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THEORY OF FINANCIAL INTERMEDIATION -

A PORTFOLIO APPROACH

by

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Recent growth of financial institutions has resulted in an increased need for the financial analysts to study their behavior closely. In this study an attempt is made to explain the behavior of financial intermediaries in terms of portfolio theory using a preference function approach. The model developed here is largely theoretical in nature, and deals only with pure intermediation rather than the diversified activities of today's intermediaries.

Financial intermediation presupposes the absence of complete financial self-sufficiency, the existence of some economic units whose receipts exceed their expenditure and of other units whose expenditure are in excess of their receipts. Financial intermediaries transmit excess funds efficiently and promptly from surplus units to deficit units. They do so by issuing claims on themselves (by accepting deposits etc.) to surplus units and by the purchase of primary securities from deficit units.

The financial intermediary in purer forms of intermediation offers one rate for its deposits and lends these funds at another rate. It is the maintenance of this rate discrepancy which makes intermediation possible. In an economically rational world, such a rate differential is feasible only if it is smaller than the full costs that the intermediary's debtor would incur in seeking the funds directly. The financial intermediary offers portfolio advantages of diversifying such credit risks across a large number of borrowers and helps in smoothing the differences in asset-liability maturity. Even the liability side of the financial intermediary's balance-sheet is clearly a portfolio problem since the predictability of deposit turn-over is increased by broad diversification across depositors. So long as deposit inflows and outflows are uncertain and so long as the costs of excessive and insufficient reserves are asymetrical, intermediaries will have good reasons to diversify their portfolios. Thus, at the core of the opportunity for intermediation is the portfolio problem - the achievement not only of appropriate mixes of assets and liabilities separately but of the appropriate mix of assets and liabilities together.

The attractiveness of any business activity depends on both return and variability. In creating a portfolio one wants not simply to create a given level of return, but given some level of return, to minimize the risk associated with it. To minimize the risk, non-financial corporations diversify their investment among different productive assets, but in the case of financial intermediaries, yields on many assets tend to be highly correlated through the common capital market, and this high correlation tends to reduce the advantages of diversification among assets. Hence, the financial intermediary can reduce the default risk on loans by diversifying among different borrowers, but the value of its assets portfolio is quite unprotected against the ups and downs of interest rates.

However, the consideration of both assets and liabilities together, whose returns typically have high positive correlation in a common capital market, can change the picture radically for the better. By owning one asset and owing another, the increased cost of a liability is offset by the increased return on an asset and vice versa. The significance of this fact lies not on its impact on the profitability of intermediation but on the riskiness of the return.

By and large the literature on the theory of financial intermediation has concentrated on either the asset side or the liability side of the balance sheet. Very few efforts have been made to consider the explicit dependence between the securities bought and sold in explaining the portfolio behaviour of financial intermediaries. The first and perhaps the only attempt in this direction was made by Pyle (12). Pyle has presented a theoretical model of financial intermediaries in terms of risk-aversion. His model takes the deposit rate and loan rate as random variables and suggests a method for determining the optimal levels of the deposits and loans in terms of means and variances of the deposit and loan rates.

The major limitation of his model is that he assumes away the phenomena of deposit variability. Clearly not all deposits are endogenous for financial intermediaries in the real world. Financial intermediaries usually accept all deposits from customers and also suffer exogenous decreases in the deposit volumes. A representative financial intermediary (in its pure form) sets the deposit rate (by custom or by legal requirements) and faces an uncertain volume of deposits which it may receive. In a world of uncertainty, the intermediary must estimate the amount of deposits which it can attract with the deposit rate it offers.

It is uncertainty, in its various guises, far more than anything else which makes the intermediary's job a difficult one. Its task is to choose the optimal values of the deposit rate and the loan volume so as to maximize its utility which is a function of return and variance over the planning period. The important areas of uncertainty arise because the intermediary cannot know exactly:

i) How large its deposit liabilities will be at any moment of the future.

ii) The loan rate which intermediary would receive for the optimal level of loans it plans to make.

The firm (the financial intermediaries) begins the period with some net worth (capital K). It fixes a deposit rate (presumably at its optimal level) to which depositors respond during the period.

With a given deposit rate, there is an anticipated level of average deposits. This level of average deposits is based on the interest elasticity of deposits. The actual amount of deposits varies, and this variability depends upon many factors including size of the firm, its deposit growth, average deposit size, the number of depositors, etc.

The securities which the firm has in its balance sheet are deposits, loans and riskless securities. Since the problem of diversification within each of these portfolios (that is, what types of loans or deposits are held) will not be of concern in this analysis, each of these categories will be assumed internally homogeneous (for example, no distinctions are made between time and demand deposits) in order to keep the model simple.

The planning period is that span of time upon which the firm concentrates all of its attention and over which it sets, and does not plan to alter, its asset portfolio. The firm knows or estimates with complete confidence all the parameters of its environment that are relevant to its portfolio choice for the ensuing period. The portfolio of the current period is not affected by the expectations of change in the parametric climate of the next period. In short, the assumption about the period are those required to keep the model manageable and static.

The symbols used in this study are:

Decision Variables

X_L = Amount of loans per period

i_d = Deposit rate per period (rate paid on deposits)

Random Variables

$\tilde{i}_L$ = Loan rate per period with mean $E(i_L)$ and variance S_{LL}. The period yield consists of income received and capital gains (or losses) on the security over the period. These are subjective estimates or known quantities depending on the maturity of the security relative to the length of decision period.

$\tilde{X}_d$ = Deposit amount per period with mean $\bar{X}_d$ and variance S_{xx}. The level of average deposits $(\bar{X}_d)$ is based on the interest-sensitivity of deposits $(\delta \bar{X}_d / \delta i_d)$. It might be assumed for simplicity that the distribution is homoscedastic at all levels of i_d so that while $\bar{X}_d$ might be a function of i_d, the variance of the distribution would not.

Other Symbols

S_{Lx} is the covariance of the loan rate (i_L) and the amount of deposits $(\bar{X}_d)$. This covariance arises from the fact that potential creditor has the opportunity to buy the asset (to make a loan) himself without the interposition of the intermediary. So if the rate differential between (i_L and i_d) increases, it is likely that investors would find it profitable to lend funds directly to the debtor, and hence, the total amount of deposits with firm would go down. In short, the loan rate and the volume of deposits are inversely related.

K is the initial capital or net worth,

X_o the amount invested in a riskless security

i_o riskless interest rate, and

θ risk-aversion index which can take value $0 \leq \theta \leq \infty$

Structure of the Model

The firm's objective function is to maximize its utility in terms of the expected additions to its net worth i.e., the expected profit (u) and its variability (σ^2). Thus, our task is to Max $F(u,\sigma^2)$ with respect to the amount of loans (X_L) and the deposit rate (i_d). Since, the firm likes increased profits but dislikes increased variability, we need to have $\delta F / \delta u$ positive and $\delta F / \delta \sigma^2$ negative. If we define $\theta = -\frac{1}{2}\left[\frac{\delta F / \delta u}{\delta F / \delta \sigma^2}\right]$, we can be sure of having the risk-aversion factor (θ) to be positive. The balance sheet constraint is given by

$$X_L + X_o = K + X_d \tag{1}$$

The expected profits is measured by

$$u = E\,(i_o X_o + \tilde{i}_L X_L - i_d \tilde{X}_d) \qquad (2)$$

Replacing the value of X_o obtained from the equation (1), we get

$$u = \left[E(i_L) - i_o\right] X_L - (i_d - i_o)\tilde{X}_d + i_o K \qquad (3)$$

The variance is defined by

$$\sigma^2 = X_L^2 S_{LL} - 2\,(i_d - i_o)\, X_L S_{Lx} + (i_d - i_o)^2 S_{xx} \qquad (4)$$

Now, we optimize $F(u, \sigma^2)$ with respect to X_L and i_d

$$\frac{\delta F}{\delta X_L} = \frac{\delta F}{\delta u}\left[E(i_L) - i_o\right] + \frac{\delta F}{\delta \sigma^2}\left[2X_L S_{LL} - 2\,(i_d - i_o)\, S_{Lx}\right] = 0$$

$$\frac{\delta F}{\delta i_d} = \frac{\delta F}{\delta u}\left[-\tilde{X}_d - (i_d - i_o)\,\frac{\delta \tilde{X}_d}{\delta i_d}\right] + \frac{\delta F}{\delta \sigma^2}\left[-2X_L S_{Lx} + 2\,(i_d - i_o) S_{xx}\right] = 0$$

Replacing $\theta = -\frac{1}{2}\left[\frac{\delta F}{\delta u} \Big/ \frac{\delta F}{\delta \sigma^2}\right]$ and rearranging terms, we get

$$\theta\left[E(i_L) - i_o\right] = X_L S_{LL} - (i_d - i_o) S_{Lx} \qquad (5)$$

$$\theta\left[-\tilde{X}_d\right] = -X_L S_{Lx} + (i_d - i_o)\left(S_{xx} + \frac{\delta \tilde{X}_d}{\delta i_d}\,\theta\right) \qquad (6)$$

To solve for i_d, multiply equation (5) by S_{Lx} and equation (6) by S_{LL}

$$\theta\left[E(i_L) - i_o\right] S_{Lx} = X_L S_{LL} S_{Lx} - (i_d - i_o)\, S_{Lx}^2 \qquad (7)$$

$$\theta\left[-\tilde{X}_d\right] S_{LL} = -X_L S_{LL} S_{Lx} + (i_d - i_o)\left(S_{xx} + \frac{\delta \tilde{X}_d}{\delta i_d}\,\theta\right) S_{LL} \qquad (8)$$

by adding the two equations (7) and (8) and solving for $(i_d - i_o)$

$$(i_d - i_o) = \theta \left[\frac{\left[E(i_L) - i_o\right] S_{Lx} - \bar{X}_d S_{LL}}{\left(S_{xx} + \frac{\delta \bar{X}_d}{\delta i_d}\theta\right) S_{LL} - S^2_{Lx}} \right] \quad (9)$$

Similarly, to solve for X_L, multiply equation (5) by $\left(S_{xx} + \frac{\delta \bar{X}_d}{\delta i_d}\theta\right)$ and equation (6) by S_{Lx}, the value of X_L we get is

$$X_L = \theta \left[\frac{(E(i_L) - i_o)\left(S_{xx} + \frac{\delta \bar{X}_d}{\delta i_d}\theta\right) - \bar{X}_d S_{Lx}}{\left(S_{xx} + \frac{\delta \bar{X}_d}{\delta i_d}\theta\right) S_{LL} - S^2_{Lx}} \right] \quad (10)$$

For a firm to engage in intermediation, the loans (X_L) and deposits (X_d) must take positive values. The positive loan position implies the right-hand side of the equation (10) has to be positive.

For easy analysis, the right hand side of the equation (10) can be split into three parts: the risk-aversion factor θ,

the denominator $\left[\left(S_{xx} + \frac{\delta \bar{X}_d}{\delta i_d}\theta\right) S_{LL} - S^2_{Lx}\right]$

and the numerator $\left[(E(i_L) - i_o)\left(S_{xx} + \frac{\delta \bar{X}^2_d}{\delta i_d}\theta\right) - \bar{X}_d S_{Lx}\right]$

The θ (risk aversion factor) is positive by definition. The denominator is also positive because the term $S_{xx}S_{LL} - S_{L}^{2} \geq 0$ since correlation coefficient (p^2) is always less than or equal to one. Given $p^2 = \frac{S_{Lx}^2}{S_{xx}S_{LL}} \leq 1$ implies $S_{Lx}^2 \leq S_{xx}S_{LL}$. The remaining term in denominator $\frac{\delta \bar{X}_d}{\delta i_d}\theta\, S_{LL}$ is also positive, because $\frac{\delta \bar{X}_d}{\delta i_d} > 0, \theta > 0$ and $S_{LL} > 0$. Thus, the whole denominator $\left(S_{xx} + \frac{\delta \bar{X}_d}{\delta i_d}\theta\right) S_{LL} - S_{Lx}^2$ is positive.

Now, the numerator $E(i_L - i_o)\left(S_{xx} + \frac{\delta \bar{X}}{\delta i_d}\theta\right) - \bar{X}_d S_{Lx}$ will be positive only if

$$E(i_L - i_o) > \frac{\bar{X}_d S_{Lx}}{S_{xx} + \frac{\delta \bar{X}_d}{\delta i_d}\theta}$$

now, let us define $\beta = \frac{S_{Lx}}{S_{xx} + \frac{\delta \bar{X}_d}{\delta i_d}\theta}$

$$E(i_L - i_o) > \beta \bar{X}_d$$

or, $$E(i_L - i_o) = \alpha + \beta \bar{X}_d \qquad (11)$$

where, $\alpha > 0$ and $\beta < 0$. β is negative because $S_{xx} + \frac{\delta \bar{X}_d}{\delta i_d}\theta$ is positive and S_{Lx} is negative. S_{Lx} is the co-variance of loan rate (i_L) and the amount of deposits (X_d). Such co-variance would be negative because as the loan rate increases, with the deposit rate fixed, the amount of deposits would go down (disintermediation).

In interpreting the above results, we can make the following observations :-

1. For a fixed deposit rate (by choice or where rates are fixed by the Central bank), the risk premium in the expected loan rate $(E(i_L) - i_o)$ is proportional to the slope-coefficient for the deposits in relation to the loan rate which means that the more sensitive are the deposits to the loan rate, the smaller is the risk premium. As the premium charged on the loan rate increases, the surplus units (depositors) would have incentive to lend funds directly without going through the intermediaries. It can also be inferred from the results that if capital markets are very competitive, the differential between deposit rate and lending rate would be minimal comparedto a restricted and undeveloped capital markets.

2. The other factors influencing the size of the risk premium in loan rate would be the variability of deposits (S_{xx}), the firm's attitude towards risk-taking (the value of θ), the interest - sensitivity of the deposits, and the size of the firm. A higher variability of the deposits involves larger risk and the firm would require additional premium. A higher value of θ (the higher compensation desired for risk-taking) would result in a larger premium. The bigger firms

for which X_d is large would operate on a smaller margin (premium) suggesting the economies of scale.

3. In a perfect capital market, the loan rate is determined by the market demand and supply of the funds and does not get significantly affected by the amount of loans offered by any one intermediary; that is, loans can be assumed to be in perfectly elastic supply to the intermediary. Question can be asked: given the loan rate (and thereby market determined risk premium), under what conditions will be desired level of loan be positive? Our equation (10) shows that if $S_{Lx} = 0$, the risk-premium must be positive if X_L is to be greater than Zero. If, however, S_{Lx} were negative, then X_L could be greater than zero even if the risk premium were negative. However, this conclusion is a bit strained. If $E(i_L) < i_o$, the depositors would never purchase loans directly as they would be dominated by the riskless asset. Thus, $E(i_L) > i_o$ would appear to be necessary for positive loan position.

The other question examined in this study is whether a firm can pay positive premium on deposits over the risk-free rate of return and still engage in intermediation. For this, we analyse the equation (9). In equation (9), we have a positive θ, and a positive denominator, therefore, the numerator and the left-hand side of the equation would be of identical sign. A positive sign would mean a positive premium in deposit rate over risk-free rate. A negative sign would mean the rate paid on deposits is lower than the risk-free rate. Let us examine each case -

Case 1) $i_d - i_o < 0$ means $(E(i_L) - i_o)S_{Lx} - \bar{X}_d S_{LL} < 0$ which implies

$$\bar{X}_d > \frac{S_{Lx}}{S_{LL}} \left[E(i_L) - i_o\right]$$

Case 2) $i_d - i_o > 0$ means $(E(i_L) - i_o)S_{Lx} - \bar{X}_d S_{LL} > 0$ which implies

$$\bar{X}_d < \frac{S_{Lx}}{S_{LL}} \left[E(I_L) - i_o\right]$$

For intermediation to be possible, the deposits ($\bar{X}_d$) must take a positive value. With a negative premium on deposits (case 1), $\bar{X}_d$ takes a positive value if the inequality is sufficiently large. This also substantiates Pyle's (12)observation on page 745 "If the yields on loans and (yields on)deposits are independent, the necessary and sufficient conditions for intermediation are a positive risk premium on loans and a negative risk premium on deposits."

However, Pyle also concludes that in certain conditions a firm may engage in intermediation even if a firm pays a positive premium on deposits. The conditions under which this would be possible is when the yield on deposits is positively related with the yield on loans. In my model, a positive premium on deposits is feasible only if S_{Lx} takes a positive value. S_{Lx} is positive if an increase in the loan rate has a p sitive influence on deposits. This was possible in Pyle's model where the deposit rate is considered variable and positively related to the loan yield. An increased loan rate would mean an increased deposit rate which in turn would result in a higher level of deposits. In my model, the deposit rate in the planning period does not change. It is optimally or legally fixed at the beginning of the planning period, and the size of deposits becomes stochastic in nature, influenced by changing market conditions including the loan yields. With an increase in loan yields, a depositor would have incentive to invest the funds directly. This would result in a decreased level of deposits suggesting a negative value of S_{Lx}.

Conclusion

In conclusion, it can be stated that the portfolio theory approach to analyse the behaviour of financial intermediaries provides interesting insights in their working. By and large, the literature on the theory of financial intermediation has concentrated on either the asset side or the liability side of the balance sheet. In this paper, we have explicitly considered the fact that two sides of an intermediary's balance sheet are not independent. If the interest rate it charges for making the loans gets out of alignment with deposit rate it offers, the process of disintermediation begins.

Clearly there are limitations of a static model like one presented here. A dynamic model would greatly aid in understanding the working of different policy at macro-level. Finally, the analysis suggests much empirical testing should be done to guage the actual interdependencies between the assets and liability of financial intermediaries.

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