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Social learning and principal-agent problems in profit sharing contract

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Abstract

Purpose – The purposes of this study are twofold. First, to theoretically examine the profit-sharing (mudarabah) contract that produces an optimal distribution of return in the presence of social learning (shuratic process) within the environment of asymmetric information. Second, to empirically investigate the optimal condition of profit-sharing ratio (PSR) and social learning for profit-sharing (mudarabah) contract in Islamic banking.

Design/methodology/approach – Data from one of the biggest and earliest Islamic banks in Malaysia were taken as a proxy of an Islamic bank. The data are collected from the period of 2009 to 2013, and these will be used for the simulation process by using the genetic algorithm (GA) technique.

Findings – The empirical results discovered that Islamic banks had used social learning in their daily activities, especially in the asset side. The results also showed that the trend of social learning has a positive relationship with the trend of Islamic banks' net profit. Additionally, the results also indicated that the Islamic banks' net profit has a positive relationship with its PSR from the profit-sharing (mudarabah) financing and securities investment.

Originality/value – This study is the first of its kind that investigates the implementation of the social learning process in Islamic banking operation. This study also used the latest technique from artificial intelligence system, i.e. a GA, to attain an optimal value for PSR and social learning process.

Keywords Islamic bank, Genetic algorithm, Social learning, Profit-sharing contract

Paper type Research paper

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1. Introduction

The principal–agent problems occur when at least one party to the transaction has more relevant information than the others. This will result in a considerable amount of uncertainty and inefficiency in the information transfer that cause one party to have better knowledge about the venture than the others (Ross, 1973; Mirrlees, 1975; Harris and Raviv, 1979; Holmstrom, 1979; Grossman and Hart, 1983). There are limited studies which discuss regarding the principal–agent problems in the Islamic financial instruments, especially in profit-sharing (*mudarabah*) contract (Sapuan, 2016; Sapuan *et al.*, 2015; Khalil *et al.*, 2002).

Generally, profit sharing (*mudarabah*) is a partnership, whereby one party provides the capital (*rabbul maal*) and the other party (*mudarib*) provides the labor. The profit, if any, will be shared between them at a mutually agreed ratio. In the event of losses, it will be borne by the capital provider (*rabbul maal*), while the labor provider's (*mudarib*) efforts are all in vain. However, in the case of negligence, all losses will be borne by the labor provider (*mudarib*).

In profit-sharing (*mudarabah*) contract, the realized profit is partly influenced by information. Typically, in the asset side, entrepreneur (*mudarib*) who is the agent has better information than the Islamic bank (*rabbul maal*), as the principal. Hence, one reason on why an Islamic bank (*rabbul maal*) has a low level of investment in profit sharing (*mudarabah*) may have to do with its inability to monitor the firm's operation. This is because the Islamic bank (*rabbul maal*) acts as a silent partner in this venture. Monitoring the entrepreneurs may also be an inconvenience to the Islamic bank (*rabbul maal*), as it cannot effectively ascertain as to whether the entrepreneurs (*mudarib*) using the profit-sharing (*mudarabah*) funds is for the interest of the project, which results in adverse selection and moral hazard problems.

Based on the above discussion, the problem of asymmetric information can be mitigated if more information is made available to the Islamic bank (*rabbul maal*) by the entrepreneur (*mudarib*). To achieve this, information should be disclosed and communicated effectively by both parties. In this study, we provide suggestion on mitigating the principal–agent problem and increasing the returns of the contracting parties involved in this contract through the social learning (*shuratic* process).

Social learning (*shuratic* process) is the process where the contracting parties meet, discuss and consult each other on the arising issues to generate better ideas and finding the best solution based on their previous experiences and knowledge. As indicated by Choudhury (1991, 2001) and Abdullah and Ismail (2014), a *shuratic* process is an important element in the management decision process from an Islamic perspective, especially in a cooperation system, namely, joint venture (musyarakah) and partnership (mudarabah). The shuratic process can also become a medium of learning by doing that which encourages the expansion of knowledge and technology innovation (Choudhury *et al.*, 2016).

Hence, a contract developed based on social learning (*shuratic* process) by the contracting parties is necessary as to ensure a fair distribution of return. In the social learning (*shuratic*) process, every action is based on mutual agreement. This is in parallel with what is being mentioned in the Al-Quran, whereby decision-making should be based on mutual consensus:

> And those who answer the call of their Lord (i.e. to believe that he is the only God, and to worship none but Him Alone), and perform prayers, and who conduct their affairs by mutual consultation, and who spend of what. We have bestowed on them (Surah Alshura; 38).

The social learning (*shuratic*) process will encourage all parties involved in the contract to be open-minded, respectful, trusting and accepting of opposite views, as well as free to express thoughts and ideas (Alhabshi *et al.*, 1998), share problems and experiences (Abdullah and Ismail, 2014). The social learning process can be a monitoring mechanism toward the attainment of accountability, fairness and transparency in the venture (Abdul Rahman, 1998; Iqbal and Mirakhor, 2004; Hasan, 2009). In the profit-sharing (*mudarabah*) contract, the designing of a contract in the presence of social learning (*shuratic* process) will definitely allow the contracting parties to develop a comprehensive and incentive compatible contract that benefits both contracting parties. This contract can be an important guideline, as a monitoring and supervision tool in profit-sharing (*mudarabah*) contract and minimizes agency problems.

The objectives of this study are twofold. First, to theoretically present the profit-sharing (*mudarabah*) contract that is able to produce an optimal distribution of return in the presence of social learning (*shuratic* process) under the environment of asymmetric information. Second, to empirically examine the optimal condition of profit-sharing ratio (PSR) and social learning for profit-sharing (*mudarabah*) contract in Islamic banking. In this study, the genetic algorithm (GA) technique is performed to find the optimal condition for PSR, and the social learning algorithm is used that results in maximum net profit to the Islamic bank and a fair distribution of returns to the contracting parties.

2. Methodology

2.1 Theoretical model

In this study, we will adapt a mathematical model based on a two-tier profit-sharing (*mudarabah*) contract (Muda *et al.*, 2011). The first tier is an agreement between the bank and the depositors in the liability side of Islamic banks' balance sheet. The depositors are the providers of the capital (*rabbul maal*) and the bank (*mudarib*) functions as the manager of the funds. Meanwhile, the second tier is an agreement between the bank and the entrepreneur from the asset side of Islamic banks' balance sheet. The entrepreneur (*mudarib*) seeks finance from the Islamic bank (*rabbul maal*) to be invested in a profit-sharing (*mudarabah*) contract.

The social learning (*shuratic*) process will open the door for the exchange of ideas and information and better communication between the contracting parties. Hence, the social learning (*shuratic*) process can facilitate the mitigation of asymmetric information problem and reduce transaction cost of this venture.

Before investing the funds in the chosen project, the Islamic bank has observed other projects which can provide returns at least similar as that in this project. The Islamic bank will only invest in the chosen profit-sharing (*mudarabah*) project if the entrepreneur (*mudarib*) succeeds in convincing the Islamic bank that the return from this financing or investment will be either equal or exceed the returns earned from investments in the non-*mudarabah* project. If this assumption fails to be met, the Islamic bank will not involve in the project. We also assume that financing and investment are operated in a dynamic setting, where the time period (i) can be indexed as 0, 1 [...] n. We also assume that the Islamic bank (*rabbul maal*) is risk-averse and sensitive toward risks that exist in the investment process, especially the risks that influence the final return of the investment process.

At $i = 0$, the Islamic bank (*rabbul maal*) must make a decision of whether to enter into the investment for n years with the entrepreneur (*mudarib*). It is assumed that the Islamic bank will only agree to enter into the contract if and only if it believes the profit from the profit-sharing (*mudarabah*) investment is at least equal to non-profit-sharing (non-*mudarabah*) investment return which is risk-free for the same duration. Therefore, this assumption will become one of the constraints to consider and be fulfilled by the Islamic bank during the selection process. The selection process will be done by the Islamic bank through a rigid and stringent process. After the Islamic bank (*rabbul maal*) has chosen a suitable entrepreneur to run their investment, it (*rabbul maal*) will invite them in the discussion process. The first meeting between the Islamic bank (*rabbul maal*) and the entrepreneur (*mudarib*) is about arriving to a mutual agreement regarding the project. This meeting is called the *shuratic* process. During this meeting, they will discuss the details of the project, including the PSR, types of investment and maturity of the investment. All the decisions are based on discourse and consensus of both parties.

After the contract is signed, we assume that the Islamic bank (*rabbul maal*) will make the first move by selecting the amount of capital to be invested based on the sources of fund through deposits earned from investment accounts and shareholders' funds. The financing and investment activities can only generate outcome at the end of each year, $i = 1, 2 [\ldots] n$. The crucial assumption in this study is that there is an asymmetric information (ρ) problem occur in the financing and investment process represented by $\rho = 1$. The existence of asymmetric information indicates that the Islamic bank cannot monitor the level of effort taken by the entrepreneur (*mudarib*) in managing the financing and investment activities. Nonetheless, the Islamic bank can only observe its share of net return from the venture.

The Islamic bank (*rabbul maal*) has two sources of funds. First, the Islamic bank raises equity capital from the shareholders (TS), and second, the Islamic bank accepts deposits from depositors in term of current deposits (TD_D) and investment account deposits (TD_{IA}). The structure for sources of fund can be stated as:

$$TL = TS + TD_D + TD_{IA} + \varepsilon_1 \quad (1)$$

Where, TL is the total source of funding, TS is the total shareholders' fund, TD_D is the total number of current deposits, TD_{IA} is the total investment account deposits and ε_1 is the residual on sources of profit based on other types of contract. To simplify this study, we assume that investment account deposits and shareholders' funds are governed by profit-sharing (*mudarabah*) contract. Initially, the Islamic bank (*rabbul maal*) will decide to allocate the funds from the liability side for two purposes, i.e. for financing and investment decision (TVF). For simplicity, we will divide the financing and investment opportunities of these funds according to profit-sharing (*mudarabah*) financing and investment (TVFm) and non-profit-sharing (non-*mudarabah*) financing and investment (TVFnm). The structure of the used funds on the asset side (TA) can be stated as follows:

$$TA = TVFm + TVFnm + \varepsilon_2 \quad (2)$$

Where, TA is the total asset, TVFm is total financing and investment which comprise total financing on assets and total investment in the securities portfolio based on profit-sharing (*mudarabah*) contract, meanwhile TVFnm comprises total

financing on assets and total investment in the securities portfolio based on non-profit-sharing (non-*mudarabah*) contract. ε_2 is the residual on uses of funds based on other types of contract. Equation (2) also shows that the Islamic bank allocates funds and makes investment decisions at any opportunity available, to generate value to the total funds (TL) from the shareholders' (TS) and depositors (TD_D and TD_{IA}).

In this model, it is assumed that account deposits from shareholders and investments are governed by the mudarabah contract only. Thus, in the mudarabah contract, the investment account holders (*rabbul maal*) supply funds to the Islamic bank (*mudarib*) for financing and investment purposes. The Islamic bank contributes its expertise. The returns are in terms of net profit that the Islamic bank receives from the financing and investment activities on the asset side that will be paid to the depositors of investment accounts and shareholders based on a pre-determined ratio. The net income generated from the investment account deposits is divided between the Islamic bank that contributes expertise and depositors' investment accounts as a funds provider, according to the pre-determined ratio. Let α be the pre-determined PSR of the Islamic banks for the contribution of their expertise in managing the deposits of investment account that are based on profit-sharing (*mudarabah*) contract, while depositors' entitlement as $(1 - \alpha)$. The value of pre-determined PSR is in the range of $0 < \alpha < 1$, accumulates from the distribution of profit received from the return of investment account. In the event of losses, all losses will be borne solely by the depositors as the capital providers (*rabbul maal*). However, any loss due to misconduct and negligence would be borne by the Islamic bank (*mudarib*). On the other hand, the Islamic bank also derived income, that is net income, after zakah and tax from the shareholders' funds (TE). Thus, the net profit is derived from the Islamic bank's entitlement of α. The return for shareholders' funds will not be explained in this study. The Islamic bank also offers current accounts that are assume to be based on al-qard (benevolent loan) contract that is a loan extended without interest or profit sharing.

Meanwhile, the returns for the Islamic bank and the entrepreneur on the asset side are in terms of net profit from the financing and investment in the securities portfolio activities. The net profit will be shared based on the pre-determined ratio. Let the pre-determined PSR for net profit on the asset side be θ. The Islamic bank (rabbul maal) gets θ of the net profit and $(1 - \theta)$ is retained by the entrepreneur (mudarib). The value of the pre-determined PSR (in the asset side) is in the range of $0 < \theta < 1$, which is accumulates from the distribution of profit received from financing. In the case of losses, all losses will only be borne by Islamic banks as the capital provider (*rabbul maal*). However, any loss due to misconduct and negligence will be borne by the entrepreneur (*mudarib*). Hence, the net total profit is a net of direct operating cost for investment accounts.

Meanwhile, for non-profit-sharing (non-*mudarabah*) contract, the Islamic bank will purchase an asset from the vendor on behalf of the entrepreneur. Then, the Islamic bank will resell the assets of the entrepreneur at a predetermined price, P_1 that covers the original asset price (P_0) plus the negotiated profit margin (β). Basically, the market value of the debt may be lower than the face value of debt because the entrepreneur may default.

Thus, the balance sheet of an Islamic bank can be simplified as follows:

$$TS + TD_{IA} + \varepsilon_1 = TVFm + TVFnm + \varepsilon_2 \quad (3)$$

Whereby the sources of funds that Islamic banks can earn from depositors and shareholders are equal to the total assets that comprise total financing and total investment in securities. Meanwhile, the residual can be in three situations. If $\varepsilon_{1t} = \varepsilon_{2t}$, the capital structure is fully matched to fund applications. On the other hand, if $\varepsilon_{1n} > \varepsilon_{2n}$, then there are residual resources which are underemployed during that period; if $\varepsilon_{1n} < \varepsilon_{2n}$, then there is a need for further sourcing of funds for deployment.

In terms of social learning (*shuratic* process), we assumed that it involves the learning process of both contracting parties, represented by the social learning value (φ). Similar to the study done by Choudhury (2001), the learning process arose from a discourse between the capital provider and non-capital factors (entrepreneurs) where the knowledge flows represented the ordinal values evolved by discourse and consensus among the contracting parties. In this venture, the net profit is distributed in accordance to a pre-determined PSR (θ) based on the social learning. The value of the social learning is in the range of $0 \leq \varphi \leq 1$. This value indicates that if there is no cooperative spirit in both contracting parties, the value is 0. Thus, it is assumed that the contracting parties will not be involved in the agreement as they cannot agree to any decision. Meanwhile, if the social learning shows a value of $0 < \varphi < 1$, it means the social learning involves different weighting in the decision made between the Islamic bank and the entrepreneurs. However, if the value is near to 1, the co-operation in the decision-making process between the contracting parties is improving. Finally, if there is a mutual agreement (perfect cooperation) in the decision-making process, the social learning value is 1. The latter value shows that both contracting parties will equally share their experiences and knowledge in deciding the best solution to the project. This is in line with the suggestion from Choudhury (2001) and Choudhury *et al.* (2016), where better outcomes can be evolved through *shuratic* decision-making, especially over the evolutionary process of learning by doing that is comprehended from continuous discussion between the contracting parties.

Given the description above, Islamic bank profit maximization can be written as below:

$$\begin{aligned} \pi_{IB} &= TR - TC \\ &= [(TID_{IA} - OC_{IA})\alpha + (TID_{SA}OC_{SA})] - (TOC + Tax + Zakah) \end{aligned} \tag{4}$$

Where:

(1) π = Total net profit after tax and *Zakah* and it is derived from total revenue and total costs.

(2) $TR = [(TID_{IA} - OC_{IA})\,\alpha + (TID_{SA} - OC_{SA})]$, is the total revenue. The variables represent total revenue comprises:

- TID_{IA} is the total profit derived from investment of depositors' funds in financing and investment based on profit-sharing (*mudarabah*) contract and non-profit-sharing (non-*mudarabah*) contract. Thus, TID_{IA} comprise three items, i.e. total profit derived based on profit-sharing (*mudarabah*) financing and investment in the securities portfolio (TFI_{MD}), total profit derived based on non-profit-sharing (non-*mudarabah*) financing and investment in the securities portfolio (TFI_{NM}) and other profits consisting of fees and

commission from profit-sharing (*mudarabah*) investment, i.e. OI_{MD}, and non-profit sharing (non-*mudarabah*), i.e. OI_{NM}. For profit-sharing (*mudarabah*) contract, it will be influenced by the value of the *shuratic* process (φ) and asymmetric information (ρ). Meanwhile, the return for non-profit-sharing (non-*mudarabah*) funds is based on the financing rate (β). Therefore, the equation can be written as below:

$$TID_{IA} = [(TFI_{MD}(\theta))(\phi)(\rho) + OI_{MD}] + TFI_{NM}(\beta) + OI_{NM} \tag{4.1}$$

- TID_{SA} is total profit derived from shareholders' fund for financing and investment based on profit-sharing (*mudarabah*) contract. Thus, it comprises three elements, total profit derived based on profit-sharing (*mudarabah*) financing, investment from shareholders' funds (TFI_{SA}) and other profits (OI_{SA}) (e.g. fee and commission) from shareholder account. For profit-sharing (*mudarabah*) contract, it will be influenced by the value of the *shuratic* process (φ) and asymmetric information (ρ). The equation for this account can be written as below:

$$TID_{SA} = [(TFI_{SA}(\theta))(\phi)(\rho) + OI_{SA}] \tag{4.2}$$

- Meanwhile, OC_{IA} and OC_{SA} are other expenses directly attributable to the financing and investment of the investment account based on profit-sharing (*mudarabah*) contract, other deposit using non-profit-sharing (non-*mudarabah*) contract and shareholders' fund (represent by expenses related to operational risk) + allowance for losses on financing (represent by expenses related to credit risk) and other direct operating costs (including profit equalization reserve and loan provision).
- TC = TOC + tax + *Zakah*; the total cost is equal to additional of non-operating cost which includes personnel expenses and other overhead expenditures, tax and *Zakah*. The *Zakah* payment needs to be calculated under total cost, as Islam discourages concentration of wealth, of economic agent only in certain hands, but encourages it to be circulated among the society. This is aligned with the objective of Shariah (*maqasid al-shariah*) that aims to achieve just and equitable distribution of wealth among economic participants.
- Expanding equation (4) by detail up each component according to each type of investment or financing:

$$\begin{aligned}\pi_{IB} = {} & [((TFI_{MD}(\theta))(\phi)(\rho) + OI_{MD}) + (TFI_{NM}(\beta) + OI_{NM}) - OC_{IA}]\alpha \\ & + [((TFI_{SA}(\theta))(\phi)(\rho) + OI_{SA}) - OC_{SA}] - (TOC + Tax + Zakah)\end{aligned} \tag{5}$$

Based on the full description above in equation (3.13), the Islamic bank profit maximization condition in a dynamic setting can be described using a linear optimization equation as shown below:

$$\text{Max } \pi_{IB} \sum_{i=1}^{n} [((TFI_{MDi}(\theta_i))(\phi_i)(\rho_i) + OI_{MDi}) + (TFI_{NMi}(\beta_i) + OI_{NMi}) - OC_{IAi}]\alpha_i + [((TFI_{SAi}(\theta_i))(\phi_i)(\rho_i) + OI_{SAi}) - OC_{SAi}] - (TOC_i + tax_i + Zakah_i) \quad (6)$$

Subject to:

$$0 < \alpha_i < 1 \quad (6.1)$$

$$0 < \theta_i < 1 \quad (6.2)$$

$$0 \leq \phi_i \leq 1 \quad (6.3)$$

$$\alpha_i < \theta_i \quad (6.4)$$

$$\theta_i > \beta_i \quad (6.5)$$

$i = 1,2,3,4,5$ (i represent the year) and $\rho = 1$.
Where:

TFI_{MD} = total profit derived from the financing and investment from the profit-sharing investment account;
TFI_{NM} = total profit derived from the financing and investment from the non-profit-sharing investment account;
OI_{MD} = fee and commission in a profit-sharing investment account;
OI_{NM} = fee and commission on non-profit-sharing investment account;
TFI_{SA} = total profit derived from the financing and investment from the shareholders' funds based on profit sharing;
OI_{SA} = fee and commission on the shareholders' funds;
OC_{IA} = other expenses and allowances (such as expenses on operational risk, allowance for losses on financing and profit equalization reserve) in the deposit investment account;
OC_{SA} = other expenses and allowances (such as expenses on operational risk, allowance for losses on financing and profit equalization reserve) in the shareholders' funds;
TOC = non-operating cost;
tax = business tax;
zakah = Zakah payment;
α = pre-agreed PSR on investment account deposits;
θ = pre- agreed PSR of profit derived from the financing/investment activities;
β = financing rate;
ρ = asymmetric information parameter; and
φ = social learning parameter.

2.2 Genetic algorithm parameters

GA is an adaptive learning mechanism in an artificial intelligence system and is effective in finding optimization. Generally, GA is developed based on the principles of genetics and natural selection. In this system, an optimal point can be achieved through

the adoption of behavior that did well in the past with the occasional process of experimentation.

Referring to Table I, we will use two test runs, with the first test run consisting of a crossover rate of 80 per cent and a mutation rate of 5 per cent. Meanwhile, the second test run comprised a crossover rate of 80 per cent and a mutation rate of 7 per cent. Based on Table I, the first set of parameters indicated the population size. The population size specifies how many individuals are there in each generation. For a large population size, the GA searches the solution space more thoroughly. However, a large population size also causes the algorithm to run slower. In this analysis, we used 20 population size parameters, with 20 individuals in each generation. The initial range specifies lower and upper bounds for the entries of the vectors in the initial population. The initial range can be in the matrix form. The matrix has the form of [lb;ub], where "lb" is the lower bound and "ub" is the upper bound for the entries in that coordinate. In this study, we are limiting the lower bound to 0 and the upper bound to 1. The elite count specifies the number of individuals that are guaranteed to survive to the next generation under reproduction process. The set of elite count should be a positive integer less than or equal to the population size. In this study, we only limit the elite count on 2.

In this study, we will use the data from one of the biggest and earliest Islamic banks in Malaysia as a case study, which is from the period of 2009 until 2013. The data will be tested using the GA tool in MATLAB 2014a software.

3. Results and discussion

3.1 Simulation results for the optimization

In this study, the test of optimization is conducted to find the optimal solution for three important indicators in an Islamic bank's operations. The first simulation process is to examine the optimal solution for social learning (*shuratic* process) between Islamic banks and entrepreneur on the asset side, when they meet and discuss regarding the contract and the financing or investment activities. The second simulation process is to find the optimal solution for the PSR of profit-sharing financing and investment activities of the Islamic bank (*rabbul maal*) and the entrepreneur (*mudarib*) on the asset side. Finally, the last simulation process is to find the optimal solution for the PSR for profit-sharing investment account for depositors (*rabbul maal*) as fund providers and the Islamic bank (*mudarib*) which manages the fund on behalf of the depositors in the liability side.

Table I. Parameter values for GA technique

Parameters	Test series 1	Test series 2
Generations	100	100
Population size	20	20
Initial range	[0;1]	[0;1]
Elite count	2	2
Crossover rate (p_c) (%)	80	80
Selection operator	Tournament (k = 4)	Tournament (k = 4)
Crossover operator	Scattered	Scattered
Mutation operator	Uniform	Uniform
Mutation rate (p_m) (%)	5	7

The results of PSR and social learning (*shuratic* process) will be in terms of percentage. The values of PSR and social learning (*shuratic* process) mentioned earlier in the model are described as more or equal and less or equal to 0 and 1. Later in the results, the value of 0 is indicated as 0 per cent, the value of 1 is indicated as 100 per cent and the value in between 0 and 1 will also be represented in percentage.

3.2 Optimal solution for social learning

Table II shows the result of the optimal condition for social learning (*shuratic* process). The first test series run the simulation process for 100 generations and converge to an optimal point at 90 iterations, with a crossover rate (p_c) of 80 per cent and a mutation rate (p_m) of 5 per cent. The fitness function that represents the simulation value of an Islamic bank's profit for the five years is RM 1,979,639.97. This figure is relatively high compared to the actual data of an Islamic bank's net profit for the same period with a total value of RM 1,853,974.

Based on Table II, the value of social learning is low at 75.67 per cent in 2009 compared to the rest of the year. This is similar to the trend of net profit for an Islamic bank in 2009 where the value of net profit is low at RM 160,607. The value of the social learning for 2010 increased to 99.74 per cent, and this is in line with the increase in the net profit to RM 411,778 of the same year. However, the value of social learning reduced in 2011 to 91 per cent, consistent with a decrease in the net profit for Islamic bank in 2011 to RM 359,159. Meanwhile, in 2012 and 2013, the optimal value of the social learning increased to 94.42 and 96.50 per cent, respectively. These values aligned with the increasing of the net profit for the same period from RM 430,785 in 2012 to RM 491,645 in 2013.

In the second test series, we run the simulation process for 100 generations with a crossover rate (p_c) of 80 per cent and a mutation rate (p_m) of 7 per cent. This series converges to the optimal point at 67 iterations. The result of the five-year fitness test is RM 2,060,144.61. This figure is considerably high compared to the actual data of net profit of an Islamic bank from 2009 to 2013, with the total value of RM 1,853,974. The optimal solution for social learning in 2009 is low compared to other years with the value of 68.15 per cent. This value corresponds to the low net profit of 2009 at RM 160,607. The

Test series	Year (i)	Net profit (RM)	Generation	Iteration	φi (%)	Fitness function (RM)
1 ($pc = 80\%; pm = 5\%$)	2009	160,607	100	90	75.67	
	2010	411,778			99.74	
	2011	359,159			91	
	2012	430,785			94.42	
	2013	491,645			96.5	
Total		1,853,974				1,979,639.97
2 ($pc = 80\%; pm = 7\%$)	2009	160,607	100	67	68.15	
	2010	411,778			100	
	2011	359,159			70.48	
	2012	430,785			81.93	
	2013	491,645			90.83	
Total		1,853,974				2,060,144.61

Table II. Simulation results for social learning in profit-sharing contract

optimal value of the social learning for 2010 increased to 100 per cent, showing a perfect mutual consultation between the contracting parties when they met for a discussion. This is consistent with the growth of the net profit of an Islamic bank in 2010 at RM 411,778. In 2011, the social learning value slightly decreased to 70.48 per cent before it increased again in 2012 and 2013 to 81.93 and 90.83 per cent, respectively. Comparing the trend of the actual net profit of the Islamic bank, we realized that the value of the net profit was low in 2011 at RM359,159, and this value increased again in 2012 and 2013 to RM 430,785 to 491,645, respectively.

Based on the results in Table II, we can significantly conclude that the trend of social learning has a positive relationship with the trend of Islamic bank's net profit. We realized that when the social learning is low, Islamic banks' net profit will also be low, and vice versa. This showed that the social learning plays very important roles to be a benchmark for Islamic banks' profitability. Better cooperation in the decision-making process between the contracting parties in the asset side can generate better profit for the Islamic bank.

3.3 Optimal solution for profit-sharing ratio in profit-sharing financing and investment activities

Table III shows the result of optimal condition for PSR in profit-sharing (*mudarabah*) financing and securities' investment for Islamic bank. The first test series runs the simulation process for 100 generations and converges to an optimal solution at 90 iterations, with a crossover rate (p_c) of 80 per cent and a mutation rate (p_m) of 5 per cent. The result of the five-year fitness functions showed that the Islamic bank will maximize their profit at RM 1,979,639.97. This figure is rather high compared to the actual data of net total profit of an Islamic bank from 2009 to 2013 with the total value of RM 1,853,974.

In 2009, the value of the PSR for Islamic bank in financing and investment activities was small at 89.08 per cent compared to other years. This is similar to the trend of net profit for Islamic banks in 2009, where the value of net profit was low at RM 160,607. However, the PSR value for entrepreneurs in 2009 was relatively high at 10.92 per cent compared to the other years. The value of PSR for Islamic banks for 2010 increased to 99 per cent consistent with the increased in net profit to RM 411,778, but the value of PSR

Table III.
Simulation results for PSR in profit-sharing financing and securities investment

Test series	Year (i)	Net profit (RM)	Generation	Iteration	θi (%)	$100 - \theta i$ (%)	Fitness function (RM)
1 ($pc = 80\%$;	2009	160,607	100	90	89.08	10.92	
$pm = 5\%$)	2010	411,778			99	1	
	2011	359,159			94.06	5.94	
	2012	430,785			99	1	
	2013	491,645			99.32	0.68	
Total		1,853,974					1,979,639.97
2 ($pc = 80\%$;	2009	160,607	100	67	82.04	17.96	
$pm = 7\%$)	2010	411,778			99.14	0.86	
	2011	359,159			96.8	3.2	
	2012	430,785			98.33	1.67	
	2013	491,645			99	1	
Total		1,853,974					2,060,144.61

for the entrepreneur decreased at 1 per cent. The PSR for profit-sharing (*mudarabah*) financing and securities investment for Islamic bank declined in 2011 to 94.06 per cent. This reduction is in line with a decrease in the net profit for Islamic banks in 2011 at RM 359,159. Meanwhile, in 2012 and 2013, the optimal value of the PSR in financing and investment activities for Islamic bank improved to 99 and 99.32 per cent, respectively. These values are in accordance with the increase in the net profit of the two years from RM 430,785 in 2012 to RM 491,645 in 2013. Observing from the entrepreneur side, the PSR increased in 2011 to 5.94 per cent before decreasing to 1 and 0.68 per cent in 2012 and 2013, respectively.

In the second test series, we run a simulation process for 100 generations with a crossover rate (p_c) of 80 per cent and a mutation rate (p_m) of 7 per cent. This series converges to the optimal point at 67 iterations. The result of the five-year fitness function is at RM 2,060,144.61. This figure is significantly higher compared to the actual data of total net profit of Islamic banks from 2009 to 2013 with the total value of RM 1,853,974. The optimal solution for PSR in financing and securities investment activities for Islamic bank in 2009 was low compared to other years at 82.04 per cent. This value is consistent with a lower net profit for 2009 at RM 160,607. Meanwhile, the PSR for the entrepreneur is 17.96 per cent. The optimal PSR in financing and securities investment activities for Islamic bank in 2010 increased to 99.14 per cent and decreased slightly in 2011 to 96.80 per cent. This is consistent with the increase in the net profit of Islamic banks in 2010 to RM 411,778 and later a decrease to RM359,159 in 2011. In contrast, the value of PSR for the entrepreneur decreased from 0.86 per cent in 2010 and improved to 3.20 per cent in 2011. Moreover, in 2012 and 2013, the value of the net profit increased from RM 430,785 to 491,645. This trend is in line with the increasing trend in the optimal solution PSR in financing and securities investment for Islamic banks from 98.33 to 99 per cent for 2012 and 2013, respectively. However, the PSR for the entrepreneur decreased from 1.67 per cent in 2012 to 1 per cent in 2013.

Based on the above results, we can strongly conclude that the second test series has produced better solution, whereby it has less computation time with 67 iterations compared to the first test series with 90 iterations, as well as is a higher fitness function. We can also conclude that the net profit for Islamic banks has a positive relationship with the PSR for Islamic banks for profit-sharing (*mudarabah*) financing and securities investment but a negative relationship with the PSR for the entrepreneur.

3.4 Optimal solution for profit-sharing ratio in profit-sharing investment account

The profit-sharing (*mudarabah*) investment account is one of the most important savings deposits in Islamic banking that contributes funds to the operation of Islamic banking. Table IV shows the result of optimal solutions for PSR in the profit-sharing (*mudarabah*) investment account.

The first test series run the simulation process for 100 generations and converge to the optimal point at 90 iterations with a crossover rate (p_c) of 80 per cent and a mutation rate (p_m) of 5 per cent. The results of the five-year fitness function show that the Islamic bank will maximize their profit at RM 1,979,639.97. This figure is slightly high compared to the actual data of total profit of Islamic bank for the same period with the total value of RM 1,853,974. The value of the PSR for profit-sharing (*mudarabah*) investment account for Islamic banks shows the same trend as the actual net profit of the Islamic banks, whereby in 2009, the net profit was low at RM 160,607 and the optimal

Test series	Year (i)	Net profit (RM)	Generation	Iteration	α_i (%)	$100 - \alpha_i$ (%)	Fitness function (RM)
1 ($pc = 80\%$;	2009	160,607	100	90	68.91	31.09	
$pm = 5\%$)	2010	411,778			96.09	3.91	
	2011	359,159			83.86	16.14	
	2012	430,785			86.12	13.88	
	2013	491,645			98.6	1.4	
Total		1,853,974					1,979,639.97
2 ($pc = 80\%$;	2009	160,607	100	67	58.76	41.24	
$pm = 7\%$)	2010	411,778			96.54	3.46	
	2011	359,159			93.64	6.36	
	2012	430,785			82.3	17.7	
	2013	491,645			98.05	1.95	
Total		1,853,974					2,060,144.61

Table IV.
Simulation results for PSR in profit-sharing investment accounts

solution for PSR for a profit sharing (*mudarabah*) investment account was also low at 68.91 per cent.

However, the PSR for depositors was comparatively higher at 31.09 per cent in 2009. The value of Islamic banks' PSR in profit-sharing (*mudarabah*) investment savings account for 2010 increased to 96.09 per cent, in line with the increase in Islamic banks' net profit to RM 411,778. Meanwhile, the PSR for depositors decreased considerably to 3.91 per cent. Additionally, Islamic banks' PSR for 2011 decreased to 83.86 per cent, consistent with a decrease in the net profit for Islamic banks in 2011 at RM 359,159. In 2011 and 2012, the optimal value of the PSR of profit-sharing (*mudarabah*) investment account for the Islamic bank increased to 86.12 and 98.60 per cent, respectively. These values are consistent with the increase of the net profit of the two years from RM 430,785 in 2012 to 491,645 in 2013. Conversely, the value of PSR for depositors increased slightly to 16.14 per cent in 2011 but declined in 2012 and 2013 to 13.88 and 1.40 per cent, respectively.

In the second test series, we run the simulation process for 100 generations with a crossover rate (p_c) of 80 per cent and a mutation rate (p_m) of 7 per cent. This series converges to the optimal point at 67 iterations. The result of the five-year fitness function is RM 2,060,144.61. This figure is considerably high compared to the actual data of total net profit for Islamic banks from 2009 to 2013 with the total value of RM 1,853,974. The optimal solution for Islamic banks' PSR in 2009 is very low compared to other years with the value of 58.76 per cent. This value is consistent with lower net profit for the 2009 at RM 160,607. Meanwhile, the value of depositors' PSR was slightly high at 41.24 per cent. The optimal PSR of profit sharing (*mudarabah*) investment account for 2010 increased to 96.54 per cent and decrease slightly in 2011 to 93.64 per cent. This is associated with an increase in the net profit of Islamic banks in 2010 to RM 411,778 and a decrease to RM 359,159 in 2011. However, the value of PSR for the depositor decreased to 3.46 per cent in 2010, but the value increased to 6.36 per cent in 2011. Moreover, the value of net profit increased to RM 430,785 and 491,645 in 2012 and 2013, respectively. In line with these changes, the optimal solution for PSR of the profit-sharing (*mudarabah*) investment saving account decreased to 82.30 per cent in 2012 but

increased to 98.05 per cent in 2013. On the contrary, the PSR for depositors decreased from 17.70 per cent in 2012 to 1.95 per cent in 2013.

Based on the results above, we can conclude that the second test series has better optimal solution compared to the first test series, whereby its fitness value is higher and the computation time as indicated by the iteration time is much shorter, showing virtuous quality solutions. We can also ascertain that when the net profit for Islamic banks is high, the optimal solution for Islamic banks' PSR in profit-sharing (*mudarabah*) investment accounts is also high. This indicates a positive relationship between both variables. However, there is a negative relationship between depositors' PSR and Islamic banks' net profit.

3.5 Convergence to optimal solution

The performance of GA can be evaluated based on the average performance of the entire population of chromosomes and the performance of the best individual in the population. Figures 1 and 2 show the plots of the best and average values of the fitness function across 100 generations. The x-axis of the performance graph indicates how many generations have been created and evaluated at a particular point in the run. Meanwhile, y-axis displays the value of the fitness functions at every point of a generation. We can examine how fast the population converges toward the best solution during one run. Through this, we will know the number of generations that we should let the GA goes through at each run. Figures 1 and 2 show the global convergence of the population for each test series. In Figure 1, the convergence happens with a crossover rate of 80 per cent and a mutation rate of 5 per cent. Meanwhile, in Figure 2, the convergence occurs with a crossover rate of 80 per cent and a mutation rate of 7 per cent. Based on the diagrams in Figure 1 and 2, the population converges faster in Figure 2 at

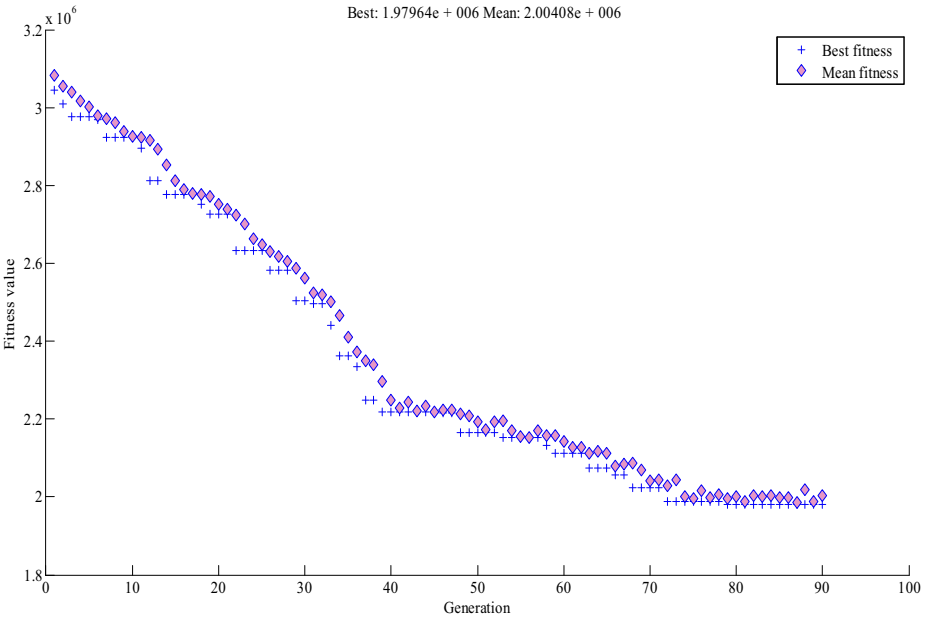

Figure 1.
Performance graphs for crossover rate = 80 per cent and mutation rate = 5 per cent

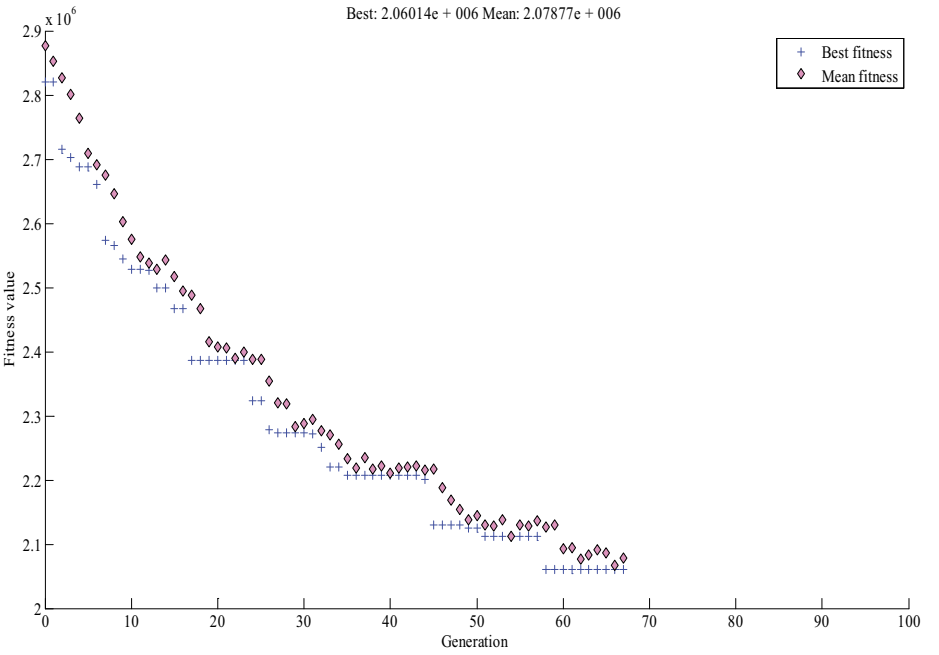

Figure 2.
Performance graphs for crossover rate = 80 per cent and mutation rate = 7 per cent

67 iterations compared to 90 iterations in Figure 1. We can conclude that, the higher the mutation rate, the faster the population converges to the optimal point and the better the solution that can be generated. These results are consistent with the findings of Yu (2004), Affenzeller *et al.* (2009), Shukla *et al.* (2010) and Negnevitsky (2011).

4. Conclusion

The Islamic bank is currently using the social learning (*shuratic*) process in its operation, especially in determining the terms and conditions of the contract, such as the ratio of return that needs to be determined early in a contract. The results also showed that when the value of the social learning is high, the value of the PSR for financing and securities investment activities of Islamic bank will also be high. This is believed to be caused by a reduction in the asymmetric information and an improvement in the principal–agent problems as the contracting parties can meet and thoroughly discuss about the contract and investment activities. The dissemination of information will be more effective between the contracting parties and reduce the transaction cost. Based on the results above, we can strongly conclude that the trend of the social learning has a positive relationship with the trend of Islamic bank's net profit. Thus, when the value of the social learning is increasing, the Islamic banks' net profit will also increase and vice versa. This proved that the social learning (*shuratic*) process plays an important role as a benchmark for Islamic banks' profitability. Better cooperation between the contracting parties on the asset side can generate better profit for the Islamic bank.

Meanwhile, on the liability side, when an Islamic bank's net profit is increased, the optimal solution for the Islamic bank's PSR from the return on profit-sharing investment accounts is also increased and vice versa. Therefore, this shows a positive relationship

between PSR from investment savings accounts for Islamic banks and the Islamic bank's net profit. However, the optimal condition of depositors' PSR from the return on profit-sharing investment accounts is low when an Islamic bank's net profit increases. This indicates a negative relationship between depositors' PSR and of the Islamic bank's net profit.

Additionally, on the asset side, the Islamic bank as a capital provider (*rabbul maal*) will earn higher PSR when the net profit of the Islamic bank increases and vice versa. This showed a positive relationship between the Islamic bank's PSR and net profit. Meanwhile, an entrepreneur (*mudarib*) who manages the venture will earn lower PSR when the Islamic bank's net profit increases and vice versa. The results also indicate a negative relationship between the entrepreneur's PSR and the Islamic bank's net profit. In this two-tier profit sharing, we can see the relationship between the contribution of the social learning and the Islamic bank's net profit, as well as the return from the financing and investment activities. With the implementation of social learning (*shuratic* process), Islamic banks should propose more profit-sharing contract in their operations because the agency problem that previously arises from this kind of contract can be minimized. A higher profit can be generated from higher social learning and, simultaneously, Islamic banks can generate higher returns from their operation, namely, by higher PSR that Islamic banks can earn from financing and securities investment on the asset side and higher returns from the profit-sharing investment account on the liability side.

Meanwhile, in terms of the convergence process, we found that, the higher the mutation rate, the faster the population converges to the optimal point and thus a better solution can be achieved. In this case, the second test run that consists of a crossover rate of 80 per cent and a mutation rate of 7 per cent will converge faster to the optimal point compared to the first test run.

The findings can provide some basis for the imposition of policy measure, especially in alleviating principal–agent problems in profit-sharing (*mudarabah*) contract. First, the social learning (*shuratic*) process that involves a discussion between contracting parties during the creation of a contract is already implemented by the Islamic bank but in varying degrees of execution. It can become a monitoring tool for the Islamic bank, especially in a profit-sharing (*mudarabah*) contract, where the Islamic bank cannot interfere in the management of the project. Through the social learning (*shuratic*) process, both contracting parties can develop terms and conditions in the contract that fulfil the need for both parties when the venture is carried out. This contract is capable to be the guideline to the entrepreneurs (*mudarib*), whereby they need to adhere to managing the funds from an Islamic bank (*rabbul maal*). The optimal condition in social learning (*shuratic* process) can generate effective decision-making in creating a comprehensive contract that can satisfy the contracting parties. Second, the optimal condition from the simulation process proved that social learning (*shuratic* process) plays an important role in the development of a contract. A social learning (*shuratic*) process is able to minimize asymmetric information in the contract when information between the contracting parties can be disseminated effectively, thus increasing the net profit of the Islamic bank. Third, the social learning (*shuratic*) process can become a signaling tool for Islamic banks, whereby when mutual discussion (*shura*) increases, the asymmetric information problem will decrease and enhance the Islamic banks' net profit. Moreover, the implementation of social learning (*shuratic* process) should be extended to other types of contract, whether in equity-based contract, such as profit–loss

sharing (*musyarakah*), or debt-based contract, such as short-term loan (*murabahah*) and leasing (*ijarah*), to reduce asymmetric information and improve the Islamic bank's profit in the future.

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