Introducing debt

Argument in MM:

With equity financing firm issues & invests only if

$$A+C \leq (A+R)\frac{E[A+R|\text{issuance},C] - (I-C)}{E[A+R|\text{issuance},C]}$$

= $(A+R) - [A+R]\frac{(I-C)}{E[A+R|\text{issuance},C]}$
= $(A+C+R-I^*) - [I-C]\frac{(A+R) - E[A+R|...]}{E[A+R|...]}$
= $(A+C+R-I^*) - \log \text{ or gain to (new) equity holders}$

Note: E[loss/gain]=0 in equilibrium -> see formally above.

With debt financing

 $A + C \leq (A + C + R - I^*)$ - loss or gain to (new) debt holders holders

Use option-pricing argument: $|\Delta_E| > |\Delta_D|$, i.e. gain or loss for equity holders always larger than for debt-holders.

-> If firm pre-announces use of debt or equity: if both negative, the firm invests; if both positive or 0, then debt will be issued in some states of the world where equity will not be issued. Thus less underinvestment under debt. Thus ex-ante value of the firm higher under debt.

-> If firm announces use of debt or equity only at t = 1: Issuing equity signals $\Delta_E < 0$ (since $|\Delta_E| > |\Delta_D|$ and firm choose equity if $\Delta_E < \Delta_D$. Thus, issuing equity signals a sure loss. Thus the firm will never issue equity.

Formally

Suggestion: Consider an investment project with cost I and a stochastic return \tilde{R} , given by R_G with probability p and R_B with probability 1 - p, where $R_G > R_B$.

Start with A non-stochastic.

The firm can use cash $c \in [0, C]$, can issue debt with face value w, and offer new shares s'.

The firm can thus obtain sufficient financing for the investment project if

$$I \le A + C + E[\tilde{R}]. \tag{1}$$

First derive the CEO's choice of financing conditional on implementing the project.

The CEO will implement the project only if the resulting value to old shareholders is higher than A + C, the value of the firm without implementing the investment project.

$$\max \ \frac{s'}{s+s'} E[(A+C+\tilde{R}-c-w)^+]$$
(2)

s.t.
$$\frac{s}{s+s'}E[(A+C+\tilde{R}-c-w)^+] = I-c-d$$
 (3)

$$E[\min\{w, A + C + \tilde{R} - c\}] = d \tag{4}$$

$$\mathbf{0} \le c \le C, \ d \ge \mathbf{0}, \ c+d \le I \tag{5}$$

Note that the right-hand side of (3), I - c - d, is the financing gap remaining after the use of cash and debt and equals the market price of the new shares if the investment project is implemented.

==> Next steps: Homework 1. (**Due:** Friday by 1:15pm in Evans 645, Judi Chan, or Evans 643, Ulrike Malmendier).