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# Optimal Capital Adequacy Ratio in an Islamic Banking System

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**Abstract:**
With the advent and growth of Islamic banking, various researches have been performed to analyze the performance and mechanisms of regulatory rules of this industry. Due to the special role of banks in the economic systems of countries and the world, significant regulatory and control rules were used. In the meantime, the commitment to implement the rules of the Basel II Capital Accord as the most important international agreement to ensure banking health is of particular importance, and among all the issues raised in this agreement, compliance with the minimum capital adequacy has been considered by many researches. One of the most important questions in this area is whether the Basel method of calculation and the minimum rate (8%) is appropriate for the Islamic banking system? To answer this question, this study has calculated the capital adequacy ratio for Islamic banks of Iran and by modeling its effect on the bank' profit efficiency, as the most important incentive indicator for banks, has estimated an optimal rate these banks.

## Introduction

The capital adequacy for financial institutions, as the main stability indice, after financial crisis 2007, has become the most important issue in banking scientific literature and particularly in bank supervisory committee capital statements, (Basel I, II, and III). Insufficient equity has been identified as a

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reason for recent financial crisis and also Southeast Asia 2019 financial crisis (21-31). Thus, it seems vital to define some disciplinary conditions for the banks and financial institutions to achieve health of financial system. For the mentioned research purposes and including to provide financial and banking stability, the well-known agreement on Basel committee, requires financial system to maintain at least 8% of the capital adequacy ratio. This requirement not only determines assets compound, but also indirectly determines a bank capital structure, deposit, reserves, embedded loan and equity (5).

In despite that it seems that the capital adequacy limitation imposes cost on deposit maintenance, but in fact it determines risk strategy and bank input and in fact choosing total optimal compound for asset and deposits (5). Diversity of Islamic banks assets make them riskier than usury customary banks based on their contractual nature and their business model. These properties are either based on real commercial activity (such as: murabaha, musharaka, salam, and istisna) or such as ijara makes additional risk in bank offices. These risks not only are unique in such contracts, but also change in different steps of the contract implementation process based on fraud probability (5). These differences in the Islamic banks structure cause Basel (II) rules implementation to have different results for Islamic banks than conventional banks. These results mainly cause to increase risk in Islamic banks (35). Therefore, it seems that the rules on the capital adequacy ratio of the Basel Committee are not efficient enough for Islamic banks or at least to the extent that it has reduced the risk of conventional banks, it has not affected Islamic banks.

Although the capital maintained by the bank is considered a shield against shocks, is of complex relation with taking risk and bank efficiency. To optimize the capital levels requires an exact evaluation of the bank risk taking characteristics, which should be based on accurate information (Including asset composition, debt composition, liquidity nature and level of tension and the issue of agency between depositors and shareholders) (Grais et al. 2007).

While increasing capital level causes to increase stability, it has negative effect on the bank profitability empirically, and this leads to heterogeneous effect of the capital adequacy ratio on the bank efficiency. Therefore, it is obvious that optimal amount of the capital adequacy ratio doesn’t be identical in different bank structures. It is for this that IFSB has adjusted a complete framework instead determining desire capital adequacy ratio that

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can present a standard to control distinct risks resulted from different nature of Islamic banks (33-8).

Based on the aforementioned difference between Islamic bank systems comparing to conventional banks, it seems that there are two requirements for Islamic banks to identify the suitable capital ratio. First, based on Islamic bank different properties, it is necessary to determine different risk rates related to specific elements of the Islamic bank balance sheet. Second, based on above theoretical analysis, it is expected that at low levels of capital ratio, a higher level of capital adequacy is associated with a higher level of risk-taking and banking performance. However, in high amounts of capital adequacy ratio, maintaining high levels of capital leads to the opportunity cost of maintaining it and weakens the bank's performance. Therefore, a certain level of capital adequacy ratio can be considered as the optimal level, which both increases the profitability of choosing a risk portfolio and minimizes the cost of risk-taking. So, the present study intends to estimate its optimal level, after calculating capital adequacy ratio particularly for Iran Islamic banks.

Reviewing related researches background indicates that in local and foreign literature conducted on this, only Li and Wang (2012)(24) study pointed to this relationship and modeled it, but in this study has not been estimated its empirical relation. This article is the first to propose this hypothesis for Islamic banks. With the development of the hypothesis of non-uniform relationship between capital adequacy rate and banking performance, this research has a contribution in the research literature of Islamic capital adequacy and banking. Therefore, providing the optimal rate for capital adequacy in the Islamic banking system of Iran is the most important goal of this study.

## 1- Theoretical bases

The most important condition to maintain bank system health is suitable and sufficient capital, and each bank and credit institutions should establish a suitable ratio between capital and risk in their properties to guarantee their activities stability and consistency. The most important role of this indicator is to support bank against unexpected harm and to support depositors and creditors as well (2). To promote a healthy financial system, legislators ask banks to attract sufficient amounts of capital in order to limit moral risks. Yet, this precautionary legislation can have negative aspects that caused to apply some considerations in its

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usage. High rate of capital adequacy may limit cash creation (10), lending capacity and bank growth. Capital adequacy requirements is one of the main supervisory tools for bank system. It is expected that two main duties are done. First, risk sharing function in these requirements serves, as a shield against losses, that protect depositors and makes resources limited to insurance deposits.

Second, it limits the shareholders moral risk motivation that causes much risk taking. Second duty relates to agency costs between shareholders and lenders. This is based on agency costs hypothesis and also agency cost among shareholders and managers is posed based on which higher capital ratios can increase the manager's motivation to do works well, and cause to promote efficiency. The first effect of the capital adequacy requirement is the effect on the bank efficiency that indicated that it is through its effect on bank bankruptcy, future loan problems and risk taking, one of the main determinant for financial stability (26-1). Based on the agency theory hypothesis, some contrast views are posed on the effect of the capital adequacy rates on the bank operation. On the other hand, the agency costs are being created from involving stockholders and lenders profits. Shareholders motivation is towards activities providing their profit to the lenders cost, so they don't tend to maximize the bank efficiency (27-28) they prefer to invest in risky projects or the least investment than lenders. Over risk taking behavior is encountered through adopting governmental explicit or implicit guarantees by the lenders. These agency costs are because of the importance of the lenders role and along with reducing the capital adequacy. In other words, to increase the capital adequacy ratio causes to reducing the agency costs and increasing cost efficiency.

On the other hand, agency costs problem may occur between managers and shareholders (20). The main issue is that due to committing moral hazards by the managers, rather than improving bank operation, they try to waste resources or minimize their effort. Reducing the capital adequacy rate as a result of debt financing, increases pressure on managers such that it reduces free cash flow availability and then, liability makes it necessary to pay interest and causes the managers to motivate to avoid bankruptcy personal costs. Therefore, lower capital adequacy rate will have positive effect on the efficiency.

Which effect dominates, is a question that will have different answers in different conditions. Research literature indicates different evidences. Berger & Di Patti (2006)(12) is a primary research on this area, examined

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the relationship between capital and bank efficiency in America bank industry from 1990 to 1995. Fiordelisi et.al (2011)(17), evaluated the relationship between capital rate and bank efficiency in banking industry during 1995 to 2007. These studies had contrast results. Berger & Di Patti (2006)(12) found that lower capital rate relates to higher efficiency, but Fiordelisi et.al (2011)(17), obtained opposed results.

**1.2- capital rates and Islamic bank efficiency**

Although Islamic banks efficiency measurement literature is growing, this question that whether capital ratio has increased bank efficiency index or prevents it, still has not received suitable answer.

Pasiouras et al. (2008)(29) state that the bank system efficiency for different reasons can be influenced by capital rates. First, based on definition, banks are financial mediators that convert their input (investment deposits) into output (loans and investments). So, capital limitation may affect amount and quality of lending activities. The need for banks to balance the proportion of capital with the amount of risk accepted may affect the allocation of assets in the bank's portfolio, thereby altering the level of return that managers can earn. Finally, capital rates may change bank decisions on the composition and structure of deposits and equity using for their activities financing (13).

Rosman et al (2014)(30) examined the factors affecting Islamic banking efficiency and found a positive relation between capital and bank efficiency. They stated that the Islamic banks maintain higher precautionary capital to protect from future losses. In addition, as efficient banks probably have less financial leverage (and more equity), they perform cost of capital reduction activities, thus obtain more efficiency. In theoretical level, Islamic bank can use PLS principles for investment accounts, therefore, they can use more leverage power and create more profit and keep shareholders satisfied at the expense of the owners of the investment accounts, which bear any potential losses. Accordingly, bank managers and shareholders may attract more investment accounts and use more leverage causing to reduce agency costs.

This implicit agreement presents higher profit to the Islamic banks shareholders, and increases the Islamic bank managers reward, reputation and wage as well. In other word, Islamic banks investment accounts may use as a leverage to maximize bank interest. In fact, the bank's profits increase at the expense of investment account holders. As, a result, higher leverage and less capital rate improves bank efficiency (12). However, in

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practical level, Islamic banks can't impose loss on the investment accounts holders, since finally they no longer invest in Islamic banks and their withdrawal fund cause to lack the bank cash. A solution is that the Islamic banks maintain profit smoothing reserves leading to maintain accumulated profit. Through these reserves, they can compensate the accounts losses and prevent any decrease desire to investment, especially when compete with conventional banks. However, Islamic banks need to structure adjustment when there are intense losses or when their reserves no more be able to present interest to investment accounts. Thus, they may decide to keep higher capital rates than conventional banks to prevent any probable problem in paying debt. This can increase the bank shareholder's motivation to control the bank's manager's investment decisions. Higher capital rates force the bankers to attract loss using their resource (3), thus, moral hazard problem supports the above mentioned hypothesis.

However, it should be noted that as there is no investment accounts with its common structure in the world Islamic banks, and one of the most important operational components distinguishes the Islamic banks from conventional banks, is the, investment accounts, so, it is, expected that regarding the relationship between capital adequacy and banking efficiency, there is no difference between Iranian banks and the conventional usurious banking system.

This study has various innovations in literature present at banking area. Most important of all, for the first time, it examines Basel agreement capital adequacy ratio effect on Iranian Islamic banks profit efficiency. New scientific discussions have been posed on the capital ratios effectiveness. Recently, much studies including Demirgüç-Kunt et al (2014)(3) and Bitara et al. (2017)(14) have posed this subject that how to examine bank capital structure, and what type of capital, the banks should maintain. In these researches, capital various ratios suitability has been examined. So, in this study the capital ratios based on risk and non-based risk is used.

Importance of choosing suitable index for capital is more obvious in Ariss & Sarieddine (2007)(6) Khan and Jabeen, Z. (2011)(22) Cathcart et al ( 2015) (15) Baldwin et al (2019)(8) results. They doubted to being suitable the risk weighed assets index to indicate bank real encountering to risk especially in great crisis. This article by examining Iran Islamic banks tries to make the capital indices effectiveness research literature richer.

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**2.2- research theoretical model**

Based on the model proposed by Kopecky and VanHoose (2004)(23), developed by Wang et al (2014)(34), this research examines commercial banks profit efficiency with double constraint functions. In this analysis, an internal mechanism is used to show how capital adequacy ratio (CAR) and non-performing loan reserves (NPL) affects banks efficiency. Results indicate that at first, NPL rate has inverse relationship with profit efficiency. Second, there is nonlinear relationship between capital regulations, monetary policy with cost efficiency.

**Assumptions:**

1- There is a profit maximizing bank.

2- Bank asset includes legal reserves (R), loan (L), and governmental bonds (G). Bank debt includes deposit debts (D), and allocated capital (K). Loan risk weight is 100%, all other assets except loan and reservoirs are considered governmental bonds, whose risk weigh is 0%. It is assumed that deposit, loan and bonds market is a perfect competition market, thus, loan, deposit and bond rates have been shown with $r_D$ $r_L$ and $r_G$, respectively. Equity return, determined by $r_k$, provides following conditions:

$r_G \leq \max(1-w)rL, rK)$

When commercial bank attempts to manage each project, there is management costs. Therefore, they can be shown with quadratic function, introduced by Kopecky and VanHoose (2004)(23). These functions are as, following:

$C_D=(d/2)D^2$ , $C_K=(k/2)K^2$ , $C_L=(l/2)L^2$, $C_G=(g/2)G^2$

Which indicates that each project margin management cost increases with its value.

It is, assumed that deposit is obtained from creating central bank money. Consumers take all additional money to the bank.

Bank encounters to double constraints, that is, here, $R \geq Pd$ $K \geq \theta L$ , and ،ρ and θ indicate SRR statutory reserve ratio and capital adequacy ratio, CAR, respectively.

NPL reserves ratio equals to W.

Loan income, is the main source of the bank income, therefore the inequality $(1-w)r_l L > r_G G + r_K K)$ should be satisfied.

And for stocks return, the following constraint is posed:

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$$r_G \leq r_K \leq \frac{1}{\theta}[(1-w)r_L + (1-\theta)r_G]$$

Costs results from increasing shareholders equity value to higher than bonds cost.

Specially, issuing covered bonds for financing, following condition should be established:

$k\theta - g(1-\theta) > 0$

**Model and its solution**

Based on so called hypotheses, equation bank behavior and its encountering constraints is as following:

$$\text{Max } \pi = (1-w)r_l L + r_G G - r_K K - r_D D - \frac{d}{2}D^2 - \frac{k}{2}k^2 - \frac{g}{2}G^2 - \frac{l}{2}L^2$$

S,t $K \geq \theta L$

$R \geq \rho D$

R+L+G=D+K

Forming Lagrange function along with multiple constraints and establishing Kuhn–Tucker conditions and being concave the function, after extracting loan optimal amounts, stocks and bonds, K, L and G are obtained:

$$L^* = \frac{(1-w)r_L - r_K - (1-\theta)(r_G - r_K - g\left(1-\frac{\rho}{\rho}\right)R}{l + k\theta^2 + g(1-\theta)^2}$$

$$K^* = \frac{\theta(1-w)r_L - r_K - (1-\theta)(r_G - r_K - g\left(1-\frac{\rho}{\rho}\right)R}{l + k\theta^2 + g(1-\theta)^2}$$

$$G^* = \frac{1-\rho}{\rho}R + (\theta - 1)\frac{(1-w)r_L - r_K - (1-\theta)(r_G - r_K - g\left(1-\frac{\rho}{\rho}\right)R}{l + k\theta^2 + g(1-\theta)^2}$$

Accordingly, these optimal amounts behavioral reaction to parameters can be shown as following:

$$\frac{\partial L^*}{\partial w} = \frac{-r_L}{l+k\theta^2+g(1-\theta)^2} < 0 \quad \frac{\partial L^*}{\partial \rho} = \frac{-g(1-\theta)(\frac{R}{\rho^2})}{l+k\theta^2+g(1-\theta)^2} < 0$$

$$\frac{\partial K^*}{\partial w} = \frac{-\theta r_L}{l+k\theta^2+g(1-\theta)^2} < 0 \quad \frac{\partial K^*}{\partial \rho} = \frac{-g\theta(1-\theta)(R/\rho^2}{l+k\theta^2+g(1-\theta)^2} < 0$$

$$\frac{\partial G^*}{\partial w} = \frac{(1-\theta)r_L}{l+k\theta^2+g(1-\theta)^2} > 0 \quad \frac{\partial K^*}{\partial \rho} = \frac{-R}{\rho^2}\left[\frac{l+k\theta^2}{l+k\theta^2+g(1-\theta)^2}\right] < 0$$

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$$\frac{\partial L^*}{\partial \theta} = \frac{r_G - r_K - g(\frac{(1-\rho)}{\rho}}{l+k\theta^2+g(1-\theta)^2} - \frac{\left[(1-w)r_L - r_K - (1-\theta)(r_G - r_K - g(\frac{(1-\rho)}{\rho}\right]2[k\theta - g(1-\theta)]}{l+k\theta^2+g(1-\theta)^2} < 0$$

$$r_G - r_K - g\frac{1-\rho}{\rho}R < 0\ k\theta - g(1-\theta) > 0$$

$$\frac{\partial K^*}{\partial \theta} = L^* + \theta\left\{\frac{r_G - r_K - g(\frac{(1-\rho)}{\rho}R}{l+k\theta^2+g(1-\theta)^2} - \frac{\left[(1-w)r_L - r_K - (1-\theta)(r_G - r_K - g(\frac{(1-\rho)}{\rho}\right]2[k\theta - g(1-\theta)]}{[l+k\theta^2+g(1-\theta)^2]}\right\}$$

$$\frac{\partial G^*}{\partial \theta} = L^* + (\theta - 1)\frac{r_G - r_K - g(\frac{(1-\rho)}{\rho}R}{l+k\theta^2+g(1-\theta)^2} - \frac{\left[(1-w)r_L - r_K - (1-\theta)(r_G - r_K - g(\frac{(1-\rho)}{\rho}\right]2[k\theta - g(1-\theta)]}{[l+k\theta^2+g(1-\theta)^2]} > 0$$

Next question is that how is profit efficiency and bank to the model parameters?

To solve this problem, the profit efficiency functions are defined as:

$\pi^*=\pi(K^*,L^*,G^*,R,D)$

In this equation, $\pi^*$ represents profit efficiency. K*,L*,G* Are stocks, loan and bonds optimal volume. D and R have been considered external. Therefore, partial efficiency derivatives can be obtained with first and second order conditions which is as follows.

$$\frac{\partial \pi^*}{\partial w} = -r_L L^* < 0 \qquad \frac{\partial \pi^*}{\partial \rho} = -\frac{R}{\rho^2}(r_G - gG^*)$$

$$\frac{\partial \pi^*}{\partial \theta} = -\left(r_G - r_K - g\frac{1-\rho}{\rho}R\right)L^* - [k\theta - g(1-\theta)](L^*)^2$$

$$\frac{\partial^2 \pi^*}{\partial w^2} = -r_L\frac{\partial L^*}{\partial w} > 0$$

$$\frac{\partial^2 \pi^*}{\partial \rho^2} = -\frac{g}{2\rho^3}G + \frac{r_G}{2\rho^3} + \frac{g}{\rho^2}\frac{\partial G^*}{\partial \rho}$$

$$\frac{\partial^2 \pi^*}{\partial \theta^2} = (k+g)(L^*)^2 - (r_G - r_K - g\left(1 - \frac{\rho}{\rho}\right)R)L^*$$

After examining the parameters ω ،ρ ،θ partial derivatives, one can infer following results:

1-Based on the primary hypothesis 6, as NPL increases, the bank profit efficiency increases as well $\frac{\partial^2 \pi^*}{\partial w^2} < 0$.Also, this increasing, decreases over the time,.

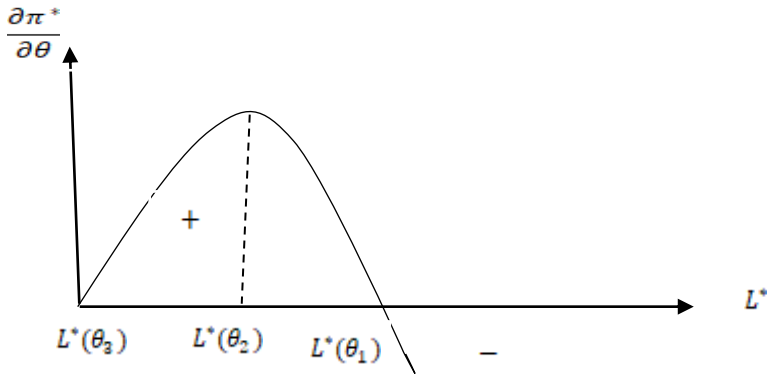
$\frac{\partial^2 \pi^*}{\partial w^2} > 0$.

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2-Based on assumptions 6 and 7, the profit efficiency first increases and when exceeds from$\theta_1$, it reduces, as, was in case of CAR.
Thus, developing commercial bank decision making model it can be shown that the relationship between profit efficiency with capital adequacy ratio is as following:




Accordingly it can be claimed that as capital adequacy ratio changes, there is no linear relationship between profit efficiency and minimum capital adequacy ratio, and at first it increases and then decreases. This relationship for cost efficiency is opposite to the profit efficiency. So, the optimal ratio for capital adequacy can be a ratio that maximizes profit efficiency and cost efficiency (24). $\theta_2$ , $\theta'_2$ represent capital adequacy ratio maximizing the profit efficiency of Iranian banks.

**Data and methodology**

**Statistical society and sample**

Studied society is all formal banks active in Iran money market. But, as there is limitation on data availability and need to constant information at considered time period, systematic removal method is necessary. Accordingly, banks without access to data at considered time period, have removed from sample. Thus, the sample examined in this, study, is data from 15 private and public banks from 2013 to 2018.
Research process is as following: upon collecting data, data is processed and calculations related to ratios are done through excel software. Then, data transfers to Stata software to estimate SFA model. Two residuals are obtained, one of which represents each observation (year-bank) profit efficiency index. This variable is, used as dependent variable in the main model, this model estimated by data panel regression method.

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**1-3.Research pattern and variables**

Aggregating theoretical model in Arnold et al (2012)(7), Wang et al (2014)(34), Cathcart et al (2015)(15), and Bitara et al (2017)(14), the research model can be explained as:

$$PrEfficiency_{i,t} = \alpha + \beta_1 LAS_{i,t} + \beta_2 GAS_{i,t} + \beta_3 FAS_{i,t} + \beta_4 GGDP_{i,t} + \beta_5 CAR_{i,t} + \beta_6 CAR^2{}_{i,t} + \varepsilon_{i,t}$$

Where:

$PrEfficiency$: Banks profit efficiency index measured by SFA model

GAS: asset growth,

LAS: assets natural logarithm,

GGDP: gross domestic production growth

FAS: fixed asset to total asset,

CAR capital adequacy ratio

**Variables measuring method**

**Independent variable**

**Capital adequacy ratio**

Following previous studies (3-14), the capital adequacy ratio measured by following formula. There are two capital components in the numerator main capital and complementary capital. Main capital is sum of shareholders' funds and non-aggregated constant preferential stocks. Complementary capital includes compound capital, loan harmful reserves and evaluation reserves. Risk weighted assets are inserted in denominator. These risk weighed assets index are calculated by risky weighs purposed by Basel agreement. This index calculation is, as following:

$$CAR = \frac{Tier1\ Capital + Tier2\ Capital}{Risk\ Weights * Assets}$$

Where CAR represents capital adequacy ratio, Tier1 capital is main capital, Tier2 capital is complementary capital, $\sum Risk\ Weights * Assets$ is risk weighted assets.

Based on the problems posed for Basel committee introduced method to apply in Islamic banks, researchers, supervisory institutions and central banks in Islamic countries tried to design capital adequacy index calculation method based on each country special characteristics and present limitations. As pointed before, this study tries to present special Iran banking system method based on special structure of Iran banking

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system and information limitations and test its suitability. Since Islamic financial services boards (19-8), has introduced a new method for measuring this index based on Islamic contracts, this study tries to follow this method and modify measurement method for Iranian banks assets and balance sheet structure.

One of the Iranian banks' balance sheet structure characteristics, is asset multiplicity except loan, and another characteristic, is the loan under different contracts. Similarly, special limitation to calculate capital adequacy ratio in Iran, is lack of validity and financial reports on credit allocated to real and legal persons divided by various validity ranks.

Based on two characteristics and one mentioned limitation it is tried that the purposed index has IFSB characteristics and divided loans by contract type, however to fill the validity system gap, we can used conventional methods applied in Khan et al (2011)(22) and Manzoor and Yadi pour (2019)(25) and similar studies. So, assets weighs are measured through questionnaire distributed among 40 banking industry and academic experts. A questionnaire was set based on Likert scale from 1 to 7, and main risks on assets and loan paid with various contracts are particularly evaluated. Each risk component is determined and obtained new index of bank capital adequacy. To insure questionnaire validity, content validity has been used by financial and banking area elites.

**Control variables**

The first control variable is bank size measured by natural logarithm of assets (Las), second is, assets growth (Gas), which is equal to total bank assets changes in percent.

Third, is fixed asset to total assets (Fas). Since growth of immovable properties without bank activity growth leads to going out a part of bank resources from main services circle, and causes to increase banks debts, efficiency will be reduces. This variable is applied to control the effects, resulted from assets unsuitable compounding.

Fifth, GGDP is used to control change effect in macroeconomic variables.

Dependent variable

**A. Cost efficiency**

In this study, Bank profit efficiency is considered as dependent variable. Stochastic frontier analysis (SFA) can be used to estimate efficiency in models with an output. The stochastic frontier function coefficients, is estimated using maximum likelihood method developed by Battese &

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Coelli, (1988)(9). Variables have been chosen based on previous researches, it can pointed to Tabibi et al (2010)(32), ghayouri moghaddam (2017)(18).

The profit function is specified in terms of production (y) and inputs price (w) expressed as Cobb Douglas function and estimated using SFA model and based on following equation.

$$\ln \pi_{i,t} = \alpha + \sum_{j=1}^{n} \beta_j \ln y_{j,i,t} + \sum_{k=1}^{m} \gamma_j \ln w_{k,i,t} + v_{i,t} + u_{i,t}$$

Where:

$\pi_{i,t}$ is bank profit,

$y_{j,i,t}$ is j'th product or services of ith Bank at time t,

$w_{k,i,t}$ is price of input k from bank k at time t.

$y_1$ is facilities

$w_1$ labor's cost,

$y_2$, investments

$w_2$ physical capital cost

$y_3$, deposits to other banks,

$w_3$ is financial capital price.

$u_{i,t}$ is nonnegative random variables and represents costs inefficiency in production, and it is assumed that it has interrupted normal independent distribution in zero with mean $Z_{it}\delta$ and variance $\sigma^2$.

$v_{i,t}$ is vector of unknown parameters should be estimated, and are random errors with distribution iid.N(0, $\sigma_v^2$) that are independent from model residual.

In research related to measuring the efficiency of banks, the intermediary approach is usually used instead of the production approach. According to this approach, each bank is considered as a financial intermediary that by collecting deposits and funds as financial capital and using labor and physical capital, to pay facilities, investment and deposit with other banks as products does.

So, inputs include labor cost, $w_1$ physical capital price, $w_2$ and financial capital $w_3$, and three products, i.e. facilities, $y_1$, investments, $y_2$ and deposits, of other banks, $y_3$ as independent variables. In other words, the profit function is influenced by independent variables such as labor force

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price, financial capital price and physical capital price, and facilities, investments and deposits near other banks as well.

**Research findings**

To examine research questions, efficiency model should be estimated at first and the model residual applied in the research pattern. This model estimation results presented in table 1. Also, this study important results, are scores of bank efficiency in each year, shown in table 2.

**Table 1: profit function coefficient through SFA model with ML estimator**

| *variable* | *symbol* | *coefficient* | *Z.statistic* | *Prob* |
|---|---|---|---|---|
| *Facilities* | $y_1$ | 0.011 | 1.562 | 0.119 |
| *labor cost* | $w_1$ | 0.156 | 1.436 | 0.154 |
| *Investments* | $y_2$ | 0.257 | 5.567 | 0.000 |
| *Physical capital cost* | $w_2$ | -0.157 | -6.331 | 0.000 |
| *Deposit near other banks* | $y_3$ | 0.387 | 8.554 | 0.000 |
| *Financial capital price* | $w_3$ | -0.258 | -1.112 | 0.2661 |

Results indicate the positive and significant effect of investments and deposits on bank profit. Also, results show that physical capital has negative and significant effect on bank profit. All other variables have no significant effect on profit.

**Table2: banks' profits efficiency**

| *Bank* | *2018* | *2017* | *2016* | *2015* | *2014* | *2013* |
|---|---|---|---|---|---|---|
| Eqtesad e Novin | 0/79 | 0/83 | 0/61 | 0/41 | 0/63 | 0/59 |
| Ansar | 0/97 | 0/71 | 0/86 | 0/52 | 0/57 | 0/68 |
| Iran zamin | 0/45 | 0/48 | 0/48 | 0/26 | 0/24 | 0/99 |
| Parsian | 0/66 | 0/85 | 0/16 | 0/31 | 0/86 | 0/24 |
| Post bank | 0/04 | 0/55 | 0/43 | 0/31 | 0/48 | 0/99 |
| Tejarat | 0/05 | 0/66 | 0/31 | 0/26 | 0/28 | 0/64 |
| Hekmat e Iranian | 0/11 | 0/63 | 0/94 | 0/63 | 0/76 | 0/32 |
| Khavar e miane | 0/95 | 0/81 | 0/15 | 0/01 | 0/23 | 0/98 |
| Dey | 0/98 | 0/96 | 0/99 | 0/86 | 0/98 | 0/99 |
| Sarmayeh | 0/13 | 0/56 | 0/36 | 0/36 | 0/48 | 0/37 |
| Sina | 0/92 | 0/84 | 0/86 | 0/60 | 0/78 | 0/77 |
| Saderat | 0/13 | 0/65 | 0/41 | 0/09 | 0/12 | 0/86 |
| Gardeshgari | 0/11 | 0/57 | 0/53 | 0/79 | 1/08 | 0/41 |
| Karafarin | 0/65 | 0/98 | 0/81 | 0/71 | 0/75 | 0/90 |
| Mellat | 0/57 | 0/80 | 0/71 | 0/28 | 0/08 | 0/94 |

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To examine capital adequacy optimal ratio in Iran bank system, the research regression pattern was estimated by panel data regression model. The estimation result presented in tables 3 and 4.

**Table3: estimation of main model**

| variable | symbol | coefficient | Z.statistic | Prob |
|---|---|---|---|---|
| Total assets Natural logarithm | $LAS$ | 0.224 | 6.061 | 0.000 |
| Assets growth | GAS | 0.846 | 0.957 | 0.339 |
| Fixed asset to total assets | $FAS$ | 0.751 | 5.591 | 0.000 |
| Growth gross domestic production | $GGDP$ | 0.229 | 2.108 | 0.036 |
| Capital adequacy ratio | $CAR$ | 0.205 | 4.013 | 0.000 |
| Capital adequacy ratio square | $CAR^2$ | -1.125 | -6.161 | 0.000 |
| Fit goodness statistic | F statistics: | 12.060 | R sqared: | 0.745 |
| | Prob: | 0.000 | Adj R sqared: | 0.683 |
| Model selection statistics | Chow Statistic: | 22.763 | Hausman Statistic: | 29.682 |
| | Probability: | 0.000 | Probability: | 0.000 |

It is necessary to estimate latitude from source to calculate optimal rate. Because to find optimal amount, it should be able to solve a quadratic equation. For this the so called equation is estimated with two variables, capital adequacy ratio and its square. This model estimation results are in Table 4.

**Table 4: two variable pattern estimation coefficient**

| variable | symbol | coefficient | Z statistic | Significant level |
|---|---|---|---|---|
| Latitude from source | c | 2.110 | 3.003 | 0.003 |
| Capital adequacy ratio | $CAR$ | 0.225 | 6.715 | 0.000 |
| Capital adequacy ratio square | $CAR^2$ | -0.901 | -3.982 | 0.000 |
| Goodness of fit tests | F statistics: | 14.257 | R sqared: | 0.63 |
| | Probability: | 0.000 | Adjusted R sqared:: | 0.58 |
| Model selection statistics | Chaw test: | 6.879 | Hausman Test: | 10.589 |
| | Probability: | 0.000 | Probability: | 0.005 |

Results indicate that capital adequacy ratio estimated in both models, has a significant effect on banks profit efficiency. Results indicate that total assets natural logarithm, fixed assets to total assets have positive and significant relation with profit efficiency.

Similarly, results indicate that the assets growth and GGDP have no significant effect on profit efficiency. R squared statistics show that the model have suitable explanatory power (63%) explanation.

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A model without control variables has been used to calculate optimal capital adequacy ratio. Solving equation related to the model estimated for finding optimal capital adequacy ratio to maximize profit efficiency, indicates that optimal rate for capital adequacy in Iran banks is 12.5%.
This result is consistent with theoretical literature on more risk in Islamic banks and need to maintain more capital in these banks compared to the rates proposed by the Basel Committee (8%).

**5- Conclusions**

In the legal supervision of Islamic banks, the standards and practical tools common in usurious banks are used. But Islamic banks differ from other banks in several respects. Existence of different financing instruments and different relationship of the bank with the customer in the Islamic banking system causes that the minimum capital adequacy for covering risks in Islamic banks should be more. Due to the characteristics of each asset, and liquidity management tools, Islamic banks need stronger supervision than conventional banks.
Various researches indicated that Islamic banks not only involve risks faced by conventional banks, but also, they encounter with a kind of new and unique risks which are as, a result of their different financial structures and unique assets. The most important evidence is that Islamic banks need various risk identification processes, approaches and different risk management techniques, as, such need different supervisory systems.
This study tries to examine the capital adequacy conditions and determine its optimal rate based on special characteristics Islamic banking in Iran. So, upon with banking industry experts, the capital adequacy rate was determined in Iran banks, and then theoretical model identified to explain relationship between profit efficiency and capital adequacy.
Theoretical background indicate that the relationship between capital adequacy ratio and profit efficiency is not steady and first increases as capital adequacy increases, and after passing a threshold level, reduces the efficiency. Empirical evidence also argued theoretical model are confirmed. Based on this view this threshold rate can be considered as optimal capital adequacy rate for banking system. Then, the relatioship between capital adequacy and bank profit efficiency was explained through a quadratic equation.
Solving quadratic equation estimated to maximize profit efficiency, indicated that optimal capital adequacy ratio in Iran banks is 12.5%.

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# نسبت کفایت سرمایه بهینه در نظام بانکداری ایران اسلامی

**چکیده:**

با ظهور و رشد بانکداری اسلامی، تحقیقات مختلفی برای تحلیل عملکرد و سازوکارهای قوانین نظارتی این صنعت انجام شده است. با توجه به نقش ویژه بانک ها در نظام های اقتصادی کشورها و جهان، قواعد نظارتی و کنترلی قابل توجهی مورد استفاده قرار گرفت. در این میان تعهد به اجرای قوانین بازل ۲ به عنوان مهمترین توافقنامه بین المللی برای تضمین سلامت بانکی از اهمیت ویژه ای برخوردار است و از میان تمامی موارد مطرح شده در این قرارداد، رعایت حداقل کفایت سرمایه مورد توجه قرار گرفته است. توسط بسیاری از تحقیقات یکی از مهمترین سؤالات در این زمینه این است که آیا روش محاسبه بازل و حداقل نرخ (۸ درصد) برای نظام بانکداری اسلامی مناسب است؟ برای پاسخ به این سوال، این پژوهش نسبت کفایت سرمایه بانک‌های اسلامی ایران را محاسبه کرده و با مدل‌سازی تأثیر آن بر کارایی سود بانک، به‌عنوان مهم‌ترین شاخص تشویقی برای بانک‌ها، نرخ بهینه این بانک‌ها را برآورد کرده است.

**کلمات کلیدی:** نسبت کفایت سرمایه، بانک های اسلامی ایران، کارایی سود، ریسک.

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