

INTEREST RATE SWAPS: A MANAGERIAL COMPENSATION APPROACH

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Abstract

The market for interest rate swaps has grown consistently since its inception. Swaps involve “swapping” fixed interest rate debt for variable rate debt. We explain this growth using a game theoretic model. We focus on managerial and owner compensation differences under swaps and open market restructuring. We conclude that swaps occur because the swap market incorporates information about the firm more quickly than the open debt market. Hence, managers of firms whose credit risk has improved may capture the lower default risk premium more quickly in the swap market than they can in the open market. The lower default risk premium benefits owners and managers of firms whose compensation depends on the value of the firm.

INTRODUCTION

Many financial innovations occurred during the 1980's. One of the most important innovations is the interest rate swap. An interest rate swap involves an exchange of interest rate payments between two parties. The usual arrangement is to exchange the difference between the fixed and the variable interest rate payment on a predetermined principal base. The principal amount involved in swaps quadrupled over the 1987-1990 period.

The growth of interest rate swaps has been discussed in the finance literature and a number of theories have been formulated to explain this growth. Theoretical explanations range from the argument of comparative advantage (by Bicksler and Chen (1986)) to reduction in the agency cost (by Wall and Pringle (1988)). Others (Arak et. al. (1988)) have argued that the growth of the swap market is due to the fact that swaps lower the risk free premium. However, changes in managerial and owner compensation due to swaps has not been explored as an explanation for swaps. The relation between managerial compensation and firm's performance (agency theory) was first set forth by Jensen and Meckling in 1976. The principal-agent relationship, in brief, implies that presence of incentives (pecuniary or non-pecuniary or both) is consistent with owner's wealth maximization goals. Although the evidence on this relationship between a firm's performance and managerial compensation is weak [for example see Jensen and Murphy (1990), Antle and Smith (1986) and Sharma and Fok (1993)], it is still widely acknowledged that managerial compensations is related to a firm's performance. We use this relationship to explain the expansion of the swap market. If swaps or the choice of using swaps (instead of open market restructuring) is treated as another performance variable, then it is possible to show that, if swaps maximize the value of a firm, all rational managers will exercise the choice of swaps (above open market restructuring or no action). It is important to reemphasize at this point that our goal in this study is not to determine an explicit managerial compensation structure but rather to establish that expansion of the swap market is consistent with agency theory. Since swaps are merely an alternative to the open market restructuring of debt, compensation is an important issue. For swaps to occur, owners and managers must have an incentive to undertake them. The current literature has not explicitly explored the issue of changes in compensation as a result of the swaps, thus doubts remain about the appropriateness of swaps (see Copper and Mello (1991)).

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We explicitly model the compensation structure of management and use game theory to show that swaps are consistent with both the equity holder's and management's wealth maximization, i.e., consistent with the principal-agent relationship. Our conclusions mostly follow from our assumption that information is asymmetric in the debt market and symmetric in the swap market. Information symmetry in the swap market allows a firm to immediately capture the benefits of any positive changes in its credit risk.

Our first section models the compensation structure of management and of owners. The second section uses comparative analysis to examine the payoffs from swapping and market restructuring. The third section discusses an equilibrium of the game. Finally, we summarize our results.

THE MODEL

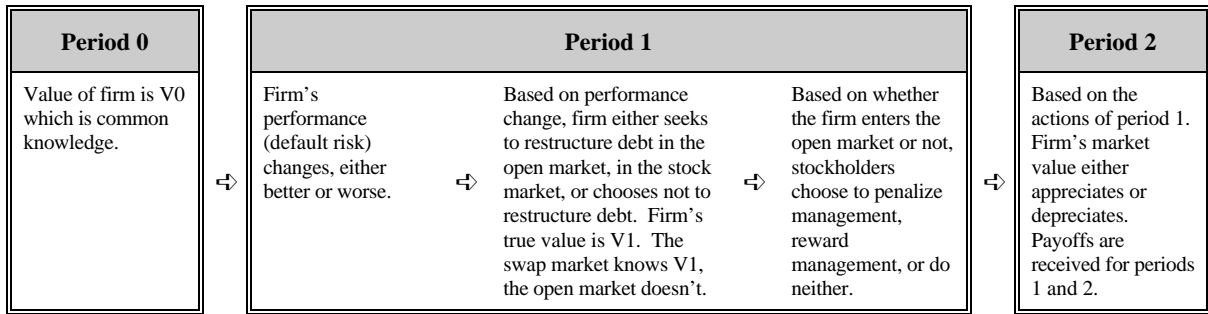
In order to model the compensation structure of the management and owners we define the variables we use in Table 1.

TABLE 1
Definitions

P	Probability that the credit risk of the firm will improve. Such a firm is referred to as a better (B) firm.
1 - p	Probability that the credit risk of the firm deteriorates. Such a firm is referred to as a worse (W) firm.
ΔD	Change in the default risk premium for firm B.
$-\Delta D$	Change in the default risk premium for firm W.
V_0	Initial (period 0) value of the firm, known to the market.
V_1	True value in periods one and two ($V_1 = V_0 + \Delta D$ if the firm is type B, $V_1 = V_0 - \Delta D$ if the firm is type W).
R	The value of the reward.
-R	The value of the fine.
F_m, F_{ns}	Owners' strategies: probability of fine if the managers restructure debt in the market, probability of fine if the managers do not restructure debt in the open market.
R_m, R_{ns}	Owners' strategies: probability of reward if the managers restructure debt in the market, probability of reward if the managers do not restructure debt in the open market.

The time line in Figure 1 and the extensive form game in Figure 2 illustrates a two period model where the firm's default risk profile improves with probability p and deteriorates with probability $1-p$. Under each state the management has the option of restructuring the debt in the open market, in the swap market, or taking no action. After this decision the owners may reward management, punish management or take no action in response to the management's action. The owners are unable to tell (until later) the difference between a swap or no action (which is a result of the fact that market permission of equity holders need not be obtained in order to conduct the swap), but the owners know if market restructuring has occurred. The owners may then offer an additional reward for the management's actions, may penalize (or fine) management, or may elect to neither reward nor penalize the management. The principals use the reward/punishment structure to insure that the agents pursue the principals' interests. The owners will be in agreement with any strategy as long as it maximizes the owners' wealth.

FIGURE 1



The information structure can be seen in Figure 2. Since the owner doesn't know if the firm's default risk has improved or deteriorated then when the owner sees a market restructuring occur, he may be at either of the nodes labeled "Market,," hence we enclose these two nodes with the dashed lines. If no market restructuring has occurred, the owner is even less informed--there may have been a swap or no action AND the firm's credit risk may have improved or deteriorated. Hence, the owner can't distinguish between amongst the other four nodes, two of which are labeled "Nothing" and two of which are labeled "Swap." Thus, the owner's strategy is formulated while not knowing the firm's true credit risk and knowing only whether a market restructuring occurred or not.

FIGURE 2

			Owner's Payoff	Manager's Payoff
Worse	Market	Fine	$(2-2x)V_0-(1-x)\Delta D+R$	$2xV_0-x\Delta D-R$
		Inaction	$(2-2x)V_0-(1-x)\Delta D$	$2xV_0-x\Delta D$
		Reward	$(2-2x)V_0-(1-x)\Delta D-R$	$2xV_0-x\Delta D+R$
	Nothing	Fine	$(2-2x)V_0-(1-x)\Delta D+R$	$2xV_0-x\Delta D-R$
		Inaction	$(2-2x)V_0-(1-x)\Delta D$	$2xV_0-x\Delta D$
		Reward	$(2-2x)V_0-(1-x)\Delta D-R$	$2xV_0-x\Delta D+R$
	Swap	Fine	$(2-2x)(V_0-\Delta D)+R$	$2x(V_0-\Delta D)-R$
		Inaction	$(2-2x)(V_0-\Delta D)$	$2x(V_0-\Delta D)$
		Reward	$(2-2x)(V_0-\Delta D)-R$	$2x(V_0-\Delta D)+R$
Better	Swap	Fine	$(2-2x)(V_0+\Delta D)+R$	$2x(V_0+\Delta D)-R$
		Inaction	$(2-2x)(V_0+\Delta D)$	$2x(V_0+\Delta D)$
		Reward	$(2-2x)(V_0+\Delta D)-R$	$2x(V_0+\Delta D)+R$
	Nothing	Fine	$(2-2x)V_0+(1-x)\Delta D+R$	$2xV_0+x\Delta D-R$
		Inaction	$(2-2x)V_0+(1-x)\Delta D$	$2xV_0+x\Delta D$
		Reward	$(2-2x)V_0+(1-x)\Delta D-R$	$2xV_0+x\Delta D+R$
	Market	Fine	$(2-2x)V_0+(1-x)\Delta D+R$	$2xV_0+x\Delta D-R$
		Inaction	$(2-2x)V_0+(1-x)\Delta D$	$2xV_0+x\Delta D$
		Reward	$(2-2x)V_0+(1-x)\Delta D-R$	$2xV_0+x\Delta D+R$

The payoffs which can be seen in Figure 2 are difficult to derive. We begin by assuming a basic structure for payoffs and building on it. We assume that managerial compensation is a fixed percentage, x , of the value of the firm plus an incentive in the form of a possible reward or penalty. For our two period model, the general structure of the managerial compensation (ignoring possible rewards and penalties) is given by:

Equation 1

$$MC = xV_0 + xV_1$$

Since V_1 may only differ from V_0 due to a change in the default risk premium, then, if the default risk premium increases managerial compensation (again, ignoring rewards and penalties) is:

Equation 2

$$MC = xV_0 + x(V_0 + \Delta D)$$

that is:

$$MC = 2xV_0 + x\Delta D$$

This is the payoff for a firm whose default risk has improved. A central assumption in our analysis is that the lower default risk will not be priced in the market as soon as it occurs, but will be priced in the market in the second period. Equation (3) says that the two period management compensation is equal to a fixed percentage of the initial value of the firm plus a percentage of the change in the default risk premium of the firm over the two periods. If the firm's credit risk increases, the second term in (3) will be subtracted, rather than added. The owners payoffs are the new value of the firm, minus the manager's compensation. Having established the general compensation structure over the two periods, we next establish the dominance of swapping over inactivity for a firm whose default risk has fallen. To show that swapping is the dominant strategy it must be shown that the managerial compensation in any state is greater under the swap strategy than under inactivity, regardless of the owner's strategy.

Payoff Structures For The Better Firm

If the default risk of the firm improves, ideally management should take an action to reduce its existing default risk premium. If the firm chooses to restructure the debt in the open market, then the expected managerial payoff structure is as follows:

Equation 4

$$R_m(2xV_0 + x\Delta D + R) + F_m(2xV_0 + x\Delta D - R) + (1 - R_m - F_m)(2xV_0 + x\Delta D)$$

which simplifies to:

Equation 5

$$2xV_0 + x\Delta D + R(R_m - F_m)$$

The payoff equation states that the total managerial compensation is equal to a percentage of the value of the firm plus a percentage of the change in the default risk premium in the second period. The last term in the equation (5) gives the expected value of the reward/fine (as an incentive) for taking the appropriate action. We reiterate our assumption that the market prices reflect the lower default risk only in the second period.

If the management decides to take no action (when the credit risk of the firm improves), its payoff structure is given as follows:

Equation 6

$$R_{ns}(2xV_0 + x\Delta D + R) + F_{ns}(2xV_0 + x\Delta D - R) + (1 - R_{ns} - F_{ns})(2xV_0 + x\Delta D)$$

Which simplifies to:

Equation 7

$$2xV_0 + x\Delta D + R(R_{ns} - F_{ns})$$

The difference between the market and no action payoff is in the probabilities of fine and no fine actions by the owners. The reason for the presence of the $x\Delta D$ is that despite the fact that managers do nothing, the market still knows (with a lag) the change in the default risk of the firm. As a result, the position of the equity holders is improved.

If the firm decides to go the swap market, it captures the change in the default risk premium in both periods. The total payoff for this case is:

Equation 8

$$R_{ns}(2x(V_0 + \Delta D) + R) + F_{ns}(2x(V_0 + \Delta D) - R) + (1 - F_{ns} - R_{ns})(2x(V_0 + \Delta D))$$

which simplifies to:

Equation 9

$$2x(V_0 + \Delta D) + R(R_{ns} - F_{ns})$$

The payoff structure in this equation clearly shows that the difference between the swap and other strategies is in capturing the change in the default risk premium immediately.

Payoff Structures For The Worse Firm

If the credit profile of a firm declines and it chooses, subsequently, to restructure in the open market, it has to pay an increased default risk premium. Since market information lags one period, increased default risk premium is reflected only in the second period. The exact payoff structure is given by:

Equation 10

$$R_m(2xV_0 - x\Delta D + R) + F_m(2xV_0 - x\Delta D - R) + (1 - R_m - F_m)(2xV_0 - x\Delta D)$$

which simplifies to:

Equation 11

$$2xV_0 - x\Delta D + R(F_m - R_m)$$

If the management decides to take no action, the payoff structure is similar to the payoff structure under the decision to go to market. The only difference is due to the different probabilities associated with reward and fine. The payoff structure in this state is given by:

Equation 12

$$R_{ns}(2xV_0 - x\Delta D + R) + F_{ns}(2xV_0 - x\Delta D - R) + (1 - R_{ns} - F_{ns})(2xV_0 - x\Delta D)$$

which simplifies to:

Equation 13

$$2xV_0 - x\Delta D + R(R_{ns} - F_{ns})$$

If the management decides to use the swap market, the change in the default risk premium is immediately reflected in the payoff structure. Thus, the final payoff structure for this state can be given by:

Equation 14

$$R_{ns}(2x(V_0 - \Delta D) + R) + F_{ns}(2x(V_0 - \Delta D) - R) + (1 - R_{ns} - F_{ns})(2x(V_0 - \Delta D))$$

which reduces to:

Equation 15

$$2x(V_0 - \Delta D) + R(R_{ns} - F_{ns})$$

Once again, the difference between the market and the swap approach is that the change in the default risk premium is immediately reflected in the value of the firm as opposed to lagging in the open market.

We reiterate that the owner's payoff is the new value of the firm minus the manager's compensation and can be seen in Figure 2.

Comparative Analysis Of The Payoffs

We establish the dominance of swapping over doing nothing for manager B by showing that the payoff from swapping, (9), is greater than the payoff of taking no action, (7), i.e.:

Equation 16

$$2x(V_0 + \Delta D) + R(R_{ns} - F_{ns}) > 2xV_0 + x\Delta D + R(R_{ns} - F_{ns})$$

This simplifies to:

Equation 17

$$x\Delta D > 0$$

which is true because both x and ΔD are positive. $x\Delta D$ is the manager's second period payoff from the lower default risk. Hence, swapping dominates inactivity for firm B. Therefore it is clear that type B firm should never choose an "inactive" strategy. This follows because the owner's inability to distinguish inactivity from swapping means that any punishment will punish both activities equally. Therefore any compensation (for both swap as well as inactivity) will be greater under swap than for inactivity. Given this structure, only the maximization of the value of the firm without respect to penalties or reward strategies is the optimal strategy.

For market restructuring payoffs to exceed the swap payoffs (5) must exceed (9), that is:

Equation 18

$$2xV_0 + x\Delta D + R(R_m - F_m) > 2x(V_0 + x\Delta D) + R(R_{ns} - F_{ns})$$

which can be simplified into:

Equation 19

$$R[(R_m - F_m) - (R_{ns} - F_{ns})] > x\Delta D$$

Thus the decision between swapping and market restructuring is a function of the relative probabilities of fine and reward under both strategies.

Managers of better firms will always prefer swapping over inactivity. However, neither market restructuring or swapping dominate each other. B's best reply is a function of the relative levels of probabilities of reward and fine under the various (swap or market restructuring) options.

To establish the optimal strategy for a firm which experiences a decline in its credit profile (firm W), we first compare the payoff from swapping to payoff from inactivity. If inactivity dominates swapping, then (13) exceeds (15). That is:

Equation 20

$$2xV_0 - x\Delta D + R(R_{ns} - F_{ns}) > 2x(V_0 - \Delta D) + R(R_{ns} - F_{ns})$$

which can be reduced to:

Equation 21

$$x\Delta D > 0$$

which is true as both x and ΔD are positive. Hence, inactivity dominates swapping for firm W. Firm W should never swap, as swapping will lower the value of the firm and managerial compensation immediately, rather than later.

Inactivity weakly dominates market restructuring for the worse firm if (13) is greater than or equal to (11). That is, if:

Equation 22

$$2xV_0 - x\Delta D + R(R_{ns} - F_{ns}) \geq 2xV_0 - x\Delta D + R(R_m - F_m)$$

Which reduces to:

Equation 23

$$R_{ns} - F_{ns} \geq R_m - F_m$$

So the dominant strategy is a function of the relative levels of probabilities of reward and fine under both swap as well as market restructuring strategies.

Thus the managers of worse firms never choose swap because swaps will result in lower total compensation. Worse firm either choose market restructuring or inactivity depending upon the probabilities of fine and reward.

EQUILIBRIA

One equilibrium of the swap game is as follows:

Better Firm: Swap if $R_{ns}=F_{ns}=0$, $F_m=1$, $R_m=0$. Go to the market, otherwise.

Worse Firm: Choose inactivity if $R_{ns}=F_{ns}=0$, $F_m=1$, $R_m=0$, go to the market, otherwise.

Owner: Neither fine nor reward inactivity. Fine market transactions. ($R_{ns}=F_{ns}=0$, $F_m=1$, $R_m=0$)

We now demonstrate that the preceding is an equilibrium. Suppose that the owner will fine any manager who goes to the market or is inactive. Then for a better firm, swapping is superior to market restructuring (since (19) is violated). For a worse firm, inactivity is a best reply (since (23) is met with equality). In this equilibrium, there is no market restructuring, better firms swap, worse firms choose inactivity. An informal rationale for fining market transactions is that in the absence of the fine/reward structure, a better firm would always swap, hence only worse firms would restructure in the market. We have demonstrated that swapping is consistent with maximization of managerial compensation and will be undertaken in this equilibrium. The equilibrium is not compelling; the use of game theory mostly serves us in that it helps models the information structure of the parties, not their strategic interactions.

The previous equilibrium is not a sequential equilibrium (Kreps and Wilson (1982)). The owner moves last. Given the manager's move has been made--the swap, market transaction, etc., is a fait accompli hence the owner, at any node should levy the maximum fines, whatever the manager has done to maximize his (the owner's) payoffs. Hence any beliefs by the owner regarding what the history of the game has been lead to fining being the rational move. So in sequential equilibrium, $F_{ns}=F_m=1$, $R_{ns}=F_m=0$. Hence the left hand side of (19) is equal to 0, implying that better firms swap in sequential equilibrium. Worse firms are indifferent between inactivity and market transactions since (23) is satisfied with equality. Hence, in the play of the sequential equilibrium, better firms swap, worse firms are indifferent, and owners fine, regardless.

We must resolve a common issue with sequential equilibria. One possibility above has better firms always swapping and worse firms choosing inactivity, hence, in one equilibrium, no market transactions occur. But what if, with this prescription, the owners sees a market transaction? Are there beliefs about what kind of firm he owns that would lead him to change his strategy? No. Any beliefs lead the owner to fine the manager, hence, out of equilibrium moves, which commonly shape sequential equilibria are not a problem here.

SUMMARY

The swap market has experienced large growth since its introduction. Many motives have been given in the literature for the growth, but the issue of managerial compensation as a resultant motive has not been explored. We argue that swaps are just another means of restructuring the existing debt and therefore any action taken by the management must be rewarded (punished) depending upon its contribution to the total value of the firm.

In this paper we showed that if a firm is a "better" firm, its management will always choose swaps over inactivity and if the firm is a "worse" firm, its management will never choose swaps as a means of restructuring the debt. The choice between market restructuring and swaps for better firms is not clear, as is the choice between market restructuring and inactivity for worse firms. These choices depend on the owner's strategy. No market restructuring is done in the equilibrium that we formulate.

The results of our model are driven by the open debt market's correct, but lagging, pricing of changes in the firm's default risk. The market isn't wrong on a consistent basis, just slower than the swap market. The swap market may be quicker to assess changes in the firm's value because swapping firms have to reveal more information to financial intermediaries than they would in the open debt market. Hence, the growth in the swap market may be due to the fact that its confidential nature allows for owners and managers to recoup improvements in credit risk quickly.

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