Liquidity Management Based on Goal Programming Model in Saderat Bank

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Abstract: Todays, Banking is considered as one of the most important departments in economy. From one side, banks facilitate the affair of commercial transactions and expand markets through receipts and payments, and on the other hand by equipment of small and big savings and lead them toward productive institutions, they provide the backgrounds for economic growth and efflorescence. Banks experience different challenges for achieving these goals that liquidity risk is the biggest one. Liquidity management is related to bank ability in planned equipment of resources and providing justified requests. Therefore, the main factors in liquidity management include recognizing the justified request of liquidity and proper answering based on time and the cost of providing liquidity. The linear goal programming is one of the main techniques for models that the decider is going to achieve several goals simultaneously. In this research, the liquidity management is studied based on goal programming during 2004 and 2014 in Saderat Bank branches in Iran. The achieved results present that, there is a significant relation between goal programming models and liquidity management, between productivity and liquidity management and resources allocation and liquidity management in Saderat Bank.

Keywords: Liquidity Management, Goal Programming, Allocation of Resources, Productivity

Introduction

It should be accepted that one of the most important economy departments in the present society is banking. From one side, banks facilitate commercial transactions by organizing receipts and payments and develop the markets; on the other hand by equipment of small and big savings and lead them toward productive institutions, they provide the backgrounds for economic growth and efflorescence. Banks experience different challenges for achieving these goals that liquidity risk is the biggest one.

Banks as the biggest financial intermediates have an important role in providing required investment for economic institutions. These financial institutions are encountered with serious challenges in liquidity management for playing their role. Iranian banks experience these challenges more than the other standard banks because of being usury of many liquidity management instruments and try to find a solution and approach to replace. For a while, financial and banking experts and scientist have paid attention to this problem and attempt to plan a compatible instrument based on Islamic and efficient jurisprudence principals in liquidity management.

In many political and social backgrounds, creating and developing international intercourse especially in the situation of globalization of economy and also duration of Joint Comprehensive Plan of Action (JCPA) have caused that enough motivations have an especial position for integration banking and financial systems. Consequently, the importance of accounting and banking management issues is very significant in the global concept and understanding it. So, the permanent controlling and studying of key balance sheet items and evaluating important issues in balance sheet such as liquidity, the ability of deposit debts and financial flexibility and also, density, diversity scheduling and property and debt quality are very necessary. Banks are in relation with various monetary and financial markets through different investors and borrowers. Therefore, they are always encountered with different risk as the entry into a market and exist it will be resulted in decrease on increase in one or several risks.

The goal programming is a multi-criteria decision making model in the field of linear algebra. This model includes several goals simultaneously that sometimes they are opposite each other and they are organized based on minimizing the deviations of goals. The main art of goal programming is considering limitations and goals with decision criteria and also removing and blurring the human reasoning at the time of programming and decision making. This art will have an especial effect in the situation when we are searching an optimization of several factors simultaneously.

Theoretical Basis

Liquidity is the volume of money in turnover. Liquidity volume in an economy should be proportioned with the rate of producing goods and services. Otherwise, it will cause inflation or stagnation in production certainly. Liquidity risk in banking is related to interactions deposits and their potential abilities for starting an activity. Liquidity management of bank includes forecasting liquidity prerequisites and providing them with minimum cost and the main reason of liquidity risk may be this fact that most banks resources are provided by short-term deposit, while banks facilities are spend for
investing in properties with approximately low liquidity. So, one of the main duties of bank is creating a balance between short-term financial commitments and long-term investments. Saving an insufficient amount of liquidity will make bank to be encountered with the risk of inability in performing commitments and bankruptcy and saving great amount of liquidity causes the inefficiency allocation of resources, decreasing profitability to deposits and finally losing market. According to Islamic banking, liquidity management is referred to bank ability in planned equipment of resources and providing justified requests. So, the main factors in liquidity management includes recognizing the request of justified liquidity and proper answering based on time and cost of providing liquidity. The ability of an Islamic bank in providing liquidity needs saving financial properties with the ability of high liquidity and ability of quick transfer. Therefore, liquidity and ability of transfer are the most important principals in this interaction. Liquidity of property means that the financial property must be available at least time (a day or less), for this purpose, Islamic banks must keep some of property in liquid form or by less profitability. So, Islamic banks want to answer to liquidity requirement in addition to minimizing the volume of less profitable properties; while increasing competition of banks from one side and take deposits for difference in profit rate in different economic departments from another side increase the attempt for optimizing unprofitable properties.

Banks which are stables based on central deposits and shareholders incomes are stable resources of financial providing and lend to other banks. If banks which have more illiquidity in their sheet balance, they will increase liquidity property and decrease lending. Liquidity risk of sheet balance fulfills balance sheet. Liquidity crisis management has been lead to decrease in the field of credit by banks. Liquidity management in the frame of risk management is a financial services industry that in all financial institutions such as Islamic and traditional are observed. The study of liquidity management topic is not only a basic topic but also is a very complicated one. The lack of correct liquidity management can be resulted to consequences and outcomes such as decline of banking and even financial system. Actually, many of banks declines are referred to problems of liquidity management. For this reason, legislation is sensitive to position of liquidity of financial institutions and relies on reinforcing liquidity frameworks of banks. Liquidity management means the ability of bank for its performing financial commitments along time. Liquidity management in different levels is as followed:

The first type of liquidity management is performed daily and diverse required liquidity is forecasted for next days.

The second type of liquidity management that is based on liquidity flow management forecasts the required liquidity for longer distance than 6 months to 2years.

The third type of liquidity management studies the required liquidity of bank in critical situations.

The point that should be considered is that the monetary politics are depended on the condition of creating liquidity of banks.

In codification and allocation of resources, modeling is a regular instrument that can provide enough information for decisions for reaching to goals. Planners can study some relations and connections among factors systematically through using models. The relations that their understanding can be possible without using model are not probable easily. It is expected from a model to satisfy our request through programing. Some of these requests include the ability of forecasting, flexibility, the capability of evaluating function, optimized allocation of sources, compatibility among programs and their simple efficiencies.

Certainly, many programming issues have more than one major goal as maximizing profit or minimizing cost in real world; the goals such as providing stable profit, increasing or at least keeping share in market, products diversity, prices stability, improving staffs’ temperament, increasing productivity, etc., that sometimes these goals are considered by managers simultaneously. Although single criteria are easier for creating a model, they don’t present the reality. In most cases, the considered goals may be against each other or if they are put in one direction, most of them are created from different units of measurement and their linear algebra cannot be written in the form of a linear goal.

One issue in the linear programing is its lack of flexibility; which means that imitations are unconditional and no deviation from limitations is permitted. For solving faults and defects of linear programing, the developed technique of goal programing is used. Based on Lee, Moor and Tailor report, the goal programing is considered as the most powerful technique in the field of multi-criteria decision making methods. Generally, it is assumed that the decider is able to limit the value of related goals with decision making situation without any problem. Therefore, these rates may have probable identity. In this situation, the decider does not know about value of different goals certainly. So, in this decision making situation, goal programming model is suggested. The goal programming model presents the simultaneous movement toward several goals even opposite goals; so in the real situation, the plan of systems can use goal programming as an efficient instrument in planning functional systems.

John Schneider knows the necessity of solving any problem of multi-criteria decision making in determining collection of opportunities (possible answers) and decider’ distinction function. Goal programing technique is used for solving diverse goals and especially opposite (solving simultaneous inequalities) and performing the comparing act among different opposite goals.

Professor Henan considers the goal programing as a technique between mathematic programing of diverse goal (without asking decider's distinctions) and theory of several criteria of desirability (where the amounts of different parameters should be determined).
Items of goal programing include
Economic limitations
Goal limitation
Goal function

The processes of using goal programing are as followed
Definition of decision criteria
Definition of deviation criteria of goals
Formulation of limitation equations (such as economic and goal)
Formulation of goal function

In this research, Saderat Bank of Iran is as a statistical population. The performed research is based on liquidity management based on goal programming. In short it can be said that Saderat bank is the biggest private and exchange bank in the country with probability of more than 6 decades experiences.

Literature Review
International Previous Researches

Den Den and Desmond (2013) has studied the problem of budget allocation of Owerri University in Imo state in an essay through weighed goal programming model. In this essay, five goals are considered for formulation of the issue such as: increasing individual cost (stuffs’ income and ration), decreasing overload cost, increasing investment cost, increasing income (national production) and decreasing general budget. The results have revealed that first, third and fifth goals will be achieved through optimizing goal function such as increasing individual costs, increasing investment expenses and decreasing general budget by using this model but second and forth goals will not be achieved such as decreasing overload costs and increasing income respectively.

Sharma et al (2009) has presented in an essay that the model of simple and weighted fuzzy goal programming can be bought effectively and efficiently for developing real and flexible models in portfolio management and used for investment in credit institutions. This model has been defined for access to goal of optimized allocation for cashes in the process of maximizing profit and minimizing functional cost through considering limitations. The comparison of results in two models has presented that weighted fuzzy goal programing increases costs and decreases efficiency than quantitative simple model but through allocated weights to criteria, it provides more controls.

Chernozhukov (2000) has used this model for measuring liquidity risk of undated debts of time structure concept of liquidity for the purpose of risk liquidity management and fluctuation risk of undated debt rate. By this concept and using time series, liquidity volume can be forecasted for a while in the future. The time structure measures the probability of decrease of liquidity volume than a standard level and in a specified period and therefore, in immunization, debts portfolio is used opposite liquidity risk.

National Previous Researches

Mousavi Moqadam et al. (2013) has presented a mode in a research with combining fuzzy goal programing and fuzzy analytic hierarchy process for optimized allocation of financial resources in different departments of Mashhad Water and Waste Water Organization and choosing important projects for every department of organization. The results include two categories: the rate of allocation budget for every unit of the organization and the projects chosen based on each department budget that this information causes the productivity promotion of organization and the best result will be achieved from allocation of budget.

Mehregan et al. (2012) has used the model of goal programming in a research for modeling investments management and optimized allocation of resources. The most important result has been helping optimized allocation of sources (optimized investment) and its optimized equipment (absorbing amount of specialized insurance in any insurance field) and also through this, it is possible to calculate the amount of accessibility to goal management and its deviation too. Soleymani (2007) in his essay “the Necessary Organized Foundations for Liquidity Management in Islamic Banking” has studied first the liquidity management challenges in Islamic banks and then organized foundations of liquidity management such as: monetary market of inter-bank and international Islamic financial market (IIFM). He has also mentioned the experience of some Islamic countries in this field.

Bakhtiyari (2006) in the essay “the Effective Method of Liquidity Management in Banks” has mentioned first the necessary principals for establishment liquidity management in banks and then features of liquid properties and debts in banks. In the following, some instruments for providing liquidity in banks and models of liquidity management have been studied.

Research Method

This research studies and describes the present situation regularly and systematically, their features and qualities and necessarily relations among criteria.
Based on the process of research, it can be said first the necessary information is gathered through library studies from related resources including instrument for gathering information and research background. Then, after gathering necessary information and sampling of statistical population, its results will be analyzed.

In this research, goal programming model is used that is explained as followed:

The modeling of multi-criteria goal programming includes goal function, linear or nonlinear limitations and also continuous and discontinuous variables. The decider first determines a numeral desirable level (goal) for each of goal and then it should search an answer to minimize the total (weighted) of deviation of these goals of related ones. In mathematical concepts, variables are defined as followed:

\( x_1, x_2, \ldots, x_n \) are variables of decision making in the problem. \( k \) is the number of considered goals. \( g_k \) is the goal of number \( k \). \( C_{jk} \) is the coefficient of \( X_j \) for every goal \( k \) in the goal function. The desired answer for the problem of goal programming is the one that is near to goal results possibly. Therefore:

Goal (1):

\[
\sum_{j=1}^{n} C_{j1}X_j = g_1
\]

Goal (2):

\[
\sum_{j=1}^{n} C_{j2}X_j = g_2
\]

Goal (3):

\[
\sum_{j=1}^{n} C_{jk}X_j = g_k
\]

Generally the possibility of simultaneous accessibility to all goals is not possible. So, it is necessary to have a combined goal function to reach to different goals for responsiveness.

\[
I = \sum_{k=1}^{K} (d^+_k + d^-_k)
\]

\( d^+_k \) and \( d^-_k \) are deviation variables that express the success more than extent and success less than extent of each goal and because it is not possible to have both simultaneously, one or both deviation variables are equal to zero \( (d^+_k, d^-_k = 0) \). Goal programming model can be written as followed:

Minimize \( I = \sum_{k=1}^{K} (d^+_k + d^-_k) \)

Subject to:

\[
\sum_{j=1}^{n} C_{jk}X_j - (d^+_k + d^-_k) = g_k
\]

Research Hypotheses

The main hypothesis

There is a significant relation between goal programming model and liquidity management in Saderat Bank.

The subsidiary hypothesis

There is a significant relation between productivity and liquidity management in Saderat Bank.

There is a significant relation between productivity on liquidity management in Saderat Bank.

There is a significant relation between resources allocation on liquidity management in Saderat Bank.

Research Scope

The scope of present research is about liquidity management discussions.

Time Scope

The time scope of this research is from 2004 to 2014 during eleven years.

Place Scope

The place scope of this research is management of Iran Saderat bank braches.

The Method of Sampling and Determining the Sample Volume

In this research, the method of sampling is cluster; it means some reigns are chosen among Sadaerat bank regions and then among present Saderat bank managements in these regions, some regions are chosen as research samples. For
determining the volume of sample, Morgan and Krejcie tables are used and finally 18 regions are studied as statistical population.

**Descriptive Statics**

In table (1), the descriptive quantities of research variables are presented.

<table>
<thead>
<tr>
<th>Variable Names</th>
<th>Mean</th>
<th>Median</th>
<th>Dispersion Variables</th>
<th>Variables of Distribution Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquidity Management</td>
<td>3/62</td>
<td>2/53</td>
<td>8/62</td>
<td>13/18</td>
</tr>
<tr>
<td>Resources Allocation</td>
<td>0/95</td>
<td>0/90</td>
<td>0/55</td>
<td>1/02</td>
</tr>
<tr>
<td>Productivity</td>
<td>2/44</td>
<td>1/90</td>
<td>1/40</td>
<td>1/16</td>
</tr>
<tr>
<td>Goal Programing</td>
<td>6/17</td>
<td>3/45</td>
<td>33/35</td>
<td>13/78</td>
</tr>
</tbody>
</table>

Liquidity and Lin Test

The results related to unit root test of model variables based on LL test are reported in table (2). The results show that model variables are stable based on LL test.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Statistic</th>
<th>Significance</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquidity Management</td>
<td>-13/43</td>
<td>0/000</td>
<td>Stable</td>
</tr>
<tr>
<td>Resources Allocation</td>
<td>-2/05</td>
<td>0/01</td>
<td>Stable</td>
</tr>
<tr>
<td>Productivity</td>
<td>-4/66</td>
<td>0/000</td>
<td>Stable</td>
</tr>
<tr>
<td>Goal Programing</td>
<td>-2/64</td>
<td>0/004</td>
<td>Stable</td>
</tr>
</tbody>
</table>

The H0 in LL test on instability of variables is studied and the hypothesis can be written as followed:

H0: the studied variable is instable.

H1: the studied variable is stable.

For refusing the H0, it is enough that significance level to be less than 0/05. According to stability of four studied variables, the regression model can be performed.

The Test of lack of Co-linearity among Variables

Before estimating correlation axis, model variables can be very proper. The correlation can show the co-linearity of model details. If the Pearson correlation is more than 0/7, it is probable that the co-linearity is existed in the model. In table (3), the studied variables correlations are achieved from Pearson correlation method.

<table>
<thead>
<tr>
<th>Liquidity Management</th>
<th>Resources Allocation</th>
<th>Productivity</th>
<th>Goal Programing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resources Allocation</td>
<td>0/01</td>
<td>1/000</td>
<td></td>
</tr>
<tr>
<td>Allocation</td>
<td>0/87</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Productivity</td>
<td>0/21</td>
<td>0/44</td>
<td>1/000</td>
</tr>
<tr>
<td>0/002</td>
<td>0/000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goal Programing</td>
<td>0/98</td>
<td>0/01</td>
<td>0/09</td>
</tr>
<tr>
<td></td>
<td>0/000</td>
<td>0/78</td>
<td>0/19</td>
</tr>
</tbody>
</table>

In table (3), the correlation rate is written in first level and significance of correlation in second line. While the significance is less than 0/05, the considered correlation is significant statistically. Obviously, in some cases there are significant correlations among independent variables but the correlations intensity is less than the probability of co-linearity in the model. Also, correlation among independent variable and dependent variables is in the way that the followed results can be achieved.

There is a significant relation between goal programing and liquidity management in Saderat bank.
There is a significant relation between productivity and liquidity management in Saderat bank. Therefore, the main hypothesis and the first subsidiary hypotheses are affirmed. For studying two other subsidiary hypotheses, the regression model should be estimated.

**Studying Research Model**

The test of research hypotheses is performed based on regression model estimation. In continue, regression model is fitted and then hypotheses are studied. The regression model is rewritten.

\[ \text{CASH} = \alpha + \beta_1 \times P + \beta_2 \times R + \beta_3 \times S + \epsilon \]  

(1)

First, the Chow test is used for determining this fact that applying the Panel method for estimating model is more efficient or method of combined data.

**Table 4. The result of Chow test for regression model**

<table>
<thead>
<tr>
<th>Regression Model</th>
<th>Test Statistic</th>
<th>Freedom Degree</th>
<th>Significance Level</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>6/76</td>
<td>177/71</td>
<td>0/000</td>
<td>Using Panel Model</td>
</tr>
</tbody>
</table>

As it is shown in the table (4), the significance level in Chow model is calculated lesser than \( \alpha = 0/05 \) so with confidence 95% the possibility of performing model through Panel method is affirmed. According to this fact that \( H_0 \) of the Chow test is based on the equality of y-intercept point, in continue the Hausman test is used for determining the stable or random effects.

**Table 5. The result of Hausman test for regression model**

<table>
<thead>
<tr>
<th>Regression Model</th>
<th>Test Statistic</th>
<th>Freedom Degree</th>
<th>Significance Level</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>19/85</td>
<td>3</td>
<td>0/000</td>
<td>Stable Effects</td>
</tr>
</tbody>
</table>

As it is shown in the table (5), the significance level of Hausman test is calculated prob=0/000 so the Hausmen test suggests the stable effects in regression estimate. The results of estimating model through panel mode with stable effects are shown in table (6).

**Table 6. Results of Regression fitted model**

<table>
<thead>
<tr>
<th>Response Variable= Liquidity Management</th>
<th>Independent Variables</th>
<th>Regression Coefficients</th>
<th>Test Statistic</th>
<th>Significance Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed Equitation (a)</td>
<td>0/72</td>
<td>9/01</td>
<td>0/000</td>
<td></td>
</tr>
<tr>
<td>Goal Programing</td>
<td>0/25</td>
<td>250/5</td>
<td>0/000</td>
<td></td>
</tr>
<tr>
<td>Productivity</td>
<td>0/87</td>
<td>27/21</td>
<td>0/000</td>
<td></td>
</tr>
<tr>
<td>Resources Allocation</td>
<td>-0/81</td>
<td>-10/59</td>
<td>0/000</td>
<td></td>
</tr>
<tr>
<td>Test Statistic F=3656/7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Significance Level= 0/000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Durbin-Watson Statistic= 1/59</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coefficient if Determination= 0/99</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In Diagram 1 the linear diagram of regression model residue is presented.

As it is presented in diagram (1) the residual of regression model does not have any form and this subject show the propriety of fitted model. In continue, Jarque and Bera test and Histogram diagram are used for getting information...
from normality position of fitted model residuals. Jaruque-Bera statistic is a chi 2 distribution and freedom degree 2, if this statistic is lesser than 5/7, it can be resulted that considered statistic distribution based on Chi2 distribution is normal.

<table>
<thead>
<tr>
<th>Regression Residual Model</th>
<th>Test Statistic</th>
<th>Significance Level</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1/77</td>
<td>0/41</td>
<td>Normality of Distribution in Model Residual</td>
</tr>
</tbody>
</table>

As it is presented in table 7, the significance level of Jaque-Bera test is calculated more than $\alpha = 0/05$, so with the confidence 95% the residuals distribution is normal. In diagram 2 the histogram of first regression model residual is presented.

According to diagram 2, the residual of regression model is symmetric and cluster form and this subject shows the normality in distribution of regression model residual. Therefore the model does not have the probable statistic problem.

In the followed table, the studied relations in the hypotheses are considered.

<table>
<thead>
<tr>
<th>The Considered Variable</th>
<th>The Effect on Net Entry Logarithm</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal Programing</td>
<td>0/25</td>
<td>***</td>
</tr>
<tr>
<td>Productivity</td>
<td>0/87</td>
<td>***</td>
</tr>
<tr>
<td>Sources Allocation</td>
<td>-0/81</td>
<td>***</td>
</tr>
</tbody>
</table>

*** Significance with confidence more than 99% 

According to table 8, the effects of different variables are shown. It is resulted from above table that:

There is a significant relation between goal programing on liquidity management in Saderat bank.

There is a significant relation between productivity on liquidity management in Saderat bank.

There is a significant relation between sources on liquidity management in Saderat bank.

All hypotheses are affirmed according to mentioned explanations in correlation test and performed results in this part. In the followed table, the research hypotheses are applied:

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main</td>
<td>There is a significant relation between goal programing and liquidity Affirmed management in Saderat bank.</td>
</tr>
<tr>
<td>First Subsidiary</td>
<td>There is a significant relation between productivity and liquidity Affirmed management in Saderat bank.</td>
</tr>
<tr>
<td>Second Subsidiary</td>
<td>There is a significant relation between productivity on liquidity Affirmed management in Saderat bank.</td>
</tr>
<tr>
<td>Third Subsidiary</td>
<td>There is a significant relation between resource allocations on liquidity Affirmed management in Saderat bank.</td>
</tr>
</tbody>
</table>

Research Discussion and Suggestions

Liquidity management means forecasting the required volume for cash and providing the enough amounts of cash for answering these requirements. Also, answering customers' facilities requires is another important duty for the bank that
through correct and efficient liquidity management can decrease the risk of liquidity. Liquidity management is one of the most important duties of financial managements of the economic institutions. In relation to credit and financial institution especially Saderat bank, its importance is doubled. Saderat bank needs to keep some of its properties as cash for its affair identity to answer to referees and deposit owners that this subject creates opportunity costs for the properties. In another words, keeping the cash property in current accounts, central bank decreases the risk of liquidity besides other banks and legal savings. While investment opportunities are divested from bank and finally reduce the profits.

References