433,023,473	451,606,900	18,583,427
Bond	X ₅	20,292,014	39,764,130	19,472,116
Investments and partnerships	X ₆	18,563,453	20,529,550	1,966,097
Constant assets and other assets	X ₇	62,911,525	62,912,250	725
Sum		669,867,751	760,000,050	90,132,299
Guarantees	X ₈	100,145,001	100,245,000	99,999

1. The allocated amount to the cash variable in this model for year 2010 is 6,732,657 Million Rials more than its real amount. This difference was 12,679,193 Million Rials in year 2011. The dedicated amount difference by model to receivables variable of banks and credit institutions and the real amount of the balance sheet in 2010 and 2011 is respectively 763,261 Million Rials and 18,371,645 Million Rials. Also the amount of bond which is allocated by model for years 2010 and 2011 is respectively 17,164,376 Million Rials and 19,472,116 Million Rials more than its real amount in related balance sheet. Being lower of mentioned current assets in balance sheet in proportion to model's dedicated amount is indicating that bank managers are followed of a bold policy in management of their current assets, it means that managers are always trying to reach the cash and marketable securities to the possible minimum. In other words, they will increase the assets operating working. This method is risky, risk of losing the customers and reduction of obligations payment.

2. The allocated amount to Receivables variable from central bank by model in proportion to its real amount in balance sheet of years 2010 and 2011 respectively 14,439,029 Million Rials and 19,059,096 Million Rials is more. Receivables variable of the central bank consists of legal deposit which is calculated weekly with a rate that each year is announced by central bank for each types of deposits (Demand, savings, term) also is reposit in Central Bank. This rate was 14.5% for studied levels. So reposit of legal deposits with Central Bank is a legal necessity. The existing difference is because non-compliance of related necessity by bank.

3. The studying on the model's result show that allocated amount by model to facilities group for years 2010 and 2011 is respectively 10,525,480 Million Rials and 18,583,427 Million Rials is more than of balance sheet's real amount.

Also the presented model suggests the increasing in investments and partnerships sector for years 2010 and 2011 is respectively 3,803,419 Million Rials and 1,966,097 Million Rials.

Mentioned differences indicate that the policy of resource allocation to investments and facilities which has acceptable return in such way that is lower than the amount of model's allocation that this matter reduced the return and obtained profit by bank.

4. In constant assets sector, bank has observed the existing necessity in studied sections and the model's allocated amount has not much different with the real amount in balance sheet of years 2010 and 2011.

Since the constant assets are as assets with low return, so it is better that its amount is in existing necessity level. This observance necessity of constant assets' proportion to equity which should be less than 0.7. About this matter the bank's performance was suitable and this variable's amount has been in the determined necessity level in balance sheet.

5. The allocated amount to issued guarantees by model about 99,998 Million Rials is less than its real amount in 2010 and about 99,999 Million Rials is more than its real amount in 2011 which is not much difference. Guarantee is as underline assets or off-balance sheet items. Off-balance sheet items are transactions that were potential then until being real has not any affect on bank's advantage or disadvantage. But on the other hand the received wage for performed operations is effective in bank's advantage or disadvantage. Since in addition to the limit of issuance for issued guarantees this type of assets are affective on bank's advantage so the model with consideration of all cases offers the less amount in 2010 and more amount in 2011 until with compliance of guarantees' issuance limit so obtained profit of received wage also increases. The bank's performance about the mentioned variable is relatively appropriate.

6. The amount of objective function is zero for model in two studied section. This matter is indicated the complete realization of the objectives in identified priorities levels.

7. Obtained profit and in following of that the proposed dividend as resource allocation method to assets group by model in two studied section was more than of obtained profit as resource allocation method to assets group by bank.

8. Capital adequacy which shows the bank's ability to perform its obligations is as the most important measures of bank in international level also are measure for rating the banks. D3P about 11,908,350 Million Rials for years 2010 and 1,455,354 Million Rials for years 2011 which means that based on the assets allocation by model this ratio has been improved about mentioned amount for each section.

9. Risk management is one of the main goals of assets and liabilities management's process. Assets with a high degree of liquidity (Cash, receivables from banks and credit institutions, bond) should be at least 17% of total deposits. Observance of this subject protects the bank from liquidity and insolvency risk.

D4P about 31,676,210 Million Rials for years 2010 and 47,148,890 for years 2011 which means that assets allocation between different groups by model is in such way that about mentioned amount is reduced the liquidity risk which is as model's advantage.

5- Conclusion

1. Design a quantitative model for the optimal management of assets and liabilities is possible in studied bank.
2. Design a quantitative model for determining the balance sheet's appropriate structure for its elements is possible in the level of studied bank and this model can determine an appropriate structure for bank's balance sheet elements.
3. The management of assets elements is possible with using of quantitative model in the level of studied bank and could be manage the assets elements with using of mentioned model in total levels of bank.
4. The designed quantitative model can be used in other commercial banks level for assets and liabilities management, determining the appropriate balance sheet structure and the management of assets' elements.

6- Suggestions

1. Using of other quantitative models and comparison of its results with used model and also using of statistical models and econometric for predicting the model's inputs.
2. Using of presented model in public and private banks, Comparison and analysis of obtained results.
3. Entrance of balance sheet's off items and affective on balance sheet to model.
4. Entrance of other financial concepts in model for example liquidity gap and other risks.
5. Presentation and analysis of quantitative models in shorter time for example Six month or monthly.
6. Other type's definition of necessities, new goals and a test about its effect on model results.

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