Masters in FINANCE

RISKY DEBT - II
Anderson and Sundaresan (1996)

Corporate Investment Appraisal

Fall 2017

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0. General View

Integrates literature of:

corporate finance;
pricing (options).

Strategic Concerns in a valuation model.

How?

Game in extensive form, determined by:

Covenants/clauses of the debt contract;
Bankruptcy law (and enforcement).

Determine "sub-game perfect" *Equilibrium*, with endogenous:

- cash-flow allocation;
- "boundaries of reorganization" of the firm (i.e., for which values of the parameters is control transferred from shareholders to creditors).

Shareholders (owner-manager) and creditors play *non-cooperatively.*

Complete Information about the structure of the game and cash flows.

<u>Objectives:</u> How to design an optimal debt contract? (e.g., cash-payout ratio, level of leverage, tax effects).

Results:

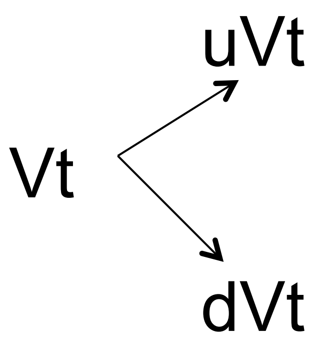
Possibility of Strategic Debt Service;

Higher Default Premium than in previous studies;

And many others...

1. Model

Technology:



d=1/u

Vt is the present value of all cash flows (future and current).

Cash Flows: ft = ßVt

ß is the payout ratio;

a high ß corresponds to a “cash cow” project;

a low ß corresponds to growth opportunities.

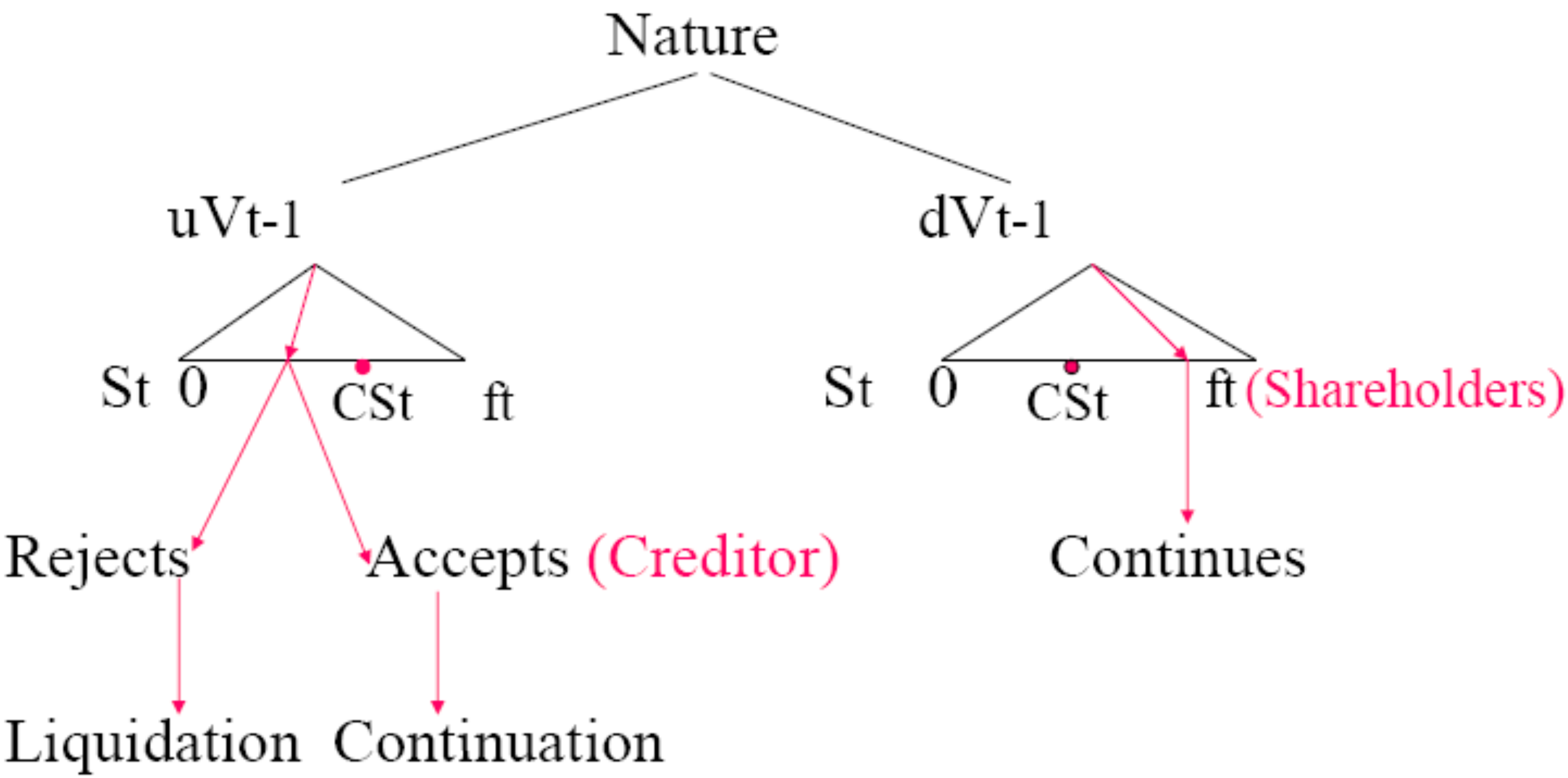
Risk neutral Probability "up": $$p = \frac{R(1-\beta)-d}{u-d}$$

Liquidation Cost: K (fixed)

Contracted Debt Service, date t: CSt

Actual Debt Service, date t: St $$S_t \in [0, f_t]$$

- Game from date (t-1) to date (t): an example



Equilibrium:

At *terminal date T:*

V_T is observed;

Shareholder decides S_T;

If S_T > = CS_T, game ends with payoffs: (V_T-S_T;S_T) for shareholder and creditor, respectively;

If S_T < CS_T, the creditor may accept or reject;

If the creditor accepts, the payoffs are: (V_T-S_T;S_T);

If the creditor rejects, the payoffs are: (0, max(V_T-K,0));

In equilibrium the Value of Equity is: $E(V_T) = V_T - B(V_T)$

And the Value of Debt is: $B(V_T) = \min(CS_T, \max(V_T - K, 0))$

Argument for equilibrium:

- If the shareholders decide $S_T >= CS_T$, payoffs are:

(V_T-S_T;S_T). In this case they would choose $S_T = CS_T$.

- If the shareholders decide $S_T < CS_T$, then:

  Creditor accepts if: $S_T >= \max(V_T-K,0)$.

  In this case, the shareholders would choose:

  $S_T = \max(V_T-K,0)$

- Hence, shareholders choose to pay whichever minimizes

the Value of Debt.

Moving backwards in time… until <u>date t</u>:

- Realization of V_t (and of f_t);
- Shareholders choose S_t;
  - If $S_t >= CS_t$, the game continues to date (t+1);
  - If $S_t < CS_t$, creditors decide to:

Reject, obtaining: $\max(V_t - K, 0)$; or

Accept, getting:

$$S_t + \frac{pB(uV_t) + (1-p)B(dV_t)}{R}$$

They choose the largest of the two.

Shareholders anticipate this decision when choosing S_t.

For relatively high values of V_t, there will be no default;

For relatively low values of V, they choose "strategic default", paying an amount that leaves creditors just indifferent.

If no liquidation takes place, in state Vt, the Debt Service is:

$$S(V_t) = \min\left(CS_t, \max\left(0, \max(V_t - K, 0) - \frac{pB(uV_t) + (1-p)B(dV_t)}{R} \right)\right)$$

The Value of Debt is: $$B(V_t) = S(V_t) + \frac{pB(uV_t) + (1-p)B(dV_t)}{R}$$

And the Value of Equity: $$E(V_t) = f_t - S(V_t) + \frac{pE(uV_t) + (1-p)E(dV_t)}{R}$$

In some cases, *forced liquidation* will occur: S(Vt)>ft; the Debt Value being:

$$B(V_t) = \max\left(0, \min\left(V_t - K, CS_t + P_t\right)\right)$$

And Equity Value: E(Vt)=Vt-K-B(Vt)

2. Valuation

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- For “straight debt”, with fixed coupon and 100% reimbursement at maturity T (CSt=cP and t<T; CSt=(c+1)P if t=T).

- With c=0 and K=0, this is the case of Merton (1974). Useful to compare for “calibration”. Denominate a ratio “d” of *quasi*-debt:
  - Obtain the same results as Merton in terms of risk premium.
  - When we consider K≠0: the spread in this model changes significantly!! Much more so than in Merton. (Check the tables).

The analysis is extended in order to include non-zero coupon debt.

The paper also makes adjustments with taxes so as to consider the Tax Shield of Debt in the valuation, with tax-deductible coupons:

$$E(V_t) = (f_t - S(V_t))(1-\tau) + \frac{pE(uV_t) + (1-p)E(dV_t)}{R}; t < T$$

$$E(V_T) = (1-\beta)V_T + (f_T - s_T cP)(1-\tau) - s_T P; s_T = \frac{S(V_T)}{(1+c)P}$$

In case of forced liquidation, the taxes are deducted before computing the liquidation value – this is the only difference in the way in which the value of Debt is computed.

As T*ß*Vt is small relative to Vt, taxes don't have too large an effect in the strategies for "St".

But Taxes do affect to a large extent the value of "E". They constitute an important factor for the "design".

Security Design Problem:

$$\max_{c,T,P,g} E\left(V_0;\sigma^2,\beta,R,K,\tau\right)$$

$$s.t.$$

$$D \leq B\left(V_0;\sigma^2,\beta,R,K,\tau\right)$$

c = coupon

T = maturity

P = face value

g = number of "grace periods" (no reimbursement of principal)

A_t = amortization at date t

$$A_t = \begin{cases} 0 & \text{if } t \leq g \\ \dfrac{P}{T-g} & \text{if } t > g \end{cases}$$

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Some Results:

High growth (Low Beta) use low coupons;

Low growth use high coupons;

When the Tax Rate rises, tendency to choose higher coupons;

Highly levered firms use low coupons;

etc...