

Schöler, Klaus

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On Credit Supply of PLS-Banks

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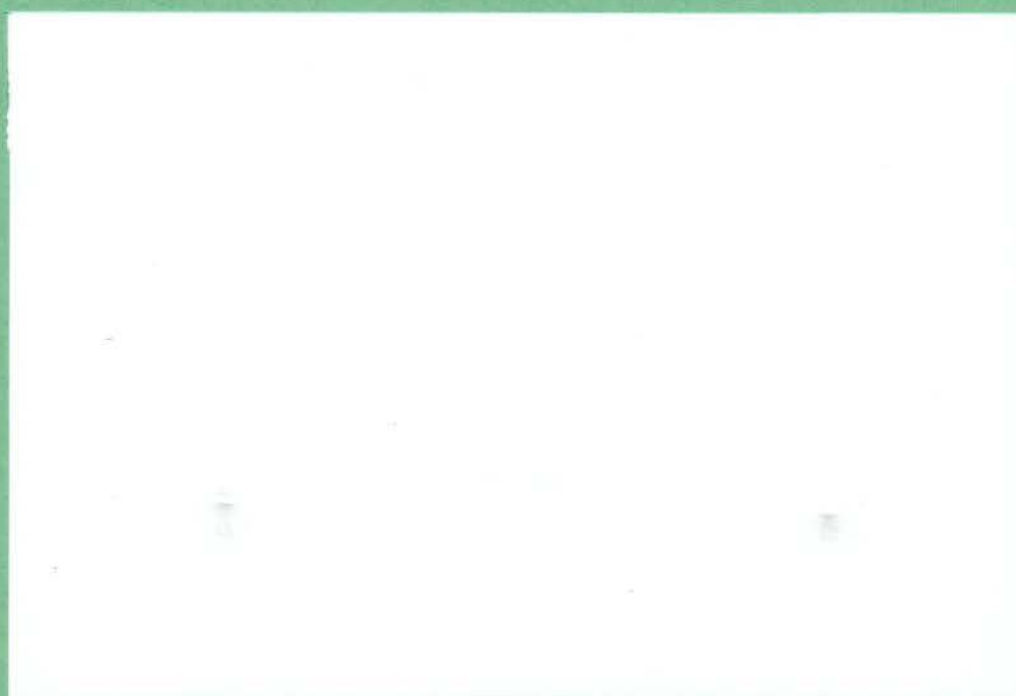
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ON CREDIT SUPPLY OF PLS-BANKS

by

Klaus Schöler

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Address of the Author:
Dr. Klaus Schöler
University of Siegen
Department of Economics
Hölderlinstr. 3
5900 Siegen
West Germany

I. INTRODUCTION

In the past decades a strong revival of the Islam could be observed in all aspects of life of the people in the Near and the Middle East countries. This fundamentalistic movement has caused the Pakistani government to start a readjustment of the whole economic system according to the principles of the Islam. In other countries like Iran, Saudi Arabia, Egypt, Bahrain, the United Arab Emirates, and in Sudan there is an increasing tendency towards an Islam-oriented social policy. Since 1980 this development has led to establishment of numerous Islamic banks¹⁾. The difference between an Islamic and a western bank is that an Islamic bank complies with the interest rate prohibition of the Koran²⁾. Interest rates (Riba) are any kind of ex-ante determined income resulting from a monetary transaction. Therefore, this prohibition concerns the bank's lending as well as its borrowing activities. According to its orthodox interpretation this restriction applies not only to investor loans but also to consumer and government credits. Instead of charging interest to compensate for a temporary surrender of his monetary capital, the lender in the Islamic system shares the profits of the borrower (Modaraba). This principle affects the credit transactions between the bank and the investor as well as those between the saver and the bank; it pertains to profit as well as to loss-sharing and is therefore called "Profit and Loss-Sharing"-System (PLS). The lender's share of the earnings is not fixed in advance but is subject to negotiations.

This paper analyzes some economic effects of the PLS-System. The system in which the earnings on monetary transactions are determined in advance, i.e. the western interest rate system, shall be taken as a reference, and its banks are to be abbreviated as i-banks. Disregarding the religious motives of the Islamic banks, a fundamental issue is to be discussed in the following: which of the two systems is to be favored from a purely economic point of view.

Although plenty of literature is available on the Islamic bank system, only few authors have dealt with this subject on an analytical basis. For example Bashir (1983) has developed a complex programming model of an Islamic bank, and Khan (1986) has in his model analyzed the macroeconomic effects of the interest-free credits. In many, among others, older publications (Qureshi (1967), Uzair (1956), (1978), Mannau (1986)) the advantages of the PLS-System are emphasized, an analytical comparison, however, is missing. Such a comparison is to be attempted

in this paper with the help of a simple model dealing with the banks' loan transactions, only. Section II introduces some basic assumptions allowing for a simplification of the model formulation and contains some figures showing the basic differences between the two banking systems. Section III presents an analytical model of credit supply, and Section IV offers some conclusions from the model discussion.

II. A COMPARISON OF THE TWO BANKING SYSTEMS

Disregarding the fact that among the objectives of some banks (frequently of the government-owned ones) are those of regional or sectoral development, one can generally assume that both types of the banks, the PLS and the i-banks, pursue the goal of profit maximization. The amount of the loan is subject to a potential risk of loss which can neither partially nor fully be covered by a collateral provided by the borrower. In the following discussion, the borrower is a business firm investing an amount x which is partially financed by taking out a credit k and partially out of the borrower's own funds s :

$$\bar{x} = s + k \quad (1)$$

The project's cash flow is a random variable; its expected value is

$$E(x) = x^e = \int_{-\infty}^{\infty} x\phi(x)dx \quad (2)$$

its probability density $\phi(x)$, and its probability distribution function is $\Phi(x)$. The moments of the probability density function are known to the bank and to the firm and are not dependent on the credit amount.

The investor and the i-bank negotiate a credit interest rate r equivalent to an exogenously given market interest rate; the market interest rate also applies to the transactions between the saver and the i-bank. Compulsory bank reserves

are to be neglected in this model. A PLS-bank has to meet an agreement with its customers on the share β of the bank's profit π . This is done on the assumption that the share of the profit is determined independently of any particular credit decision and, as an exogenous variable, corresponds to a market rate of participation. The participation rate α on the business firm's investment profit is a result of negotiations between the two parties. Suppose that for the values $k > 0$ and $s > 0$ the profit sharing rate is equivalent to the portion of the investment financed by a loan:

$$\alpha = k/\bar{x} = k/(k + s), \quad 0 < \alpha < 1 \quad (3)$$

Furthermore, a symmetry condition is true for both variables α and β ($0 < \beta < 1$), i.e. they apply to profits as well as to losses.

The borrowing transactions of the banks are to be disregarded at this point, and the fact that the gross earnings on the investment project are a random variable is to be considered. This leads to a break down of the possible earnings into profits and losses (Baltensperger/Milde (1987)). The ex post cash flow of the i -bank is

$$x^{B,i} = \begin{cases} x & \text{for } x < k(1 + r) \\ k(1 + r) & \text{for } x \geq k(1 + r) \end{cases} \quad (4)$$

and that of the business firm is

$$x^{F,i} = \begin{cases} 0 & \text{for } x \leq k(1 + r) \\ x - k(1 + r) & \text{for } x > k(1 + r) \end{cases} \quad (5)$$

The cash flows of the PLS-bank with the profit participation rate α are

$$x^{B,PLS} = \alpha x \quad \forall x \quad (6)$$

and those of the firm

$$x^{F,PLS} = (1 - \alpha)x \quad \forall x \quad (7)$$

Although a combination of the two systems is possible, as for example profit sharing in the case of a surplus and interest payments in the case of a loss on the investment, only the two ideal bank types will be considered in this discussion. Different effects of the two systems can be shown in a diagram (Fig. 1). The firm's own resources for financing the investment (s), the amount of credit (k), and the expected value of the earnings on the project (x^e) are plotted on the X-axis; the payments to the bank (x^B) are presented on the Y-axis. Negative values of x^e and x^B are to be disregarded for simplification.

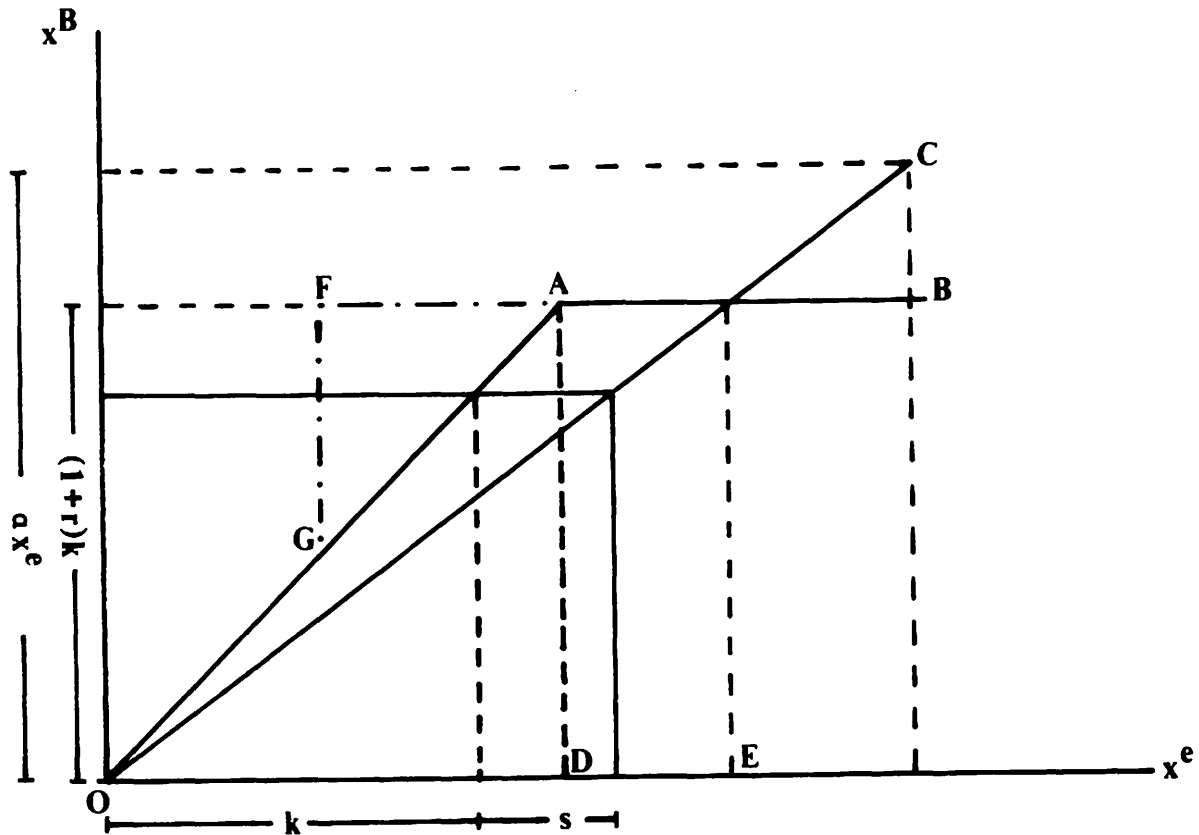


Fig. 1: Cash flows of the i-banks and the PLS-bank

Line OAB shows the firm's payments to the bank on an unsecured loan depending on the expected investment earnings. For the case of a loan collateralization with the amount FA , the payments to the i-bank are represented by the segment $OGFAB$. Line OC shows the corresponding payments to the PLS-bank on a loan with no collateral. Fig. 1 makes, thus, two distinctions: (1) Only if a PLS-bank fully finances the investment ($x=k$, $s=0$), do the payment lines of the two banking systems coincide a) in the region OA if the loans are unsecured and b) in the area OG if the loans are partially collateralized. Case b) is to be omitted in the future. (2) The marginal expected project earnings x^e represent a critical point between the domains of profit and loss ($(1+r)k$ and $(k+s)$), and can be smaller for the i-banks than for the PLS-banks. The repayment to the i-bank stated in a contract is realized at the expected earnings of OD ; the PLS-bank receives the same amount only if higher earnings OE are expected. The larger the investment portion to be financed out of the firm's own funds, the bigger

the difference between the segments OE and OD. Should the expected earnings exceed the amount OE, then c.p. the PLS-bank is repaid a higher amount than the i-bank.

These results are of particular importance for the markets in which the two systems are in competition with each other. Suppose, the borrowers have no preferences for one or the other banking alternative, and their actions are economically rational; the firms, the i-banks, and the PLS-banks have the same information at their disposal meaning they have the same earnings expectations. The firms' attempts to minimize their repayments to the banks will then have the following consequences: (1) If the expected earnings are $x^e > OE$, then the firm will sign a credit contract with an i-bank because in that case a constant amount $(1+r)k$ is to be repaid, regardless of the earnings on the investment, and all of the profits go to the firm. (2) In the case that the earnings expectations are $x < x^e < OE$, then the firm will take out a credit at a PLS-bank, since the amount of the repayment is smaller than $(1+r)k$. This means that on a credit market in which such two systems compete with each other, the i-banks will be more attractive than the PLS-banks for financing the investment projects with higher expected earnings.

One other difference between the two bank systems, although not a part of the model presented here, is to be mentioned at this point. The costs of verifying the borrower's credit record are not the same for the two types of banks, especially if the i-banks insure their credits completely by requesting a collateral. In this case only the liquidity of a collateral is to be reviewed which is easier to do and is less expensive than the evaluation of the project profitability. The PLS-banks have to perform the latter with the expert help since this is the only way to determine the expected value of the cash flow and of the amount of profit to be shared. Different information seeking activities of the i-banks and the PLS-banks lead to discrepancies in the data available to each kind of a bank. This fact was left out at the beginning of this section for purposes of the model simplification.

III. A SIMPLE LOAN MODEL

The following loan model dealing with the profit sharing banks discusses a basic behavioral structure of these banks on a credit market. Analogous to the Equations (6) and (7), the expected value of a PLS-bank's cash flow is

$$E(x^B) = \alpha \int_{-\infty}^{\infty} x\phi(x)dx = \alpha x^e \quad (8)$$

and the expected value of the borrowing firm's cash flow

$$E(x^F) = (1 - \alpha) \int_{-\infty}^{\infty} x\phi(x)dx = (1 - \alpha)x^e \quad (9)$$

The probability of a profit realization in this case can be expressed as follows:

$$\int_{k+s}^{\infty} \phi(x)dx \equiv 1 - \Phi(k+s) \quad (10)$$

and the probability of making a loss as

$$\int_{-\infty}^{k+s} \phi(x)dx \equiv \Phi(k+s) \quad (11)$$

Expected profit on the investment is then

$$E(\pi^I) = x^e - k - s \quad (12)$$

The PLS-bank's profit function should take into account the fact that the investor is entitled to a compensation for the capital surrender amounting to the portion β of the expected profit.

Further, by considering the bank's administrative expenses c , the expected earnings equation for a profit sharing bank can be written as follows:

$$E(\pi) = (1 - \beta)[\alpha(x^e - k - s) - c] \quad \text{with} \quad \alpha = k/(k + s) \quad (13)$$

The first and the second-order conditions for a profit maximization amount of credit k^* are

$$E(\pi)_k = (1 - \beta) \left(\frac{x^e - 2k^* - s}{k^* + s} - \frac{k^*(x^e - k^* - s)}{(k^* + s)^2} \right) = 0 \quad (14)$$

and

$$E(\pi)_{kk} = (1 - \beta) \left(-\frac{2}{k^* + s} - \frac{2(x^e - 2k^* - s)}{(k^* + s)^2} - \frac{2k^*(x^e - k^* - s)}{(k^* + s)^3} \right) < 0 \quad (15)$$

The second-order condition is fulfilled always in the case of $x^e - 2k^* - s \geq 0$ or if the following is true for the expressions $x^e - 2k^* - s < 0$ and $x^e - k^* - s > 0$.

$$|(k^* + s)^2 + k^*(x^e - k^* - s)| > |(x^e - 2k^* - s)(k^* + s)|$$

The first-order condition is satisfied in the trivial case of $\beta=1$ as well as in the case that the value in the second brackets is zero. The profit maximization credit amount k^* can be ascertained from the latter case depending on the expected project earnings x^e and on the extent to which the investment is

financed out of the firm's own funds

$$k^* = -s + \sqrt{sx^e} \quad (16)$$

Under the assumption that $k^* > 0$, the above result implies firstly that s also exceeds the value of zero and secondly that the expected value of the project earnings is larger than that of the firm's capital used for project financing. Both outcomes are economically meaningful. If $s=0$, then the total profit on the investment belongs to the bank, presenting no incentive to the firm for a successful project implementation. Should the expected total earnings x^e have a value smaller or equal to that of the firm's own funds, then, in the case that an additional credit is taken out, the bank and the firm will incur proportionally equal losses.

The fact that the function k^* has one maximum for a given x^e can be easily checked

$$k'_s = -1 + [s^{-1/2}(x^e)^{1/2}]/2 = 0 \quad (17)$$

$$k''_{ss} = [s^{-3/2}(x^e)^{1/2}]/4 < 0 \quad (18)$$

where $s=x^e/4$. This results in a maximum credit amount of

$$k^*_{max} = x^e/4 = s \quad (19)$$

In other words, a PLS-bank whose objective is profit maximization provides at the most one half of the amount required to finance the investment project. As opposing to this, a traditional bank does not have such a limit which makes a

considerable difference between the two systems. Plugging in the optimal credit amount k^* from the Eq. (16) into the PLS-bank function of the expected profit (13) yields, on the one hand, a maximum expected profit of

$$E(\pi) = (1 - \beta)[\alpha(k^*) \cdot E(\pi^I(k^*)) - c] = (1 - \beta)[s + x^e - 2(sx^e)^{1/2} - c] \quad (20)$$

and, on the other hand, the firm's expected portion of the profit, under consideration of k^*

$$E(\pi^{I,F}) = [1 - \alpha(k^*)] \cdot E(\pi^I(k^*)) = -s + \sqrt{sx^e} \quad (21)$$

This amount is equivalent to the profit maximum amount k^* . The optimal credit amount k^* , the total investment amount x , and the firm's expected profits $E(\pi^{I,F})$ as well as those of the PLS-bank $E(\pi)$ are shown in Fig. 2, where x^e is the cash flow, and $0 < s < x^e$ are the variable values of s .

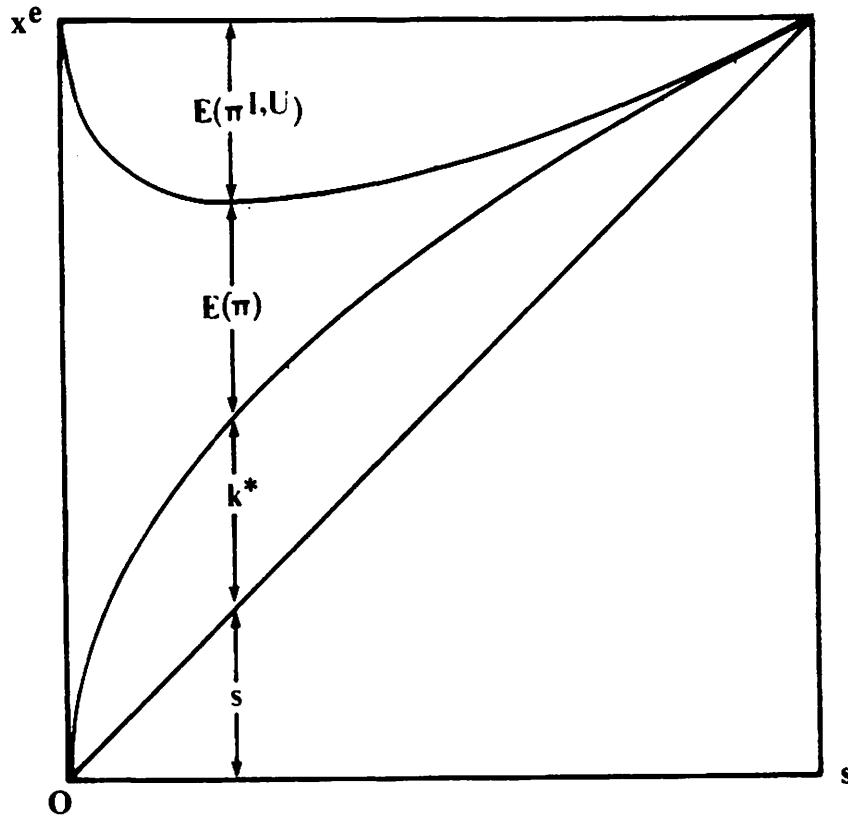


Fig. 2: Development of the optimal credit amount k^* ($x^e = \text{const.}$)

To simplify the diagram without limiting its general character, suppose that $\beta = c = 0$ is true. In the case of k^*_{\max} , the project funds ($k^*_{\max} = s = x/2 = x^e/4$) and the profits are distributed proportionally to the PLS-bank and to the firm responsible for the project completion:

$$E(\pi(k^*_{\max})) = E(\pi^{I,F}(k^*_{\max})) = x^e/4 \quad (22)$$

Until now this paper has implicitly assumed that the bank management has a neutral attitude towards risk; the only decision-making criterion was the value

of the expected profit. Observations of management behaviour show, however, that it usually, for understandable reasons, tries to avoid taking risks. The utility of the expected profits to the bank management depends on the risks of attaining these profits. Assuming that the goal of the bank management is utility maximization, and that the expected utility is a function of profits on the investment, yields the following objective function

$$E[U(\pi)] = E[(U((1 - \beta)(\alpha(x^e - k - s) - c))] \quad (23)$$

as well as the first and the second-order conditions, in respect to k

$$E[U(\pi)]_k = E[(U'(\pi) \cdot \pi_k)] = 0 \quad (24)$$

and

$$E[U(\pi)]_{kk} = E[U''(\pi) \cdot (\pi_k)^2 + U'(\pi) \cdot \pi_{kk}] < 0 \quad (25)$$

Should the utility function have a concave form ($U'(\pi) > 0$, $U''(\pi) < 0$), then the first-order condition, with $\pi_k = 0$, and the second-order condition, with $\pi_{kk} < 0$, are satisfied. The premises for $\pi_k = 0$ and $\pi_{kk} < 0$, already discussed in connection with Eqs. (14) and (15), will not be repeatedly explained at this point. The first-order condition can also be formulated as follows:

$$E(U'(\pi)) \cdot E(\pi_k) + cov(U'(\pi), \pi_k) = 0 \quad (26)$$

or

$$E[U'(\pi)] \cdot \left((1 - \beta) \left(\frac{E(x) - 2k^{**} - s}{k^{**} + s} - \frac{k^{**}(E(x) - k^{**} - s)}{(k^{**} + s)^2} \right) \right) + cov(U'(\pi), \pi_k) = 0 \quad (27)$$

Assuming a risk averse management attitude ($U''(\pi) < 0$), it can be concluded that a covariance component is negative since the increasing x value causes the marginal utility $U'(\pi)$ to decrease. Several transformations yield the following utility maximizing credit amount:

$$k^{**} = -s + \sqrt{\frac{s(x)}{1 - v}} \quad (28)$$

$$\text{with } v = \frac{cov(U'(\pi), \pi_k)}{[E(U'(\pi))] \cdot (1 - \beta)}$$

$$\text{and } k^{**} > 0 \quad \text{if } 0 > v > -(E(x) - s)/s$$

The value of v is negative due to a negative value of the covariance component shown above. Further, the following is true: $E(U'(\pi)) > 0$ and $0 < \beta < 1$. Comparison of the optimal credit amount in the case of a neutral attitude towards risk k^* ($v=0$) and in the case that the management goal is to avoid the risk k^{**} ($v < 0$) shows that the higher the risk, as perceived by the management, the lower the credit supply:

$$k^{**} < k^* \quad (29)$$

Moreover, one has to consider the fact that the credit supply k^{**} is also influenced by the extent of saver participation on the gross profit β of the bank; the higher the participation ratio β , the lower the optimal credit amount ($dk^{**} < 0$).

IV. SUMMARY AND CONCLUSIONS

A bank participating on profits and losses of the investment projects which it finances completely or, as in the above model, partially and providing interest-free credits is at a competitive disadvantage with the banks charging interest on their loans. In order for the PLS-banks to make the same profit on their credit transactions as the i-banks, they have to finance investment projects with higher expected earnings. In the case that the credit and the investment interest rates are exogenous variables, the profit maximizing credit amount of the i-bank is determined by the equality between the expected marginal interest earnings and the marginal costs of refinancing. The optimal credit amount of the PLS-banks depends on the expected profits on the investment and on the scope of the firm's own financial resources. For any given value of the expected profits on the investment, under the optimization conditions, a PLS-bank never provides any more than one half of the project's financing. By incorporating the bank management's attitudes towards the perceived investment risks into the model it can be shown that, on the one hand, the management with a risk averse attitude offers a lower credit amount than the management with a neutral attitude towards risk; on the other hand, the higher the participation ratio of the investors on the bank's gross profits, the lower the bank's credit supply.

What conclusions and contemplations follow from the above results? Two issues seem to be of primary importance: (1) It should be tested if the empirically determined stagnation of the PLS-banks' market shares is connected to their competitive disadvantage with the traditional banks. Exact market research is necessary for this purpose. (2) Though their influence on the aggregate credit supply is small, a possible significance of the PLS-banks for financing the innovations in a non-islamic market system should be examined. In all cases in which market interest rates do not cover the investment risks, and high interest rates increase the probability of losses on the investment, a flexible type of

compensation for a capital surrender in form of a profit sharing plan could be a logical solution for the capital market.

FOOTNOTES:

* Many thanks to B.-Th. Ramb, A. Sapozhnikov and M. Schlemper for their valuable ideas and help.

1) An overview is presented in the work of Karsten (1982), p.138.

2) See the Koran (1962) surah 2, verses 275-276 and 278-279, as well as surah 3, verse 130 and surah 30, verse 39.

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