PORTFOLIO OPTIMIZATION BY FINANCIAL INTERMEDIARIES IN AN ASSET PRICING MODEL

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Summary

The object of this paper is to analyse the portfolio behavior of a financial intermediary when its shareholders are able to diversify their wealth with primary and secondary securities. This implies that the demand for assets by individuals will depend on the portfolio structure of the intermediary. This approach, which differs from the expected utility maximization literature, provides interesting insights on the limits of standard capital budgeting rules for portfolio managers and on the costs of capital regulation.

The object of this paper is to analyze the portfolio behavior of a financial intermediary when its shareholders are able to diversify their wealth with primary and secondary securities. This approach for modeling the optimal choice of assets by financial intermediaries differs from a large segment of the literature which assumes that the objective function is the expected utility of the profit of the intermediary.[1] This 'partial equilibrium' line of reasoning has in the author's view two major limitations. The first one is that the economic function of financial intermediaries is not explicitly modeled. The intermediary is assumed to mimic an individual who maximizes his expected utility. The absence of 'raison d'être' raises several problems when one wants to analyze the benefits (costs) of regulation. The second limitation of the expected utility[2] approach is that it tends to ignore the opportunity for shareholders to reshuffle their portfolio of primary and secondary securities when the financial intermediary changes its assets mix. For instance, the mismatching position of a bank in the eurodollar market can in principle be offset by an opposite mismatch realized by its shareholders in the primary securities market. How should a financial intermediary behave in such a situation?[3] The paper discusses this question by analyzing the portfolio optimization of a financial intermediary when its shareholders have access to the same set of efficiently priced primary securities. The main benefit of this approach is that an economic function for financial intermediaries--in this case, efficient diversification--is explicitly modeled. This provides interesting insights on the limits of standard capital budgeting rules for portfolio managers and on the costs of capital regulation.

One can argue that financial intermediation involves more than a portfolio of primary securities traded in the market and that these firms create liquidity (Sealey, 1983) or that they help to solve information problems (Diamond, 1984, or Ramakrishnan-Thakor, 1984). Our model gives a partial explanation of an intermediary's raison d'être which follows the diversification argument of Klein (1973) and Kane-Buser (1979). This paper differs from theirs in that it is interested not in indivisibilities and in the number of securities held in the portfolio but rather in the optimal quantity of each primary securities held by the intermediary. Finally, a survey of the literature shows that some authors have analyzed the behavior of banks whose shares are traded in the market (Pringle, 1974, Mason, 1979 and Chateau, 1982), but none of these papers deals with the optimal choice of primary securities traded in the market. This article meets a recent call by Santomero (1984) in a survey on bank modeling for an integration of bank behavior with the efficient allocation of funds by its shareholders.

This paper owes much to J. Wood (1981) who studies the effects of monetary policy in a model where financial intermediaries exist and where the demand for primary and secondary securities by investors depends on the portfolio structure of the intermediary. Also, the author's attention has been called to a recent paper by Senbet-Taggart (1984) who look at the optimal capital structure in an imperfect market. They suggest that corporate firms have an advantage for leverage because they incur lower transaction costs; this results in capital structure equilibrium and in clientele effects. It will appear that the optimal portfolio structure of a financial intermediary in an imperfect market raises similar questions. However, unlike the result obtained by Senbet-Taggart, unanimity among initial shareholders is not likely to follow.

The paper is organized as follows. In the first section, we present the portfolio optimization by individuals when there are no financial intermediaries. The intermediary is introduced in section two where we discuss the portfolio behavior of individuals, their preferences for the intermediary's portfolio structure and, finally, the optimal choice of primary securities by the financial intermediary. Section three concludes the analysis with some comments on the limits of standard capital budgeting rules for portfolio managers and on the optimal capital structure of a financial intermediary.

Section I: Portfolio Optimization with Primary Securities Only

We consider a one-period model[4] with two assets: a risk free asset M and a risky asset B. The risk free rate is denoted by r_f, and the risky return by $\tilde{r}$ with expected return μ and variance σ^2. Each investor incurs a cost β for a positive holding of any unit of the two assets and a cost α for a negative holding. These costs are assumed to be incurred in the transactions and information gathering process. The return pattern net of the transaction costs follows:

$r_f - \beta$ when $M > 0$ (denoted M^+)

$r_f + \alpha$ when $M < 0$ (M^-)

$\tilde{r} - \beta$ when $B > 0$ (B^+)

$\tilde{r} + \alpha$ when $B < 0$ (B^-).

We assume that there are H investors and that each of them (h H) maximizes the following utility function where $\tilde{W}_h$ denotes his end-of-period wealth and where E and V are the expectation and variance operators:

$$\text{Max } E(W_h) - b_h/2\, V(W_h) \tag{1}$$

with $$\tilde{W}_h = (1 + \tilde{r} - \beta)B_h^+ - (1 + \tilde{r} + \alpha)B_h^- + (1 + r_f - \beta)M_h^+ - (1 + r_f + \alpha)M_h^- \tag{2}$$

The optimization is subject to a wealth constraint (3) and four non-negativity constraints (4). Denoting initial wealth by $\overline{W}_h$, we have:

$$B_h^+ + M_h^+ = \overline{W}_h + B_h^- + M_h^- \qquad \text{for } h \quad H \tag{3}$$

$$B_h^+,\ B_h^-,\ M_h^+,\ M_h^- \geq 0 \ . \tag{4}$$

Substituting for M_h^+ in relations (2) and (3), we obtain:

$$\tilde{W}_h = (1 + r_f - \beta)\overline{W}_h + (\tilde{r} - r_f)B_h^+ + (r_f - \tilde{r} - \beta - \alpha)B_h^- + (-\beta - \alpha)M_h^- \tag{2'}$$

$$\overline{W}_h + M_h^- + B_h^- - B_h^+ \geq 0 \tag{3'}$$

$$B_h^+,\ B_h^-,\ M_h^- \geq 0 \tag{4'}$$

The expectation and variance of the end-of-period wealth of investor h are respectively:

$$\mu_{w_h} = (1+r_f-\beta)\overline{W}_h + (\mu-r_f)B_h^+ + (r_f - \mu - \beta - \alpha)B_h^- + (-\beta - \alpha)M_h^- \tag{5}$$

$$\sigma_{w_h}^2 = \sigma^2(B_h^+ - B_h^-)^2 \tag{6}$$

Each investor will maximize its utility function (1) subject to the constraint (3') and (4'). An immediate result follows from (5) and (6): at the optimum, we must observe

$$B_h^- \cdot B_h^+ = M_h^- \cdot M_h^+ = 0 \ .$$

The first-order conditions for B_h^+, B_h^- and M_h^- follow, m_h^+ denoting the dual variable associated with constraint (3'):

$$\frac{\partial}{\partial B_h^+} = \mu - r_f - b_h\sigma^2 B_h^+ - m_h^+ \leq 0 \qquad = 0 \text{ if } B_h^+ > 0 \tag{7i}$$

$$\frac{\partial}{\partial B_h^-} = r_f - \mu - \beta - \alpha - b_h\,\sigma^2\,B_h^- + m_h^+ \leq 0 \qquad = 0 \text{ if } B_h^- > 0 \tag{7ii}$$

$$\frac{\partial}{\partial M_h^-} = -\beta - \alpha + m_h^+ \leq 0 \qquad = 0 \text{ if } M_h^- > 0 \tag{7iii}$$

The complementary slackness conditions imply that

$$m_h^+ = \beta + \alpha \qquad \text{if } M_h^- > 0 \ (M_h^+ = 0)$$

$$m_h^+ = 0 \qquad \text{if } M_h^+ > 0 \ (M_h^- = 0) \ .$$

We can therefore distinguish two types of demand for the cases where M_h^+ or M_h^- is positive.[5]

$$B_h^+ \Big|_{M_h^+ > 0} = \frac{\mu - r_f}{b_h\sigma^2} \tag{8}$$

$$B_h^+ \Big|_{M_h^- > 0} = \frac{\mu - r_f - \beta - \alpha}{b_h\sigma^2} \tag{9}$$

$$B_h^- \Big|_{M_h^+ > 0} = \frac{r_f - \mu - \beta - \alpha}{b_h\sigma^2} \tag{8'}$$

$$B_h^- \Big|_{M_h^- > 0} = \frac{r_f - \mu}{b_h\sigma^2} \tag{9'}$$

A market equilibrium requiring some positive holding of the risky asset, we assume $\mu > r_f$. We observe the standard mean-variance model results where demand is a function of the expected returns differential divided by the product of the variance and of the risk aversion factor.

We denote by I the set of investors with a positive holding of the risk free asset ($M_h^+ > 0$) and by II the set of investors with a negative holding ($M_h^- > 0$). The market equilibrium for the risky asset B is given by the supply-demand equality:

$$\sum_{h \in I} B_h^+ + \sum_{h \in II} B_h^+ = B \tag{10}$$

Substituting (8) and (9) into (10), we have:

$$\frac{\mu - r_f}{\sigma^2} \sum_{I} \frac{1}{b_h} + \frac{\mu - r_f - \beta - \alpha}{\sigma^2} \sum_{II} 1/b_h = B \tag{11}$$

Let us denote $R = \sum_{h \in I \cup II} 1/b_h$

$R_{II} = \sum_{h \in II}' 1/b_h$

$\overline{B}$ the expected value of the risky asset $\left(\mu = \frac{\overline{B} - B}{B}\right)$

S^2 the variance of the value of the risky asset $\left(\sigma^2 = \frac{S^2}{B^2}\right)$.

Substituting into (11) and solving for B, we obtain the equilibrium value of the risky asset:

$$B = \left(\overline{B} - \frac{S^2}{R}\right)\left(\frac{1}{1 + r_f + (\beta + \alpha)\frac{R_{II}}{R}}\right) \tag{12}$$

The equilibrium value of the risky asset B is the standard CAPM result with transaction costs. The certainty equivalent is discounted by an adjusted risk free rate which takes into account the transaction costs incurred by the investors who have a negative holding of the risk free asset. In this world, there is room for a financial intermediary who can operate with lower transaction costs. This is the object of section two.

Section II. Portfolio Equilibrium with Financial Intermediation

We introduce in the model a financial intermediary which has invested equity funds ($\overline{F}$) in a portfolio of risky assets (B_i) and risk free assets (M_i) in respective proportions δ and $(1 - \delta)$,

$$\delta = \frac{B_i}{\overline{F}} \qquad (1 - \delta) = \frac{M_i}{\overline{F}} .$$

For expository convenience, we assume that the intermediary does not incur any real costs and that there are no transaction costs when buying a share of the intermediary.[6] The shares traded in the market have a value $F \geq \overline{F}$. If the market is very competitive, the market value F would tend to equal the invested funds $\overline{F}$ (the case considered by Wood, 1981) but this need not be the case in general, for instance if there are entry barriers. In this model, we assume for simplicity that the intermediary issues equity shares only. A more complex version would allow to intermediate on the risk free asset market with a supply of low transactions cost deposits. The results of this paper hold as long as intermediation costs create a returns differential between the assets and liabilities of the intermediary. The return $\tilde{r}_i$ on a share of the intermediary[7] is equal to:

$$\tilde{r}_i = \frac{\overline{F}}{F}\left(1 + \tilde{r}\,\delta + (1 - \delta)r_f\right) - 1 = q\left(1 + \tilde{r}\,\delta + (1 - \delta)r_f\right) - 1 \tag{13}$$

where q is the inverse of the famous letter used by Tobin.

The expectation and variance of the return on a share of the intermediary are:

$$\mu_i = q(\mu \ \delta + (1 - \delta)r_f) \tag{14}$$

$$\sigma_i^2 = q^2 \delta^2 \sigma^2 \ . \tag{15}$$

Each investor has now access to two primary securities (B, M) and a secondary security (F). His end-of-period wealth is (dropping the h for convenience):

$$\begin{aligned}\tilde{W} = (1 + \tilde{r} - \beta)B^+ - (1 + \tilde{r} + \alpha)B^- + (1 + r_f - \beta)M^+ \\ -(1 + r_f + \alpha)M^- + q\ F(1 + \tilde{r}\ \delta + (1 - \delta)r_f)\end{aligned} \tag{16}$$

and the wealth and non-negativity constraints[8] are:

$$\overline{W} + M^- + B^- = M^+ + B^+ + F \tag{17}$$

$$B^+,\ B^-,\ M^+,\ M^-,\ F \geq 0\ . \tag{18}$$

We substitute for M^+ to obtain the constraints (17', 18') and the expectations (19) and variance (20) of the end-of-period wealth:

$$\overline{W} + M^- + B^- - B^+ - F \geq 0 \tag{17'}$$

$$B^+,\ B^-,\ M^-,\ F \geq 0 \tag{18'}$$

$$\begin{aligned}\mu_w = (1 + r_f - \beta)\overline{W} + (\mu - r_f)B^+ + B^-(r_f - \mu - \beta - \alpha) + M^-(-\beta - \alpha) \\ + F\big(q - 1 + q\ \mu\ \delta + r_f(q(1 - \delta) - 1) + \beta\big)\end{aligned} \tag{19}$$

$$\sigma_w^2 = \sigma^2(B^+ - B^- + q\ \delta\ F)^2\ . \tag{20}$$

An immediate result follows from (19) and (20); at the optimum, we must observe:

$$B^+ \cdot B^- = M^+ \cdot M^- = 0\ .$$

The optimal amounts of primary and secondary securities follow.

The demand for primary and secondary securities

Each investor maximizes its expected utility of end-of-period wealth (1) subject to the constraints (17') and (18'). The first-order conditions follow:

$$\frac{\partial}{\partial B^+} = \mu - r_f - b\sigma^2(B^+ + q\,\delta\,F) - m^+ \leqslant 0 \qquad = 0 \quad \text{if } B^+ > 0 \tag{21i}$$

$$\frac{\partial}{\partial B^-} = r_f - \beta - \alpha + b\,\sigma^2(-B^- + q\,\delta\,F) + m^+ \leqslant 0 \qquad = 0 \quad \text{if } B^- > 0 \tag{21ii}$$

$$\frac{\partial}{\partial F} = (q-1+q\,\mu\,\delta + r_f\big(q(1-\delta)-1\big) + \beta - b\,\sigma^2\,q\,\delta(B^+ - B^- + q\,\delta\,F) - m^+ \leqslant 0 \tag{21iii}$$

$$\frac{\partial}{\partial M^-} = -\beta - \alpha + m^+ \leqslant 0 \qquad = 0 \text{ if } M^- > 0\,. \tag{21iv}$$

The complementary slackness conditions imply that

$$m^+ = 0 \qquad \text{if } M^+ > 0 \qquad (M^- = 0)$$

$$m^+ = \beta + \alpha \qquad \text{if } M^- > 0 \qquad (M^+ = 0)\,.$$

The demand equations for primary and secondary securities follow:

$$B^+ = \frac{\mu - r_f - m^+ - b\,\sigma^2\,q\,\delta\,F}{b\,\sigma^2} \tag{22i}$$

$$B^- = \frac{r_f - \beta - \mu - \alpha + m^+ + b\,\sigma^2\,q\,\delta\,F}{b\,\sigma^2} \tag{22ii}$$

$$F = \frac{(q-1 + q\,\mu\,\delta + r_f\big(q(1-\delta) - 1\big) + \beta - m^+ - b\,\sigma^2\,q\,\delta(B^+ - B^-)}{b\,\sigma^2\,q^2\,\delta^2} \tag{22iii}$$

The demand for primary securities have an intuitive interpretation. As in the model presented in section one, they are functions of the expected return differential divided by a risk factor, but they are netted out of the holding of primary securities held through the intermediary ($q\ \delta\ F$). A similar interpretation applies for the demand of secondary securities F. An analysis of the efficiency frontier faced by each investor will permit to characterize the demand for primary and secondary securities.

Characteristics of the demand functions

The demand for primary and secondary securities by investors can usefully be interpreted as a two step process. In the first step, the investor buys only secondary securities issued by the intermediary and since the portfolio structure $\left(\delta,\ (1-\delta)\right)$ is unlikely to be optimal from his own point of view, he adjusts his portfolio in a second step by increasing or reducing the relative share of risky securities. There are two ways to proceed; if the investor prefers more risky securities, he can sell in the second step some secondary securities and buy some risky asset ($\Delta^+\ B^+$) or he can buy additional secondary securities and go short the risk free asset ($\Delta^+\ M^-$).[9] A reverse procedure can be used if the investor wants to reduce its share of risky securities ($\Delta^+\ B^-$ on $\Delta^+\ M^+$). The best strategy will depend on the various transaction costs incurred in reshuffling the portfolio. The following proposition establishes that an investor with positive holding of secondary securities will in general hold only one of the two primary securities, that is:

$$\mathrm{Min}(M,\ B) = 0 \qquad \text{if } F > 0.$$

Proof: We show that the portfolio ($F > 0$, $B^+ > 0$, $M^- > 0$) cannot in general be optimal. Other particular cases are taken in appendix. Holding the variance of the portfolio constant and respecting the wealth constraint, we compute the effect of a change in B^+ on the expected return μ_w:

$$d\,\sigma_w^2 = 0 \rightarrow d\,\sigma^2(B^+ + \delta\, q\, F)^2 = 0 \rightarrow d\,F = -\frac{dB^+}{q\,\delta}$$

$$\text{wealth constraint} \rightarrow d\,M^- = d\,B^+ + d\,F = (1 - 1/q\delta)d\,B^+$$

$$\left.\frac{d\,\mu_w}{dB^+}\right|_{\sigma_w^2\ \text{constant}} = (\mu - r_f) + (1 - 1/q\delta)(-\beta - \alpha)$$

$$- 1/q\delta\left(q - 1 + q\,\mu\,\delta + r_f\left(q(1-\delta) - 1\right) + \beta\right)$$

$$= -\beta - (1 - (1 - 1/q\delta)\alpha - (1 + r_f)\left(\frac{q-1}{q\,\delta}\right) \qquad (23)$$

For q = 1, relation (23) represents the transaction cost savings (losses) when the risky asset B^+ is substituted for the secondary security F. The investor will increase (reduce) its holding of risky asset B^+ when relation (23) is positive (negative). For instance, in the case $0 < \delta < 1$, an increase of B^+ will be financed by a reduction of F and M^- and ultimately the holding (F, B^+) will be realized.[10] When relation (23) is negative, the investor will attempt to realize (F, M^-).[11] A similar analysis (see the appendix) shows that the portfolio structure (F, B^+, M^+), (F, B^-, M^-) or (F, B^-, M^-) are not in general optimal.

The optimization process is illustrated in figure one where we have drawn the efficiency frontier and have assumed q = 1 and $0 < \delta < 1$. This figure shows the economic functions of financial intermediaries in improving the efficiency frontier faced by individuals.

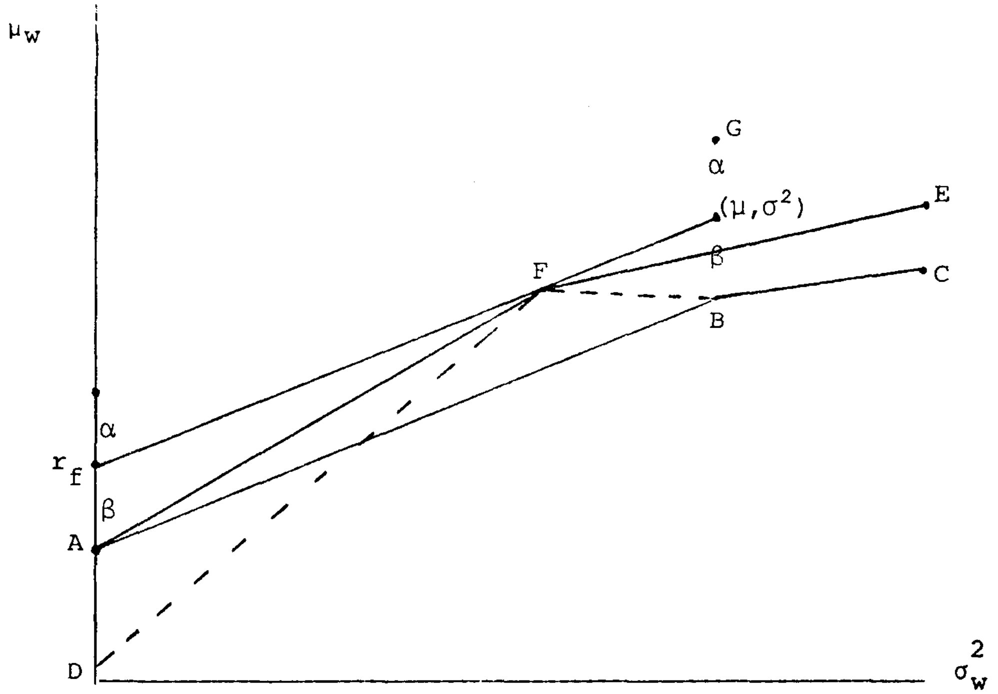

Figure One

In the absence of intermediary, the efficiency frontier is given by the kinked line A B C, in Figure One, which takes into account the transaction costs α and β. The intermediary's portfolio is represented by F on the zero transaction cost frontier. From F, the investor who wants to reduce the relative share of risky asset can do it by holding M^+ or B^-, that is moving along the line AF or DF (the slope of which is given by FG). In this particular example, the line AF dominates and the investor will not hold any primary risky securities. If the investor wants more risky asset, he can achieve his goal with M^- or B^+, that is moving along the line FE or FB. In Figure One, the efficiency frontier is given by the line AFE. The efficiency frontier depends obviously on the portfolio structure chosen by the intermediary. Another case is shown in Figure Two where the efficiency frontier is the line DFBC; with positive holding of secondary securities F, the investor does not hold any risk free securities.

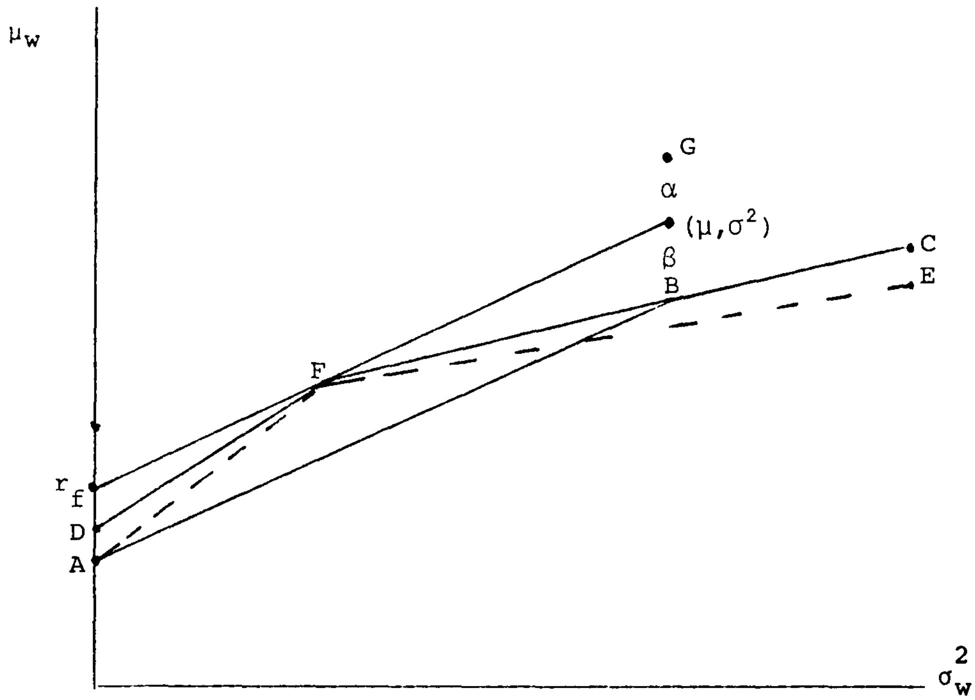

Figure Two

The demand for primary and secondary securities has been discussed for a given portfolio structure of the intermediary. The optimal portfolio of the investor is likely to be composed of secondary securities and of one of the two primary securities. The choice of the primary security will depend on transaction costs and on the portfolio structure of the intermediary. We discuss next the preferences of investors for the portfolio parameter δ and the optimal strategy of the intermediary.

The preferences of investors for the portfolio structure of the intermediary

The economic function of financial intermediaries in this model is to improve the efficiency frontier by reducing the transaction costs incurred by investors. At the extreme, all transaction costs would be saved if the portfolio structure of the intermediary corresponds exactly to the optimal portfolio of the investor. But this is unlikely as investors differ with respect to wealth and risk aversion. The following proposition shows that investors who correct the portfolio of the intermediary by increasing the relative share of risky asset ($\Delta^+ B^+$ or $\Delta^+ M^-$) would prefer that the intermediary increases its share of risky asset ($\Delta^+ \delta$). And the investors would prefer a reduction in parameter δ if they act to increase the share of risk free securities ($\Delta^+ M^+$ or $\Delta^+ B^-$).

Proof: The proof is shown for the case (F, M^-) where investors increase the relative share of risky assets.[12] In this case, an increase in δ will make them better off. Other particular cases could be dealt with a similar proof. Holding the variance of the portfolio constant and respecting the wealth constraint, we show that the expected return of the portfolio increases with δ.

$$\sigma_W^2 \text{ constant} \rightarrow d\, q\, \delta\, F = 0 \quad \rightarrow \quad dF = -F\frac{d\delta}{\delta}$$

$$\text{budget constraint} \rightarrow dM^- = d\,F = -F\frac{d\delta}{\delta}$$

$$\left.\frac{d\mu_W}{d\,\delta}\right|_{\sigma^2 \text{ constant}} = -(-\beta - \alpha)\frac{F}{\delta} - \frac{F}{\delta}\left(q - 1 + q\,\mu\,\delta + r_f\big(q(1-\delta)-1\big)+\beta\right)$$

$$+ F(q\,\mu - r_f\, q)$$

$$= \alpha\frac{F}{\delta} - \frac{F}{\delta}\Big((q-1)(1+r_f)\Big) > 0 \quad \text{if } \delta > 0 \qquad (24)$$

This is illustrated in Figure Three.

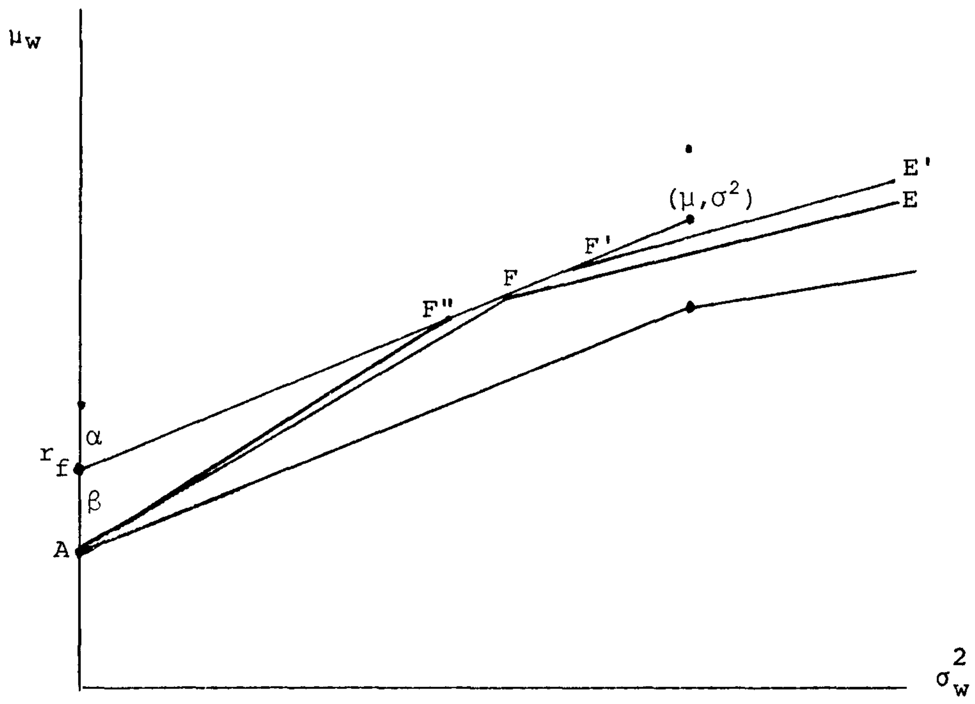

Figure Three

A portfolio (F, M^-) will be on the segment FE. These investors prefer an increase in δ and a displacement of the efficiency frontier to F'E'. But investors with a portfolio (M^+, F) on the segment AF would prefer a reduction in δ and a displacement of the frontier to AF". The investors are not indifferent to the portfolio choice of the intermediary because of the transaction costs involved in the realization of their own portfolio.[13] This conflict of interest among shareholders raises the question of the optimal portfolio structure to be chosen by the financial intermediary.

The optimal policy of the intermediary

Standard corporate finance theory would suggest that the initial shareholders of the intermediary select a portfolio structure (a parameter δ) which maximizes the market value of the intermediary F and their initial wealth. A standard assumption in this type of approach is that the efficiency frontier, the risk-return pattern available to shareholders is not affected by the portfolio strategy.[14] However, in this model with a single intermediary, the hypothesis is unlikely to be met; a parameter δ which maximizes wealth is unlikely to be optimal for all shareholders because it affects also their efficiency frontier. In this case, it is very likely that some initial shareholders would agree to trade some wealth in favor of a better efficiency frontier. The portfolio structure chosen by the initial shareholders will therefore balance wealth with efficiency frontier maximization.[15] One cannot ignore the changes in efficiency frontier in this type of model because they are caused by the transaction costs which are the raison d'être of the intermediary.

The market value for the risky asset B can be computed. It will depend on the type of demand that prevails (B_h or M_h equal to zero). For instance, in the case $\left[(F, M^+) \text{ and } (F, M^-)\right]$, we would have the following supply-demand equality:

$$\sum_{I} q\,\delta\,F_h + \sum_{II} q\,\delta\,F_h = B \tag{25}$$

Substituting (22iii) in (25), we have:

$$\sum_{I} \frac{\frac{q-1}{q\,\delta} + \mu + r_f\left(\frac{q(1-\delta)-1}{q\,\delta}\right) + \frac{\beta}{q\,\delta}}{b_h\sigma^2} + \sum_{II} \frac{\frac{q-1}{q\,\delta} + r_f\left(\frac{q(1-\delta)-1}{q\,\delta}\right) - \frac{\alpha}{q\,\delta} + \mu}{} = B \tag{26}$$

Defining $a = \frac{1-q}{q\,\delta}$ $(a = 0 \quad \text{when } q = 1)$

$b = -\frac{q(1-\delta)-1}{q\,\delta}$ $(b = 1 \quad \text{when } q = 1)$, and solving

relation (26) for B, we have:

$$B = \left(\overline{B} - \frac{S^2}{R}\right)\left(\frac{1}{1 + a + b\,r_f - \frac{R_I}{R}\frac{\beta}{q\,\delta} + \frac{R_{II}}{R}\frac{\alpha}{q\,\delta}}\right). \tag{27}$$

As in the model of section one, we observe that the market value of the risky asset is equal to the certainty equivalent divided by a risk free rate adjusted for transaction costs. We find here too the conflict of interest among shareholders; for $\delta > 0$ and $q = 1$, the investors with a positive holding of the risk free asset ($h \in I$) would like the intermediary to reduce δ while those with a negative holding of the risk free asset ($h \in II$) would prefer an increase in δ. This situation creates incentives to develop financial intermediaries specialized in specific clienteles. Although this is outside the scope of the paper, one can conjecture that the financial industry structure will depend on the demands for specialized products (i.e. particular δ's) and on the real cost structure of each financial intermediary.

Section III: Implications of the Model

The object of this article has been to discuss the optimal portfolio structure of a financial intermediary when its shareholders have access to the same set of primary securities. A portfolio optimum will exist if the financial intermediary has a transaction cost comparative advantage and clientele effects should follow. This model leads to four additional comments related to capital budgeting rules for financial intermediaries, their optimal capital structure, the modeling of the banking firm and, finally, to the information assumption implicit in the model.

It has been argued (Simonson-Hempel, 1982) that standard capital budgeting rules can be applied to the management of the portfolio of a bank. The suggestion is to buy bonds when their expected return is larger than the required return given by the security market line. However in the light of our model, this result appears unsatisfactory because it does not tell how many bonds a bank should buy and that, by increasing its share of bonds, the bank changes its portfolio structure and therefore the efficiency frontier faced by individuals. For instance, if a bank buys too many high expected return bonds, it will force the risk averse shareholders to incur heavy transaction costs, while reshuffling their own portfolio. One should not ignore these transaction costs and the change in efficiency frontier, because if one does so, he takes away the raison d'être of the intermediary.

A second result of this portfolio model is to develop an equilibrium capital structure for financial intermediaries which does not rely on taxes, bankruptcy costs or principal-agent arguments. When the portfolio parameter δ lies outside the interval [0, 1], it implies that the intermediary finances assets with debt and equity. In this case, the capital structure equilibrium relies on a transaction cost advantage for the intermediary.[16] In this world, a binding capital regulation has a cost: the inability of the financial intermediary to reach its optimal portfolio structure and fulfill completely its transaction costs savings function. This view differs from the analysis of Santomero-Watson (1977) on the cost of capital regulation. In their model, the demand for assets by individuals (p. 1273) is independent of the capital structure of the intermediary. Capital regulation produces a shift in the supply of capital and a change in relative returns which is detrimental to the real capital stock of the economy. In our model, a binding capital regulation implies a shift in the demand for primary and secondary securities as individuals attempt to recover their initial portfolio but the move is imperfect because of the transaction costs.

A third implication concerns bank modeling and the need to incorporate in a model the raison d'être of financial intermediation. As far as the portfolio of primary securities traded in the market is concerned, it seems that transaction costs savings offer a reasonable coherent theory. As is stressed in the introduction, other functions exist such as information screening and liquidity creation which generate loans and deposits. It appears useful for bank modeling to distinguish between the broker and the transformer function;[17] this parallels the distinction made in the neoclassical model of the banking firm (Klein, 1971, Monti, 1972) between perfect market securities and deposits and loans. In the neoclassical model, the distinction is due to perfect and imperfect competition; in this approach, the distinction is due to transaction costs savings (for the portfolio of primary securities) and to screening or liquidity creation (for loans or deposits).

Finally, we must emphasize the perfect information assumption of the model: shareholders know the portfolio structure chosen by the intermediary. It would seem logical for managers to inform the shareholders about the portfolio structure (the mismatching position) to reduce the uncertainty about the parameters of the efficiency frontier. The fact that this is not always the case could be explained by the fear of the regulators or, in a principal-agent context, by the unwillingness of managers to announce continuously the bets they are taking.

Footnotes

[1]This includes Parkin (1970), Pyle (1971), Hart-Jaffee (1974) and more recently in the context of an optimal interest rate risk exposure Niehans-Hewson (1976), Santomero (1983) and Desmukh-Greenbaum-Kanatas (1983). The utility function is concave in all but the last case when it is linear.

[2]One must note that the existence of utility functions for firms is controversial in economic theory (Dreze, 1982).

[3]This question is of practial relevance as banks do play the mismatching game to increase their profits (Stigum-Branch, 1983).

[4]The model is similar to the one used by Wood (1981) except that we have two assets (instead of three) and that we introduce explicit transaction costs.

[5]For simplicity, we ignore the case $M_h^+ = M_h^- = 0$, $0 < m_h^+ < \beta + \alpha$

[6]Real costs would certainly help to explain the size of the intermediary but this is not the objective of the paper which seeks to explain the optimal portfolio structure of a given intermediary and what is needed is a relative transaction cost differential in favor of the intermediary.

[7]As in Wood (1981) and Senbet-Taggart (1984), we assume that the risk of bankruptcy is non-existant.

[8]We assume that the holding of the intermediary's shares must be non-negative. This assumption is not essential for the results.

[9]This strategy is correct for $\delta > 0$. If $\delta < 0$, he would buy the risk free asset $(\Delta^+ M^+)$ to increase his relative holding of risky securities.

[10]Note that the non-negativity constraint on F can be binding in the process; in this case, the investor holds only the two primary securities (M^-, B^+).

[11]For a particular set of parameters, relation (23) could be equal to zero; the holding (F, M^-, B^+) would be on the efficiency frontier in this special case but it could be replaced by the portfolio (F, B^+).

[12]Note that if δ is negative, a portfolio (F, M^-) implies that the investor wants to reduce its share of risky assets (see fn. 9). In this case, the investor cares for $\Delta - \delta$.

[13]This result contrasts with Wood (p. 154) where the investors could always duplicate costlessly the strategy of the intermediary so that its optimal portfolio structure was indeterminate.

[14]This assumption is taken by Sealey (1983) and Senbet-Taggart (1984).

[15]In a model with several intermediaries (and specific transaction costs for each of them), the initial shareholders will agree to maximize wealth only if they rely exclusively on the other intermediaries to obtain their optimal portfolio. This implies that they sell all their shares once the intermediary has been created.

[16]This meets the result obtained by Senbet-Taggart (1984) with one important difference. In their model, the corporate firm has a comparative advantage with respect to only one financial asset (bond). The clientele effect which follows creates firms specialized in lending and others in borrowing (p. 98) so that 'ex post' unanimity among shareholders is likely to be observed in the end. This is unlikely to happen in this model because financial intermediaries have a comparative advantage w.r.t. two financial assets so that shareholders with different wealth or risk aversion are unlikely to agree on the portfolio structure.

[17]This distinction is discussed in Niehans (1978).

Appendix

1. We shall show that the portfolio ($F > 0$, $B^- > 0$, $M^+ > 0$) is not in general optimal. Holding the variance of the portfolio constant and respecting the wealth constraint, we derive the expected return w.r.t.the volume of risky asset (B^-):

$$d\sigma_w^2 = 0 \quad \rightarrow \quad d\sigma^2(-B^- + q\,\delta\,F)^2 = 0$$

$$\rightarrow -\,d\,B^- + q\,\delta\,d\,F = 0 \rightarrow d\,F = \frac{dB^-}{q\delta}$$

$$\text{wealth constraint} \rightarrow d\,M^+ = d\,B^- - \frac{d\,B^-}{q\,\delta} = \left(1 - 1/q\delta\right)dB^-$$

$$\left.\frac{d\,\mu_w}{d\,B^-}\right|_{\sigma_w^2\ \text{constant}} = -\beta\,(1 - 1/q\delta) - \alpha + (1 + r_f)\left(\frac{q - 1}{q\,\delta}\right) . \tag{A.1}$$

The investor will prefer (F, B^-) if A.1 is positive.

2. The portfolio ($F > 0$, $B^+ > 0$, $M^+ > 0$) is not in general optimal.

$$d\sigma_w^2 = 0 \rightarrow d\,F = -\frac{d\,B^+}{q\,\delta}$$

$$\text{wealth constraint} \rightarrow d\,M^+ = -d\,B^+ + \frac{d\,B^+}{q\,\delta} = d\,B^+(1/q\delta - 1) .$$

$$\left.\frac{d\,\mu_w}{d\,B^+}\right|_{\sigma_w^2\ \text{constant}} = -\frac{(q - 1}{q\,\delta}\,(1 + r_f) - \frac{\beta}{q\,\delta} \tag{A.2}$$

3. The portfolio ($F > 0$, $B^- > 0$, $M^- > 0$) is not in general optimal.

$$d\,\sigma_w^2 = 0 \rightarrow d\,F = \frac{d\,B^-}{q\,\delta}$$

wealth constraint $\rightarrow d\ M^- = -d\ B^- + \frac{d\ B^-}{q\ \delta} = (1/q\delta - 1)d\ B^-$

$$\left.\frac{d\ \mu_w}{d\ B^-}\right|_{\sigma_w^2 \text{ constant}} = -\ 1/q\delta\ \alpha + (1 + r_f)\ \frac{(q - 1)}{q\ \delta} \qquad \text{(A.3)}$$

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