



Agency Cost and Court Action in Bankruptcy Proceedings in a Simple Real Option Model

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Abstract

While legally considered the residual interest, equity holders are often given a very small share of the liquidation value of a bankrupt corporation, even when liquidation value does not cover all other claims with higher priority. Such expected residual value for equity holders can lead to changed corporate investment incentive which counteracts the well-documented sub-optimal operation for a firm in financial distress. This paper constructs a model illustrating the agency problem in sub-optimal investment of a firm in financial distress and how court action in compensating equity restores the proper incentive. Such court action that violates the priority rule is ex ante rational and result in higher social benefit, even though it seems ex post unfair.

Keyword: Real Option; Agency Cost; Bankruptcy.

1. Introduction

When a firm goes into bankruptcy, all stakeholders suffer. Depending on the severity of the loss of firm value before bankruptcy, creditors can usually expect to be given priority in recovering their loss before equity holders. However, given the fact that public equity holders could suffer a total loss of their investment in a bankrupt firm, it has been customary for bankruptcy court to distribute a small fraction (for example, 5 cents on the dollar) of the liquidated value to equity holders. Although acting out of concern for the loss of small investors and non-insiders, this expected residual claim on liquidated value can serve an additional function of counteracting on the distorted investment incentive of a firm in financial distress.

Black and Scholes (1976) point out that equity is similar to a call option on the value of a corporation with an exercise price at the face value of the corporate bond. Myers (1977) further points out that, given the option-like characteristics of equity, a firm in financial distress may forgo project with positive NPV if most of the investment has to be provided by the equity. Similarly, equity may choose a high-risk project over a low-risk project if equity receives most of the gain in the good states. Narayanaswamy, Schirm, and Shukla (2001) apply a real option model to illustrate such option-like characteristics of equity and the distorted incentive in corporate incentives for a firm in financial distress.

A similar but distinct agency problem is explored in this paper. It will be demonstrated in our model that when equity does not expect to receive any part of the liquidation value in bankruptcy court proceeding, it may choose to forego valuable salvage real option if any additional equity investment or effort is required in the process of exercising such salvage option. This is similar to the distorted investment incentive discussed by Myers (1977). The probability of a management buy-out would further increase the likelihood of such disincentive to exercise the salvage real option as managers would wait to buy the desired assets in the auction conducted through the bankruptcy.

When the bankruptcy court allocates a fraction of the liquidation value to equity, the incentive to exercise the valuable salvage real option is restored, to the degree that the investment costs or effort costs of such exercise for the equity holders are lower than their expected payouts in a bankruptcy proceeding. *A priori*, the expectation of receiving such compensation would cause the value of such salvage real option to be properly priced as part of the firm value. The increase in firm value benefits both equity and debt holders.

Contingent Claim Analysis (CCA) is used in the valuation of real options (Cox, Ross, and Rubinstein 1979). Varian (1987) gives a detailed illustration of the theoretical foundation and application of CCA. Trigeorgis (1993, 1996) gives a comprehensive review of the real option literature. Other studies apply real options in many different areas of business enterprise valuation. For example, Brennan and Schwartz (1985) and Kemna (1993) apply real option valuation to natural resource industry. Copeland and Weston (1982) and McConnell and Schallheim (1983) apply real option valuation in leasing. Kulatilaka (1988) and Kulatilaka and Trigeorgis (1993) apply real option to flexible production. Kolbe, Morris, and Treisburg (1991) analyze real options in research and development, Smith and Triantis (1993) on strategic acquisition, Baldwin (1987) and Kogut and Kulatilaka (1993) on foreign investment, and Bjerksund and Ekern (1993) on shipping. On public sector, Mason and Baldwin (1988) analyze government subsidies and Treisburg (1993) looks at regulation. Amram and Kulatilaka (1999) give a variety of real option applications in many diverse areas.

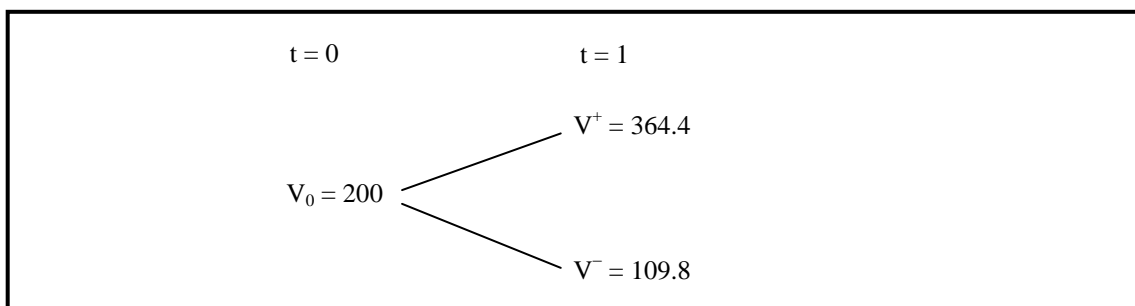
A basic contingent claim analysis (CCA) model is constructed in section 2, and the implications are discussed. Numerical examples are given in section 3 to illustrate the issues. Section 4 gives concluding remarks.

2. A Real Option Model

2.1 A Firm NOT in Financial Distress

Assume that a firm faces the following evolution of firm value:

Fig 1: Evolution of Firm Value



The value of the firm is driven by uncertainty about the state of the economy. Further, suppose that the risk of the business requires a $k = 18.55\%$ required rate of return, while the riskfree rate is $r = 5\%$. There is a 50% probability that the firm value will go up by 82.2% each period, and a 50% probability that it will go down by 45.1% each period. Using option pricing terminology, the firm value has an up-move factor $u = 1.822$, and a down-move factor $d = 0.549$, based on a $t = 1$ year time period, $n = 1$ sub-period, and per-period volatility $\sigma = 60\%$.

Suppose the firm issued 1-year riskfree debt with face value $F = 40$ with a $t = 1$ promised payoff of 42 (a coupon rate of 5%). Since the firm will have enough value at $t = 1$ to pay off the debt no matter what state of economy realizes, the firm is not in financial distress, and the debt is riskfree. The value of debt and equity can be described by the following trees:

Fig 2: Evolution of Risk Free Debt Value

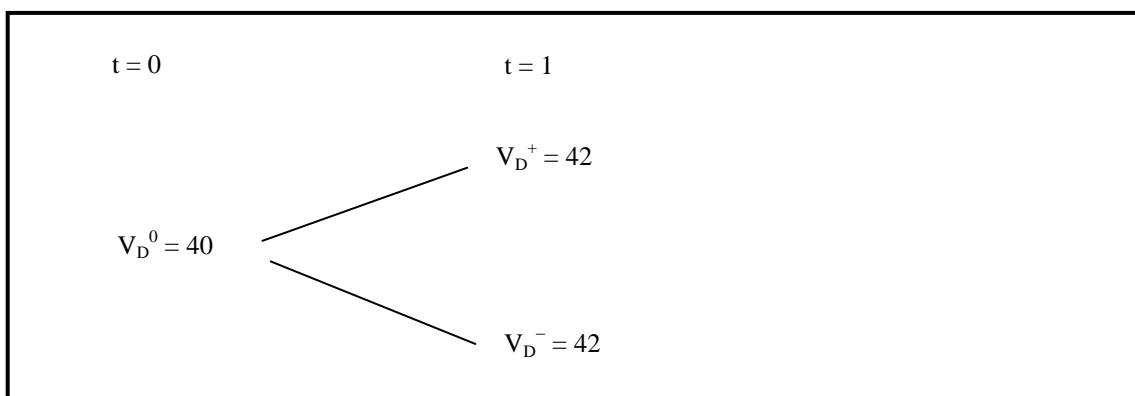
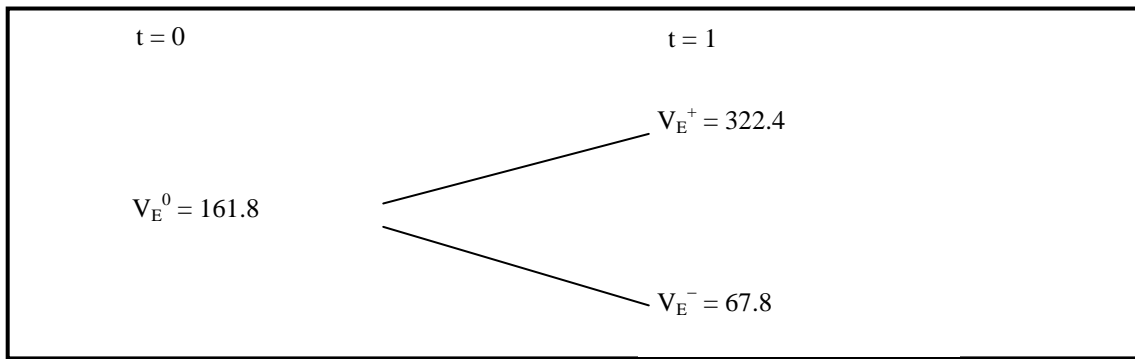


Fig 3: Evolution of Equity Value



If a similar un-levered stock is traded, then the value of the debt and levered equity can be priced by a simple binomial option pricing methodology (Narayanaswamy, Schirm, and Shukla, 2001).

Using conventional DCF technique, we can find the NPV of the firm as:

$$\text{PV (future value of the project)} = (0.5 \times 364.4 + 0.5 \times 109.8) / (1 + 18.55\%) = 200$$

The Binomial Option Pricing approach uses a backward risk-neutral valuation process.¹ The risk-neutral probability p is defined as:

$$p = [(1 + r) \times V_0 - V^-] / (V^+ - V^-).$$

Given the risk-neutral probability, the Certainty Equivalent cash flow is computed by taking integration of the risky cash flows over the risk-neutral probabilities, or:

$$V^{CE} = p \times C^+ + (1 - p) \times C^-$$

The present value of future project value is then found by discounting the Certainty Equivalent Value at the risk-free rate:

$$C_0 = V^{CE} / (1 + r) = [p \times C^+ + (1 - p) \times C^-] / (1 + r)$$

We have: $p = ((1 + 5\%) \times 200 - 109.8) / (364.4 - 109.8) = 100.2 / 254.6 = 0.3936,$

$$(1 - p) = 0.6064,$$

and: $V_0 = (0.3936 \times 364.4 + 0.6064 \times 109.8) / (1 + 5\%) = 210 / 1.05 = 200$

The Binomial Option Pricing result confirms the valuation derived from conventional DCF valuation. In this scenario no real option is considered, and thus the two valuations yield identical results. In situations involving complex options, conventional DCF would generate erroneous value by valuing the expected future value of the firm but ignoring the value of real options, whereas Binomial Option Pricing is a straightforward and elegant tool that can be used to properly account for all the embedded options in project valuation, as will be illustrated below.

The equity and debt can be priced similarly, with the Binomial Option Pricing essentially providing state prices. The value of the debt is:

$$D_0 = (0.3936 \times 42 + 0.6064 \times 42) / (1 + 5\%) = 42 / 1.05 = 40$$

The value of the levered equity can be computed similarly:

$$E_0 = (0.3936 \times 322.4 + 0.6064 \times 67.8) / (1 + 5\%) = 168 / 1.05 = 160$$

and we have:

$$V_0 = D_0 + E_0 = 40 + 160 = 200$$

Again, this confirms earlier results using DCF methodology. We next consider a firm in financial distress.

¹See Varian (1987) for a detailed discussion of the theoretical foundation and derivation of CCA in general, and a comparison of risk-neutral probabilities and decision-tree probabilities in particular.

3. A Firm in Financial Distress

Consider now a similar firm with a risky debt of $F = 120$ with a promised payment of 132 in $t = 1$ (a coupon rate of 10%). As the firm will NOT have enough value in the down-state to pay off the debt in $t = 1$, the firm will go into bankruptcy and the debt holders will receive the remaining value $V_1^- = 109.8 < F = 132$.

The value of the risky debt and the levered equity will evolve as follows:

Fig 4: Evolution of Risky Debt Value

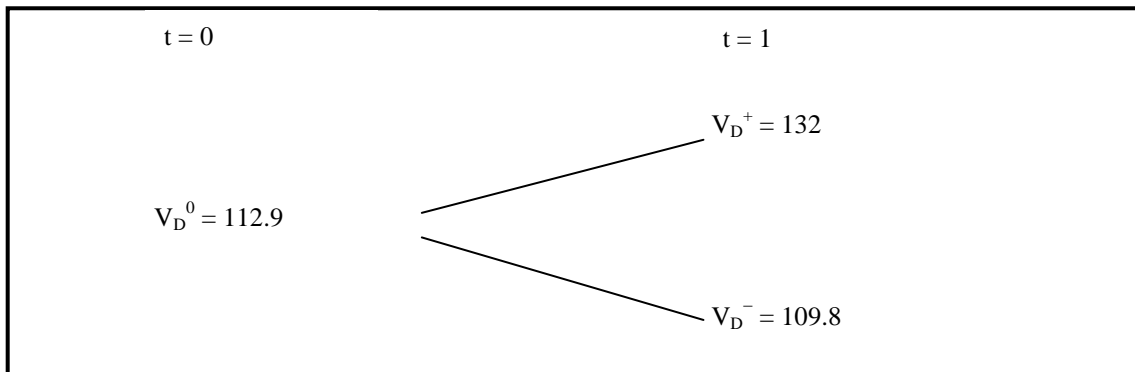
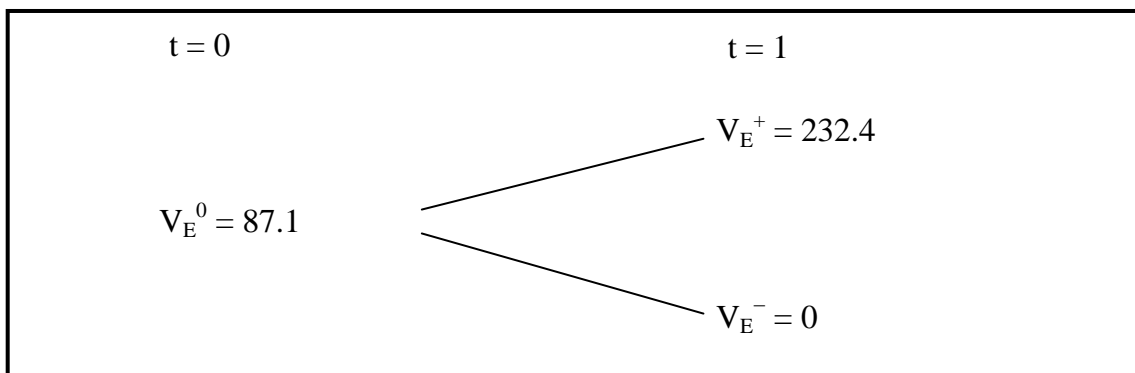


Fig 5: Evolution of Equity Value



Using Binomial Pricing, the risky debt and levered equity for this firm can be valued as follows:

$$D_0 = (0.3936 \cdot 132 + 0.6064 \cdot 109.8) / (1 + 5\%) = 118.5 / 1.05 = 112.9$$

The value of the levered equity can be computed similarly:

$$E_0 = (0.3936 \cdot 232.4 + 0.6064 \cdot 0) / (1 + 5\%) = 91.5 / 1.05 = 87.1$$

And we have:

$$V_0 = D_0 + E_0 = 112.9 + 87.1 = 200$$

The valuation of debt and equity properly reflects the expected bankruptcy in the down-state.

3.1 A Salvage Real Option

A firm in financial distress often has the option of selling off valuable assets before the firm actually goes into bankruptcy, when firm would be in a much worse position to bargain for the true value of its assets. However, entrenched management often only seeks Chapter 11 protection when it is unavoidable. This often leads to a fire-sale of firm assets at substantial discount from their market/replacement value. In addition, when equity does not receive any distribution of firm value in the bankruptcy proceeding, the incentive to exercise valuable salvage real option may be distorted if any additional investment is required from equity while most of the benefits accrue to debt holders. In the framework of Myers (1977), the salvage option is a project with positive NPV. The loss of such positive NPV is an agency cost of debt.

Continuing earlier numerical examples, assume that firm has the option of selling off its asset for 120 (= 80%*200, or 80% of its $t = 0$ value) at the down-state with an equity investment of 5 (at the down-state). Since the firm is in financial distress, it is not able to raise this required investment of 5 by raising additional debt.

The salvage option has no value in the up-state, as the firm value is higher than the salvage value. The NPV for the salvage option can be valued as the incremental value that the firm gains in the down-state:

$$\begin{aligned} NPV_S &= (0.3936*0 + 0.6064*(120 - 5 - 109.8))/(1 + 5\%) \\ &= 5.2/1.05 = 4.95 > 0 \end{aligned}$$

However, since equity holders have to provide the required investments, they may not have the incentive to exercise the salvage real option. The following trees describe the evolution of value for the risky debt and the equity when the salvage real option is exercised:

Fig 6: Evolution of Risky Debt Value

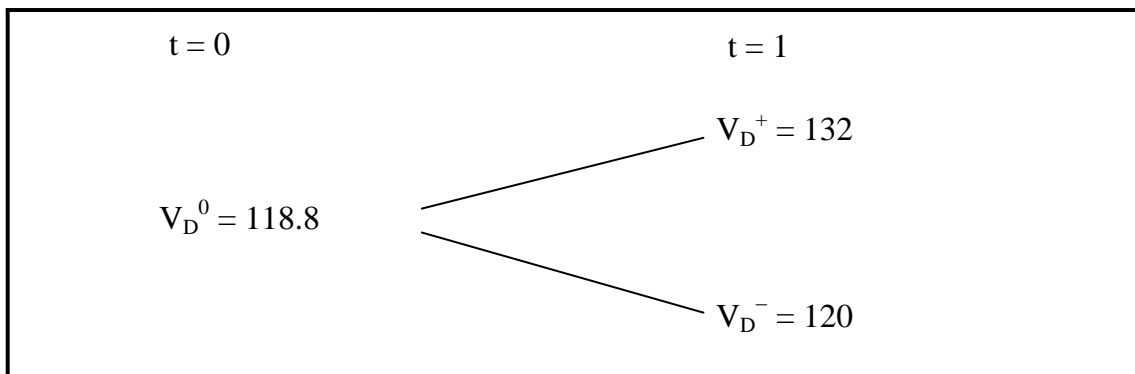
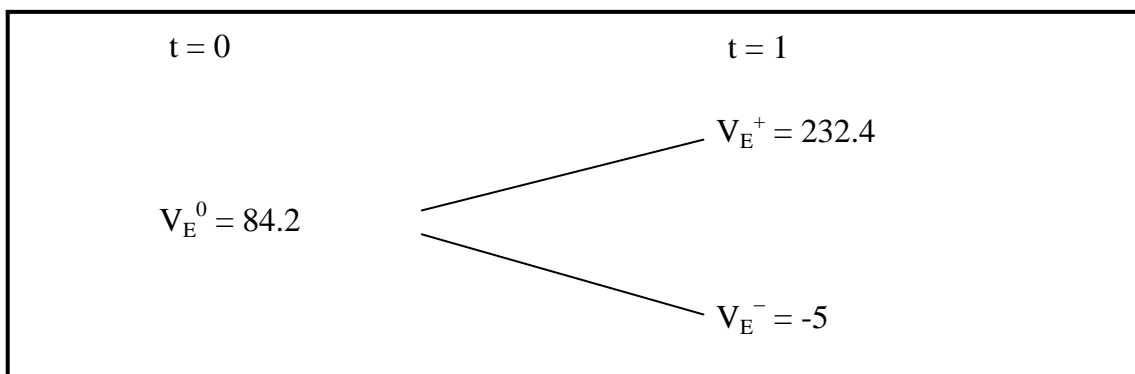


Fig 7: Evolution of Equity Value



All the salvage value still goes to the debt holders, and the risky debt is valued as:

$$D_0' = (0.3936*132 + 0.6064*120)/(1 + 5\%) = 124.7/1.05 = 118.8$$

The equity is valued as follows:

$$E_0' = (0.3936*232.4 + 0.6064*-5)/(1 + 5\%) = 88.44/1.05 = 84.2$$

And we have:

$$V_0' = D_0' + E_0' = 118.8 + 84.2 = 203 > V_0 = 200$$

Note that, with the exercise of the salvage real option, $V_0' > V_0$. The higher firm value reflects the value of the salvage real option. The required equity investment of 5 is a leakage of firm value when the salvage option is exercised. The magnitude of this leakage affects the existence and magnitude of the agency cost.

Even though firm value would be high, equity value becomes lower with the exercise of the salvage real option: $E_0' = 84.2 < E_0 = 87.1$, and the equity will not exercise the salvage real option if any investment by equity is required. Comparing the firm value with the exercise of the salvage real option (203) and the firm value without the exercise of the salvage real option (200), the agency cost is a loss of firm value of 3 ($= 203 - 200$) at $t = 0$, or 1.5% of $t = 0$ firm value.

3.2 Bankruptcy Proceeding

When the court attempts to protect outside/small equity investors in a bankruptcy case by distributing some of the liquidated value of a bankrupt firm to equity, this expected compensation in a down-state alters incentives.

Consider a case where the court distributes $0 < \delta = 0.05 < 1.0$ (5%) of the liquidated value (120, or the salvage value) to equity in the down-state. The following trees describe the evolution of equity value and debt value:

Fig 8: Evolution of Equity Value

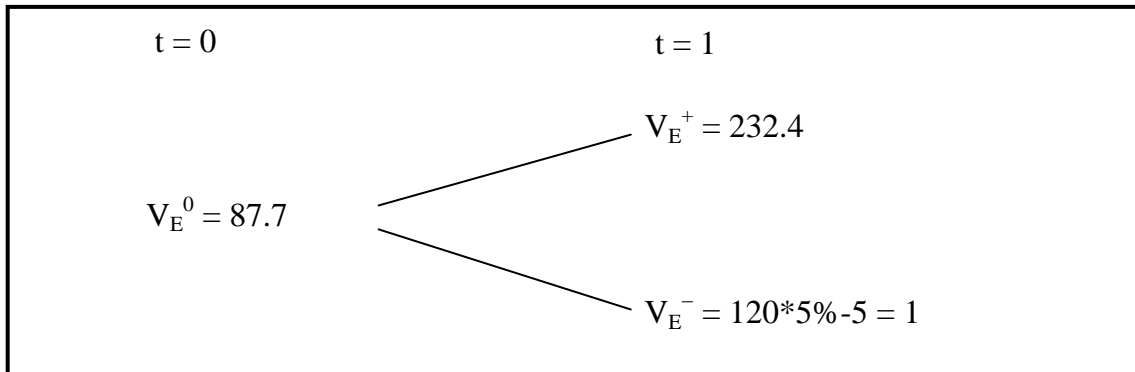
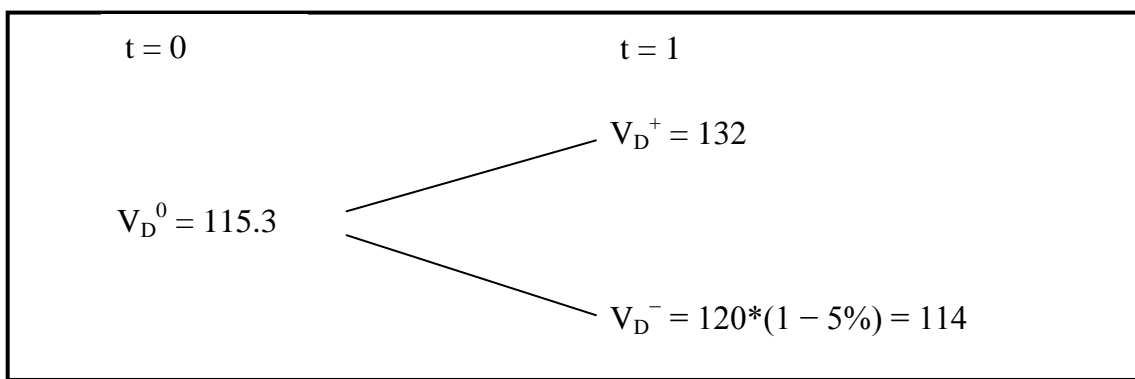


Fig 9: Evolution of Debt Value



The debt holders receive 95% of the salvage value in the down-state, and the risky debt is valued as:

$$D_0'' = (0.3936 * 132 + 0.6064 * [120 * (1 - 5\%)]) / (1 + 5\%) = 121.08 / 1.05 = 115.3 > V_0 = 112.9$$

The equity receives 5% of the salvage value in the down-state, and thus is valued as:

$$E_0'' = (0.3936 * 232.4 + 0.6064 * 1) / (1 + 5\%) = 92.08 / 1.05 = 87.7 > E_0 = 87.1$$

And we have:

$$V_0'' = D_0'' + E_0'' = 115.3 + 87.7 = 203 = V_0' > V_0 = 200$$

It is obvious that when a bankruptcy court distributes a fraction of the liquidation value of a firm to the equity, it is redistributing wealth from the debt holders to the equity holders. However, it is clear from our model and numerical examples above that this redistribution restores the incentive for equity to exercise the salvage real option and effectively solves the agency problem. As both equity and debt value gain, $t = 0$ firm value is also higher, and all the stakeholders benefit from such court action.

4. Conclusions

We have applied the modern finance theory of real options to the analysis and evaluation of bankruptcy court distribution. Although legally equity is the residual claim holder and thus should not receive any distribution from asset sales, this paper illustrates the important incentive problem when valuable salvage real option is present. If any investment or effort is required on the part of the equity, such salvage real option may not be exercised, and both debt and firm value are lower by the amount of the agency costs/lost value. Court action in distributing a small fraction of the liquidation value is shown to counter-act on this perverse incentive and restore equity's incentive to exercise the salvage real option. All stakeholders benefit from such court action.

The importance of salvage real option in business valuation has often been assumed but not analyzed in depth. This paper investigates the particularly important issue of court distribution of liquidation value to equity and its impact on equity's incentive in optimally exercising valuable salvage real option. A potentially serious agency problem is solved even though on the surface the court re-distribute wealth from debt holders to equity. This intricate relationship is important for both debt and equity holders.

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