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Bank Income Taxes and Interest Rate Risk Management
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BANK INCOME TAXES AND INTEREST RATE RISK MANAGEMENT

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1. INTRODUCTION

Banks and other financial institutions are concerned with the management of their interest rate risk. The interest rate experience of the last decade appears to have intensified this concern. The finance literature does not provide convincing reasons for managers to want to control interest rate risk. Consequently this literature has provided little guidance on what to control, how far to go with that control, or on how to explain differences in interest rate risk exposure among banks.

Other writers (Lanstein and Sharpe[1978], Nelson and Schaefer[1982]) have noted that the use of interest rate risk management tools such as duration and immunization leaves open the question of why the managers of financial intermediaries try to reduce the earnings variability due to interest rate fluctuations and the question of how much to reduce that variability if one does undertake interest rate risk management. In the frictionless markets of most finance theory, banks are "neutral mutations" (Miller[1977]) and one interest rate risk management policy is just as good as another. This does not provide a satisfactory explanation for the concern with this policy decision that bankers have shown. Nor does it provide a satisfactory explanation for the diversity among banks with respect to their sensitivity to interest rate risk. Flannery and James [1982] and others provide evidence that bank stocks are not homogeneous with respect to stock price movements associated with interest rate fluctuations. Preliminary estimates from our research in progress confirm and extend this result.

The interest rate experience of the 1970s and 1980s has given maturity intermediation a bad name. Forward rates have frequently underpredicted future spot rates. Maturity mismatch strategies in government securities have, on average, been money losing strategies. Given frictionless markets, managerial preference for a quiet life plus shareholder indifference to the bank's interest rate risk policy could lead to policies that reduce or eliminate exposure to interest rate risk, i.e. to immunization strategies. If banks are something other than neutral mutations, the effect of managerial preferences on interest rate risk policy is not so clear.
For example, if part of the reason for the existence of banks is the provision of maturity intermediation services, managers who settle for the quiet life by avoiding exposure to interest rate risk are likely to come out second best to managers who choose asset and liability portfolios that do expose the bank's shareholders to interest rate risk. We do not wish to dismiss managerial preferences and the associated agency problems as potential explanations of bank behavior toward interest rate risk. However, with competitive markets for bank intermediation services and for managerial labor, it is not clear to us how these considerations would lead to testable hypotheses on the interest rate risk exposure of banks.

In this paper, we develop and analyze a model of bank decisions in which tax considerations induce banks to control interest rate risk. In particular, we take into account the potential loss of corporate tax shields if bank income falls below some critical level. This is a specific application of the tax shield effects discussed by Brennan and Schwartz[1978], Miller[1977], DeAngelo and Masulis[1980] and Kim[1982], except that our interest is in the effects of tax shields on risk taking by financial institutions rather than a concern with capital structure decisions.\(^1\) In the U.S., banks have many opportunities to shield current income against federal and state taxation. Foreign tax credits, investment tax credits, and investment in tax-exempt securities are three examples. For many bank holding companies, the tax position can be thought of as a stock of credits usable in the current or in future years. We assume that bankers make their portfolio decisions given a particular tax position that may include a stock of tax shields. The bank's managers attempt to maximize the value of the bank's shares taking into account those tax shields. To do so, the bank's managers must estimate the future taxable income plus the carryback potential that will be available to utilize the tax shields. The tax shields are an asset and if the bank's income falls below some level then the value of that asset will be reduced either by the loss of tax shielding opportunities or by the postponement of their realization. In practice, the effect of the stock of tax shields on the bankers' decisions is undoubtedly quite complex. Rosenberg has suggested a linear programming optimization as the basis for a

\(^1\)Cooper and Franks[1982] present a model where the existence of tax credits changes the investment decisions of the firm. Their model is a certainty model in which transactions costs prevent the firm from fully utilizing its tax credits.
bank's tax plan in order to capture the complex interactions of alternative tax shields.\(^2\) We shall use a model of a bank with what we shall call a tax asymmetry. This asymmetry is created since below a predetermined level of income the bank is unable to use its stock of tax shields. We believe that this tax asymmetry will capture the essence of the effect of tax shields on bank risk management, and in particular on interest rate risk management.

2. THE MODEL

We want to analyze a model that allows us to focus on a bank's policy toward interest rate risk. To do so, we shall use a two date framework in which there is a complete set of market prices for $1 in every date 2 state of the world. The bank's managers and shareholders agree on this set of state-contingent prices.\(^3\) In this framework we allow for the possibility that banks are compensated for providing lending services, perhaps at competitive rates. Furthermore, since we want to examine the effects of tax shields without confusing them with tax clientele effects, we assume that a tax equilibrium such as that proposed by Miller [1977] holds.

Formally, we assume:

A.1 There is a set of prices, \( p(s) \), for $1 (after taxes) in state \( s \) at date 2 such that

\[
\int_{s=0}^{s=\infty} p(s) \, ds = r^-1
\]

where \( r^- \) is the one-period riskless, after-tax return (one plus the after-tax, riskless interest rate).

A.2 The tax rate for individuals is \( T \) on interest income and 0 on equity income. The corporate tax rate is \( T \).

\(^2\)See also DeAngelo and Masulis (1980) for a discussion on the effect of carryback-carryforward rules on the capital structure decision.

\(^3\)As discussed by Sharpe (1978), if this is taken literally as a complete market paradigm, banks are inessential agents in the economy. However, we intend this aspect of the model to represent an economy in which there are market prices for risk and for time patience and in which the actions of a given bank cannot alter those prices.
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A.3 The present value of a bank ($V$) is given by the (vector) product of the net after-tax value ($V_T(s)$) of the bank's portfolio at date 2 in state $s$ times the state-contingent price ($p(s)$).\(^4\)

$$
V = \int_{s=0}^{s=\infty} V_T(s) \ p(s) \ ds
$$

Bank managers are assumed to maximize this value.

A.4 The one-period return ($r(L,m;s)$) on a $\$1$ default-free loan of maturity $m$ is assumed to follow a single factor return generating process of the form\(^5\)

$$
 r(L,m;s) = r + \alpha(L,m) + e(m) \ u(s)
$$

where $L$ is the total loans of maturity $m$

$r$ is the before-tax riskless return such that $r_T = 1 + (r-1)(1-T)$

$\alpha(L,m)$ is the before-tax return to the bank for providing loans in the amount $L$ of maturity $m$\(^6\)

$u(s)$ is a random factor affecting loan returns and the expected value of $u(s)$ is zero

$e(m)$ is the factor loading for $u(s)$ in the return on a loan of maturity $m$ ($e(1) = 0$, $\frac{\partial e(m)}{\partial m} > 0$).

A.5 The present value of an $m$-period default-free loan is a non-decreasing function of $m$ up to some maturity $\hat{m}$.

$$
\frac{\partial}{\partial m} \int_{s=0}^{s=\infty} r(L,m;s) \ p(s) \ ds \ \{ \begin{array}{l}
0 \quad \text{for} \ m < \hat{m} \\
0 \quad \text{for} \ m \geq \hat{m}
\end{array}
$$

This assumption deserves some clarification. If the change in present value as a result of an increase in the maturity gap is zero for all $m$, then maturity intermediation is a "value preserving spread" (see Sharpe[1978]), and banks do not receive any

\(^4\)For simplicity we will treat the economic earnings of the bank as taxable income.

\(^5\)For a similar model of loan return see Bierwag, et al[1982].

\(^6\)\(\alpha(L,m)\) represents the return to intermediation which may consist of a return for providing lending services or a return for providing maturity intermediation services or both.
excess return for providing this service. Conversely, if this change is positive, then increasing the maturity gap is a "value increasing spread" and banks receive excess return for providing maturity intermediation services. We suggest that the latter is a reasonable characteristic of banks' lending opportunities, in particular their lending to individuals and small and medium size businesses. A similar assumption regarding pricing of banks' services can be found in Thakor, et al.[1981] where banks' opportunities are attributed to "bank customer relationship". We will assume that if the present value is increasing in m, then it is increasing at a decreasing rate.\(^7\)

A.6 The bank's stock of tax shields creates a tax asymmetry point (\(\bar{Y}\)) in the bank's before-tax income such that\(^8\)

\[
Y_T(s) = \begin{cases} 
(Y(s) - \bar{Y})(1 - T) + \bar{Y} & \text{if } Y(s) > \bar{Y} \\
Y(s) & \text{if } Y(s) \leq \bar{Y}
\end{cases}
\]

where

\[
Y(s) = r(L, m; s) L - rD - (L - D) - C(L)
\]

\[
\bar{Y} = r(L, m; \bar{Y}) L - rD - (L - D) - C(L)
\]

D is total single-period deposits\(^9\)

\(C(L)\) is a cost function for producing lending services.\(^10\)

---

\(^1\)In our model the pricing of maturity intermediation is exogenous. We could have derived this pricing endogenously using a more general model without a significant change in the results. See DeAngelo and Masulis[1980] for a general equilibrium treatment of the capital structure problem in the presence of tax shields.

\(^2\)We have assumed that the states s can be ordered so that u(s) is increasing in s.

\(^3\)We shall treat the single-period deposits as if they offer depositors an after-tax riskless return. This allows us to focus on the effects of the assumed tax asymmetry on interest rate risk policy without the additional, and for our purposes complicating, tax effects of bankruptcy.

\(^4\)The lending service cost function may be made to depend on m without materially altering the results. We shall assume that \(C(L)\) displays increasing and then decreasing returns to scale.
Given these assumptions, the bank manager's decision problem is to choose the volume of loans and deposits and the loan maturity to maximize the value of the bank's shares.

$$\max V = \int_{s=0}^{s=\infty} V_T(s) p(s) \, ds = \int_{s=0}^{s=\infty} (Y_T(s) + L - D) p(s) \, ds$$

$$= \int_{s=0}^{s=T} (Y(s) + L - D) p(s) \, ds + \int_{s=T}^{s=\infty} [(Y(s) - \bar{Y})(1-T) + \bar{Y} + (L - D)] p(s) \, ds$$

$$= \int_{s=0}^{s=\infty} (Y(s) + L - D) p(s) \, ds - T \int_{s=T}^{s=\infty} (Y(s) - \bar{Y}) p(s) \, ds$$

$$= [(L - D) r + \alpha(L,m) L - C(L)] r_{T}^{-1} + L e(m) \int_{s=0}^{s=\infty} u(s) p(s) \, ds$$

$$- T [(L - D) (r - 1) + \alpha(L,m) L - C(L) - \bar{Y}] \int_{s=T}^{s=\infty} p(s) \, ds$$

$$+ L e(m) \int_{s=T}^{s=\infty} u(s) p(s) \, ds]$$

The role of the tax asymmetry is clearer in an alternative version of equation (1)

$$\max V = (L - D) r_{T}^{-1} + TR - TC$$

where

$$TR = (1-T) [(L - D) (r - 1) r_{T}^{-1} + \alpha(L,m) L r_{T}^{-1} + L e(m) \int_{s=0}^{s=\infty} u(s) p(s) \, ds] + T \bar{Y} r_{T}^{-1}$$

$$TC = (1-T) C(L) r_{T}^{-1} + T \int_{s=0}^{s=\infty} [\bar{Y} - [(L - D) (r - 1) + \alpha(L,m) L + L e(m) u(s) - C(L)]] p(s) \, ds]$$

The last term of TR is the present value of the stock of tax shields if this stock can be fully utilized. The last term of TC reflects the present value of the foregone tax shields in those states in which this stock cannot be fully utilized.
3. **TAX ASYMMETRIES AND INTEREST RATE RISK POLICIES**

As shown by Brennan and Schwartz[1978], DeAngelo and Masulis[1980] and others, uncertainty regarding the utilization of tax shields can lead to an internal optimum for a firm’s leverage decision even when the tax environment is the one we have described in assumption A.2. Since we want to focus on the effects of tax asymmetries on interest rate risk policy, we shall restrict our analysis to the case in which bank capital is fixed.

After some rearrangement of terms, the first derivatives of V (with L-D constant) are

\[
\frac{\partial V}{\partial L} = \left[ \alpha(L,m) + \frac{\partial \alpha(L,m)}{\partial L} L \right] r_T^{-1} + e(m) \int_{0}^{s_{\infty}} u(s) p(s) \, ds - \frac{\partial C}{\partial L} r_T^{-1} \\
- T \left[ \alpha(L,m) + \frac{\partial \alpha(L,m)}{\partial L} \right] \int_{s_{\infty}}^{s_{\infty}} p(s) \, ds + e(m) \int_{s_{\infty}}^{s_{\infty}} u(s) p(s) \, ds - \frac{\partial C}{\partial L} \int_{s_{\infty}}^{s_{\infty}} p(s) \, ds \\
+ T \left[ (L-D)(r-1) + \alpha(L,m) L + L e(m) u(\tilde{z}) - C(L) - \tilde{v} \right] \frac{\partial \tilde{z}}{\partial L}
\]

\[
\frac{\partial V}{\partial m} = L \left[ \frac{\partial \alpha(L,m)}{\partial m} r_T^{-1} + \frac{\partial e(m)}{\partial m} \int_{0}^{s_{\infty}} u(s) p(s) \, ds \right] (2b) \\
- T \left[ \frac{\partial \alpha(L,m)}{\partial m} \int_{s_{\infty}}^{s_{\infty}} p(s) \, ds + \frac{\partial e(m)}{\partial m} \int_{s_{\infty}}^{s_{\infty}} u(s) p(s) \, ds \right] \\
+ T \left[ (L-D)(r-1) + \alpha(L,m) L + L e(m) u(\tilde{z}) - C(L) - \tilde{v} \right] \frac{\partial \tilde{z}}{\partial m}
\]
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Noting (using A.6) that

\[ \bar{r} = (L - D) (r - 1) + \alpha (L, m) L + L e (m) u (\bar{\alpha}) - C (L) \]

and defining the present value of \( u (s) \) as \( A \)

\[ A \equiv \int_{s=0}^{s=\infty} u (s) p (s) ds \]

equations (2a) and (2b) may be rewritten as \(^{12}\)

\[ \frac{\partial \bar{r}}{\partial L} = \left[ \alpha (L, m) + \frac{\partial \alpha (L, m)}{\partial L} L - \frac{\partial C (L)}{\partial L} \right] r_{T}^{-1} e (m) A \right) \left( 1 - T \right) \]

\[ + T \left[ \alpha (L, m) + \frac{\partial \alpha (L, m)}{\partial L} L - \frac{\partial C (L)}{\partial L} \right] \int_{s=0}^{s=T} p (s) ds + e (m) \int_{s=0}^{s=T} u (s) p (s) ds \right) \]

\[ \frac{\partial \bar{r}}{\partial m} = \left[ \frac{\partial \alpha (L, m)}{\partial m} r_{T}^{-1} + \frac{\partial e (m)}{\partial m} A \right] \left( 1 - T \right) \]

\[ + T \left[ \frac{\partial \alpha (L, m)}{\partial m} \int_{s=0}^{s=T} p (s) ds + \frac{\partial e (m)}{\partial m} \int_{s=0}^{s=T} u (s) p (s) ds \right) \]

3.1. Bank Policies With No Tax Asymmetry

If the bank does not face an asymmetry in its tax function (i.e., \( \bar{\alpha} = 0 \)) the necessary first order conditions for an internal solution to the bank maximization problem are

\[ \alpha (L, m) r_{T}^{-1} + L \frac{\partial \alpha (L, m)}{\partial L} r_{T}^{-1} + e (m) A = \frac{\partial C (L)}{\partial L} r_{T}^{-1} \]

\[ \frac{\partial \alpha (L, m)}{\partial m} r_{T}^{-1} + \frac{\partial e (m)}{\partial m} A = 0 \]

\(^{11}\) In our loan return model, \( u (s) \) is assumed to be a zero mean random variable. With risk neutrality, the price vector \( p (s) \) will be such that \( A = 0 \); with risk aversion the sign of \( A \) is not clear. No excess return to maturity intermediation will mean that the effect of non-zero values of \( A \) for a given loan maturity \( m \) will be exactly offset by the present value of the return to maturity intermediation that is incorporated in \( \alpha (L, m) \). Notice that this definition of profitless maturity intermediation does not preclude term premia on loans made for periods longer than one-period. Rather it implies that these term premia are the market determined compensation for bearing interest rate risk.

\(^{12}\) The effects of a tax asymmetry enter the second order conditions of our model. However, they do not materially affect the sufficiency conditions. If an internal optimum is possible without a tax asymmetry, the sufficiency conditions will be satisfied for the corresponding case with a tax asymmetry.
3.1.1. Optimal Maturity Gap

If the bank receives no excess return for providing maturity intermediation services (i.e. if \( \alpha(L,m) r^*-1 + e(m) A = \alpha(L,1) \)), the maturity gap is irrelevant for the bank. Equation (4b) will hold for all values of \( m \). This is the basic maturity indifference result that we mentioned in the introduction.

Alternatively, as we suggested in the introduction, banks may receive compensation for providing maturity intermediation services as part of a package of lending services. As we shall illustrate later, this compensation need not imply monopolistic returns to banking. For the present, we assume that the risk-adjusted return to lending, \( \alpha(L,m) r^*-1 + e(m) A \), is strictly increasing in \( m \) up to maturity \( \hat{m} \). From equation (4b) it is clear that the optimal loan maturity for this case will be \( \hat{m} \). The bank will be induced to increase the maturity gap as long as there are marginal returns to maturity intermediation.

Clearly neither maturity indifference nor full exploitation of maturity intermediation opportunities provides a rationale for the concerns that bank managers appear to have regarding interest rate risk.

3.1.2. Optimal Bank Size

In the absence of a tax asymmetry, bank size is determined in the usual way. If the bank is a price taker on loans and the cost function \( C(L) \) is well-behaved, the derivative \( \frac{\partial \alpha(L,m)}{\partial L} \) will be zero and the bank will increase loans until the present value of the marginal cost of lending is equal to the present value of the risk-adjusted return from lending. If the bank faces a downward sloping demand for loans, a similar result, including the effect of the marginal return to lending \( \frac{\partial \alpha(L,m)}{\partial L} < 0 \), will determine the optimal loan volume given fixed capital.

3.2. Bank Policies With Tax Asymmetry

The underlying concept of a tax asymmetry in our model is that a bank may come to a decision point with an inherited stock of tax shields. These tax shields are a valuable asset, but
the value of this asset depends on the ability of the bank to generate income to shelter from taxes.

The existence of such a tax asymmetry has a profound effect on bank policies. The necessary first order conditions for an internal solution to the bank maximization problem include terms for the present value of tax shields that will be foregone in those states \( s < \bar{s} \) in which the bank income is less than the maximum income that can be sheltered from taxation.

\[
(1-T) \left\{ \alpha(L,m) r^{-1} + L \frac{\partial \alpha(L,m)}{\partial L} r^{-1} + e(m) A \right\} \tag{5a}
\]

\[
= (1-T) \frac{\partial C(L)}{\partial L} r^{-1}
\]

\[
- T \left\{ \left[ \alpha(L,m) + L \frac{\partial \alpha(L,m)}{\partial L} - \frac{\partial C(L)}{\partial L} \right] \int_{s=0}^{s=\bar{s}} p(s) \, ds + e(m) \int_{s=0}^{s=\bar{s}} u(s) p(s) \, ds \right\}
\]

\[
(1-T) \left\{ \frac{\partial \alpha(L,m)}{\partial m} r^{-1} + \frac{\partial e(m)}{\partial m} A \right\} \tag{5b}
\]

\[
= - T \left\{ \frac{\partial \alpha(L,m)}{\partial m} \int_{s=0}^{s=\bar{s}} p(s) \, ds + \frac{\partial e(m)}{\partial m} \int_{s=0}^{s=\bar{s}} u(s) p(s) \, ds \right\}
\]

The final terms on the r.h.s. of equations (5a) and (5b), terms that we shall identify as \( \phi_L \) and \( \phi_m \), respectively, are the result of foregone tax shields when \( \bar{s} > 0 \). In the bank's equilibrium, each of these two terms will be negative for \( \bar{s} > 0 \)

\[
\phi_L = \left[ \alpha(L,m) + L \frac{\partial \alpha(L,m)}{\partial L} - \frac{\partial C(L)}{\partial L} \right] \int_{s=0}^{s=\bar{s}} p(s) \, ds + e(m) \int_{s=0}^{s=\bar{s}} u(s) p(s) \, ds < 0
\]

\[
\phi_m = \frac{\partial \alpha(L,m)}{\partial m} \int_{s=0}^{s=\bar{s}} p(s) \, ds + \frac{\partial e(m)}{\partial m} \int_{s=0}^{s=\bar{s}} u(s) p(s) \, ds < 0
\]
3.2.1. Optimal Maturity Gap

With an effective tax asymmetry and no excess return from maturity intermediation, the necessary condition given by equation (5b) cannot be satisfied for any maturity gap policy in which the bank is subjected to interest rate risk. For the maturity matching strategy, the tax asymmetry does not come into play (i.e. for \( \bar{m} = 1 \bar{s} = 0 \)). The optimal maturity in this case is \( m = 1 \) or a policy of maturity matching for loans and deposits.

However, if the risk-adjusted return to lending is increasing in \( m \) (at a decreasing rate), the effect of the tax asymmetry will be to induce the bank to choose an optimal maturity \( \bar{m} \) such that \( \bar{m} > \bar{m} > 1 \).

With or without returns to maturity intermediation, the existence of a tax asymmetry will induce bank managers to be concerned about interest rate risk management and to take maturity gap positions that conform to an optimal policy and are different from the full exploitation of maturity intermediation return. We emphasize that the only market imperfection that we have invoked to obtain this result is the existence of an inherited stock of tax shields that cannot be fully utilized (or sold) when there is insufficient income.

It is important to note here that these results apply also to a bank which has very large tax shields relative to its zero-exposure income. The asymmetry, which is created in this case at the upper tail of the income distribution (in states \( s > \bar{s} \) the bank pays taxes while in all other states its income can be sheltered), will induce the bank to avoid full exploitation of the return to maturity intermediation.\(^{13}\)

3.2.2. Optimal Bank Size

The necessary condition for an optimum given by equation (5a) includes the effect of the loss of tax shields on the net marginal revenue from financing an additional $1 of loans with deposits. This marginal effect, \( -T \phi_L \), can be thought of as an increase in the marginal cost of lending above the cost included in \( C(L) \). The marginal cost function for loans for every

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\(^{13}\)This consideration is important to institutions which suffered large losses during previous years. Of course in these cases the opposite effect of limited liability and deposit insurance may be significant also. We will return to this issue at the end of this section.
maturity choice (except $m=1$) will be greater at every value of $L$. Therefore, the optimal bank size given a tax asymmetry will be smaller than it would have been if the bank's tax shields were fully utilizable in all states. This effect results from the increase in the instability of income that results from an increase in lending when there is a loan maturity gap.

3.2.3. A Graphical Analysis

The results that we have reported for the effects of a tax asymmetry on the optimal maturity gap and optimal bank size can be obtained in a competitive loan market. For the competitive case, we take the present value of $\$1$ of a loan of maturity $m$ to be independent of $L$, but to be increasing with $m$ (at a decreasing rate). This is what we meant in suggesting that maturity intermediation might be an integral part of the lending services offered by a bank.

Graph 1 illustrates the situation for a bank in this competitive loan market if there is no tax asymmetry. The optimal loan maturity is $\bar{m} = \hat{m} = 3$ and, with increasing costs, the optimal loan position is $L^*$. The curve AC represents the average variable costs for the firm and $\pi$ is the bank’s profit.

Graph 2 illustrates the situation for the bank if there is a tax asymmetry. The bank’s fixed assets include the inherited stock of tax shields. If the bank adopts a maturity matching strategy, its marginal costs are determined by the cost function $C(L)$. However, for $m > 1$, the tax asymmetry comes into play. The marginal cost function $MC_m$ is

$$MC_m = (1-T) \frac{\partial C(L)}{\partial L} - T \phi_L(m).$$

It can be shown that the function $-T \phi_L(m)$ is positive and increasing in $L$ for $m > 1$. In the situation shown on graph 2, the optimal loan position is $L_2$ and the optimal loan maturity is $\bar{m} = 2$. This size and maturity combination provide the bank with the maximum value that is currently available to it, since $\pi_2 > \pi_3 > \pi_1$. The conditions for the bank managers to choose a maturity at which there remain marginal returns to maturity intermediation are assured by the necessary conditions for the optimum. The value of the bank is increased by balancing off addi-

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14 The existence of tax asymmetries for banks could produce increasing marginal costs of lending even if the cost
GRAPH 1.
Optimal Lending \((L^*)\) and
Maturity \((m=3)\) with no
Tax Asymmetry.

GRAPH 2.
Optimal Lending \((L_2)\) and
Maturity \((m=2)\) with a
Tax Asymmetry.
tional return from maturity intermediation against a maturity position that yields a more favorable value to the bank's stock of tax shields.

3.2.4. Change In The Tax Asymmetry Point

Our analysis treated the stock of tax shields, and hence the tax asymmetry point, as a variable over which the bank does not have control. If the bank can change its asymmetry point during the period, one may ask what the value to the bank of an additional $1 of tax shields is.

From a derivative of $V$ with respect to $\bar{Y}$, an increase in $\bar{Y}$ will increase the value of the bank by

$$dV = T \left[ \int_{i}^{s} \rho(s) \, ds \right] \leq T \hat{r}^{-1}$$

which is equal to the present value of the reduction in tax payments, where the possibility of not utilizing the additional tax shields is taken into account. It is clear that the present value of additional tax shields will be smaller the higher the tax asymmetry point is and the larger the maturity gap is. This consideration might prevent banks from being competitive in providing services where part of the profits comes in the form of additional tax shields.\footnote{See Rosenberg for a discussion of this point in the context of leasing.}

It can also be shown that if the bank's stock of tax shields increases, then its optimal maturity gap and its optimal size will be smaller.

3.2.5. Deposit Insurance And Tax Asymmetry

In this paper we considered a model in which the bank's optimal strategy was a trade-off between the loss of tax shields and the gains from providing maturity intermediation services. We showed that, with a tax asymmetry, a condition for an internal solution to the bank's optimal maturity gap problem was that banks receive excess return for bearing interest rate risk.

Merton\cite{Merton1977}, Sharpe\cite{Sharpe1978} and others showed that deposit insurance with a fixed premium induces banks to increase their risk. In the presence of both deposit insurance and a tax asymmetry, the bank's optimal strategy is a joint decision regarding size, capital and maturity

\footnote{function $C(L)$ was not increasing in $L$.}
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gap. This decision should take into account the trade-off between (1) the loss of tax shields, (2) the increase in the bank’s value which is accompanied by an equal increase in the insurer’s liability and (3) any gains from providing maturity intermediation services. In contrast to our previous results and to Sharpe’s results, an internal optimal solution may exist and its existence does not depend on the presence of excess return to providing maturity intermediation services.

4. CONCLUSION

Our objective in this paper has been to demonstrate that the existence of tax shields and the circumstances in which these tax shields may not be fully utilizable by a bank can lead to decisions to restrict the maturity gap between loans and deposits. We have shown that this will be the case with or without returns to maturity intermediation and with competitive loan markets.

There are analytical problems that we have not dealt with. Many of these are related to the artificial separation between bank markets and the market that determines the state prices. In fact, in our model, state prices are just a convenient way of pricing the bank’s equity in alternative states so we can engage in a partial equilibrium analysis of the bank’s policies. If we took the complete market paradigm seriously, there would be no role for banks.

Our model does not deal with the opportunity that banks may have to eliminate some of their risk in the futures market. The effect of interest rate futures on bank behavior will depend on the pricing of futures contracts relative to bank loans and deposits and on the degree to which banks can hedge loans in the futures market. This and other aspects of the question of interest rate risk policy deserve more attention. Whatever the outcome of further research on this topic, we believe that tax shield effects are likely to be a part of the explanation of bank behavior with respect to interest rate risk management. Hopefully, the comparative statics results which are implied by our model will prove to be empirically testable propositions.

\[\text{In the presence of deposit insurance, equations (5a) and (5b) have additional terms which represent the insurer’s liability in states in which the bank is insolvent.}\]


Bank Income Taxes and Interest Rate Risk Management


Rosenberg, B. [no date] "Planning in Regard to Taxation for Banks: A Pragmatic Approach via Linear Programming", undated manuscript, U.C. Berkeley.
