Chapter 2
Investment, Dividend, Financing, and Production Policies: Theory and Implications

Abstract The purpose of this chapter is to discuss the interaction between investment, financing, and dividends policy of the firm. A brief introduction of the policy framework of finance is provided in Sect. 2.1. Section 2.2 discusses the interaction between investment and dividends policy. Section 2.3 discusses the interaction between dividends and financing policy. Section 2.4 discusses the interaction between investment and financing policy. Section 2.5 discusses the implications of financing and investment interactions for capital budgeting. Section 2.6 discusses the implications of different policies on the beta coefficients. The conclusion is presented in Sect. 2.7.

Keywords Investment policy • Financing policy • Dividend policy • Capital structure • Financial analysis • Financial planning, Default risk of debt • Capital budgeting • Systematic risk

2.1 Introduction

This chapter discusses the three-way interaction between investment, financing, and dividend decisions. As shown in financial policy literature, there exists a set of ideal conditions under which there will be no interaction effects between the areas of concern. However, the ideal conditions imposed by academicians to analyze the effects dividend and financing policy have on the investment decision and the value of the firm are not realistic, when one considers financial management in the real world. Thus, an overview of the interactions of financing, investment, and dividend decisions is important for those concerned with financial analysis and planning.

This chapter sequentially addresses the three interaction effects. In Sect. 2.2 the relation between investment and dividend policy is explored through a discussion of internal vs. external financing, with the emphasis on the use of retained earnings as a substitute for new equity, or vice versa. The interaction between corporate financing and dividend policies will be covered in Sect. 2.3, where default risk on debt is recognized. Then in Sect. 2.4, the interaction between investment and financing policy is discussed; the role of the financing mix in analyzing investment opportunities will receive detailed treatment. Again, the recognition of risky debt will be allowed, so as to lend further practicality to the analysis. The recognition of financing and investment effects are covered in Sect. 2.5, where capital-budgeting techniques are reviewed and analyzed with regard to their treatment of the financing mix. In this section several numerical comparisons are offered, to emphasize that the differences in the techniques are nontrivial. Section 2.6 will discuss implication of different policies on systematic risk determination. Summary and concluding remarks are offered in Sect. 2.7.

2.2 Investment and Dividend Interactions: The Internal Versus External Financing Decision

Internal financing consists primarily of retained earnings and depreciation expense, while external financing is comprised of new equity and new debt, both long and short term. Decisions on the appropriate mix of these two sources for a firm are likely to affect both the payout ratio and the capital structure of the firm, and this in turn will generally affect its market value. In this section an overview of internal and external financing is provided, with the discussion culminating in a summary of the impacts that earnings retention or earnings payout (with or without supplemental financing from external sources) can have on a firm's value and on planning and forecasting.

Internal Financing

Changes in equity accounts between balance-sheet dates are generally reported in the statement of retained earnings. Retained earnings are most often the major internal source of funds made available for investment by a firm. The cost of these retained earnings is generally less than the cost associated with raising capital through new common-stock issues.

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Table 2.1 Payout ratio – composite for 500 firms

1962	0.58	1974	0.405	1986	0.343	1998	0.234
1963	0.567	1975	0.462	1987	0.559	1999	0.435
1964	0.549	1976	0.409	1988	0.887	2000	0.299
1965	0.524	1977	0.429	1989	0.538	2001	0.383
1966	0.517	1978	0.411	1990	0.439	2002	0.04
1967	0.548	1979	0.38	1991	0.418	2003	0.259
1968	0.533	1980	0.416	1992	0.137	2004	0.311
1969	0.547	1981	0.435	1993	0.852	2005	0.282
1970	0.612	1982	0.422	1994	0.34	2006	0.301
1971	0.539	1983	0.399	1995	0.346		
1972	0.491	1984	0.626	1996	0.327		
1973	0.414	1985	0.525	1997	0.774		

It follows that retained earnings, rather than new equity, should be used to finance further investment if equity is to be used and the dividend policy (dividends paid from retained earnings) is not seen to matter. The availability of retained earnings is then determined by the firm's profitability and the payout ratio, the latter being indicative of dividend policy. Thus we find that the decision to raise funds externally may be dependent on dividend policy, which in turn may affect investment decisions.

The payout ratios indicated in Table 2.1 show that, on average, firms in the S&P 500 retained more than 50% of their earnings after 1971 rather than pay them out in dividends. This is done because of the investment opportunities available for a firm, and indicates that retained earnings are a major source of funds for a firm.

External Financing

External financing usually takes one of two forms, debt financing or equity financing. We leave the debt vs. equity question to subsequent sections, and here directly confront only the decision whether to utilize retained earnings or new common stock to finance the firm.

We have previously shown that the market value of the firm is unaffected by such factors if dividend policy and capital structure are irrelevant. It should also be clear that dividend policy and capital structure can affect market values. Therefore, the consideration of an optimal internal-external financing combination is important in the field of financial management. This optimal combination is a function of the payout ratio, the debt-to-equity ratio, and the interaction between these two decision variables. From this it can be shown (and this will be the topic of discussion in the following paragraphs) that different combinations of internal and external financing will have different effects on the growth rate of earnings per share, of dividends per share, and, presumably, of the share price itself.

Higgins (1977) considered the amount of growth a firm could maintain if it was subject to an external equity constraint and sought to maintain certain debt and payout ratios. He was able to show the sustainable growth rate in sales, S*, to be:

$$S* = \frac{p(1-d)(1+L)}{t - p(1-d)(1+L)} = \frac{(rr)(ROE)}{1-(rr)(ROE)} \tag{2.1}$$

where p, profit margin on sales; d, dividend payout ratio; L, debt-to-equity ratio; t, total asset-to-sales ratio; *rr*, retention rate; *ROE*, return on equity.

Higgins (1977) used 1974 U.S. manufacturing firms' composite financial statement data as an example to calculate S^*. Using the figures $p = 5.5\%, d = 33\%, L = 88\%$ and $t = 73\%$, he obtained:

$$S* = \frac{(0.055)(1-0.33)(1+0.88)}{0.73-(0.055)(1-0.33)(1+0.88)} = 10.5\%$$

Using this method we can calculate sustainable growth rate in sales for financial analysts and planning models.

From this we can see that a firm with many valuable investment opportunities may be forced to forego some of these opportunities due to capital constraints, and the value of the firm will not be maximized as it could have been. Dividend and capital-structure decisions relate directly to investment decisions. While it may not be reasonable to assume that the firm could not issue new equity, the question is at what cost it can be raised under such a constraint.

In an even more practical vein, Higgins also incorporated inflation into his model, acknowledging the fact that most depreciation methods that serve to make depreciation a source of funds are founded on historical costs, and not the replacement values the firm must pay to sustain operations at their current level. Introducing the new variables defined below, it is possible to define sustainable growth in real and nominal terms, the former being the item of interest here.

Let c, nominal current assets to nominal sales; f, nominal fixed assets to real sales; j, inflation rate.

So real sustainable growth S_r^* is

$$S_r^* = \frac{(1+j)p(1-d)(1+L) - jc}{(1+j)c + f - (1+j)p(1-d)(1+L)}. \tag{2.2}$$

Using figures from the manufacturing sector and an inflation rate of 10%, which at the time of writing was approximately the actual inflation rate then prevailing, it was found that real sustainable growth was only a third of that of the nominal figure; this serves to further emphasize the importance of the interaction between dividend policy and investment decisions, since the former acts as a constraint on the latter. Higgins (1977) paper has recently been generalized by Johnson (1981) and Higgins (1981).

The usual caveat associated with the dividend-irrelevance proposition is that investment policy is unaffected; that is, new equity is issued to replace those retained earnings that are paid out. Here we emphasize new equity with the intent of avoiding financing-policy questions. Knowing that the flotation costs involved with new issues could be avoided by employing retained earnings, the effect such a strategy has on firm value is largely an empirical question. Any such tests directed toward this issue must also recognize that there may be a preference for dividends that may dominate or mitigate the flotation-cost effects. With these factors in mind, Van Horne and McDonald (1971) ran cross-sectional regressions on samples of utility stocks and electronics manufacturers to see whether dividend payouts and the rates of new issues of common stocks had significant effects on price-earnings ratios. The utility industry results indicate that, at the lower end of the new-equity issue spectrum, the dividend-preference effect overshadowed the flotation-cost effect, a result that appeared to shift in direction when higher levels of new equity financing were considered. Further analysis into the dividend-preference question has been performed by Litzenberger and Ramaswamy (1979). Using a generalized capital-asset-pricing model, they examined this trade-off between dividend preference and tax effects, all in an effort to justify the contention of an optimal dividend policy. The results presented by Van Horne and McDonald were admittedly tentative (especially since the electronics industry sample yielded few corroborating results), and most of the t-statistics associated with the utility sample new-issue coefficients were quite low. The strongest statement that could be made following this analysis is that there appears to be little detrimental effect on firm valuation from following a strategy of maintaining a high payout rate and financing further investment with new-equity issues.

2.3 Interactions Between Dividend and Financing Policies

If we were able to hold the capital structure of firms constant, then we would be able to determine the advantage or disadvantage of internal financing relative to external financing. Van Horne and McDonald, as briefly mentioned before, were able to empirically test for the effects created by either policy, providing the substance for a major part of the following discussion. If we were to go into more depth and specifically consider firms that issue risky debt while maintaining shareholder's limited-liability status, and still keeping to the chosen internal or external equity plan, then the interactions between financing and investment decisions can affect the relative positions of stock and bondholders. Black (1976) argued that a possible strategy a firm could follow to transfer economic resources from bondholders to stockholders is to pay as generous dividends as possible. In this way the internal-external financing plan is predetermined, as paying large dividends jeopardizes the bondholders' position as assets are siphoned away from the firm, all to the gain of the shareholders.

In this section the interactions between dividend and financing policy will be analyzed in terms of (1) cost of equity capital and (2) the default-risk viewpoint of debt.

Cost of Equity Capital and Dividend Policy[1]

Van Horne and McDonald (1971) chose to develop a cross-sectional model to test for the significance of dividend payouts in the valuation process in the electric utility industry. The use of the electric utility industry proved to be operationally less difficult than other industries because it was desired to hold interfirm differences constant, and independent variable selection to this end was relatively straightforward. Since the authors were interested in capitalization rates, year-end P/E ratios were selected to be the dependent variables.[1] This value was thought to be a function of three variables: growth in assets, dividend payout, and financial risk. The latter variable is considered sufficient for this sample due to the homogeneity of the other aspects of the included firm's risks. The model can be written out and more carefully defined by the following;

$$P/E = a_0 + a_1 g + a_2 p + a_3 R + u, \tag{2.3}$$

where g, compound growth of assets over eight previous years; p, dividend payout ratio on an annual basis; Lev, interest charges/[operating revenues – operating expenses]; u, error term.

While the growth and risk factors do not correspond exactly to what most capital-market theory tells us is relevant, research with respect to this particular industry lends credence to these variables as defined here (see Malkiel 1970).

Upon regressing the data for the 86 companies included in the sample, all three independent variables are found to be statistically significant. Of the 86 firms, all of which paid dividends, 37 firms also had new equity issues. Testing to see whether the 37 firms that issued new equity came from the same population as those that did *not* raise new equity, the researchers found no essential difference. Since we know there are nontrivial flotation costs associated with the issuance of new equity, the finding of no difference between the sub samples implies one of two things: either the costs associated with new issues are relatively too small compared to the total costs of the firm to be detected (despite their large absolute size, or size relative to the new issue by itself), or a net preference for dividends by holders of electric utility stocks exists that acts to offset the aforementioned expenses.

The main thrust of this paper was to assess the impact of new equity flotation costs on firm value. With the number of firms issuing new equity, Van Horne and McDonald were able to calculate new-issue ratios – that is, new issues/total shares outstanding at year-end – and separate these firms into four groups, leaving those firms issuing new equity in a separate classification, as indicated in the upper portion of Table 2.2. Adding dummy variables to Equation (2.3), the effect of new issue rates could be analyzed:

$$P/E = a_0 + a_1(g) + a_2 p + a_3(Lev) + a_4(F_1) + a_5(F_2) + a_6(F_3) + a_7(F_4). \tag{2.4}$$

where g, compound growth rate; Lev, financial risk measured by times interest earned, and $F_1,\ F_2,\ F_3,\ F_4$, dummy variables representing levels of new equity financing.

We would expect negative coefficients on the dummy variables if the flotation costs were to be relevant, but in fact all coefficients were positive, though only one was significant (possibly due to small sample size and small relative differences). Empirical results are indicated in the lower portion of Table 2.2. However, by replacing the dummy variable of Group E for any one of the four dummy variables discussed above, Van Horne and McDonald found that the estimate of its coefficient is negative.

One question pertaining to the figures presented here stems from the interpretation of the significance of the dummy variables. As it turns out, the class B dummy-variable coefficient is greater than the class A coefficient, supposedly because of a preference for dividend payout, while actually that payout was lower in class B. The question is whether the dummy that is intended to substantiate the dividend-preference claim through the new-issue ratio actually tells us that investors instead attach a higher value to higher earnings retention. The finding of higher P/E ratios resulting from earnings retention would be consistent with the Litzenberger-Ramaswamy framework cited earlier, and the new-issue effect is somewhat confounded with the dividend effect.

From the data we can see that the coefficients did decrease as the new-issue ratios increased, though they were not significant, and, not surprisingly, new-issue ratios were rather highly negatively correlated with dividend payout ratios. From this we can say, although with some hesitation, that external equity appears to be a more costly alternative compared to internal financing when pushed to rather extreme limits. Over more moderate ranges, or those more closely aligned with the industry averages, this claim cannot be made with the same degree of certainty, since we cannot be certain that the payout ratio does not have a positive influence on share price, and therefore an inverse relationship to the cost of equity capital.

Default Risk and Dividend Policy

With the development of the Option Pricing Model, Black and Scholes (1973) have made available a new method of valuing corporate liabilities or claims on the firm. Chen (1978) has reviewed some recent developments in the theory of risky debt, and examines in a more systematic fashion the determinants of the cost of debt capital. Both Reseck (1970) and Hellwig (1981) have shown that the Modigliani

Table 2.2 New-issue ratios of electric utility firms

	F dummy variable grouping				
	A	B	C	D	E
New-issue ratio interval	0	0.001–0.05	0.05–0.1	0.1–0.15	0.15 and up
Number of firms in interval	49	16	11	6	4
Mean dividend payout ratio	0.681	0.679	0.678	0.703	0.728
Dummy variable coefficient	1.86	3.23	1.26	0.89	N.A.
Dummy variable t-statistic	−1.33	−2.25	−0.84	−0.51	(N.A.)

From Van Horne and McDonald (1971), Reprinted by permission and Miller (1958 and 1963) arbitrage process that renders capital structure irrelevant is generally invalidated if the debt under consideration is risky and the shareholders enjoy limited liability. From this and the 1963 M&M article, we can show that there do exist optimal structures for firms under the more realistic conditions mentioned above.

In the option-pricing framework the two claimants of the firm, the debt holders and the equity holders, are easily seen to have conflicting interests; thus one group's claim can only be put forth at the expense of the other party. The assumption that the total firm value is unchanged is utilized to highlight the wealth-transfer effects, but, as we see in the following section, that need not be the case. It is now necessary to find a way to value corporate debt when default risk is introduced. If the total value of the firm is known or given (this value should be reasonably well known or approximated prior to debt valuation as the former is an upper bound on the latter), then once the debt value is established the total equity value falls out as the residual. It is also required that we know how to perform the transfer of wealth (since the stated goal of corporate finance is to maximize the shareholders' wealth), and learn of any possible consequences that could result from such attempts.

Merton (1974) sought to find the value of risky corporate debt, assuming that the term structure of riskless interest rates was flat and known with certainty. This was an indirect goal, since the true emphasis lay in finding a way to value the equity of the firm as a continuous option. The further assumption of consol-type debt was also employed in an attempt to avoid the transactions-cost arguments involved with rolling over debt at maturity. Invoking Modigliani and Miller's Proposition I (M&M 1958) and allowing for risky debt, we find the value of the stock to be the difference between the value of the firm as a whole and the value of the total debt financing employed to support that whole. Explicitly,

$$S = V - \frac{C}{r}(1 - L), \tag{2.5}$$

where S, total value of the firm's stock; V, total firm value; C, constant coupon payment on the perpetual bonds; r, riskless rate of interest; L, a complicated risk factor associated with possible default on the required coupon payment.

The last term of Equation (2.5) is more often represented by B, the value of the total debt claims outstanding against the firm, stated in a certainty-equivalent form. It should be apparent from this equation that by introducing a greater probability of default on the debt while maintaining firm value, the equity holders gain at the expense of the bondholders.

Rendleman (1978) took Merton's model and adapted it to allow for the tax deductibility of interest charges. As in the Merton article, debt is assumed to be of perpetual type, consols – a justifiable assumption as most firms roll over their debt obligations at maturity. The tax benefit introduced is assumed to be always available to the firm. In instances where the interest expense is greater than earnings before taxes, the carryback provision of the tax code is used to obtain a refund for the amount of the previously unused tax shield and, in the event the three-year carryback provision is not sufficient to make use of the tax shield, Rendleman suggests that a firm could sell that advantage to another firm by means of a merger or an acquisition, when the other firm involved could use the tax benefit. Thus the coupon (net) to be paid each time period is given by $C(1 - T)$.

At first glance it is apparent that the equity holders gain from this revision, as they are alleged to in the 1963 tax-corrected model of M&M. But something else is at work as well: Since the firm is subject to a lower debt-service requirement, it can build a larger asset base, which serves to act as insurance in the case of default probabilities owing to the small net coupon payment. In short, the risk premium associated with debt is reduced and the value of the stock, given in Equation (2.5) can be rewritten as shown below:

$$S = V - \frac{C(1 - T)}{r}(1 - L^*), \tag{2.6}$$

where all the variables are as defined before and L^* is less than the L given before because of the lessened default risk.

It has been argued above that the bondholders benefit when interest is tax-deductible, excluding the possibility here that an overzealous attempt to lever the firm is quickly undertaken when the tax-deductibility feature is introduced, and Equations (2.5) and (2.6) seem to indicate that the value of the shareholders' claim also increases, although we have not yet provided any theoretical justification for such a statement.

Rendleman's analysis gave us the L-value, which is the clue to this seeming problem. Management can act in a way to jeopardize the bondholders' claims by issuing more debt and thus making all debt more risky, or by undertaking projects that are riskier than the average project undertaken by the firm. This is the subject of the next section.

Another possibility is to pay large dividends so as to deplete the firm of its resources, thus paying off the shareholders but hurting the bondholders. Black (1976) goes so far as to suggest that the firm could liquidate itself, pay out the total as a dividend, and leave the bondholders holding the proverbial bag. Bond covenants, of course, prevent this sort of action (hence, agency theory), and if a firm could not sell its growth opportunities not yet exploited in the market, this may not maximize the shareholder's wealth, either, but within bounds it does seem a reasonable possibility.

In their review article, Barnea, Haugen, and Senbet (BHS, 1981) discuss the issues related to market imperfections, agency problems, and the implications for the consideration of optimal capital structures.[2] The authors make use of M&M's valuation theory and option-pricing theory to reconcile the differences between academicians and practitioners about the relevance of financing and dividend policies. They arrive at the conclusion that, without frictionless capital markets, agency problems can give rise to potential costs. These costs can be minimized through complex contractual arrangements between the conflicting parties. Potential agency costs may help to explain the evolution of certain complexities in capital structure, such as conversion privileges of corporate debt and call provisions. If these agency costs are real, then financial contracts that vary in their ability to reduce these costs may very well sell at different equilibrium prices or yields, even if the financial marketplaces are efficient. An optimal capital structure can be obtained when, for each class of contract, the costs associated with each agency problem are exactly balanced by the yield differentials and tax exposures. Overall, BHS show that optimal capital structures can exist and that this is still consistent with the mainstream of classical finance theory.

2.4 Interactions Between Financing and Investment Decisions

Myers (1974) has analyzed in detail the interactions of corporate financing and investment decisions and the implications therein for capital budgeting. He argues that the existence of these interaction effects may be attributable to the recognition of transaction costs, corporate taxes, or other market imperfections. Ignored in his analysis is the probability of default on debt obligations, or, as could otherwise be interpreted, changes in this default risk. As alluded to in the previous section, if we consider possible effects of default risk on the firm's investment and financing decisions, then further analysis must be performed to determine how these interactions can affect the wealth positions of shareholders and bondholders. In this section we will analyze this issue by considering both the risk-free debt case and the risky debt case. Chapter 92 and Chap. 60 discuss the theoretical and empirical issues of capital structure.

2.4.1 Risk-Free Debt Case

Following Myers (1974), the basic optimization framework is presented in accordance with well-accepted mathematical programming techniques as discussed in the literature of capital-rationing. It is presented as a general formulation; it should be considered one approach to analyzing interactions and not the final word *per se*. Specific results derived by Chambers et al. (1982), will be used later to demonstrate the importance of considering alternative financing mixes when evaluating investment opportunities.

We identify a firm Q, which faces several investment opportunities of varying characteristics. The objective is to identify those projects that are in the stockholders' interest (i.e., they maximize the change in the firm's market value *ex*-dividend at the end of the successive time periods $t = 0, 1, \ldots, T$) and undertake them in order of their relative values. We specify relative values so that project divisibility remains possible, as was assumed by Myers. Required is a financing plan that specifies the desired mix of earnings retained, debt outstanding, and proceeds from the issuance of new equity shares.

Let dV be a general function of four factors in a direct sense: (i) the proportion of each project j accepted, x_j; (ii) the stock of debt outstanding in period t, y_t; (iii) the total cash dividends paid in period t, D_t; and (iv) the net proceeds from equity issued in period t, E_t. For future use let Z be denoted as the debt capacity of the firm in period t, this being defined as a limit on y_t imposed internally by management or by the capital markets, and C_t is the expected net after-tax cash flow to the firm in time period t. The problem can now be written as:

$$\text{Maximize}\, dV(x_j, y_t, D_t, E_t) = W,$$

subject to the constraints;

$$\begin{aligned}
&\text{(a)}\quad U_j &&= x_j - 1 \le 0\ (j = 1, 2, \ldots, J);\\
&\text{(b)}\quad U_t^F &&= y_t - Z_t \le 0\ (t = 1, 2, \ldots, T);\\
&\text{(c)}\quad U_t^C &&= -C_t - [y_t - y_{t-1}(1 + (1-\tau)r)] + D_t - E_t \le 0,
\end{aligned} \tag{2.7}$$

where τ and r are the tax rates and borrowing rates, respectively. Both are assumed constant for simplicity, but in actuality both could be defined as functions of other variables. Constraints (a) and (b) specify the percentage of the project undertaken cannot exceed 100%, and the debt outstanding cannot exceed the debt capacity limit. Constraint (c) is the accounting identity, indicating that outflows of funds equal inflows, and could be interpreted as the restriction that the firm maintain no excess funds.

Constraint (b) can be used to investigate the interaction between the firm's financing and investment decisions by examining the necessary conditions for optimization. If we assign the symbols L_j, L_{ft}, and L_{ct} to be the shadow prices on constraints (a)–(c), respectively, and let $A_j = dW/dx_j$, $F_t = dW/dy_t$, $Z_{jt} = dZ_t/dx_j$, and $C_{jt} = dC_t/dx_j$, we can rewrite Equation (2.7) in Lagrangian form as the following:

$$\begin{aligned}
Max\, W' = {} & W - L_j(x_j - 1) - L_{ft}(y_t - Z_t)\\
& -L_{ct}\{-C_t - [y_t - y_{t-1}(1 + (1-t)r)]\}\\
& +(D_t - E_t).
\end{aligned} \tag{2.7'}$$

The necessary first-order conditions for the optimum are shown as Equations (2.8) through (2.11), with accompanying explanations. For each project:

$$A_j + \sum_{t=0}^{T} [L_{ft} Z_{jt} + L_{ct} C_{jt}] - L_j \leq 0 \tag{2.8}$$

This can be interpreted as follows: The percentage of a project undertaken should be increased until its incremental cost exceeds the sum of the incremental value of the project, the latter consisting of the added debt capacity and the value of the cash flows generated by that project. The incremental increase in value of the firm obtained by increasing x_j to this maximum point is termed the Adjusted Present Value, APV ("adjusted" because of the consideration of interaction effects).

We can examine each of these effects in turn. For the debt constraint in each period:

$$F_t - L_{ft} + L_{ct} - L_{c,t-1}[1 + (1-\tau)r] \leq 0. \tag{2.9}$$

For the constraint implied on dividends:

$$\frac{dW}{dD_t} - L_{ct} \leq 0; \tag{2.10}$$

and for the new equity constraint:

$$\frac{dW}{dE_t} + L_{ct} \leq 0. \tag{2.11}$$

While Equations (2.8)–(2.11) are all of interest, the focus is on Equation (2.8), which tells us that the Net Present Value (NVP) rule commonly put forth should be replaced by the APV rule, which accounts for interaction effects.

Specifically considering the financing constraint, Equation (2.9), we would like to be able to find the value of this constraint, which is most easily done by assuming for the moment that dividend policy is irrelevant. Combined with Equations (2.8) and (2.9) and the definition of APV we obtain[3];

$$APV_j = A_j + \sum_{t=0}^{T} Z_{jt} F_t \tag{2.12}$$

which, in the spirit of the M&M with-tax firm-valuation model, tells us that the value of a project is given by the increase in value that would occur in an unlevered firm, plus the value of the debt the project is capable of supporting. This follows from the firms ability to deduct interest expenses for tax purposes. This procedure will be further investigated in the following section when we compare it with other well-accepted capital-budgeting techniques.

When dividend policy is not irrelevant, the standard argument arises as to whether the preference for dividends, given their general tax status, outweighs the transaction costs incurred by the firm when dividends are paid and new financing must be raised. In this framework, dividends are viewed as another cash flow and, as such, the issue centers on whether the cash flows from the project plus any increases in the debt capacity of the firm are adequate to cover the cost of financing, through whatever means.

Although we are unable to discern the effect of dividend policy on the value of the firm, it is not outside the solution technique to incorporate such efforts by including the related expenses as inputs to the numerical-solution procedure.

It is generally assumed that these interaction effects exist, so if we are to consider disregarding them, as some would insist, we must know what conditions are necessary for lack of dependence of financing and investment decisions. As Myers points out, only in a world of perfect markets with no taxes is this the case. Otherwise, the tax deductibility of the interest feature of debt suggests that the APV method gives a more accurate assessment of project viability than does the standard NPV method.

Risky Debt Case

Rendleman (1978) not only examined the risk premiums associated with risky debt, but also considered the impact that debt financing could have on equity values, with taxes and without. The argument is to some extent based on the validity (or lack thereof) of the perfect-market assumption often invoked, which, interestingly enough, turns out to be a double-edged sword.

Without taxes, the original M&M article claims, the investment decision of a firm should be made independent of the financing decision. But the financing base of the firm supports all the firm's investment projects, not some specific project. From this we infer that the future investments of a firm and the risk premiums embodied in the financing costs must be considered when the firm takes on new projects. If, for example, the firm chooses to take on projects of higher-than-average risk, then this may have an adverse effect on the value of the outstanding debt (to the gain of the shareholders), and the converse holds true as well. It follows that the management of a firm should pursue more risky projects to transfer some of the firm's risk from the shareholders to the bondholders, who do not receive commensurate return for that risk. If the bondholders anticipate this action on the part of management, then it is all the more imperative that management takes the action because the bondholders are requiring and receiving a risk premium, for which they are not incurring the "standard" or market-consensus level of risk.

Myers (1977) presents an argument in which a firm should issue no risky debt. The rationale for this strategy is that a firm possesses certain real options, or investment opportunities, that unfold over time. With risky debt some of these investment projects available only to the firm of interest may not be undertaken if it is in the interest of the shareholders to default on a near-term scheduled debt payment. In this way risky debt induces a suboptimal investment policy and firm value is not maximized as it would be if the firm issued no risky debt. One problem here is that we do not have strict equivalence between equity-value maximization and firm-value maximizations, so investment policy cannot be thought of entirely in terms of firm-value maximization. This is a quirk associated with the option-pricing framework when applied to firm valuation, and it clouds the determination of what is suboptimal in the finance area.[4]

Although we concede that we aren't entirely sure as to how we should treat the interaction effects of financing and investment policy, we can state with some degree of certainty that, even in the absence of the tax deductibility of interest, these two finance-related decisions are interdependent and, as a result, the financial manager should remain wary of those who subscribe to the idea that financing decisions do not matter.

Allowing the tax deductibility of interest, it is ironic to note that the conclusions are not nearly as clear-cut as before. If the firm undertakes further, more risky projects, the value of debt may actually increase if the firm does not issue further debt. The shareholders gain from the new project only on its own merits. If no additional debt financing is raised, it is impossible to obtain a larger tax shield and the debt may actually become more secure as a result of the larger asset base. If, however, the firm does issue more debt and in that way acts to jeopardize the currently outstanding debt, the number of considerations multiply, and analysis becomes exceedingly difficult because the value of the project by itself, plus the value of the added tax shield, needs to be considered in light of the possible shifting of wealth due to transfers of risk among claimants of the firm. Thus it seems that, when we allow the real world to influence the model, as it well should, the only thing we can say for certain about financing and investment decisions is that each case must be considered separately.

2.5 Implications of Financing and Investment Interactions for Capital Budgeting

This section is intended to briefly review capital-budgeting techniques, explain how each in turn neglects accounting for financing influences in investment-opportunity analysis, and discuss the method by which they do incorporate this aspect of financial management into the decision process. We will draw heavily on the work of Chambers et al. (1982), in making particular distinctions between methods most often covered in corporate-finance textbooks and presumably used in practice, presenting numerical comparisons derived from varying sets of circumstances.

Chambers, Harris, and Pringle (CHP) examined four standard, discounted cash-flow models and considered the implications of using each as opposed to the other three. By way of simulation, they were able to deal with differences in financing projects as well as with possible differences in the risk underlying the operating cash flows generated by each project. The problem inherent in this and any project evaluation (not withstanding other difficulties) is in concentrating on the specification of the amount of debt used to finance the investment project. Project debt is therefore defined as the *additional debt capacity* afforded the firm as a result of accepting the project, and can alternatively be described as the difference between the firm's optimal debt level *with* the project and *without* it. Conceptually this is a fairly concrete construct, but it still leaves some vague areas when we are actually performing the computations.

It is essential to arrive at some value estimate of the estimated cash flows of a project. The CHP analysis considered the following four methods: (i) the Equity Residual method; (ii) the "after-tax Weighted Average Cost-of-Capital" method; (iii) the "Arditti-Levy" weighted cost-of-capital method; and (iv) the Myers "Adjusted Present Value" method. For simplicity, Table 2.3 contains the definitions of the symbols used in the following discussion, after which we briefly discuss the formulation of each method, and then elaborate on the way in which each method incorporates interacting effects of financing and investment decisions.

Equity-Residual Method

The equity-residual method is formulated in Equation (2.13) in a manner that emphasizes the goal of financial management, the pursuance of the interests of shareholders:

Table 2.3 Definitions of variables

R_t = Pretax operating cash revenues of the project during period t;
C_t = Pretax operating cash expenses of the project during period t;
dep_t = Additional depreciation expense attributable to the project in period t;
τ_c = Applicable corporate tax rate;
I = Initial net cash investment outlay;
D_t = Project debt outstanding during period t;
NP = Net proceeds of issuing project debt at time zero;
r_t = Interest rate of debt in period t;
k_e = Cost of the equity financing of the project;
k_w = After-tax weighted-average cost of capital (i.e., debt cost is after-tax);
k_{AL} = Weighted average cost of capital – debt cost considered before taxes;
ρ = Required rate-of-return applicable to unlevered cash-flow series, given the risk class of the project
r, k_e, and ρ are all assumed to be constant over time

$$NPV(ER) = \sum_{t=1}^{N} \frac{[(R_t - C_t - dep_t - rD_t)(1-\tau_c) + D_t] - (D_t - D_{t+1})}{(1+k_e)^t} - [I - NP]. \tag{2.13}$$

The formula presented above can be interpreted as stating that the benefit of the project to the shareholders is the present value of the cash flows not going to pay operating expenses or to service or repay debt obligations.

With these flows identified as those going to shareholders, it is appropriate, and rather easy, to discount these flows at the cost of equity. The only difficulty involved is identifying this cost of equity, a problem embodied in all capital-budgeting methods.

After-Tax, Weighted-Average, Cost-of-Capital Method

The after-tax, weighted-average, cost-of-capital method, depicted in Equation (2.14), has two noticeable differences from the formulation of the equity-residual method:

$$NPV = \sum_{t=1}^{N} \frac{(R_t - C_t - dep_t)(1-\tau_c) + dep_t}{(1+k_w)^t} I. \tag{2.14}$$

First, no flows associated with the debt financing appear in the numerator, or as relevant cash flows. Second, the cost of capital is adjusted downward, with k_w being a weighted average of debt and equity costs, the debt expense accounted for on an after-tax basis. In that way debt financing is reckoned with in an indirect manner. With the assumption that r and k_e are constant over time, k_w can be affected only by the debt-to-equity ratio, a problem most often avoided by assuming a fixed debt-to-equity ratio.

2.5.1 Arditti and Levy Method

The Arditti-Levy method is most similar to the after-tax weighted-average cost-of-capital method. This formulation can be written as:

$$NPV(AL) = \sum_{t=1}^{N} \frac{[(R_t - C_t - dep_t - rD_t)(1-\tau_c) + dep_t] + rD_t}{(1+k_{AL})^t} - I \tag{2.15}$$

It was necessary to restate the after-tax, weighted-average, cost-of-capital formula in this manner because the tax payment to the government has an influence on the net cash flows, and for that reason the cash-flow figures would be misleading. To rectify this problem the discount rate must now be adjusted as the interest tax shield is reflected in the cash flows and double counting would be involved. While the after-tax, weighted-average cost of capital recognized the cost of debt in the discount rate, it was akin to the equity-residual method in considering only returns to equity. The Arditti and Levy formulas imply that a weighted average discount rate including the lower cost of debt could only (or best) be used if all flows to all sources of financing were included; hence the term rD_t is found at the end of the first term. This can be rationalized if one considers the case of a firm where there is one owner. The total cash flow to the owner is the relevant figure, and the discount rate applicable is simply a weighted average of the two individual required rates of return.

Table 2.4 Application of four capital budgeting techniques

Inputs: (1) $k_e = 0.112$ (2) $r = 0.041$ (3) $\tau_c = 0.46$ (4) $\rho = 0.0802$ (5) w = 0.6		
Method	NPV results	Discount rates
1. Equity-residual	\$230.55	$k_e = 0.112$
2. After-tax WACC	270.32	$k_w = 0.058$
3. Arditti-Levy WACC	261.67	$k_{AL} = 0.069$
4. Myers APV	228.05	$r = 0.041$ and $\rho = 0.0802$

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2.5.2 Myers Adjusted-Present-Value Method

This method, derived in Sect. 2.4, is closely related to the Arditti-Levy method except for the exclusion of the interest-expense flows to the bondholders. In treating the financing mix, Myers implicitly assumes that the tax shield, created by the interest payments and afforded to the equity holders, has the same risk for the equity holders as the coupon or interest payments have for the bondholders. Instead of aggregating all factors and attempting to arrive at a suitable weighted-average discount rate, Myers found it less difficult to leave operating- and financing-related flows separated, and to discount each at an appropriate rate. This formulation can be written as:

$$APV = \sum_{t=1}^{N} \frac{(R_t - C_t - dep_t)(1 - \tau_c) + dep_t}{(1+\rho)^t} - I + \sum_{t=1}^{N} \frac{\tau_c \, r D_t}{(1+r)^t}. \qquad (2.16)$$

This formulation appears to be closely related to the Modigliani and Miller with-tax firm-valuation model, and well it should, given Myers' motivation for this work. We choose not to discuss it here, but the reader should be aware that Myers' emphasis was not solely on the tax advantage of debt, as the last term in the above equation tends to imply.

The four methods are obviously comparable, but usually give different figures for the net present value. The equity-residual, after-tax, weighted-average cost-of-capital and the Arditti-Levy weighted-average, cost-of-capital formulations are comparable if the value of the debt outstanding remains a constant proportion of the remaining cash flows; this is often taken to mean a constant debt ratio. This will not guarantee that the Myers APV method will yield the same results, although the Myers method is equivalent to the other three only if the project life can be described as one period, or as *infinite with constant perpetual flows* in all periods. By way of numerical examples we now address the task of determining the factors that create the differences in the net-present-value figures generated by each method.

The first example involves the simplest case, where a \$1,000 investment generates operating flows of \$300 per year for all 5 years of the project's life. Debt financing comprises \$600 of the project's total financing and the principal is repaid over the five time periods in equal amounts. The discount and tax rates employed are included below in Table 2.4 with the results for each of the four methods.

Because the Arditti-Levy method recognizes the acquisition of the debt capital and uses a lower discount rate, as does the after-tax WACC, these two methods give the highest net-present-value figures. The equity-residual method recognizes only the \$400 outflow at time zero, but the higher discount suppresses the net-present-value figure. The Myers APV method, though discounting financing-related flows at the cost of debt, also attains a low net-present-value figure because the majority of the flows are discounted at a higher unlevered cost-of-equity rate.

Basically we can speak of three differences in these methods that create the large discrepancies in the bottom-line figures. The risk factor, reflected in discount rates that may vary over time, is a major element, as was evidenced in the example shown above. The pattern of debt and debt payments will also be an important factor, particularly so when the debt repayment is not of the annuity form assumed earlier. Finally, the recognition and valuation of the debt tax shields will play an important role in net-present-value determination, especially when the constant-debt-repayment assumption is dropped and the interest expenses and associated tax shields grow larger.

In the CHP study the valuation models described earlier were employed in a simulation procedure that would allow the assessment of the investment proposal. The inputs to the capital-budgeting procedures were varied across simulations, and the effects of the changes in each input were scrutinized from a sensitivity-analysis viewpoint. They considered, but did not dwell upon, the effects of changing discount rates over time or by some scaling factor on the bottom-line valuation figures; further discussion was deferred primarily because of the multitude of possible combinations that would be of interest. Compounding the problem, one would also be interested in different debt-equity combinations and the effects these would have with changing discount rates, as the weighting scheme of the appropriate discount rates plays an integral part in the analysis. In avoiding this aspect of the analysis, the projects evaluated in the forthcoming discussion will be viewed as being of equivalent risk, or as coming

Table 2.5 Inputs for simulation

Project	Net cash inflows per year	Project life
1	$300 per year	5 years
2	$253.77 per year	5 years
3	$124.95 per year	20 years
4	$200 per year, years 1–4	5 years
	$792.58 in year 5	
For each project the initial outlay is $1,000 at time $t = 0$, with all subsequent outlays being captured in the yearly flows		
Debt schedule		
Market value of debt outstanding remains a constant proportion of the project's market value		
Equal principal repayments in each year		
Level debt, total principal repaid at termination of project		
Inputs:	$k_e = 0.112$	$r = 0.041$
	$k_w = 0.085$	$\rho_{(M\&M)} = 0.0986$
	$\rho_M = 0.085$	$\tau_c = 0.46$
	W = 0.3	

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from the same risk class. Lest the reader feel shortchanged, it is suggested that one examine each method and verify for him or herself what changes would be produced in the net-present-value figures with varying debt schedules.

More in tune with the basic theme of this chapter, we go on to consider the effects that changing financing mixes, debt-payment patterns, and project lives have on the figures attained for each of the four methods considered, the first (financing mix) being the major issue involved.

In confronting mix effects, we are required to select a model for valuing debt in the Myers APV method because ρ (the unlevered cost of equity capital) is unobservable. In this case we must choose between numerous alternatives, the most notable being those of Modigliani and Miller (1963), where debt provides an interest-tax shield, and that of Miller (1977), where the inclusion of personal taxes on investor interest income has the effect of perfectly offsetting the tax shield the firm receives, rendering the debt tax advantage moot. In the simulation results of CHP presented in the following paragraphs, the Myers cost of unlevered equity capital is computed using each method, with subscripts denoting the particular method used.

Four projects of varied cash-flow patterns and lives are to be presented and valued, each of which will be simulated with three different debt schedules. Brief descriptions of the projects and debt schedules can be found in Table 2.5, along with the fixed inputs to be used in the actual computations.

The projects' cash flows, as listed in the table, were actually manipulated in a predetermined way, so that the more interesting cases would be presented. Project 1 is simply a base figure, while project 2 has a cash-flow pattern that makes the net present value 0, when using the after-tax, weighted-average cost of capital. Project 3 has a longer life, and thus will serve as a method of determining the effects of increasing project life. Finally, Project 4 has four level payments with a larger final payment in year 5, intended to simulate an ongoing project with terminal value in year 5.

The results of the simulations are presented in Table 2.6. For purposes of comparison, the net-present-value figures of the after-tax, weighted-average cost of capital are reported first, for two reasons. The after-tax weighted-average cost of capital is probably the best-known technique of capital budgeting, and its net present value figures are insensitive to the debt schedule. The initial weights of the debt and equity used to support the project are all that are used in calculating the weighted discount rate, rendering the repayment pattern of debt irrelevant.

As indicated earlier, the after-tax weighted-average cost of capital, Arditti-Levy weighted-average cost of capital, and the equity-residual methods are all equivalent if the debt ratio is held constant. It is also of interest here that the Myer's APV figures, using the Miller method for determining the cost of capital, are constant over debt schedules; they are, for all intents and purposes, the same as the after-tax, weighted-average cost-of-capital figures, a finding that is reasonable if one believes that the cost of debt capital is the same as that of unlevered equity. Of all the methods cited above, the equity-residual method is the most sensitive to the debt schedule employed, with both principal and interest payments included in the cash flows, a feature compounded by the higher discount rates included in the computations. The two methods that include the interest tax shield, the Arditti-Levy method and the Myers APV (M&M) method are also sensitive to the amount of debt outstanding, the interest tax shield being of greater value the longer the debt is outstanding. In all cases the latter method gives the lowest net-present-value figures due to the treatment of the interest tax shield.

In further simulations CHP showed (and it should be no surprise) that as higher levels of debt are employed and higher tax rates are encountered, the magnitude of the

Table 2.6 Simulation results

		Net-present-value under alternative debit schedule		
Project	Capital budgeting	Constant debt ratio	Equal principal	Level debt
1	After-tax WACC	182	182	182
	Arditti-levy WACC	182	179	187
	Equity-residual	182	167	202
	Myers APV (M&M)	160	157	166
	Myers APV (M)	182	182	182
2	After-tax WACC	0	0	0
	Arditti-Levy WACC	0	−1	7
	Equity-Residual	0	−3	32
	Myers APV (M&M)	−18	−19	−10
	Myers APV (M)	0	0	0
3	After-tax WACC	182	182	182
	Arditti-Levy WACC	182	169	186
	Equity Residual	182	128	194
	Myers APV (M&M)	138	119	150
	Myers APV (M)	182	182	182
4	After-tax WACC	182	182	182
	Arditti-Levy WACC	182	174	182
	Equity Residual	182	147	183
	Myers APV (M&M)	155	146	156
	Myers APV (M)	182	182	182

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differences is amplified, and the method employed in the capital-budgeting decision takes on greater and greater importance. Even so it was argued that changes associated with changes in the inputs of the longest-lived project, where the changes in the net-present-value figures were the most pronounced, were not that great when compared with the outcomes associated with changing the estimates of the cash flows by as little as 5%. The importance of this finding is that projects that are of short duration and are financed with relatively little debt are not as sensitive to the capital-budgeting technique employed. But, in the case of longer-lived projects, the method selected can have serious implications for the acceptance or rejection of a project, particularly when higher levels of debt financing are employed. Analysts undoubtedly possess their own views as to which method is stronger conceptually and, in the event of capital-budgeting procedures, should be aware of the debt policy to be pursued. Even in light of these views, it may be prudent to use the Myers APV method with the M&M unlevered-equity cost-determination method as the first screening device for a project or set of projects. Since this method yields the most conservative figures, any project that appears profitable following this analysis should be undertaken, and any project failing this screening can be analyzed using the methods chosen by the financial manager, if further analysis is thought to be warranted.

In this book, Chap. 56 discusses the capital structure and CEO entrenchment in Asia. Moreover, Chap. 60 discusses the theory and application of alternative methods to determine optimal capital structure. Finally, Chap. 92 provides discussion on the capital structure and entry deterrence.

2.6 Implications of Different Policies on the Beta Coefficient

Investment, financing, dividend, and production policy are four important policies in financial management decision. In previous sections, we have discussed investment, financing and dividend policies. In this section, we will discuss the impacts of financing, production and the dividend policy on beta coefficient determination.

Impact of Financing Policy on Beta Coefficient Determination

Suppose that the security is a share in the common stock of a corporation. Let us assume that that this corporation increases the proportion of debt in its capital structure, all other relevant factors remaining unchanged. How would you expect this change to affect the firm's beta? We have seen that an increase in the level of debt leads to an increase in the riskiness of stockholders' future earnings. To compensate for this additional risk, stockholders will demand a higher expected rate of return. Therefore, from Equation (2.17), beta must rise for this company's stock. We see that, all other things equal, the higher the proportion of debt in a firm's capital structure, the higher the beta of shares of its common stock.

$$\beta_L = \beta_U \left(1 + \frac{B(1-\tau_c)}{S}\right) \tag{2.17}$$

where β_L is the leveraged bet; β_U is the unlevered operating beta; B is the amount of debt; S is the amount of equity; and τ_c is the corporate tax rate.

When the market model is used to estimate a firm's beta, the resulting estimate of the beta is the market assessment of both operating and financial risk. This is called *leveraged beta*. Hamada (1972) and Rubinstein (1973) suggest that Equation (2.17) can be modified to calculate the unleveraged beta. This beta is an estimate of the firm's operating or business, risk.

Impact of Production Policy on Beta Coefficient Determination

In this section, we will first discuss production policy. Then we will discuss implications of different policies on the beta coefficient determination. Production policy refers to how a company uses different input mix to produce its products. The company's production process can be classified into either capital intensive or labor intensive, which depend on whether capital labor ratio (K/L Ratio) is larger or smaller than one. We can use either Cobb-Douglas production function or Variable Elasticity of Substitution (VES) production function to show how capital and labor affect the change of the beta coefficient. The Cobb-Douglas production function in two factors, capital (K) and labor (L) can be defined as follows.

$$Q = K^a L^b \tag{2.18}$$

where Q is firm's output, a and b are positive parameters.

Lee et al. (1990) have derived the theoretical relationship between beta coefficient and the capital labor ratio in terms of the Cobb-Douglas production functions as follows in Equation (2.18).

$$\beta = \frac{(1+r)Cov(\tilde{e}, \tilde{R}_m)}{Var(\tilde{R}_m)\{\phi[1-(1-E)b]\}} \tag{2.19}$$

where r, the risk-free rate; $\tilde{R}_m$, return on the market portfolio; $\tilde{e}$, random price disturbances with zero mean; $E = -(\partial P/\partial Q)(Q/P)$, an elasticity constant; b, contribution of labor to total output; $\phi = 1-\lambda\,\mathrm{cov}(\tilde{v}, \tilde{R}_m)$, and λ, the market price of systematic risk.

In addition, the VES production function in two factors capital (K) and labor (L) can be defined as follows in Equation (2.19).

$$Q = K^{\alpha(1-s\rho)}[L + (\rho-1)K]^{\alpha s\rho} \tag{2.20}$$

where Q is firm's output and α, s, and ρ are parameters with the following constraints:

$$\begin{aligned}
&\alpha > 0,\\
&0 < s < 1\\
&0 \le s\rho \le 1,\\
&L/K > (1-\rho)/(1-s\rho)^3.
\end{aligned}$$

Lee et al. (1995) have derived the theoretical relationship between beta coefficient and the capital labor ratio in terms of the VES production functions as follows.

$$\beta = \frac{(1+r)\left\{Cov(\tilde{e}, \tilde{R}_m) - [\Phi(1-\mu E)\alpha s\rho\phi^{-1} - w(pQ)^{-1}(1-\rho)K]Cov(\tilde{v}, \tilde{R}_m)\right\}}{Var(\tilde{R}_m)\{\Phi - [\Phi(1-\mu E)\alpha s\rho - w\phi(pQ)^{-1}(1-\rho)K\}} \tag{2.21}$$

where p, expected price of output; μ, reciprocal of the price elasticity of demand, $0 \le \mu \le 1$; w, expected wage rate; $\tilde{v}$, random shock in the wage rate with zero mean; $\Phi = 1 - \lambda\mathrm{cov}(\tilde{e}, \tilde{R}_m)$, and r, $\tilde{R}_m$, $\tilde{e}$, E, ϕ, λ are as defined in Equation (2.19).

Impact of Dividend Policy on Beta Coefficient Determination

Impact of payout ratio on beta coefficient is one of the important issues in finance research. By using dividend signaling theory, Lee et al. (1993) have derived the relationship between the beta coefficient and pay out ratio as follows:

$$\beta_i = \beta_{pi}[1 + \gamma F(d_i)] \tag{2.22}$$

β_i, the firm's systematic risk when the market is informationally imperfect and the information asymmetry can be resolved by dividends; β_{pi}, the firm's systematic risk when market is informationally perfect; γ, a signaling cost incurred if firm's net after-tax operating cash flow X falls below the promised dividend D; d_i, firm's dividend payout ratio; $F(d_i)$, cumulative normal density function in term of payout ratio.

Equation (2.21) implies that beta coefficient is a function of payout ratio.

In sum, this section has shown that how financing, production, and dividend policy can affect the beta coefficient. This information discussed in this section is important for calculating the cost of capital equity.

2.7 Conclusion

In this chapter we have attacked many of the irrelevant propositions of the neoclassical school of finance theory, and in so doing have created a good news-bad news sort of situation. The good news is that by claiming that financial policies are important, we have justified the existence of academicians and a great many practicing financial managers. The bad news is that we have made their lot a great deal more difficult as numerous tradeoffs were investigated, the more general of these comprising the title of the chapter.

In the determination of dividend policy, we examined the relevance of the internal-external equity decision in the presence of nontrivial transaction costs. While the empirical evidence was found to be inconclusive because of the many variables that could not be controlled, there should be no doubt mind that flotation costs (incurred when issuing new equity to replace retained earnings paid out) by themselves have a negative impact on firm value. But if the retained earnings paid out are replaced whole or in part by debt, the equity holders may stand to benefit because the risk is transferred to the existing bondholders – risk they do not receive commensurate return for taking. Thus, if the firm pursues a more generous dividend-payout policy while not changing the investment policy, the change in the value of the firm depends on the way in which the future investment is financed.

The effect that debt financing has on the value of the firm was analyzed in terms of the interest tax shield it provides and the extent to which the firm can utilize that tax shield. In Myers' analysis we also saw a that a limit on borrowing could be incorporated so that factors such as risk and the probability of insolvency would be recognized when making each capital-budgeting decision. When compared to other methods widely used in capital budgeting, Myers' APV formulation was found to yield more conservative benefit estimates. While we do not wish to discard the equity-residual, after-tax weighted cost-of-capital method or the Arditti-Levy weighted cost-of-capital method, we set forth Myers' method as the most appropriate starting point when a firm is first considering a project, reasoning that if the project was acceptable following Myers' method, it would be acceptable using the other methods – to an even greater degree. If the project was not acceptable following the APV criteria, it could be reanalyzed with one of the other methods. The biases of each method we hopefully made clear with the introduction of debt financing. In Sect. 2.6 we have discussed how different policies can affect the determination of beta coefficient.

In essence, this chapter points out the vagaries and difficulties of financial management in practice. Virtually no decision concerning the finance function can be made independent of the other variables under management's control. Profitable areas of future research in this area are abundant; some have already begun to appear in the literature under the heading "simultaneous-equation planning models." Any practitioner would be well advised to stay abreast of developments in this area.

Notes

1. Alderson (1984) has applied this kind of concept to the problem of corporate pension funding. He finds grounds for the integration of pension funding with capital structure decisions. In doing so, he argues that unfunded vested liabilities are an imperfect substitute for debt.
2. BHS (1981) discusses the relationship between debt capacity and the existence of optimal capital structure.
3. If the dividend policy is irrelevant, then $L_{ct} = L_{c,t-1} = 0$; if $dW/dy_t = F_t$ is positive, then the constraints U will always be binding, Equation (2.7b) will be strict equalities, and L_{ft} for all t. Substituting $L_{ct} = 0$ and $L_{ft} = F_t$ into Equation (2.8), we obtain Equation (2.12).
4. This statement can be explained by the agency theory, which was developed by Jensen and Meckling (1976) and was extended by Barnea et al. (1981). According to the agency theory and the findings of Stiglitz (1972), the manager might not act out of the equityholders' best interest. For his own benefit, the manager might shift the wealth of a firm from the equityholders to bondholders.

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Appendix 2A Stochastic Dominance and its Applications to Capital-Structure Analysis with Default Risk

2A.1 Introduction

Mean-variance approaches were extensively used in the literature to derive alternative finance theories and perform related empirical studies. Besides mean-variance approaches, there is a more general approach, stochastic-dominance analysis, which can be used to choose a portfolio, to evaluate mutual-fund performance, and to analyze the optimal capital-structure problem.

Levy and Sarnat (1972), Porter and Gaumwitz (1972), Jean (1975), and Ang and Chua (1982) have discussed the stochastic-dominance approach to portfolio choice and mutual-fund performance evaluation in detail. Baron (1975), Arditti and Peles (1977), and Arditti (1980) have used the theory of stochastic dominance to investigate the optimal capital-structure question. In this appendix we will discuss only how stochastic-dominance theory can be used to analyze the issue of optimal capital structure with default risk.

2A.2 Concepts and Theorems of Stochastic Dominance

The expected utility rule can be used to introduce the economics of choice under uncertainty. However, this decision rule has been based upon the principle of *utility maximization*, where either the investor's utility function is assumed to be a second-degree polynomial with a positive first derivative and a negative second derivative, or the probability function is assumed to be normal. A stochastic-dominance theory is an alternative approach of preference orderings that does not rely upon these restrictive assumptions. The stochastic-dominance technique assumes only that individuals prefer more wealth to less.

An asset is said to be stochastically dominant over another if an individual receives greater wealth from it in every (ordered) state of nature. This definition is known as first-order stochastic dominance. Mathematically, it can be described by the relationship between two cumulative-probability distributions. If X symbolizes the investment dollar return variable and $F(X)$ and $G(X)$ are two cumulative-probability distributions, then $F(X)$ will be preferred to $G(X)$ by every person who is a utility maximizer and whose utility is an increasing function of wealth if $F(X) \leq G(X)$ for all possible X, and $F(X) < G(X)$ for some X.

For the family of all monotonically nondecreasing utility functions, Levy and Sarnat (1972) show that first-order stochastic dominance implies that:

$$E_F U(X) > E_G U(X) \tag{2A.1}$$

where $E_F U(X)$ and $E_G U(X)$ are expected utilities. Mathematically, they can be defined as:

$$E_F U(X) = \int_{-x}^{x} U(X) f(X) dx \tag{2A.2a}$$

$$E_F U(X) = \int_{-x}^{x} U(X) g(X) dx \tag{2A.2b}$$

where $U(X)$ = the utility function, X = the investment dollar-return variable, $f(X)$ and $g(X)$ are probability distributions of X. It should be noted that the above-mentioned first-order stochastic dominance does not depend upon the shape of the utility function with positive marginal utility. Hence, the investor can either be risk-seeking, risk neutral, or risk-averse. If the risk-aversion criterion is imposed, the utility function is either strictly concave or nondecreasing.

If utility functions are nondecreasing and strictly concave, then the second-order stochastic-dominance theorem can be defined. Mathematically, the second-order dominance can be defined as:

$$\int_{-x}^{x} [G(T) - F(t)] dt > 0, \text{ where } G(t) \neq F(t) \text{ for some } t. \tag{2A.3}$$

Equation (2A.3) specifies a necessary and sufficient condition for an asset F to be preferred over a second asset G by all risk-averters.

Conceptually, Equation (2A.3) means that in order for asset F to dominate asset G for all risk-aversion investors, the accumulated area under the cumulative-probability distribution G must be greater than the accumulated area for F for any given level of wealth. This implies that, unlike first-order stochastic dominance, the cumulative density functions can cross.

Stochastic dominance is an extremely important and powerful tool. It is properly founded on the basis of expected utility maximization, and even more important, it applies to any probability distribution. This is because it takes into account every point in the probability distribution. Furthermore, we can be sure that, if an asset demonstrates second-order stochastic dominance, it will be preferred by all risk-aversion investors, regardless of the specific shape of their utility functions.

Assume that the density functions of earnings per share (EPS) for both firm A and firm B are $f(X)$ and $g(X)$, respectively. Both $f(X)$ and $g(X)$ have normal distributions and the shape of these two distributions are described in Fig. 2A.1. Obviously the EPS of firm A will dominate the EPS of firm B if an investor is risk-averse because they both

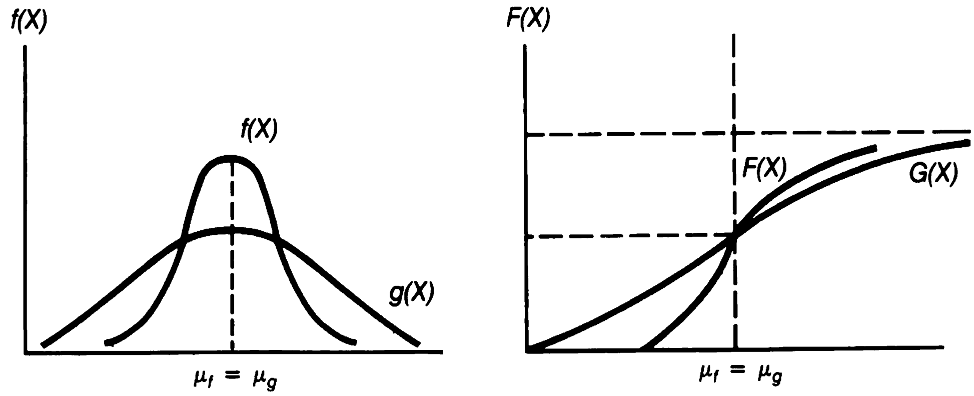

Fig. 2A.1 Probability distributions of asset F and asset G

offer the same expected level of wealth ($\mu_f = \mu_g$) and because the variance of $g(X)$ is larger than that of $f(X)$.

Based on both the first-order and the second-order stochastic-dominance theorems mentioned earlier, a new theorem needed for investigating capital structure with default risk can be defined as:

Theorem 2A.1. *Let F, G be two distributions with mean values μ_1 and μ_2 respectively, such that, for some $X_0 < \infty$, $F \leq G$ for $X \leq X_0$ (and $F < G$ for some $X_1 < X_0$) and $F \geq G$ for some $X \geq X_0$, then F dominates G (for concave utility functions) if and only if $\mu_1 \geq \mu_2$.*

The proof of this theorem can be formed in either Hanoch and Levy (1969) or Levy and Sarnat (1972). Conceptually, this theorem states that if two cumulative distributions, F and G, intersect only once, then if F is below G to the left of the intersection point and has a higher mean than does G, the investment with cumulative distribution F dominates that with cumulative return distribution G on a second-degree stochastic-dominance basis.

2A.3 Stochastic-Dominance Approach to Investigating the Capital-Structure Problem with Default Risk

The existence of default risk is one of the justification of why an optimal capital structure might exist for a firm. To analyze this problem. Baron (1975), Arditti and Peles (1977), and Arditti (1980) have used the stochastic-dominance theorem described in the previous sections to indicate the effects of debt-financing bonds on relative values of levered and unlevered firms. Baron analyzed the bonds in terms of default risk, tax rates, and debt levels.

Consider two firms, or the same firm before and after debt financing, with identical probability distribution of gross earnings X, before taxes and financial charges, such that, in any state of nature that occurs, both firms have the same earnings. In addition, it is assumed that this random variable X is associated with a cumulative-distribution function $F(X)$. Firm A is assumed to be financed solely by equity, while firm B is financed by both debt and equity. The market value V_1 of firm A equals E_1, the value of its equity, while the market value V_2 of firm B equals the market value of its equity (E_2) plus the value of its debt (D_2). Debt is assumed to sell at its par value and to carry a gross coupon rate of r ($r > 0$).

The firm can generally use the coupon payments as a tax shield and therefore the after-tax earnings for firms A and B can be defined as $X(1-T)$ and $(X-rD_2)(1-T)$, respectively (where T is the corporate-profit tax rate.) If an investor purchases a fraction of firm A, this investment results in dollar returns of:

$$Y_1 = \begin{cases} 0, & \text{if } X \leq 0, \\ \alpha X(1-T) & \text{if } X > 0, \end{cases} \tag{2A.4}$$

with cumulative probability function:

$$G_1(Y) = \begin{cases} F(0) & \text{if } Y = 0, \\ F(Y/(1-T) & \text{if } Y > 0. \end{cases} \tag{2A.5}$$

If the investor purchased a fraction α of the equity and α of the debt of firm B, this dollar return would be:

$$Y_2 = \begin{cases} 0 & \text{if } X \leq 0, \\ \alpha(1-k)X(1-T) & \text{if } 0 < X(1-T) < D_2 + rD_2, \\ \alpha(X(1-T) + TrD_2 & \text{if } x(1-T) \geq D_2 + rD_2, \end{cases} \tag{2A.6}$$

where k represents the percentage of liquidation cost. Since these bonds comprise a senior lien on the earnings of the firm, failure to pay the promised amount of $D_2 + rD_2$ to bondholders can force liquidation of the firm's assets.

The cumulative distribution associated with Equation (2A.7) is:

$$G_2(Y) = \begin{cases} F(0) & \text{if } Y = 0, \\ F[Y/\alpha(1-k)(1-T)] & \text{if } 0 < y \leq \alpha(1-k)[D_2 + rD_2], \\ F[Y/\alpha(1-T) - TrD_2] & \text{if } Y \geq \alpha[D_2 + rD_2]. \end{cases} \quad (2A.7)$$

Comparing Equation (2A.5) with Equation (2A.7), it can be found that:

$$G_1(Y) < G_2(Y) \text{ if } 0 < Y < \alpha(D_2 + rD_2), \quad (2A.8)$$

$$G_2(Y) \geq G_2(Y) \text{ if } Y \geq \alpha(D_2 + rD_2), \quad (2A.9)$$

where $\alpha(D_2 + rD_2)$ is the critical income level of bankruptcy.

Equations (2A.8) and (2A.9) imply that the levered firm cannot dominate the unlevered firm on a first-degree or second-degree stochastic-dominance basis. From the theorem of stochastic dominance that we presented in the previous section, it can be concluded that the unlevered firm cannot dominate the levered firm because the expected return of the levered firm is generally higher than that of the unlevered firm (otherwise why levered?), and because the $G_2(Y)$ and $G_1(Y)$ curves intersect only once.

Consequently, a general statement using stochastic dominance cannot be made with respect to the amount of debt that a firm should issue. However, these results have indicated the possibility of interior (noncorner) optimal capital structure. By using a linear utility function, Arditti and Peles (1977) show that there are probability distributions for which an interior capital structure for a firm can be found. In addition, they also make some other market observations, which are consistent with the implications of their model. These observations are (i) firms with low income variability, such as utilities, carry high debt-equity ratios; and (ii) firms that have highly marketable assets and therefore low liquidation costs, such as shipping lines, seem to rely heavily on debt financing relative to equity.

2A.4 Summary

In this appendix we have tried to show the basic concepts underlying stochastic dominance and its application to capital-structure analysis with default risk. By combining utility maximization theory with cumulative-density functions, we are able to set up a decision rule without explicitly relying on individual statistical moments. This stochastic-dominance theory can then be applied to problems such as capital-structure analysis with risky debt, as was shown earlier.

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