

**PRICING THE SECURITIES
OF COMPANIES
IN CHAPTER 11:**

An Options Approach

William H. White, MBA

©1990, 2007 *William H. White*

INTRODUCTION

This paper will address the issue of how to value the securities of companies that are in Chapter 11 proceedings. It is our contention that both debt and equity claims against a bankrupt firm are, in essence, comprised of call options on the company's assets. To the extent that we are correct, option pricing equations will provide the most appropriate tools for valuing these claims.¹

Some initial, simplifying assumptions about Chapter 11 securities are required if we are to use straight-forward applications of the Black-Scholes model. However, after describing our basic approach, we will then discuss how an investor can apply options pricing approaches under more realistic scenarios.

An options approach to pricing Chapter 11 securities allows an investor to incorporate, in a quantifiable manner, judgments of asset values, expectations of the length of bankruptcy proceedings, and expectations of how claims will be satisfied. Such an approach will also help an investor recognize, and quantify, the many sources of risk he faces in holding Chapter 11 securities. Finally, such an approach may allow an investor to identify ways of reducing some of his risk through various hedging techniques.

¹The author wishes to thank Edward I. Altman, Max L. Heine Professor of Finance at the New York University Stern School of Business, for his encouragement and editorial suggestions on this paper, as well as Sarah M. Treu, Vice President, The Bank of New York, and Yakil Polak, Distressed Securities Analyst, Gruss & Co., for their insights into the bankruptcy process.

USING OPTIONS TO DESCRIBE CHAPTER 11 SECURITIES

Any time that a company seeks protection from creditors under Chapter 11, creditors and stockowners understandably take a very keen interest in the value of assets that the firm has at its disposal. After all, company assets ultimately serve as the collateral for claims against the bankrupt firm, and any attempt to price securities of that corporation must begin with analyses of projected cash flows, break-up values, and liquidation values.

While a great deal of valuation work is performed in Chapter 11 proceedings, those efforts are often best described as finding market values for the left-hand side of a firm's balance sheet. However, such efforts are logically only the first step in a two-step process. Our concern in this paper will lie wholly with the second step: an examination of what drives market values for the *right*-hand side of the corporate balance sheet after bankruptcy has been declared.

Before proceeding to discuss the nature and value of claims against a Chapter 11 firm, let us make a number of simplifying assumptions:

- There are only 3 classes of claims against the firm: senior debt, junior debt, and equity.
- All claims against the firm are in the form of publicly traded securities.
- None of the debt claims have specific assets pledged as collateral.
- The company successfully suspends all interest payments (and any other non-operating cash disbursements) during the course of Chapter 11 proceedings.
- Claimants are indifferent to the form of payments (cash versus stock) in settlement of their claims.

While these assumptions are unrealistic, they serve to eliminate unnecessary complications. Also, nothing about the approach we ultimately argue for will depend upon retaining these assumptions, and we expect that practitioners will be able to make the necessary adjustments for real-life conditions rather easily.

In our view, the whole challenge in valuing debt and equity securities of a firm in Chapter 11 is that the nature of these claims against company assets has changed dramatically. Before a bankruptcy filing it was the stockholders who presumably owned the firm. However, to borrow a Finance 101 phrase, when a company is unable (or unwilling) to meet its financial obligations, 'the bondholders become the stockholders.'

Needless to say, this description of bankruptcy is an oversimplification. It depicts bankruptcy as an instantaneous event, where stockholders' claims on a company evaporate and debtholders become the new owners of an unlevered firm. Nevertheless, the phrase is not completely misleading. In fact, what it highlights is the central fact that in bankruptcy senior debtholders do have preminent claims on the assets of a company, and are therefore 'rightfully' seen as the owners of those assets.

While we realize that senior debtholders 'own' the assets of a company in Chapter 11, we also know that this ownership claim is not unbounded. If enough asset value exists to repay the debt outstanding to the senior creditors, then that settlement will supposedly come to pass (whether through a creditor-negotiated or court-imposed settlement) and the claims of senior debtholders will be considered satisfied. Thus, the net financial position is:

During Chapter 11 proceedings, holding senior debt is properly viewed as equivalent to taking a covered call position on company assets. Specifically, it is equivalent to 1) being long those assets and 2) being short a European call option on the assets, where the strike price equals the unpaid principal of the senior debt.

Intuitively this makes sense. As Figure 1 shows, our approach recognizes that if asset values are very low, then senior debt becomes what is often called 'an equity play'. Eventually,

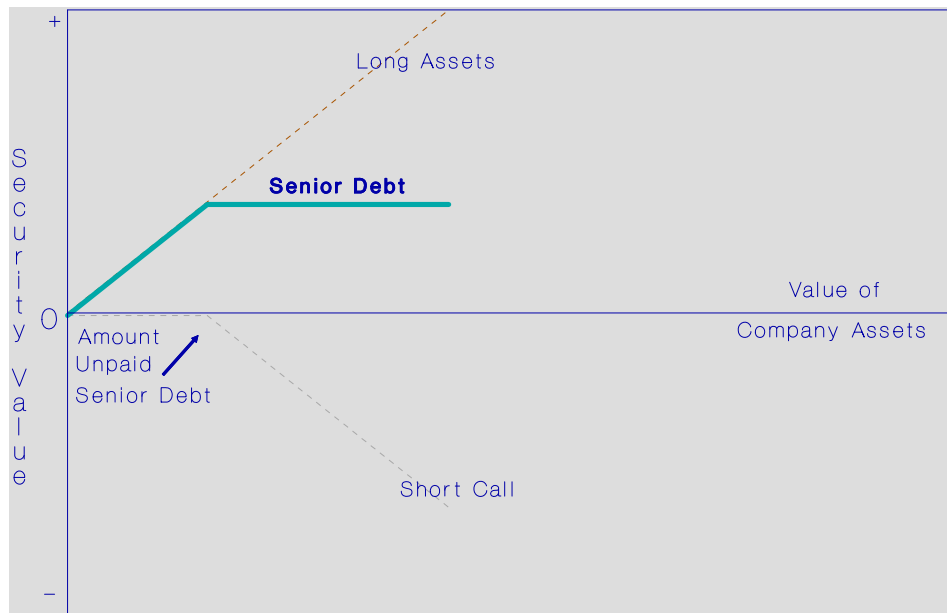


Figure 1 - Composition of Chapter 11 senior debt

though, if asset values are high enough there comes a point where the potential settlement to senior debtholders is limited.

Of course, our description of senior debt raises the question of who owns the call that the senior debtholders have 'written'? Clearly, once the outstanding senior debt is paid off, it is the junior debtholders who are next in line to have claims satisfied by company assets, and who are therefore the holders of that call. However, even the junior debtholders' claim on

assets is not unlimited. If enough value exists to repay the principal owed to both the senior and junior debtholders, then those settlements will supposedly be arranged and both claims will be considered satisfied. Thus, we are saying:

During Chapter 11 proceedings, holding junior debt is equivalent to a bullish vertical spread position on company assets. Specifically, it is equivalent to 1) holding a European call option on those assets, with a strike price equal to the unpaid principal of all senior debt, and 2) having written a European call option on company assets, with a strike price equal to the total unpaid principal of senior and junior debt.

Again, our description makes sense. As Figure 2 shows, we are implying that junior debt becomes an 'equity play' when sufficient company assets exist to repay senior creditors, but

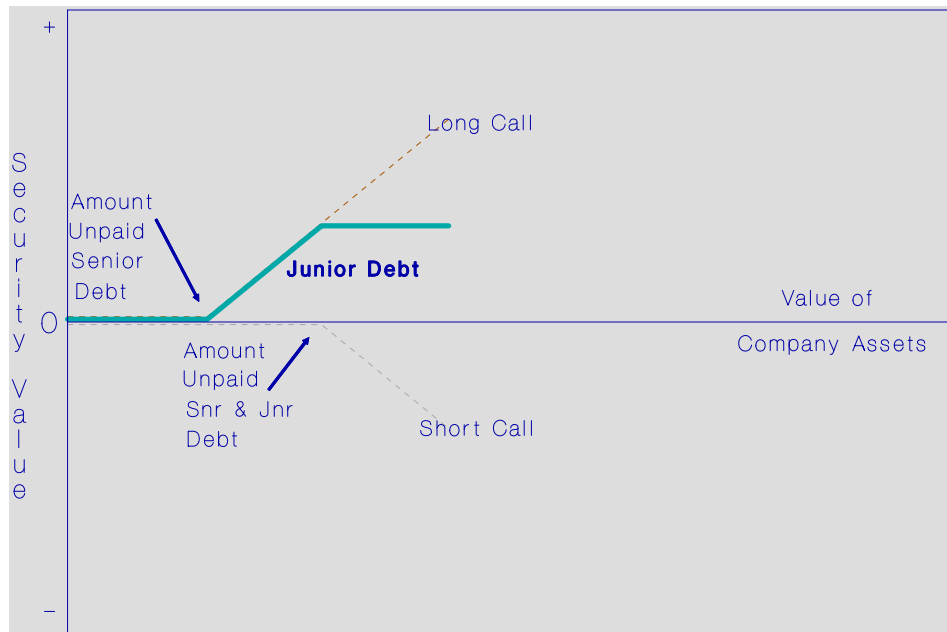


Figure 2 - Composition of Chapter 11 junior debt

that the potential pay-off in holding junior debt is ultimately limited.

In describing junior debt, we have again introduced a written call without having said who owns it. Again, the investors who own that call must be the investors who are next in line with a claim on the company, and those investors are, of course, the 'old' stockholders of a Chapter 11 firm. Therefore:

During Chapter 11 proceedings, holding common stock is properly viewed as equivalent to holding a European call option on company assets, with a strike price equal to the combined unpaid principal of senior and junior debt.

As Figure 3 shows, equity holders of a Chapter 11 company do have a potentially unlimited claim on assets (since there are no claimants more junior than the equityholders). However,

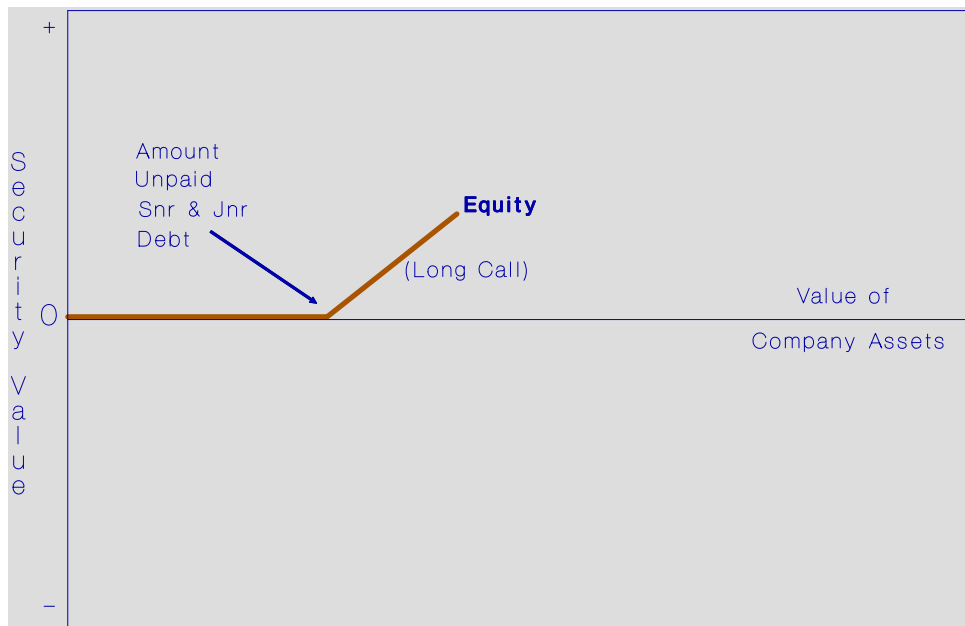


Figure 3 - Chapter 11 equity as a call option on company assets

the disadvantage of holding stock in a bankrupt firm is that the value of company assets must typically be fairly high before the first penny in settlement is received.

PRICING CHAPTER 11 SECURITIES: APPLYING THEORY TO PRACTICE

Having completed our options description of Chapter 11 securities, we ostensibly are in a position to price these claims with a straightforward application of the Black-Scholes model. After all, we need only six inputs for pricing an option, and all of those inputs have now been covered or are readily obtainable. Specifically, we need to know:

- S: The total value of company assets, which we have assumed has already been determined. In practice, we should remove from consideration any assets pledged as collateral to specific creditors.
- t: The time to expiration (i.e., until settlement). For all of the options which underlie Chapter 11 securities, expiration occurs when settlement payments are made. In the interest of simplicity, we will assume that this occurs simultaneously with the conclusion of bankruptcy proceedings.
- r: The risk-free rate currently prevailing for a maturity of t years.
- σ : The projected standard deviation in value of the company's assets. This projection can be made based on:
 - 1) the volatility of pre-filing stock price movements, adjusted for the company's level of financial leverage, or
 - 2) the volatility of the company's pre-filing market value (stock plus bonds), or
 - 3) estimates of asset value volatility for similar firms.The first projection method can be complicated by the fact that firms which declare Chapter 11 tend to have assumed enormous D/E ratios prior to filing. The second step can be complicated by the lack of price data, which is a problem when a firm has a large balance of bank loans or privately-placed debt.
- K: The strike prices to be used have already been discussed in detail.
- D: The cash dividends to be paid over the life of the option. However, we have assumed away all interest payments and cash dividends (usually this is a realistic assumption), so for the time being this variable may be ignored.

Before moving on, we should note that the absence of cash dividends means we can use the Black-Scholes model for pricing our options, even though they are European. This is because the sole advantage of an American option versus a European option lies in the ability to exercise an American option early. However, optimal exercise occurs only just prior to either 1) ex-dividend dates or 2) expiration.² Since we have assumed that there will be no

²John C. Cox and Mark Rubinstein, *Options Markets* (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1985), pp. 140-4.

cash dividends paid by the company prior to bankruptcy settlement (that is, prior to our option expiration), there is no difference in value between the European and American versions of those options.

At any rate, while it seems that we have described Chapter 11 securities in a way which allows us to plug in the Black-Scholes model in a straightforward manner, our discussion so far has implicitly assumed that strict and full priority of claims will be honored in any settlement. Further, we have also tended to assume that full payment to debtholders consists only of making good the par value of the bonds, with no compensation being given by the bankruptcy court for post-petition interest.

However, we must now address the fact that, in the real world, two critical differences exist between listed options and bankruptcy claims:

With listed options both strike prices and time to expiration are known with certainty. However, a holder of Chapter 11 securities

- 1) is uncertain about the amount of an investor's claim which will be received before more junior claimants are paid, and*
- 2) is uncertain about when those settlement payments will be made.*

These two differences will come to mean that our model cannot be applied to real world situations as cleanly as we have intimated so far. Nevertheless, adjustments can be incorporated into our model which will render it usable after all.

Accounting for the uncertainty of final settlement amounts: Let us assume for the time being that final settlement dates are fixed and known with certainty. This leaves us to address the question of how an investor accounts for the real-life uncertainty about the ultimate resolution of claims against a company in bankruptcy.

When bankruptcy is settled through negotiations among creditors, debtholders have some control over payments they eventually receive. Thus, if they agree to waive a portion of their claim, they would value their bond under our approach by making the appropriate adjustment to the strike price of the underlying call.

When faced with a cram-down (i.e., a court-imposed settlement), though, investors are uncertain about the amount of their claim that the bankruptcy court will recognize. The court is supposed to honor strict and full priority of claims. However, if creditors are eventually paid with overvalued securities, the court has, in effect, disallowed a portion of some debt claims.

As a first step in our analysis, then, let us establish a variable, called "U", which represents the potential reduction in settlement amounts that a bankruptcy court will effect. Using this variable, we can say that at the end of bankruptcy proceedings, the at-expiration value of the calls underlying our model will be:

$$C = \max[0, S^* - (K - U)]$$

where

S^*	=	the value of company assets at the end of Chapter 11 proceedings
K	=	the full, face value of the appropriate claims
U	=	the amount of a claim disallowed, not recognized, or not compensated by the bankruptcy court

In the interest of simplicity, let us assume that all parties correctly value company assets throughout the course of bankruptcy proceedings; this makes S a variable, but known amount.

Our new formulation of call values does not affect our previous treatment of K , which we continue to view as a fixed, known amount throughout the duration of Chapter 11 proceedings. Finally, we note that while U has an unknown future value, it is not a random variable, and investors will have reasonable expectations about the value U will ultimately take.

Setting up the payoff equation for our underlying calls in the above fashion will allow us to incorporate the uncertainty about final settlements into a pricing model. Recall that we have dealt with only five of six option pricing variables, by 'assuming away' dividends. Our basis for ignoring dividends was the assumption that a company in Chapter 11 proceedings would not be required to make interest payments or large non-operating payments. However, we will show that an investor who uses the Black-Scholes model to value Chapter 11 securities can account for the uncertainty about final settlements by treating that uncertainty in much the same way that he would account for dividends.

To see how this is done, let us begin by looking at a European call option on a stock with only one ex-dividend date during the life of that option. When this ex-dividend date is also the expiration date of the option, the value of the call at expiration will be:

$$C = \max[0, (S^* - D) - K],$$

where

D	=	the value of the dividend
S^*	=	the value of the stock just prior to expiration
K	=	the strike price
$S^* - D$	=	the value of the stock ex-dividend.

The importance of this payoff equation to us is that this option is very much like the call options we will use to price Chapter 11 securities. If we can price this listed option (and of course we can), then we should be able to value Chapter 11 securities, even when the final settlement amounts are uncertain.

Let us clarify the similarity between the options underlying our Chapter 11 pricing model, and a European call option on stock that goes ex-dividend when the option expires. By rearranging terms of the payoff equation shown above, we can state that the final value of a call which goes ex-dividend at expiration is:

$$C = \max[0, S^* - (K + D)]$$

But this looks very much like the final pay-off of the call underlying our Chapter 11 pricing approach:

$$C = \max[0, S^* - (K - U)]$$

In fact, what this comparison of final pay-offs illuminates is the similarity between U, which is the uncertainty about final Chapter 11 settlements, and D, an at-expiration dividend: both U and D are expiration-day 'adjustments' to the strike price of a call, and they will both take on final values which are currently unknown yet to some degree predictable.

Given the similarity between D and U, it is our contention that when pricing securities, we ought to be able to account for that uncertainty in final Chapter 11 settlements in much the same way a listed option holder accounts for dividends. Of course, a key difference between U and D is that U is subtracted from the strike price at expiration while D is added. However, this only means that U is a 'negative dividend'. (Saying that U is a 'negative dividend' may present some conceptual challenges, but there is nothing about the mathematics of option pricing that would prevent the use of negative amounts for dividends.)

Before proceeding with a discussion of how to account for U as if it is a dividend, and a negative one at that, we do have to make one digression. That is, we may have a problem in continuing to use the Black-Scholes model now that 'dividends' have been introduced to our scenario. After all, we have argued that Chapter 11 securities are analogous to being long or short European call options on the assets of a company. Yet we also know that the existence of dividends typically reduces the value of European calls versus American calls. To see if our model is affected by treating U like a 'dividend' requires an examination of the benefits of early exercise.

As discussed previously, an investor holding an American call option will only want to exercise early just prior to expiration and ex-dividend dates. At these times, the investor faces something of a dilemma. He can continue holding his option, which is desirable because of the ever-present possibility that the option will move deeper into-the-money. However, the disadvantages of holding the option through an ex-dividend date are that the stock is going to drop in value, from S to S-D, and the option holder will suffer an opportunity cost in not capturing the dividend. When an impending dividend is sufficiently large, the ability to exercise early makes an American call more valuable than an otherwise identical European call.

However, our case is somewhat unique, because the 'dividend', U, in our Chapter 11 pricing model is a 'negative' amount. Therefore, to account for U in our pricing model, we have to envision how we would price an option on a company whose stockholders *pay*, rather than receive, \$D in cash to the company on an ex-dividend date. As a first step, it should be clear that under a 'negative dividend' scenario, arbitrage would force the price of the stock to be S *plus* D on the ex-dividend date (rather than the traditional S - D). Further, it should also be apparent that someone holding an American call option on a company with a 'negative dividend' policy would *never* want to exercise his option early. When a 'negative dividend' stock goes ex-dividend, shareholders lose rather than gain \$D/share in cash, and the value of the stock underlying the call goes up rather than down.

Since a call option holder will never exercise early on a company that enforces 'negative dividends', he will be indifferent to whether the call is American or European. To wrap up our digression, this means that when treating U like a negative dividend, our approach for pricing Chapter 11 securities can continue without any adjustment for the fact that our underlying options are European rather than American.

Having established that European and American call values will be identical for a company with a negative dividend policy, we move now to the question of how to account for the amount of those dividends when pricing the option. There is a lot which could be reviewed here about the various methods of accounting for dividends in pricing listed options, and how those methods might be adapted to accounting for the uncertainty of eventual settlements when pricing a Chapter 11 security. In some ways, this 'dividend' adjustment is the most important input in valuing claims against a bankrupt company. However, we will provide only a brief treatment of the subject, since a full-fledged review of how one anticipates settlement amounts could well merit an article unto itself.

For our purposes, there are two key prerequisites to adjusting call prices for dividends:³

- 1) An investor must project dividends as a function of stock prices.
- 2) An investor must abandon a continuous-time (i.e., Black-Scholes) model of option pricing, and instead revert to a binomial option pricing approach.

The first requirement arises from the way in which the Black-Scholes model is derived. Specifically, the Black-Scholes model is based on an arbitrage argument about how an investor could use stocks and bonds to set up a continual string of riskless hedged positions if stock prices move in a binomial pattern. The problem with introducing a second independent variable (dividends) into a binomial model is that it creates up to four possible end-of-period positions. However, we cannot set up a riskless hedged position using only stocks and bonds when there are more than two possible price outcomes, and thus we cannot derive, or use, the Black-Scholes equation.

The solution to dividends is to define D as a function of stock prices, and then to replace D with its S-based equivalency in any discrete-time-period payoff scenario. When this is done, we return to having just one variable (S), and only two possible pay-offs at any time period. For example, if S can go to either 1.2S or .9S at the end of any one period, and we assume the company wants to maintain a constant dividend yield of, say, 5%, then on ex-dividend dates we still face just two possible stock prices: $1.2 * S * (1 - .05)$ if the stock price moves up, or $.9 * S * (1 - .05)$ if the price movement is down. Again, we will not conduct an in-depth analysis of the mechanics of adjusting option values for dividends. Suffice it so say that if D must be defined as a function of stock prices before a listed option can be valued, then our approach to pricing Chapter 11 securities will require defining U as a function of asset values.

The second central requirement of accounting for cash dividends in option pricing is that an options investor must abandon a continuous-time model, and instead must use a binomial option pricing model.⁴ While this equation may seem like a crude tool in comparison to the

³Ibid., pp. 236 - 45.

⁴For an exact binomial option equation, see Cox and Rubinstein, p. 178.

Black-Scholes model, results from a binomial option-pricing equation converge to those of the Black-Scholes model very quickly, so little accuracy is actually sacrificed.⁵ Further, since we must define U as a function of S, and we are forced to assume that S, the value of company assets, moves in binomial steps, we in turn must assume that the expectations of U also move in step-wise fashion.

Having to 'revert' to a binomial option pricing model to account for D, and, therefore, U, is actually quite advantageous to an investor in Chapter 11 securities, for two reasons.

The first reason is that a binomial model is virtually an ideal representation of investor's expectations about the ultimate value U will take. After all, the extent to which claims against a Chapter 11 company are disallowed, not recognized, or reduced will be determined as the bankruptcy court addresses a series of legal questions. An excellent way for an investor to anticipate the ultimate value of U is to project a decision tree of those legal questions. Further, if an investor can map that decision tree in binomial form, then an investor's expectations of U can be readily incorporated into the option pricing model.

Once this is done, an investor will discover the second advantage in having to 'revert' to a binomial option pricing model. Namely,

An investor using a binomial option pricing model does not need to estimate the probabilities of occurrence of the events under consideration.

This means that our options-based approach to pricing Chapter 11 securities will give accurate values simply by identifying the correct sequence of possible legal twists in the bankruptcy proceedings. There is no need to know probabilities, only possibilities.

In sum, there is a lot which could be covered in regard to how an investor in listed call options accounts for cash dividends. We have touched upon only those areas of particular relevance to us: that an investor must define D (and therefore U) as a function of S, and that a binomial (rather than continuous-time) model is used to price options when cash dividends will be paid. By now, though, the key point is this: an investor using our options-based approach to pricing Chapter 11 securities can account for that uncertainty by treating it like a 'negative dividend'.

Accounting for the uncertainty of final settlement dates: The second key difference between listed options and the options underlying Chapter 11 securities is that listed options have known, fixed expiration dates, whereas the final settlement dates in Chapter 11 proceedings are unknown.

In theory, the uncertainty about the length of Chapter 11 proceedings is a major obstacle to using our approach. After all, the whole derivation of the Black-Scholes model arises from the riskless hedging strategies that are available if we assume a world of binomial stock-price

⁵By definition, binomial option pricing results will be the same as Black-Scholes as one assumes an infinite number of binomial stock price moves. However, Cox and Rubinstein show examples where binomial pricing results for a variety of listed options are accurate to the penny when assuming 150 stock price moves, and are within a few cents of Black-Scholes results with as few as 20 moves (see p.243). The few calculations needed to transform continuous time assumptions to binomial inputs are shown on p. 242.

movements. If the expiration date of an option is unknown or subject to change, then we could never set up riskless hedges against stock price moves, and therefore, could not derive or use option valuation equations.

In practice, though, our options-based approach to pricing Chapter 11 securities remains useful. As an investor is able to come closer and closer to predicting the actual length of bankruptcy proceedings, his valuation of Chapter 11 securities will come closer and closer to their 'true' value (i.e., the value those securities would take if the length of Chapter 11 proceedings were known with certainty). Also, if an investor holds a portfolio of Chapter 11 securities, then he ought to be able to diversify away some, if not all, of his prediction error about the duration of Chapter 11 proceedings.

Someone holding a portfolio of Chapter 11 securities should monitor the diversification efforts carefully, and would be well-advised to look at each security value under a wide range of expected times to settlement. Generally, predictive accuracy about the time to settlement will be less important at the beginning of Chapter 11 proceedings and more important within the last few months of proceedings (i.e., as t approaches zero).

CONCLUSION

Clearly, more work is required before an investor can use our approach in the real world. For one, the issue of accounting for the uncertainty of final settlements as if that uncertainty is a 'negative' dividend needs to more fully developed. Also, we would like to be able to test the model using historical data, to see if our approach might offer opportunities for excess returns.

However, even when an examination of historical data is conducted, focusing simply on total returns is a bit like looking at a two-dimensional picture of a three-dimensional object. A major advantage of our approach is that, properly used, it will illuminate the complexity of price behavior in Chapter 11 securities. If our approach is at all valid, then the value of claims against a company in Chapter 11 will be affected by a change in any one of the six variables that determine the price of an option. Further, the relationships between security value and any one of the underlying six variables will usually be very non-linear.

As a step towards identifying some of those relationships between 'options inputs' and the value of Chapter 11 securities, we have computed valuations for a hypothetical company, where that company is intended to represent 'the' average firm in Chapter 11 proceedings. These results will be presented in a subsequent paper, and will serve to focus on the sources and magnitudes of risks and opportunities found in Chapter 11 securities. In many ways, the analysis should confirm what practitioners already recognize on an intuitive basis. Nevertheless, a useful purpose is served if our model provides a quantitative explanation of those intuitions, and the model will perhaps address some areas that had not been previously considered.