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Interest Rate Swaps and Corporate Financing Choices

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ABSTRACT

This paper describes the firm's decision to borrow short-term versus long-term and shows how the introduction of interest rate swaps affects this choice. The model shows that in the absence of a swap market, interest rate uncertainty can lead firms to substitute long-term for short-term financing. However, when swaps exist, there is a tendency for firms that expect their credit quality to improve to borrow short-term and use swaps to hedge interest rate risk. The model suggests that, while the demand for fixed for floating swaps is enhanced, the demand for floating for fixed swaps is reduced by the presence of asymmetric information.

THE ACADEMIC LITERATURE ON optimal capital structure has traditionally focused on the percentage of a firm's capital that is financed with debt. More recently, academics have become concerned with the actual design of the debt instruments. Part of this interest in security design is probably due to recent innovations from Wall Street that provide firms with greater flexibility in the determination of their liability streams. Interest rate swaps are perhaps the most popular of these innovations. These transactions, which are described in more detail in Section I, allow short-term borrowers to reduce interest rate exposure and allow long-term borrowers to transform fixed-rate loans into floating-rate loans. The interest rate swap market was introduced in 1982 and grew to over one trillion dollars worth of swapped debt outstanding within about seven years.

This paper provides one explanation for the growing popularity of these transactions. The paper builds on an idea that was originally developed by Flannery (1986) who showed that in the absence of interest rate uncertainty there is a tendency for borrowers with private information to prefer short-term loans. This tendency arises because those borrowers with the most favorable information prefer not to be locked into a fixed borrowing rate, since they expect to be able to borrow under more favorable terms in the future when their information is publicly revealed. This argument implies that the more

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favorably informed, in any given pool of potential long-term borrowers, can lower their expected borrowing costs by switching to short-term loans.

The model developed in this paper departs from Flannery's analysis by allowing for both interest rate uncertainty and financial distress costs, and by expanding the financing alternatives to include interest rate swaps. In the absence of swaps, the presence of financial distress costs create a dilemma for firms with favorable information. Borrowing long-term forces them to pool with their less-creditworthy counterparts, which increases their borrowing costs, while borrowing short-term subjects the firm to interest rate risk and hence to a greater likelihood of financial distress. I show that interest rate swaps can solve this dilemma. By borrowing short-term and swapping a floating-rate obligation for a fixed-rate obligation, a borrower with an optimistic outlook can achieve the benefits of short-term borrowing without the higher expected costs of financial distress.

I. What Are Interest Rate Swaps?

In reality there are a number of different swap transactions as well as a number of ways in which a firm can borrow. For the sake of simplicity this analysis will be limited to strategies of either rolling over short-term loans or of borrowing long-term at a fixed rate, possibly in combination with what is generally referred to as plain-vanilla interest rate swaps, that will be described below.

If a firm chooses to borrow at a fixed long-term rate, its liability stream can be expressed as,

$$R_L = R_l + D_l,$$

where R_l, the long-term default-free rate of interest, and D_l, the default premium, are contractually fixed for all periods until the maturity date. Rolling over short-term loans creates a liability stream of,

$$\tilde{R}_{st} = \tilde{R}_{ft} + \tilde{D}_t,$$

where $\tilde{R}_{ft}$, the short-term risk-free rate of interest, as well as $\tilde{D}_t$, the default spread, are determined at the beginning of each period.

In a typical interest rate swap, borrower A agrees to pay the coupon on a fixed-rate obligation to borrower B in exchange for receiving payments that are indexed to a short-term rate of interest such as LIBOR. For instance, if the swap liability is sufficiently senior that default is not an issue in the swap's price,[1] a borrower could agree to pay R_l each period in exchange for receiving $\tilde{R}_{ft}$ and generate an uncertain liability stream of $R_l - \tilde{R}_{ft}$. In this

[1] For many lower-rated firms default on the swap transaction would be relevant. Such firms cannot in practice implement a swap transaction directly, but must instead synthesize the transaction using interest rate futures (see Smith, Smithson, and Wakeman (1986)). Because the futures contracts are marked to market on a daily basis, the possibility of default on these contracts is not an important consideration.

case, the net obligation of a short-term borrower that swaps for long is,

$$\tilde{R}_{ss} = \tilde{R}_{ft} + \tilde{D}_t - \tilde{R}_{ft} + R_l = R_l + \tilde{D}_t,$$

and the obligation of a long-term borrower that swaps for short is,

$$\tilde{R}_{ls} = R_l + D_l - R_l + \tilde{R}_{ft} = \tilde{R}_{ft} + D_l.^2$$

The above expressions illustrate the key difference between a synthetic "fixed-rate" loan that is created with swaps and an actual long-term fixed-rate loan.[3] The actual loan locks in the default spread, as well as the default-free portion of the interest rate, while the synthetic loan locks in only the default-free portion. The swap transaction thus allows the short-term borrower to hedge the uncertainty in borrowing costs caused by unanticipated changes in short-term riskless rates, but not the changes in borrowing costs due to changes in the perceived quality of the borrower's credit.

The R_{ls} liability is equivalent to a floating-rate loan, which pre-dated interest rate swaps. The $\tilde{R}_{ss}$ liability, however, is an innovation. Although financial institutions could, in principle, offer loans with rates that float with $\tilde{D}_t$ but not with changes in the risk-free rate, this would create problems in practice. Since the default premium, $\tilde{D}_t$, is not observable if the firm effectively ties itself to one lender, the lender would have an incentive to renege on the contract when interest rates increase by claiming that the borrower's credit quality had declined. Likewise, borrowers would have a similar incentive to renege on the contract when interest rates decline. This problem does not arise if the firm is rolling over short-term loans since the interest rate is competitively determined at each date and the borrower is free to go to another lender. The two-step process of rolling over short-term loans in a competitive market and swapping the floating for fixed liabilities is, therefore, needed to create the $\tilde{R}_{ss}$ liability stream.

The conventional explanation for interest rate swaps given by investment bankers ignores the distinction between actual and synthetic long-term loans. They argue that markets are segmented (perhaps because of regulations) in ways that give some firms a comparative advantage borrowing long-term and others a comparative advantage borrowing short-term. As a result, the swap transaction enables firms with a comparative advantage in the short-term market to effectively borrow long-term (or vice versa) at more attractive rates than they could otherwise obtain.

Bicksler and Chen (1986) cite what they refer to as differential quality spreads to support this explanation. Typically, the spread between AAA-rated commercial paper and A-rated commercial paper is somewhat less than the spread between AAA-rated five-year obligations and A-rated five-year obliga-

[2] This assumes that the default spread on the short-term debt is unaffected by whether or not the firm initiates a swap transaction which is not true in general.

[3] See also Arak et al. (1988) for a discussion of this difference between synthetic "fixed-rate" loans and actual long-term fixed-rate loans.

tions. The argument generally given is that this spread differential provides an incentive for an A-rated firm to use the swap market to create a synthetic fixed-rate obligation with an initial spread over the AAA rate that is equal to the short-term spread rather than to the long-term spread.

Consistent with this view is the fact that most firms that borrow short and swap to achieve a fixed-rate obligation have A and BBB credit ratings and firms that issue long and swap for a floating rate obligation are generally rated higher. In addition, the evidence indicates that swap transactions reduce the initial borrowing costs of lower-rated borrowers who would have otherwise borrowed long-term, and sometimes allow AAA firms to borrow at floating rates that are below their commercial paper rates.[4] These empirical observations are also consistent with the model presented below, that relies on asymmetric information rather than on segmented markets.[5]

II. The Economic Setting

The model examines a firm that must raise \$1 at date 0 to fund a project that generates a payoff at date 2. The number of financing options is limited in this model to short- and long-term debt and the plain-vanilla interest rate swaps described in the last section. All financing is provided by a risk-neutral market. As in Flannery (1986), the implications of having slightly higher transaction costs associated with rolling over short-term debt rather than borrowing long-term will be discussed.[6] However, most of the formal analysis ignores transaction costs.

Although the project is initiated at date 0, its final form is not determined until date 1, at which time the borrower chooses between two possible payoffs that differ in risk.[7] This choice, along with choices regarding financial policy, is made to maximize the expected value of the borrower's equity given his information. The model assumes that relevant information about the project's future profitability becomes publicly known as it is being completed. This

[4] Articles in the *Investment Dealers' Digest* suggest that swaps can reduce initial funding costs to BBB companies by as much as 50 basis points (p. 9, November 6, 1989) and report that Kellogg used swaps to borrow at a floating rate that was 45 basis points below its commercial paper rate (p. 9, March 27, 1989).

[5] Wall (1989) argued that interest rate swaps may be used by firms because of the underinvestment problem associated with long-term debt (see Myers (1977)). To avoid this problem, firms may use short-term rather than long-term financing, which exposes them to interest rate risk. Wall suggests that by using interest rate swaps in combination with the short-term borrowing, the interest rate risk can be avoided along with the underinvestment problem. Since the underinvestment problem is most severe for lower-rated firms, Wall's explanation is also consistent with the above mentioned empirical observations.

[6] In an earlier version of this paper, a motive for long-term debt existed for borrowers who wished to hedge the uncertainty associated with not knowing their future credit quality (see also Diamond (1991)). This motivation to borrow long-term produces the same implications regarding the incentive to do interest rate swaps, as does transactions costs.

[7] For example, the mix between the fixed and variable costs (e.g., labor intensity) would effect the riskiness of the project's payoffs.

information, which may relate, for example, to the efficiency of the production process, is known to borrowers at date 0 but is revealed to lenders after date 0 but prior to date 1, when the project's riskiness is determined.

To simplify the analysis I assume that the information reveals whether the borrower is type G, a good or efficient firm, or type B, a bad or less efficient firm. The less risky project provides a certain payoff of G, for the type G firm, and B, for the type B firm, where $G > B > R_l$, where R_l is one plus the risk-free rate of interest for a two-period loan. The risky project's payoff is either $\tilde{G}' = G - C + \tilde{e}$ or $\tilde{B}' = B - C + \tilde{e}$ depending on the firm's type, where C is a positive constant that is less than B and $\tilde{e}$ is a random variable with a mean of zero and with a lower bound of $C - B$. The incentive to take the lower net present value (NPV) risky project when interest obligations are high creates the financial distress costs that are key to this analysis (see Jensen and Meckling (1976) and Stiglitz and Weiss (1981)). The model assumes that B is sufficiently large and that C is sufficiently small so that the risky, as well as the safe, project has a positive NPV for both types given any interest rate that may arise.

Without loss of generality assume that the short-term default-free rate of interest between date 0 and date 1 is zero. Since both projects for both types of firm have values at date 1 that exceed their costs, firms that borrow short-term at date 0 will be able to roll over their loans with certainty at date 1. This implies that a short-term loan at date 0 carries no default risk and thus has a zero rate of interest. However, one plus the risk-free rate between dates 1 and 2, R_s, is assumed to be greater than one. The analysis initially assumes that this risk-free rate is known in advance, so that $R_s = R_l$, but later allows for the future rate to be uncertain. Since default is possible at date 2 if the firm chooses to make the project risky, a long-term borrower must pay a default spread over this risk-free rate.

III. The Debt Maturity Decision in the Absence of Swaps

A. Certain Interest Rates

If the borrower could commit to selecting the safe project, it would do so and could then borrow at the default-free long-term rate of interest at date 0. However, if its interest obligation is sufficiently high, its equity value is higher if it chooses to generate the risky payoff. A type B (or type G) firm will select the risky project over the safer project if the expected value of its equity is greater given this alternative. This will be the case if the following inequality holds (with G substituted for B for the type G firm):

$$D = E\{\max[\tilde{B}' - R, 0]\} - (B - R) > 0, \tag{1}$$

where R is the loan obligation, $E\{\max[\tilde{B}' - R, 0]\}$ is the expected payoff to the equity holders from taking the risky project, $(B - R)$ is their payoff from taking the safe project, and D is the difference between these payoffs.

It can easily be seen that expression (1) holds when R is close to B and that for R close to zero the inequality is reversed and the safe project is selected. In addition, $dD/dR \geq 0$, so that there exists a critical R^*, where $0 < R^* < B$, such that the risky project is selected if $R > R^*$ and the safe project is selected if $R < R^*$. R^*, for the type B and type G firms are defined implicitly from the following equalities:

$$E\left\{\max\left[\tilde{B}' - R_B^*, 0\right]\right\} = B - R_B^*. \tag{2a}$$

$$E\left\{\max\left[\tilde{G}' - R_G^*, 0\right]\right\} = G - R_G^*. \tag{2b}$$

Inspection of these equations reveals that since $\tilde{G}' - \tilde{B}' = G - B$ that $R_G^* - R_B^*$ must also equal $G - B$. This implies that the incentive to increase risk arises at lower interest rates for the type B firm than for the type G firm.

The following propositions assume that,

$$R_B^* < R_l < R_G^*, \tag{3}$$

so that the type B firm chooses the risky project whenever it borrows long-term, but the type G firm chooses the safe project if it can borrow long-term at the default-free rate. This assumption is sufficient for illustrating Flannery's (1986) result that firms with favorable private information borrow short-term. The following proposition demonstrates this:

Proposition 1: *Given expression* (3), *if the short-term risk-free rate at date* 1 *is certain, the only sequential equilibrium* (*as described in Kreps and Wilson* (1982)) *is one in which the firm will borrow short-term if it is type G and will be indifferent between borrowing short-term or long-term if it is type B.*

Proof: It can easily be shown that a type B firm will choose to borrow long-term if lenders offer long-term loans at the risk-free rate. This implies that in equilibrium, lenders must believe that long-term borrowers may be type B. Hence, if the G firm borrows long-term at date 0 before its type is revealed, it must borrow at a risky rate $R_l' > R_l$ which reflects the possibility that it is type B and may default. If the type G firm chooses to roll over short-term obligations, it will borrow at a zero rate of interest from date 0 to date 1 and then borrow at the short-term risk-free rate at date 1, after its type has been revealed. The type G firm will therefore borrow short-term. Since the type B firm's type is revealed whether it borrows short-term or long-term, its borrowing costs are unaffected by its choice of maturity. □

The Type G firm prefers to borrow short-term because it can obtain funds at a more attractive rate in the future when its type is revealed. Since the firm is indifferent between securing a long-term or a short-term loan at date 0 if it is of type B, a small transaction cost associated with rolling over short-term loans generates Flannery's result that type B firms borrow long-term while type G firms borrow short-term.

B. Interest Rate Uncertainty

The setting described above can explain the use of both long-term and short-term debt. In order to explain the use of interest rate swaps, interest rate uncertainty is also needed. I first examine the case where cash flow realizations are independent of the date 1 interest rate and later examine the case where these variables are perfectly correlated. For simplicity a binary distribution for the risk-free rate of interest is assumed; one plus the risk-free rate will equal R_I, $(I \in H, L)$ at date 1. The probability of the low interest rate state occurring is P_L and the probability of the high interest rate state occurring is P_H. Given the assumed risk neutrality of investors,

$$R_l = P_L R_L + P_H R_H. \tag{4}$$

In order for it to be costly for the type G firm to follow the strategy of rolling over short-term loans it must be the case that R_H is sufficiently high that the type G firm is induced to take the riskier project when the high interest rate state is realized. In other words,

$$R_G^* < R_H. \tag{5}$$

Hence, if the high interest rate state occurs, the type G firm will have to borrow at a rate $R_H' > R_H$ to account for the possibility of default. To simplify the proof of the following proposition it is useful to define $\tilde{R}_H'$ as the random payoff of the risky bond where, because of risk neutrality,

$$E\left[\tilde{R}_H'\right] = R_H. \tag{6}$$

Before proving the main proposition in this section, I will prove the following two lemmas. The first describes the preferred maturity structure for firms whose types are known and the second describes how the maturity structure chosen by the type B firm depends on lender beliefs about the decision that would be made by a type G firm.

Lemma 1: *Given expressions* (3) *and* (5), *a firm known to be type G will prefer borrowing long-term rather than short-term. If* $R_L < R_B^*$, *a firm known to be type B will prefer to borrow short-term, however, if* $R_L > R_B^*$ *the firm will be indifferent between long-term and short-term debt.*

Proof: If the type G firm borrows long-term it selects the risk-free project and can borrow at the rate R_l. It will therefore achieve a value at date 2 of $G - R_l$. If the firm rolls over short-term loans it will achieve a value of $G - R_L$ in the low interest rate state and the value $\tilde{G}' - \tilde{R}_H'$ if the high interest rate state occurs, since in this case it selects the risky project. The expected value of the firm's equity at date 2 in this case is then,

$$P_L(G - R_L) + P_H\left[E\left[\tilde{G}' - \tilde{R}'_H\right]\right] = G + P_H\{E[\tilde{G}'] - G\} - R_l, \tag{7}$$

which is less than $G - R_l$, the value it achieves when borrowing long-term, since $E[\tilde{G}']$ is less than G.

If $R_L < R_B^*$ a type B firm will choose the higher NPV safe project in the low interest rate state. Again, since with symmetric information, the bondholders receive the same expected return regardless of the firm's choice, the type B firm achieves a higher value borrowing short-term since it selects the higher NPV project in the low interest rate state of nature if it does so and always chooses the lower NPV risky project if it borrows long-term. If $R_L > R_B^*$, a firm known to be type B always selects the risky project regardless of the maturity structure of its debt and is therefore indifferent to the choice. □

Lemma 2: *If the lender believes that a type G firm will borrow long-term with a probability greater than zero, the only consistent belief regarding the action of a type B firm is that it will borrow long-term with certainty.*

Proof: To see this, note that if the firm borrows short-term its type will be revealed before it takes the risky loan. Since both firm types take the risky and safe projects in the same states of nature when they borrow short-term, the difference in the cash flows to the equityholders for the two types must equal $G - B$, the difference in the total cash flow generated by both the safe and risky G and B projects. However, if both types borrow long-term, the firm's type will not be revealed prior to making the risky loan. As a result, the difference in the cash flows to the equityholders of the two types must be less than $G - B$ since the type B firms gain when they pool at the expense of the type G firms. This implies that the relative advantage of the type B firm from borrowing long-term always exceeds the relative advantage of the type G firm from borrowing long-term. As a result, if the type G firm finds it in its interest to borrow long-term with a non-zero probability, the type B firm will borrow long-term with certainty. □

Lemma 2 rules out all possible equilibria where type B firms borrow short-term and type G firms borrow long-term. However, depending on parameter values, all other equilibria are possible. These equilibria are specified in the following proposition:

Proposition 2: *If $R_H > R_G^* > R_l$, parameters exist that support a pooling equilibrium where both types borrow short-term, a pooling equilibrium where both types borrow long-term, and an equilibrium where the type G borrows short-term and the type B is indifferent between long-term and short-term debt.*[8]

[8] There also exists a partial-pooling equilibrium where the type G firm mixes between borrowing short and long-term and the type B firm borrows long-term. However, it can be shown that this equilibrium can be eliminated with the Grossman and Perry (1986) refinement.

Proof: The equilibrium that is obtained is determined by both the parameter values and the lender's beliefs about the borrower's type. These beliefs are irrelevant if the firm borrows short-term since the firm's type is revealed before it has to make a risky loan. However, the beliefs are relevant if the firm borrows long-term.

To see that parameters exist where both types borrow long-term, consider the case where the probability of being type G is close to one. Then the rate on long-term loans should be close to the default-free rate so that by Lemma 1, type G firms borrow long-term and by Lemma 2, type B firms mimic. If, however, there is a high probability of the firm being type B, but the probability of the high interest rate state occurring is close to zero, then the analysis in Proposition 1 implies that the type G firm borrows short-term. Given this, Lemma 1 implies that a type B firm will either borrow short-term or be indifferent between short-term and long-term borrowing depending on whether or not $R_L < R_B^*$. $\square$

The equilibrium that will arise depends on the type G firm's incentive to separate from the type B firm. The type G firm will borrow short when the gains from separating are high and the cost is low. This will be the case when the probability of the high interest rate state is sufficiently low and the probability of being type B is sufficiently high. In this case, the firm is willing to bear the expected costs of financial distress to achieve a lower expected cost of borrowing. The equilibrium where both types borrow long-term occurs when the gains to the type G from separating from the type B are sufficiently low and the costs are sufficiently high. This will occur when the probability of being type B is low and P_H, the probability of the high interest rate state occurring, is high.

The above analysis suggests that, without interest rate swaps, an increase in the volatility of interest rates (i.e., an increase in P_H) can induce lower-rated firms that were previously borrowing short-term (for information reasons) to switch to long-term borrowing. The observation that the emergence of the junk bond market coincided with an increase in interest rate volatility is consistent with this implication of the model. However, the analysis in the next section demonstrates that this implication will not necessarily hold when a market for interest rate swaps exists.

IV. Borrowing Short-Term and Swapping for a Long-Term Obligation

As Proposition 2 demonstrated, when the borrowing alternatives are limited to short- and long-term debt, a type G firm must either bear the higher borrowing costs associated with being pooled with type B firms or bear the expected costs of financial distress that arise when they borrow short-term. This section considers the additional alternative of borrowing short-term and swapping a floating-rate obligation for a fixed-rate obligation. The following proposition demonstrates that in this setting the type G firm will always select this alternative.

Proposition 3: *If $R_H > R_G^* > R_l$ the type G borrower can effectively borrow at the long-term default-free rate of interest, and will do so if it borrows short-term and swaps a floating-rate obligation for a fixed-rate obligation. The type B borrower will either borrow short-term and choose not to swap or be indifferent between all financing alternatives depending on whether or not $R_L < R_B^*$.*

Proof: Both types can borrow at the short-term risk-free rate from date 0 to date 1. At date 1, the borrower's type is revealed so that a type G borrower will be able to borrow at the risk-free rate of interest if its borrowing cost is less than R_G^*. A type G firm that borrows short-term and swaps a floating-rate obligation for a fixed-rate obligation effectively has a forward contract to borrow at $R_l < R_G^*$ as long as lenders are willing to lend to it at the default-free short-term rate. Since the borrower will select the safe project if its net obligation is R_l, lenders will in fact be willing to lend at this rate. The type G's borrowing cost with this transaction is therefore less than the cost of borrowing long-term and being pooled with type B borrowers as well as less than the expected cost of rolling over short-term loans.

Given that the type Gs borrow short-term, borrowers that seek long-term financing will be revealed to be type B.[9] The type B borrower will also have its type revealed prior to securing a risky loan at date 1 if it borrows short-term at date 0. Hence, its borrowing costs with either alternative equal what they would be in the symmetric information case as shown in Lemma 1. □

It should be noted that the equilibrium described in the above proposition does not require that lenders observe whether or not the firm participates in a swap. This point is relevant since swaps are currently off-balance-sheet transactions and may in fact be unobservable. In addition, since the borrower's type is revealed before it takes a risky loan, the assumption that only two types of firms exist is not needed for the above proposition. The preceding analysis, therefore, demonstrates the slightly more general result that, with multiple types, those with $R_H > R^* > R_l$ borrow short and swap for long, and those with $R_L < R^* < R_l$ borrow short and do not swap. In other words, almost all firms choose to roll over short-term loans. This equilibrium, which is supported by the belief that firms that borrow long-term are of the worst type, satisfies both the Cho-Kreps (1987) and the Grossman and Perry (1986) refinements.

The result that almost all firms roll over short-term loans will of course not hold if there are sufficient transaction costs. With such costs, only those borrowers with the most to gain from separating from their lower quality counterparts will be motivated to borrow short and swap rather than to borrow long-term. The magnitude of this gain from separating, which is determined by the extent of the information asymmetry, is not likely to be

[9] More precisely, it can be shown that a sequential equilibrium cannot exist where the lenders believe that long-term borrowers are type G.

large for highly rated firms. Hence, the analysis is consistent with the observation that firms which borrow short-term and swap for fixed obligations typically do not have AAA or AA credit ratings.

V. Borrowing Long-Term and Swapping for a Short-Term Obligation

Borrowing at a long-term fixed rate and then swapping for a floating rate obligation is essentially the same as taking out a floating-rate loan. The borrower is subject to interest rate risk but has locked in the default spread. In order to explain such a transaction the model must be altered so that type G firms prefer a floating to a fixed-rate loan when information is symmetric.

In the preceding analysis the profitability of the project was assumed to be unrelated to changes in the short-term interest rate. The following analysis examines the polar case where the profitability of the project is perfectly correlated with the short-term rate of interest so that the profits to equityholders who borrow short-term are independent of the interest rate that is subsequently realized. One scenario under which this assumption will hold is when fluctuations in the short-term rate of interest are due solely to changes in the rate of inflation and where nominal payoffs to the projects increase exactly at the inflation rate. Long-term fixed-rate debt in this setting provides the borrower with a floating real rate while rolling over default-free short-term loans provides a fixed real rate.

In this setting, R_G^* and R_B^* depend on whether interest and inflation rates are high or low, and must therefore be indexed by L and H. To be consistent with the earlier section where interest rate changes were due entirely to changes in the real rate, the case where $R_L < R_{GL}^*$, $R_H < R_{GH}^*$ and $R_{GL}^* < R_l < R_{GH}^*$ is examined. In other words, the type G firm always takes the safe project when it borrows short-term, but will take the risky project when it borrows at a long-term fixed rate if the inflation rate turns out to be low. Again, to be consistent with the earlier section it is assumed that $R_{BL}^* < R_L$ and $R_{BH}^* < R_H$ so the type B firm always selects the risky project if it borrows short-term, and $R_{BH}^* > R_l > R_{BL}^*$, so the type B firm selects the safe project when it borrows long-term if the short-term interest rate and inflation subsequently rise. These assumptions lead to the following proposition:

Proposition 4: *If $R_I < R_{GI}^*$, $(I \in H, L)$, $R_{GL}^* < R_l < R_{GH}^*$, $R_L > R_{BL}^*$, $R_{BH}^* < R_H$ and $R_{BL}^* < R_l < R_{BH}^*$, type G firms borrow short-term and type B firms borrow long-term at fixed rates.*

Proof: The proof that with symmetric information the type G firm prefers to borrow short-term and the type B firm prefers to borrow long-term is identical to the proof of Lemma 1. It is not possible for the type B firm to pool with the type G firm by borrowing short-term in this case since its type will be revealed before it borrows at date 1. Hence, asymmetric information does not effect the maturity structure of the firms' loans. □

The above analysis suggests that asymmetric information reduces the incentive for borrowers to secure floating-rate financing. Indeed, given the assumptions in Proposition 4, borrowers all prefer to either roll over short-term loans or to secure long-term financing. Howeveı, the tendency of borrowers to avoid using floating-rate financing for information reasons may be offset by the higher transaction costs associated with the alternative of rolling over short-term loans. When these transaction costs are considered, borrowers that are not subject to the above described information problems are likely to prefer the floating-rate loans. This implication is consistent with the observation that borrowers that issue long-term debt and swap for floating-rate debt generally have very high credit ratings.

The above discussion assumed that the costs of these transactions were exogenous and that the counterparty to both sides of the swap was an efficient risk-neutral market. However, in reality, the supply and demand for each side of these transactions affect their pricing. My analysis suggests that in the absence of transaction costs, lower-rated firms realize a gain from being able to roll over short-term loans and swap for a fixed obligation while AAA borrowers, who are the logical counterparties to these transactions, are indifferent between securing a floating-rate obligation and rolling over short-term loans. Therefore, to the extent that there are costs associated with these transactions, they must be borne mainly by the lower-rated firms that borrow short-term and swap for a fixed obligation. This implication of my analysis is consistent with the observation that swap transactions are priced to favor the party that swaps fixed for floating.[10]

VI. Conclusion

This paper developed a model of debt maturity structure that provides an explanation for why firms use the swap market to alter the duration of their liabilities. The key features of the model are (1) a cost associated with financial distress that provides an incentive for some firms to reduce uncertainty about their future interest expenses and (2) asymmetric information that provides an incentive for the more highly valued firms to borrow short-term so that they can take advantage of opportunities to borrow under more favorable terms in the future. The model suggests that while the demand for transactions on one side of the swap market (fixed for floating) is enhanced by the presence of asymmetric information, the other side (floating for fixed) may fail to exist for firms for which the amount of asymmetry is too great. This is consistent with the observation that on average firms that swap

[10] Swaps are typically priced so that the party that swaps floating for fixed pays about 70 basis points above the difference between the short-term LIBOR rate and the Treasury bond rate. In other words, if he can borrow short-term at LIBOR plus 2%, his effective initial borrowing costs after the swap would be the Treasury bond rate plus 2.7%. In a frictionless market, the swap spread would probably be positive, reflecting the fact that LIBOR is not a default-free rate, but would be less than 70 basis points. See also footnote 4.

fixed obligations for floating-rate obligations are riskier than those that swap floating for fixed.

The analysis suggests that lower-rated firms that expect their credit ratings to improve in the future prefer to borrow short-term and swap a floating-rate obligation for a fixed-rate obligation. This suggests that, on average, lower-rated firms that initiate such transactions should experience a subsequent increase in their values. Similarly, lower-rated firms that expect their credit ratings to deteriorate in the future will want their interest obligations determined in advance. These firms are likely to borrow either long-term or with a floating-rate note. Hence, firms that secure financing of these types are likely to realize subsequent declines in their values.

Although empirical work relating to interest rate swaps is somewhat sparse, there have been papers on the stock price reaction to announcements of bond issues that are consistent with these implications. For example, Eckbo (1986) finds very little reaction to the announcement of investment grade bond issues while Ma, Rosenfeld, and Shastri (1989) find a statistically significant -0.68% average excess return when firms announce that they will be issuing lower-rated bonds. To my knowledge, the predicted positive reaction to the issuance of commercial paper has not as yet been tested.[11] An additional testable implication of the analysis in this paper is that the magnitude of the share price response to the issuance of a lower-rated bond should be greater in the period subsequent to the introduction of interest rate swaps than it was in the prior period.

[11] James (1987) shows that when firms announce loan commitments (which are usually for short-term loans) their stock prices increased 1.98% on average. However, he does not find a statistically significant difference between long-term and short-term loans.

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