**FOR FIN 4310 MANAGERIAL FINANCE**

**LECTURE 7**

***FINANCIAL ANALYSIS, CORPORATE VALUATION AND CAPITAL FORMATION***

by

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## **7.I. Introduction[[1]](#footnote-1)**

Capital budgeting is a process that generically concerns the identification, evaluation and selection of capital projects that a business venture wants to consider investing in. The identification of potential projects occurs at a strategic level, perhaps resulting from the firm’s mission statement and the vision of its top management. Assuming that capital (money) is obtainable, capital budgeting provides an answer to whether the proposed activity is worthwhile, on a financial basis. Money may talk, as it is absolutely necessary for engaging in proposed business activities, but the creative aspects involved in developing ideas for proposed business activities require that money be made to also sing and dance. The most creative of proposals of course involve new inventions, but even more mundane proposals such as the expansion of existing business involves some creativity. The bottom line is whether what one proposes to do with capital (presuming one can obtain capital) is worthwhile.

The evaluation requires pro forma analysis, with forecasts of the projects net cash flows and cost of capital. The selection comes from the technical results of the evaluation, although the decision can be complicated when multiple projects are evaluated, especially if these are substitutes or mutually exclusive, or have unequal lives or unequal scales of investment requirements. Selection of a project is normally a conventional capital budgeting decision, although there may be strategic consequences involving effects on the firm’s competitive position, possibilities for extensions of the investment, or its effects on the firm’s subsequent investments, or its risk.

The ultimate aim of a technical analysis of a project is to decide whether it earns a sufficiently high return to at least cover the required returns to its owners and creditors. This criteria is consistent with microeconomic theory, where it is known that the firm should continue to expand output so long as its marginal revenue (MR) is greater than its marginal cost (MC). This rule is consistent with the concept (in terms of discounted values) of accepting a project so long as its net present value (NPV) is greater than zero. In this case, the project’s marginal discounted benefits are greater than its marginal discounted costs, i.e. the project’s discounted MR > MC, so that MR - MC > 0 or marginal discounted benefits are greater than marginal discounted costs, and therefore NPV > 0.

**7.2 Capital Budgeting Basics**

**7.2.1. Traditional Net Income after Taxes and Cash Flows**

Assume that we are interested in analyzing the purchase of a machine for business purposes. The machine has a 3 year life. Its purchase price, that is its cash outflow (CF0) at time zero, is $100,000. This machine will produce Operating Cash Income (OIt) of $85,000 per year and Operating Cash Expenses (OEt) of $44,000 per year, with the years represented by subscript t, and t equal to 1 to 3. All cash flows are assumed to be in the form of regular or ordinary annuities. The Tax Rate (t) is 35%.

Conceptually, forecasting Operating Cash Income (OIt) requires some knowledge of probably prices and quantities sold, which may require the expertise of individuals in economics and marketing. And forecasting Operating Cash Expenses (OEt) requires some knowledge of the technical requirements for operating the machine and its associated costs, which may require the expertise of individuals in engineering and cost accounting.

Also assume that depreciation rates and amounts (Depret) are based on the 1986 Tax Reform Act Modified Accelerated Cost Recovery System ((MACRS) for 3-year life projects. These rates are 33.33% in the first year, 44.45% in the second year, 14.81% in the third year, and 7.41% in the fourth year. These percentages are off of the purchase price of the machine, using a double-declining balance depreciation rate. These depreciation rates are based on a rate double the straight-line imposed on a declining balance depreciable basis, with one-half the normal rate going to the first year and no salvage value assumed. The straight-line rate is 33.33%, and double the straight-line rate is 66.66%. Hence, the first-year depreciation is $33,333 or $100,000 (.6666) (1/2). In the second year, the depreciable basis falls to $66,667 or $100,000 - $33,333. The second-year depreciation is $44,445 or $66,667 (.6666). In the third year, the depreciable basis falls to $22,222 or $66,667 - $4,445. The third-year depreciation is $14,813 or $22,222 (.6666), and the fourth- year depreciation is the remaining balance $7410 or $100,000 - $33,333 - $44,445 - $14,813.

Notice that even though the project has a 3-year life, the depreciation is calculated over 4 years to make up for the half-year convention allowance in year one. One caveat to this example is that the IRS does permit one to switch to straight-line depreciation at any point in time where the depreciation amount is greater with straight-line than with the double declining balance method.

Thus far, the basic information for this machine is the following.

CF0 is - $100,000

OIt is $85,000 per year t, and t equal to 1 to 3

OEt is $44,000 per year t, and t equal to 1 to 3

Tax Rate t is 35%

3 year life

Depre1 = $33,333

Depre2 = $44,445

Depre3 = $14,813

Depre4 = $7410

The traditional definition for net income after taxes (NIATt) is the after tax value of the net amount of Operating Cash Income (OIt) less Operating Cash Expenses (OEt)less Depreciation (Depret). The traditional definition for cash flow (CFt) is the amount of net income after taxes (NIATt) plus Depreciation (Depret).

Thus, using the *traditional* formulas for net income after taxes (NIATt) and cash flows (CFt) for this project,

CFt = NIATt + Depre t

or

CFt = (OI t - OE t - Depre t) (1 – t) + Depre t

we can calculate these for our machine project for each year as follows.

CF 1 = ($85,000 – $44,000 - $33,333) (1 - .35) + $33,333

= **$4,983.55** + $33,333 = **$38,316.55**

CF 2 = ($85,000 – $44,000 - $44,445) (1 - .35) + $44,445

= **-$2,239.25** + $44,445 = **$42,205.75**

CF 3 = ($85,000 – $44,000 - $14,813) (1 - .35) + $14,813

= **$17,021.55** + $14,813 = **$31,834.55**

CF 4 = (- $7410) (1 - .35) + $ 7410

= **- $4,816.50** + $ 7410 = **$2,593.50**

Note that the first bold-faced number in each year’s cash flow above is the **traditional net income after taxes** and the second is the **traditional cash flow**.

Net income after tax (NIAT) is nested within net cash flow (CF). NIAT is an amount before one adds back depreciation to obtain CF. As the project was purchased (either with equity or debt financing or both) on day zero, depreciation is simply a non-cash outlay useful as a tax deduction. It reduces taxes and therefore increases CF, and as it is a non-cash outlay should be added back to the NIAT to measure the CF. The NIAT’s failure to account for depreciation’s non-cash outlay rests effectively pays for the project twice - when initially purchased and again when expensed as depreciation.

The traditional way of measuring NIAT and CF does not include any financing costs (such as interest expenses), and therefore differs from the way accountants measure net income. Other approaches mentioned later explicitly consider financing costs. How the financing costs are considered will affect as shown later what the project’s required return should be.

**7.2.1.1. Other Cash Flow Measures: Operating and Financial Cash Flows**

In addition to the traditional cash flow, this section also illustrates the calculation of the financial cash flows, which modifies the operating (traditional) cash flow for capital and working capital expenditures. In this sense, the actual financial cash flow must consider what the firm spends on capital out of the traditional cash flow that it earns. It should be mentioned that in a capital budgeting analysis, these capital expenditures would certainly be considered, as most obvious in the analysis is the capital expenditure involved in making the initial investment.

Assume that this year a firm has operating profits (EBIT) of $10,000,000, paid $4,000,000 in taxes and had depreciation of $1,000,000, as shown below.

This year

EBIT $10,000,000

Depreciation 1,000,000

Taxes 4,000,000

Also assume that this firm had total fixed assets, current assets and current liabilities this year and last year, as shown below.

This year Last year

Total Fixed Assets $20,000,000 $18,000,000

Current Assets 3,000,000 2,800,000

Current Liabilities 2,200,000 2,200,000

This firm’s Operating Cash Flow, i.e. Traditional Cash Flow, is $7 million and equal to the after-tax EBIT plus depreciation, as shown below.

Operating (Traditional) Cash Flow

EBIT $10,000,000

Less Taxes 4,000,000

Plus Depreciation 1,000,000

Equal Operating Cash Flow 7,000,000

The Financial Cash Flow differs from the Operating Cash Flow in that it modifies the latter for capital spending and working capital spending. Thus, before calculating Operating Cash Flow, we need to calculate the firm’s Capital and Working Capital Spending.

This firm’s Capital Spending is $3 million and equal to the current year total fixed assets less the prior year total fixed assets, plus depreciation (as depreciation is also a capital expenditure), as shown below.

Capital Spending

Plus This year Total Fixed Assets $20,000,000

Less Last year Total Fixed Assets 18,000,000

Plus Depreciation 1,000,000

Equal Capital Spending 3,000,000

This firm’s Working Capital Spending is $200,000 and equal to the current year net working capital less the prior year net working capital, as shown below.

Working Capital Spending

Plus This year Net Working Capital $800,000 = 3,000,000 – 2,200,000

Less Last year Net Working Capital $600,000 = 2,800,000 – 2,200,000

Equal Working Capital Spending $200,000

As a result, this firm’s Financial Cash Flow is $3.8 million, or Operating Cash Flow less the sum of Capital Spending and Working Capital Spending, as shown below

Financial Cash Flow

Operating Cash Flow $7,000,000

Less Capital Spending 3,000,000

Less Working Capital Spending 200,000

Equal Financial Cash Flow 3,800,000

**7.2.2. Weighted Average Cost of Capital or Hurdle Rate**

As previously mentioned, it is assumed that the machine’s $100,000 purchase price is financed with $80,000 of debt such that the weight of debt (wd) is 80% with a 5% pre-tax cost of debt (kd), and with $20,000 of equity such that the weight of equity (we) is 20% equity with a 9% cost of equity (ke). Thus, the overall (weighted average) cost of capital or hurdle rate [overall discount rate (ko)] is:

ko = (w d) (k d) (1 - .35) + (w e) (k e) = (.80) 5% (1 - .35) + (.20) 9%

= 2.6% + 1.8% = 4.4%

The weighted average cost of capital is the minimum return that the machine must earn in order to satisfy the returns required by its owners and creditors, and sets the minimum criteria for project acceptance. Once we determine the NIATt and cash flows CFt for this project, and its overall (weighted average) cost of capital, then the selection decision, that is, whether we accept or reject this project’s investment, can be considered.

**7.2.3. Net Present Value, Profitability Index and Internal Rate of Return**

Highly respected selection decision criteria include the Net Present Value (NPV), and the Internal Rate of Return (IRR). The criteria for acceptance with the NPV is that it be greater than zero for strong acceptance or zero for weak acceptance, and for IRR that it be greater than the overall (weighted average) cost of capital for strong acceptance or equal to it for weak acceptance.

The NPV is the discounted value of the cash flows using the 4.4% overall cost of capital. The formula for calculating the NPV is as follows, where the discounted value of the cash flows, excepting the initial cash outflow, is the Gross Present Value (GPV).

NPV = - CF0 + **[** Gross Present Value **]**

NPV = - CF0 + **[** CF1 / (1+ r)1 + CF2 / (1+ r)2 + CF3 / (1+ r)3 + CF4 / (1+ r)4 **]**

NPV = - $100,000 + [ $38,316.55 / (1.044)1 + $42,205.75 / (1.044)2

+ $31,834.55 / (1.044)3 + $2,593.50 / (1.044)4 ]

NPV = - $100,000 + [ $105,584.72 ]

NPV = $5,584.72

The project is acceptable by NPV. The value of the NPV is a dollar for dollar increase in the value of the stockholder’s wealth, after paying the required returns to the project’s owners and creditors. The basic reason as to why this machine has value is that at a 4.4% return - the cost of capital – an investment of $105,584.72 (the GPV) is necessary in order to generate the cash flows that this machine generates, that is the cash flow stream of $38,316.55 in one year, $42,205.75 in two years, $31,834.55 in three years, and $2,593.50 in four years. However, to generate this same cash flow stream, this machine requires an investment of $100,000, that is $5,584.72 less than the markets require. This is the source of the value of this machine, as shown by its NPV.

Another way of representing the NPV selection criteria is by calculating the project’s Profitability Index (PI). The PI is the ratio of the GPV and CF0, such that for our machine,

PI = Gross Present Value / CF0 = $105,584.72 / $100,000 = 1.0558

It is obvious that if the PI is greater than one, the NPV is greater than zero (strong acceptance); and if the PI is equal to one, the NPV is equal to zero (weak acceptance). Of course, if the PI is less than one, the NPV is less than zero, and the project should be rejected.

The Internal Rate of Return (IRR) solves for the discount rate (the IRR) that makes the discounted value of a project’s future cash flows equal to the investment amount, the initial cash outflow. This discount rate is the time weighted return that the cash flow stream earns on the investment, assuming that reinvestment of the cash flows occurs at the IRR rate. Thus, the solution for the IRR is the value of the IRR in the following formula.

CF0 = **[**CF1 / (1+ IRR)1 + CF2 / (1+ IRR)2 + CF3 / (1+ IRR)3 + CF4 / (1+ IRR)4 **]**

such that

$100,000 = [ $38,316.55 / (1 + IRR)1 + $42,205.75 / (1 + IRR)2

+ $31,834.55 / (1 + IRR)3 + $2,593.50 / (1 + IRR)4 ]

The solution, solved with a financial calculator with special CFi functions that allow for entering unequal or non-annuity values of cash flows, is that the IRR is 7.352%. As the selection criteria accepts the project when it earns a return greater than the cost of capital, that is the IRR is greater than ko, this project is acceptable by the IRR. Notice that the IRR is also the discount rate that would cause the NPV at the IRR rate to be zero.

**7.2.4. Payback Period and Discounted Payback Period**

The payback period conventionally uses the non-discounted cash flows to calculate the number of years that it would take for the project’s future cash flows to equal the initial cash outflow. That amount of time is the years it takes for the nondiscounted cash flows to payback the initial investment. In our example, the cash flow pattern is the following.

CF 0 -$100,000

CF 1 $38,316.55

CF 2 $42,205.75

CF 3 $31,834.55

CF 4 $2,593.50

The payback would then cumulate the future cash flows until such time as the amount equals $100,000, at which point the project is “paid back”. Hence, the payback period is 2.6118 years, as shown below.

CF 0 -$100,000 Cumulative Cash Flow

CF 1 $38,316.55 $38,316.55

CF 2 $42,205.75 $80,522.30

CF 3 $31,834.55 Payback = 2 years + ($19,477.70/$31,834.55)

CF 4 $2,593.50

Payback Period = 2.6118 years

The payback period method of capital budgeting analysis has three major drawbacks. It does not take into account the time value of money. It also does not consider cash flows beyond the payback period – the project above could have a fifth year cash flow of any amount, and the payback would be invariant to it. Finally, the payback criteria has no benchmark against which to measure the payback period. Thus, we cannot say how good 2.6118 years is, or whether the project should be accepted or not based on this. However, the greatest benefit of the payback period is that it does stress the need at times for a quick payback. This is particularly valuable for investments where the risk is high that technological changes may make the project obsolete in a relatively short period of time, for in such cases a quick payback is desirable before further returns are earned.

A method that overcomes the payback period’s deficiency in not considering the time value of money is to calculate the discounted payback period. In this method, the cash flows are first discounted so that they are in present value dollars, and then the payback is calculated as before. The discounted payback period is 2.878 years, as shown below.

CF 0 -$100,000 Cumulative Discounted Cash Flow

Discounted Cash Flow

CF 1 $38,316.55 / (1.044)1 = $36,701.68 $36,701.68

CF 2 $42,205.75 / (1.044)2 = $38,723.15 $75,424.83

CF 3 $31,834.55 / (1.044)3 = $27,976.75 Payback = 2 years + ($24,575.17 / $27,976.75)

CF 4 $2,593.50 / (1.044)4 = $2,183.15

Payback = 2 years + ($24,575.17 / $27,976.75) = **2.878 years**

The cash outflow in year 0 is 100,000. The discounted value of the cash flows in years 1, 2, 3, and 4 are $36,701.68, $38,723.15, $27,976.75 and $2,183.15, respectively. Cumulating the discounted cash flows to total the cash outflow of $100,000 takes 2.878 years, the value of the discounted payback.

**7.2.5. Accounting or Average Rate of Return**

The Accounting or Average Rate of Return is calculated using the project’s average value of the traditional net income after taxes divided by the project’s average investment.

The project’s traditional net income after taxes in years 1, 2, 3, and 4, as previously shown, are $4,983.55, -$2,239.25, $17,021.55, and -$4,816.50, respectively. The project’s average value of the traditional net income after taxes is $3,737.34, or

($4,983.55 -$2,239.25 + $17,021.55 - $4,816.50) / 4 = $3,737.34

The project’s average investment is one-half of its initial cash outflow, or $50,000, as it is assumed that the initial cash outflow of $100,000 loses value continuously until it reaches zero, such that half the time period of the project’s life its value is greater than $50,000 and the other half less than $50,000.

As a result, the project’s Accounting or Average Rate of Return is 7.47%, or

Average Net Income After Taxes / Average Investment

= [($4,983.55 - $2,239.25 + $17,021.55 - $4,816.50)/4] / ($100,000 / 2)

= ($3,737.34) / $50,000

= 7.47%

There are three major problems with the Accounting or Average Rate of Return. One is that it uses net income after taxes instead of cash flows. The other is that it does not consider the time value of money, such that a dollar of net income in year one is treated the same as a dollar of net income in year two. The third is that there is no benchmark against which to compare the Accounting or Average Rate of Return, making it difficult to determine whether the percentage return calculated is good or bad.

**7.2.6. First Extension Question on Capital Budgeting**

A possible investment in a mechanic’s computer station for diagnosing mechanical problems on DeLorean automobiles requires an initial cash outflow (CF 0) of $40,000. This investment is subject to a 3 year life depreciation schedule, with depreciation rates (according to the IRS) of 33.34% in the first year, 44.44% in the second year, 14.81% in the third year, and 7.41% in the fourth year.

If this investment is made, it will enable the mechanic to service a greater number of automobiles per year, generating more revenues, and at a lower cost per automobile – thus a greater gross profit margin. As a result, careful analysis reveals that the annual Operating Cash Income (OIt) would equal $95,000, and the Operating Cash Expenses (OEt) would equal 65,000, each per year t, t = 1 to 3. The relevant tax rate (t) is 40% and the weighted average cost of capital (discount rate) is 9%.

### What is this project’s Accounting or Average Rate of Return?

What is this project’s Net Present Value and Internal Rate of Return?

What is this project’s Profitability Index?

What is this project’s Payback Period and Discounted Payback.

Does the Profitability Index suggest that this project is acceptable?

ANSWERS

The traditional net income after taxes and cash flows (CFt) for this project are the following.

CF t = (OI t - OE t - Depre t) (1 – t) + Depre t

CF 1 = ($95,000 – $65,000 - $13,336) (1 - .40) + $13,336

= **$9,998.40** + $13,336 = **$23,334.40**

CF 2 = ($95,000 – $65,000 - $17,776) (1 - .40) + $17,776

= **$7,334.40** + $17,776 = **$25,110.40**

CF 3 = ($95,000 – $65,000 - $5,924) (1 - .40) + $5,924

= **$14,445.60** + $5,924 = **$20,396.60**

CF 4 = (- $2,964) (1 - .40) + $2,964

= **- $1,778.40** + $2,964 = **$1,185.60**

Note that the first bold-faced number in each year’s cash flow above is the **net income after taxes** and the second is the **cash flow**.

The Accounting or Average Rate of Return is:

= Average Net Income After Taxes / Average Investment

= [($9,998.40 + $7,334.40 + $14,445.60- $1,778.40) / 4] / ($40,000/2)

= ($30,000.00 / 4) / $20,000

= $7.500.00 / $20,000

= 37.5%

#### The Net Present Value is:

NPV = - CF0 + **[** Gross Present Value **]**

NPV = - CF0 + **[** CF1 / (1+ r)1 + CF2 / (1+ r)2 + CF3 / (1+ r)3 + CF4 / (1+ r)4 **]**

NPV = - $40,000 + **[** $23,334.40 / (1.09)1 + $25,110.40 / (1.09)2

+ $20,396.60 / (1.09)3 + $1,185.60 / (1.09)4 **]**

NPV = - $40,000 + **[** $59,132.45 **]**

NPV = $19,132.45

The Internal Rate of Return is 34.45%, as an r of 0.3445 satisfies the following equation:

0 = - CF0 + **[** CF1 / (1+ r)1 + CF2 / (1+ r)2 + CF3 / (1+ r)3 + CF4 / (1+ r)4 **]**

0 = - $40,000 + **[** $23,334.40 / (1+ r)1 + $25,110.40 / (1 + r)2

+ $20,396.60 / (1 + r)3 + $1,185.60 / (1 + r)4 **]**

##### The Profitability Index is:

= Gross Present Value / CF0

= $59,132.45 / $40,000

= 1.4783

This project is acceptable according to the NPV, IRR and Profitability Index.

This project’s Payback Period is 1.664 years:

CF 0 -$40,000 Cumulative Cash Flow

CF 1 $23,334.40 $23,334.40

CF 2 $25,110.40 Payback = 1 year + ($16,665.6 / $25,110.40)

CF 3 $20,396.60

CF 4 $1,185.60

Payback Period = 1.664 years

The discounted payback period is 1.880 years, as shown below.

CF 0 -$40,000 Cumulative Discounted Cash Flow

Discounted Cash Flow

CF 1 $23,334.40 / (1.09)1 = $21,407.71 $21,407.71

CF 2 $25,110.40 / (1.09)2 = $21,134.92 Payback = 1 year + ($18,592.29 / $21,134.92)

CF 3 $20,396.60 / (1.09)3 = $15,749.92

CF 4 $1,185.60 / (1.09)4 = $839.91

Discounted Payback Period = 1 years + ($18,592.29 / $21,134.92)

= 1.880 years

**7.3. Arditti-Levy and Equity Approaches Net Income after Taxes and Cash Flows**

There are other non-traditional methods for calculating cash flows based on the Arditti-Levy and Equity approaches. These approaches explicitly take into account interest expenses and principal payments on debt, such that a debt amortization schedule is required to calculate these cash flows. These approaches are illustrated in this section following-up the example for the traditional approach that appears in Section 7.2.1. in this chapter

The debt amortization schedule shown below considers that in the financing of the $100,000 purchase price of the machine, $80,000 is financed with debt at a 5% pre-tax cost of debt. It is assumed that the loan is a 3 year loan consistent with the project’s life, and that the loan is fully amortized over 3 years with payments of $29,376.69 made at the end of each year. Then the amortization schedule for this loan is as follows.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Year | Principal on Loan  Beginning of Year | Interest on Loan  During Year | Payment on Loan  End of Year | Payment on Principal  End of Year |
|  |  |  |  |  |
| 1 | $80,000.00 | $4,000.00 | $29,376.69 | $25,376.69 |
| 2 | $54,623.31 | $2,731.17 | $29,376.69 | $26,645.52 |
| 3 | $27,977.79 | $1,398.89 | $29,376.69 | $27,977.80\* |

\* Off by one penny due to rounding.

The “Interest on Loan During Year” is calculated as 5% interest on the “Principal on Loan Beginning of Year”. The “Payment on Loan End of Year” is calculated following the approach discussed in the chapter on time value where one finds a payment given a present value. The “Payment on Principal End of Year” is the difference between the “Payment on Loan End of Year” and “Interest on Loan During Year”.

**7.3.1. Arditti-Levy Approach Cash Flows and WACC**

The Arditti-Levy (A-L) approach explicitly considers the dollar interest expense in its calculation of cash flow, such that

CFt = (OIt – OEt - Depret - Interestt) (1- t) + Depret + Interestt

Notice that in this calculation interest is subtracted before taxes are calculated, such that interest is deducted for tax purposes. However, also notice that interest is added (along with depreciation) to the net income after taxes in order to obtain the cash flow. As a result, in the Arditti-Levy approach, the cash flow is an amount going to both creditors and owners of the project, although it differs from the traditional cash flow in that the tax benefit of interest is included in the cash flow. The Arditti-Levy initial cash outflow is therefore the same as in the traditional approach, as this is the total amount of financing provided by creditors and owners.

The Arditti-Levy cash flows for the project are shown below.

CF 0 = -$100,000

CF 1 = ($85,000 – $44,000 - $33,333 - $4,000) (1 - .35) + $33,333 + $4,000

= **$2,383.55** + $33,333 + $4,000 = **$39,716.55**

CF 2 = ($85,000 – $44,000 - $44,445 – $2,731.17) (1 - .35) + $44,445 +

$2,731.17 = **-$4,014.51** + $44,445 + $2,731.17 = **$43,161.66**

CF 3 = ($85,000 – $44,000 - $14,813 – $1,398.89) (1 - .35) + $14,813 +

$1,398.89 = **$16,112.27** + $14,813 + $1,398.89 = **$32,324.16**

CF 4 = (- $7410) (1 - .35) + $ 7410

= **- $4,816.50** + $ 7410 = **$2,593.50**

Note that the first bold-faced number in each year’s cash flow above is the **A-L net income after taxes** and the second is the **A-L cash flow**.

The Arditti-Levy WACC is a weighted average of the costs of debt and equity financing without the cost of debt being adjusted to an after-tax basis. The weighted average includes debt and equity financing because the approach’s cash flows include payments to both owners and creditors (this is why interest is added back along with depreciation to obtain the cash flows). The Arditti-Levy cash flows, however, already take into account the tax benefits associated with paying interest via the deduction of interest. If the cost of debt was adjusted to an after-tax basis, then this would improperly double count this tax benefit. Hence, the Arditti-Levy WACCA-L is:

WACCA-L = wd kd + we ke

or

WACC A-L = 0.80 (5%) + 0.20 (9%) = 5.8%

Notice that as expected the Arditti-Levy WACC is higher than for the traditional approach.

Under the Arditti-Levy approach, the project’s NPV, PI and IRR are:

NPV = -$100,000 + $39,716.55 / (1.058)1 + $43,161.66 / (1.058)2 + $32,324.16 / (1.058)3 + $2,593.50 / (1.058)4 = $5,462.43

PI = Gross Present Value / CF0 = $105,462.43 / $100,000 = 1.0546

0 = -$100,000 + $39,716.55 / (1+IRR)1 + $43,161.66 / (1+IRR)2 + $32,324.16 / (1+IRR)3 + $2,593.50 / (1+IRR)4

IRR = 8.75%

**7.3.2. Equity Approach Cash Flows and WACC**

The Equity approach explicitly considers both the dollar interest expense and principal payments in its calculation of cash flow, such that

CFt = (OIt – OEt - Depret - Interestt) (1- t) + Depret - Principal Paymentt

Notice that in this calculation interest is subtracted before taxes are calculated, such that interest is deducted for tax purposes. However, also notice that depreciation is added and principal payments are subtracted to the net income after taxes in order to obtain the cash flow. As a result, in the Equity approach, the cash flow is an amount going only to the owners of the project, as creditors are paid interest and principal out of the cash flow. The Equity approach of course also needs an amortization schedule on the debt financing of the project in order to obtain the interest and principal payments. Since the Equity approach cash flows only include amounts paid to owners, the initial cash flow is only the amount of owner financing for the project.

The Equity cash flows for the project are shown below.

CF 0 = **-$20,000**

CF 1 = ($85,000 – $44,000 - $33,333 - $4,000) (1 - .35) + $33,333 - $25,376.69

= **$2,383.55** + $33,333 - $25,376.69 = **$10,339.86**

CF 2 = ($85,000 – $44,000 - $44,445 – $2,731.17) (1 - .35) + $44,445

-$26,645.52 = **-$4,014.51** + $44,445 - $26,645.52 = **$13,784.97**

CF 3 = ($85,000 – $44,000 - $14,813 – $1,398.89) (1 - .35) + $14,813

-$27,977.80 = **$16,112.27** + $14,813 - $27,977.80 = **$2,947.47**

CF 4 = (- $7410) (1 - .35) + $ 7410

= **- $4,816.50** + $ 7410 = **$2,593.50**

Note that the first bold-faced number in each year’s cash flow above is the **Equity net income after taxes** and the second is the **Equity cash flow**.

The Equity approach’s WACC is just its cost of equity, because this approach’s cash flows includes payments only to the owners (this is why not only is interest not added back after being deducted while principal payments are subtracted in the cash flow calculation). Hence, the Equty WACCE is ke, equal to 9%.

Under the Equity approach, the project’s NPV, PI and IRR are:

NPV = -$20,000 + $10,339.86 / (1.09)1 + $13,784.97 / (1.09)2 + $2,947.47 / (1.09)3 + $2,593.50 / (1.09)4 = $5,201.93

PI = Gross Present Value / CF0 = $25,201.93 / $20,000 = 1.26

0 = -$100,000 + $10,339.86 / (1+IRR)1 + $13,784.97 / (1+IRR)2 + $2,947.47 / (1+IRR)3 + $2,593.50 / (1+IRR)4

IRR = 23.81%

**7.4. Comparison of Traditional, Arditti-Levy and Equity Approaches**

**7.4.1. Comparison of Cash Flows**

Table 7.1 shows that the difference in the net cash flows between the traditional and Arditti-Levy approaches is the tax benefit of the interest expense deduction, which increase the Arditti-Levy cash flow by this amount. For example, recall that the interest expense in year 1 is $4,000, and thus the Arditti-Levy cash flow is $1,400 greater than the traditional’s, an amount equal to the 0.35 tax rate times the $4,000 interest expense. The Equity approach’s cash flows are lower than that for the other approaches, as the investment amount and the cash flow amount exclude the contributions by and payments to creditors.

# Table 7.1. Comparison of Project’s Traditional, Arditti-Levy and Equity Approaches’ Net Income after Taxes and Net Cash Flows

Traditional Approach

Year Net Income After Taxes Net Cash Flows

0 -$100,000

1 $4,983.55 $38,316.55

2 -$2,239.25 $42,205.75

3 $17,021.55 $31,834.55

4 -$4,816.50 $2,593.50

Arditti-Levy Approach

Year Net Income After Taxes Net Cash Flows

0 -$100,000

1 $2,383.55 $39,716.55

2 -$4,014.51 $43,161.66

3 $16,112.27 $32,324.16

4 -$4,816.50 $2,593.50

Equity Approach

Year Net Income After Taxes Net Cash Flows

0 -$20,000

1 $2,383.55 $10,339.86

2 -$4,014.51 $13,784.97

3 $16,112.27 $2,947.47

4 -$4,816.50 $2,593.50

**7.4.2. Comparison of NPV, PI and IRR**

Table 7.2. shows that the Arditti-Levy approach NPV is lower, PI is lower, and IRR is higher than for the traditional method, although for both methods the project is acceptable. The Equity approach NPV is the lowest among the three approaches, while the PI and IRR are the highest, although as for the other methods the project is acceptable. We leave it to the reader to calculate the non-discounted and discounted payback, and accounting or average rate of return for these other approaches.

Table 7.2. Comparison of Project’s Traditional, Arditti-Levy and Equity Approaches’ Net Present Value, Profitability Index and Internal Rate of Return

NPV PI IRR

Traditional Approach $14,849.84 1.1485 7.352%

Arditti-Levy Approach $5,462.43 1.0546 8.75%

Equity Approach $5,201.93 1.2600 23.81%

**7.4.3. Second Extension Question on Capital Budgeting**

A rock band plans to finance the purchase of music equipment (guitars, drums, amplifiers and other electronics) with 70% debt (wd) at a 6% (pre-tax) cost of debt (kd) and 30% equity (we) at a 10% cost of equity (k e). The tax rate is 35%.

**a**. What is the Traditional approach cost of capital [overall discount rate (ko)] for this music equipment based on its financing?

**b**. What is the Arditti-Levy approach cost of capital [overall discount rate (ko)] for this music equipment based on its financing?

**c**. What is the Equity approach cost of capital [overall discount rate (ko)] for this music equipment based on its financing?

**ANSWERS**

**a**. ko = (wd) (kd) (1 - t) + (w e) (k e) = (.70) 6% (1 - .35) + (.30) 10% =

= 2.73% + 3% = 5.73%

**b**. ko = (wd) (kd) + (w e) (k e) = (.70) 6% + (.30) 10% =

= 4.2% + 3% = 7.2%

**c**. ko = ke = 10%

**7.4.4. Third Extension Question on Capital Budgeting**

A rock band plans to finance the purchase of $60,000 in music equipment (guitars, drums, amplifiers and other electronics). The $60,000 in equipment is to be depreciated over three years using a straight-line approach (not accelerated depreciation).

Financing of the equipment will use 70% debt (wd) at a 6% (pre-tax) cost of debt (kd). The debt financing is to be amortized as a regular annuity over a three year period. The remainder comes from 30% equity (we) financing at a 10% cost of equity (ke).

With this equipment, the rock band would be able to function, generating Operating Cash Income (OIt) equal to $80,000, and Operating Cash Expenses (OEt) equal to $30,000, each per year t, t = 1 to 3.

The tax rate is 35%.

**a**. What is the armortization schedule for the debt financing for this project?

**b**. What is the Arditti-Levy cash flow in year 2?

**c**. What is the Arditti-Levy weighted average cost of capital?

**d**. What is the Equity cash flow in year 2?

**e**. What is the Equity weighted average cost of capital?

**ANSWERS**

**a**. The regular annuity payment on the debt of $42,000 (70% of $60,000) over 3 years at 6% is $15,712.61.

As the Arditti-Levy approach considers the dollar interest expense in its calculation of cash flow, the debt of $42,000 (70% of $60,000) must therefore be amortized over three years, as shown below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Year | Principal on Loan  Beginning of Year | Interest on Loan  During Year  6% | Payment on Loan  End of Year | Payment on Principal  End of Year |
|  |  |  |  |  |
| 1 | $42,000.00 | $2,520.00 | $15,712.61 | $13,192.61 |
| 2 | $28,807.39 | $1,728.44 | $15,712.61 | $13,984.17 |
| 3 | $14,823.22 | $889.39 | $15,712.61 | $14,823.22 |

**b**. The generic formula for the Arditti-Levy cash flow is:

CFt = (OIt – OEt - Depret - Interestt) (1- t) + Depret + Interestt

Applying this formula to the data for year 2, obtain

CF2 = ($80,000 – $30,000 – $20,000 - $1,728.44) (1- .35) + 20,000 + $1,728.44 =

$28,271.56 (.65) + $21,728.44 = $18,376.51 + $21,728.44 = $40,104.95

**c**. The Arditti-Levy WACC is a weighted average of the costs of debt and equity financing, with the cost of debt is not adjusted to an after-tax basis because the Arditti-Levy cash flows already take into account the tax benefits associated with paying interest.

Hence, the Arditti-Levy WACCA-L is:

kA-L = wd kd + we ke

As in our example, the financing is 70% debt (wd) at a 6% (pre-tax) cost of debt (kd) and 30% equity (we) at a 10% cost of equity (ke), the Arditti-Levy WACCA-L is

.

kA-L = 0.70 6% + 0.30 10% = 4.2% + 3% = 7.2%

**d**. The generic formula for the Equity approach cash flow is:

CFt = (OIt – OEt - Depret - Interestt) (1- t) + Depret - Principal Paymentt

Applying this formula to the data for year 2, obtain

CF2 = ($80,000 – $30,000 – $20,000 - $1,728.44) (1- .35) + 20,000 - $13,984.17 =

$28,271.56 (.65) + $6,015.83 = $18,376.51 + $6,015.83 = $12,360.68

**e**. The Equity approach WACC is the cost of equity financing.

Hence, the Equity approach WACCe is:

Ke = 10%

1. Introduction excerpted from Chapter 6 in.Varela, Oscar, *International Finance in the World*, Naper Publishing (September 2011), distributed via

   <http://InternationalFinance.NaperPublishing.com>, 565 pages. [↑](#footnote-ref-1)