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Why Callable Bonds Are not Called When the Market Price Reaches the Call Price: A Duration Argument

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Abstract

It is a fact that firms do not call callable bonds when bond prices reach for the first time the call price. This paper provides an original explanation for this behavior by resorting to duration analysis. It is known that, ceteris paribus, a bond with a higher coupon, or a higher yield, has a lower duration that a bond with a lower coupon, or a lower yield. This implies that the bond that is to be called has a lower duration than the bond that replaces it. A lower duration signifies a lower interest rate risk. The firm with a callable bond will wait for market interest rates to fall further in order to equalize durations and bear the same risk. The underlying assumption is that by equalizing durations the firm keeps facing the same financial risk. In this case, it is the same amount of interest rate risk. Consequently, there are no changes in the capital structure, no redistribution effects on other debt claims, and financial leverage is unaffected. The paper provides illustrations on this active law by considering four callable bonds, with different remaining maturities, and each one with a set of two different call prices.

Keywords: callable bonds, optimal redemption policy, optimal call price, duration, capital structure, financial leverage, present value

1. Introduction

Callable bonds are not called when the market price of the callable bond reaches or first exceeds the call price. King and Mauer (2000, p. 412) find that “the average (median) call delay is 27 (14) months for the overall sample, and over 86% of the calls are delayed.” Theoretically this is not an optimal policy and counts as a puzzle (Brennan & Schwartz, 1977; Ingersoll, 1977). Kraus (1983) and Mauer (1993) argue and prove that refunding and other transaction costs are recouped by calling and refinancing the bond at a lower rate if market interest rates fall further and fall enough. Longstaff and Tuckman (1994) study the importance of changes in capital structure. They show that firms, that carry more than one debt issue, avoid wealth redistribution to the remaining bondholders when the bond is called, and hence they end up delaying calling the bond, *even if the change in capital structure is minor*. They note that “firms seldom maintain the same capital structure when calling a debt issue” (p. 22). This means that called bonds are not always replaced and that, consequently, refunding costs should not be relevant in general.

Unfortunately the literature on the topic of callable bonds is scarce. Most studies dwell on calls of convertible bonds and not of straight bonds. See for example García-Feijóo et al. (2010). A relatively recent paper tries to find out the determinants of the demand for callable bonds and their inherent characteristics (Banko & Zhou, 2010), but does not provide an explanation why callable bonds are called with delay. Similarly King (2002) examines call option values and their determinants, but again does not assess the reasons for a delay in calling bonds. One interesting fact from this literature is that call provisions are appended and call option values are higher when interest rates are high and are also variable. In such cases a call feature is worthwhile if normal interest rates are considered to be lower and will tend to revert to this more normal level. In this regard the major assumption in this paper is that the firm will call and refinance immediately the bond or else will delay calling the bond. The incentive for the firm is to refinance at a lower interest rate. If there is a reasonable chance that market rates will fall further, then waiting will lead to lower refunding costs. However the rationale for delaying the call in this paper is not because of transaction and refunding costs like in Kraus (1983) or Mauer (1993), but because of changes in bond durations, and hence risk. It will be demonstrated that the duration of the refinanced bond is always higher than the duration of the callable bond if the latter is not called. Hence the interest rate risk of the refinanced bond is always higher than that of the bond kept on the books. This differential in duration measures, and in risk, is due to the recognized property that, ceteris paribus, a bond with a higher yield or a higher coupon has a lower duration than the one with a lower yield or a lower coupon (Martellini et al., 2010; Reilly & Brown, 2012). Changes in interest rate risk that are implied from changes in durations leave the firm with a higher financial risk. Equalizing the *ex ante* and the *ex post* durations seems a good strategy to keep financial leverage and capital structure the same. There might also be wealth redistribution effects on the other debt issues that the firm holds.

The paper is organized as follows. In the next section, section 2, the theory is expanded. Section 3 presents the illustrative cases. The last section summarizes and concludes.

2. The Theoretical Framework

Let τ be the remaining maturity of the bond, i.e. the maturity left after the call date. The analysis is positioned at the call date, which is denoted as the present $(t=0)$. Let P_0 be the current market price of the bond, C the call price, and let F be the yearly or periodic coupon. The bond can be called at the earliest when the market price P_0 is equal to C and is equal to the discounted cash flows after the call date till maturity:

$$C = P_0 = \sum_{t=1}^{\tau} \frac{F}{(1+r)^t} + \frac{1000}{(1+r)^\tau} \tag{1}$$

In equation (1) r stands for the market interest rate or yield, and is also the yield-to-maturity of the bond. Since C is usually above par, the required r is usually smaller then the coupon rate in percent, i.e. $F/1000$, in order for the issuing firm to benefit from the call when interest rates decline. If the firm calls the bond at this instance it will refinance the redeemed bond at the lower interest rate r. Since refinancing is usually done at par the new coupon rate will also be equal to r. Hence the characteristics of the new replacing bond is a bond of a maturity τ, having a coupon and yield both equal to r, and a current price of $C = P_O$. The duration of this bond depends on the above parameters. The existing bond, if not redeemed, will have a coupon of $F/1000$, which is higher than r, and a yield-to-maturity of r. The duration of this existing bond is smaller than the replacing bond because they have the same yields but two different coupons. The existing bond has a coupon of $F/1000$ and a yield of r, while the replacing bond has a coupon and a yield both equal to r. Since by construction $F/1000 > r$, then the duration of the existing bond is lower than the duration of the replacing bond. The two will be equal if market interest rates happen to decline further. This optimal interest rate, which is below r, will define the duration value of the existing bond, and will be used to calculate the actual call price and the call price premium, i.e. the percent amount by which the actual call price exceeds the contractual call price. Of course it is assumed that the delay between a market interest rate of r and a market interest rate lower than r occurs simultaneously, i.e. the remaining maturities of the bonds are the same.

3. The Illustrations

Four bonds, with \$ 1000 par, but with a different remaining life after the call date, are considered. These remaining lives are for 5, 10, 15, and 20 years. Therefore the call protection ends now. The coupon rate is assumed to be 10%, close to the average coupon in the real world of around 9% (King & Mauer, 2000). The call price takes two different values: 1050, i.e. a call premium of 5%, and 1100, which is a call premium of 10%. Table 1 presents the results of the illustrations. The first item, the textbook refunding rate, is the yield that ensures equality of the present value of bond cash flows with the call price. As an example, and with a 5% call premium, and a remaining life of τ years, one has:

$$1050 = \sum_{t=1}^{\tau} \frac{100}{(1+r)^t} + \frac{1000}{(1+r)^\tau} \tag{2}$$

The yield r that solves equation (2) is the required market rate of interest that drives the price of the bond to become equal to the call price. At this yield the market price of the bond reaches the call price and hence, theoretically, from the textbook analysis, the bond is called and refinanced with another bond at the lower rate r. This rate r increases with the remaining life of the bond. It is 8.724%, for the bond with 5 years left to maturity, and it rises to 9.435%, for the bond with 20 years left to maturity. If one assumes that the original bond was issued at par, then the market interest rate, at the issuance of the original bond, is equal to the coupon of 10%. These "textbook" refunding rates are not that far from 10%, which means that it takes only a small change in market interest rates for the bond to become callable.

Table 1 presents the details of the illustration. The textbook refunding rate equals the bond yield, and the coupon rate, that correspond to calling the bond at the contractual call price and refunding it at par. This refunding rate, this bond yield and this coupon rate are all equal to the current market rate of interest. The optimal refunding rate is the yield of a bond with a coupon rate of 10% that has the same duration as the duration of the bond in the textbook refunding. This optimal refunding rate is used to obtain the optimal call price. By construction the optimal call price is higher than the contractual one because the textbook refunding rate is higher than the optimal one. The last item in the table is the duration of a bond with 10% coupon rate that is not called and yields the textbook refunding rate which is the current market interest rate. This duration is smaller than the duration with a textbook refunding. This feature explains why the firm has an incentive not to call immediately but to delay the call until the market rate falls enough and becomes equal to the optimal refunding rate which is smaller than the current one.

Table 1. Bond charateristics

parameter	5 years left to maturity Contractual call premium		10 years left to maturity Contractual call premium		15 years left to maturity Contractual call premium		20 years left to maturity Contractual call premium	
	5%	10%	5%	10%	5%	10%	5%	10%
Textbook refunding rate	8.7237%	7.5266%	9.2136%	8.4775%	9.3662%	8.7758%	9.4352%	8.9114%
Optimal refunding rate	8.3692%	6.9546%	8.2165%	6.4425%	8.9286%	7.8850%	9.1960%	8.4240%
Optimal call price	1064.48	1125.02	1118.51	1256.43	1086.73	1182.32	1072.38	1149.97
Premium of optimal on contractual call prices in percent	1.3794%	2.2746%	6.5251%	14.221%	3.4982%	7.4830%	2.1312%	4.5431%
Duration with textbook refunding at par	4.25946	4.34733	6.94355	7.12438	8.62827	8.88535	9.68760	10.0051
Duration of the bond if it is not called	4.19155	4.21168	6.840623	6.91668	8.52107	8.66578	9.59073	9.80380

The market interest rate must move more if the call premium is 10%. The textbook refunding rate would be the rate r that solves the following equation:

$$1100 = \sum_{t=1}^{\tau} \frac{100}{(1+r)^t} + \frac{1000}{(1+r)^{\tau}} \tag{3}$$

The textbook refunding rates still increase with a higher remaining life τ, and vary between 7.527%, for a bond with 5 years left to maturity, to 8.911%, for a bond with 20 years left to maturity. If the bonds are called right away when market interest rates reach for the first time the textbook refunding rates, and if refinancing is carried out at par, then the durations of the replacing bonds have the following parameters: a coupon and a yield of r both, and a maturity of τ years. These durations are given in Table 1 with the caption: "duration with textbook refunding at par." These durations vary in crescendo from 4.26 years to 10.01 years. The higher the contractual call premium the higher the durations, and they are still by implication higher than the "textbook" durations.

If the bonds are not called, this means that the surviving bond has a coupon of 10% and a yield equal to the market interest rate at the time, which is r, and the same years left to maturity τ. With these parameters the durations of the surviving bonds can be calculated. These are also listed in Table 1 with the caption: "duration of the bond if it is not called." Since the surviving bonds have the same yield-to-maturity as the replacing bonds but have a higher coupon rate of 10% instead of r, then their durations are ultimately lower than the durations of the replacing bonds. The differences in durations are significant. They are respectively 0.068 years and 0.135 years for the two bonds with 5 years left to maturity and contractual call premiums of 5% and 10%. They are respectively 0.103 years and 0.208 years for the two bonds with 10 years left to maturity and contractual call premiums of 5% and 10%. They are respectively 0.107 years and 0.220 years for the two bonds with 15 years left to maturity and contractual premiums of 5% and 10%. And, finally, they are respectively 0.097 years and

0.201 years for the two bonds with 20 years left to maturity and contractual call premiums of 5% and 10%. This paper argues that because of these significant variations in the durations between the replacing bond and the surviving bond, the firm will be reluctant and refrain from calling a bond with a lower duration and replace it with a bond with a higher duration. A higher duration translates into a higher interest rate risk, resulting in a higher financial leverage, and a different capital structure. If the firm goes with the refinancing, the risk of the to-be-issued bond is higher than the risk of the existing bond at the status quo. Hence financial leverage increases. In order to avoid such inherent changes in risk and financial leverage the firm will wait for an additional decrease in market interest rates, or delay calling even though the market price of the bond becomes higher than the call price. The new lower rate that is needed to equalize durations, if market rates change instantaneously, is recorded in Table 1 with the caption: "optimal refunding rate." These rates are obtained by using the solver command in excel. These optimal rates are not that much lower than the textbook refunding rate. For the two bonds with 5 years left to maturity, the required decrease in interest rates is respectively from 8.724% to 8.369% for a contractual call premium of 5%, and from 7.527% to 6.955% for a contractual call premium of 10%. For the two bonds with 10 years left to maturity, the required decrease in interest rates is respectively from 9.214% to 8.217% for a contractual call premium of 5%, and from 8.478% to 6.443% for a contractual call premium of 10%. For the two bonds with 15 years left to maturity, the required decrease in interest rates is respectively from 9.366% to 8.929% for a contractual call premium of 5%, and from 8.776% to 7.885% for a contractual call premium of 10%. For the two bonds with 20 years left to maturity, the required decrease in interest rates is respectively from 9.435% to 9.196% for a contractual call premium of 5%, and from 8.911% to 8.424% for a contractual call premium of 10%.

If the optimal refunding rate is denoted by i then the optimal call price is obtained by solving the following equation:

$$Optimal\ \ call\ price = \sum_{t=1}^{\tau} \frac{100}{(1+i)^t} + \frac{1000}{(1+i)^{\tau}} \tag{4}$$

Table 1 calculates the premium, in percent, between the contractual call price and the needed call price to equalize durations, with the caption: "premium of optimal on contractual call prices in percent." This premium varies between 1.38% at the lowest to 14.221% at the highest. There is no perceived trend or characteristic in these figures. The required maximum change in bond prices of 14.221% is not necessarily unattainable even in non-turbulent periods. Such a maximum corresponds to a call price of 1256 instead of the original 1100, and the minimum change corresponds to a call price of 1065 instead of the original 1050.

4. Conclusion

This paper provides for an original argument on why firms, carrying a callable bond, delay redeeming this bond when the bond market price reaches for the first time the call price, preferring to wait until interest rates fall further. The argument is based on the fact that a bond with a higher yield or a higher coupon has a lower duration than otherwise. The duration, or the interest rate risk, of the existing bond is less than that of the bond that replaces it at the market rate. Because of this, rates need to fall further to equalize the durations, or the risk, and, consequently, the capital structure of the firm is not affected, and overall financial leverage is the same. The paper presented the case of four hypothetical illustrations of this argument, each with two different call prices. One limitation to the analysis is that some firms, contrary to what is assumed here, refrain from refinancing after calling the callable bond.

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