recharge workshop

the time value of money

Key Financial Concepts (I) - Understanding Net Present Value (NPV) and the Internal Rate of Return (IRR)

Alan Hargreaves

alanhargreaves.com

recharge workshop

In brief

As we found in the module on the cost of capital, most financial concepts come down to basic common sense. None could be more so than the *time value of money* (TVM) and its associated concepts: Present Value (PV), Net Present Value (NPV) and the Internal Rate of Return (IRR).

Start with Present Value. If you put money on deposit, it will increase in value over time as it earns interest. No surprises there. The reverse is also true. If you make an investment such that someone is going to pay you $100,000 at the end of 12 months, that investment is not worth $100,000 now. Rather, it is worth $100,000 minus what you could have earned had you put it on deposit now.

If interest rates are 10%, that $100,000 is worth only $90,909 today, because if you put that amount on deposit at 10%, it would be worth $100,000 in 12 months time. So its present value is $90,909.

That is about all there is to the concept of Present Value.

But, clearly this logic applies to all future cash flows in any business. Therefore, we must incorporate TVM into our forecasts when making business investment decisions. We need to adjust our expected returns to ensure we are clearing the financial hurdles required to make money. This will become clear as we examine the two key TVM concepts that are used for this purpose:

- Net Present Value (NPV)
- The Internal Rate of Return (IRR)

alanhargreaves.com

Present Value Factors

How present value diminishes over time

As we said on the previous page, if you are due to get $100,000 in 12 months time and interest rates are 10%, the value of that money today is $90,090. In other words, we reduce the amount by a discount factor of .909. You can work this out via your own arithmetic but it is easier to browse the net for Present Value Tables or use the PV function in spreadsheets.

Similarly, if you were to receive $100,000 in 24 months time you have to discount two years of interest. The present value would be lower still at $82,644. In other words, the factor would be .826, and so on. Using an interest rate of 10% as the example, Present Value tables would show us the following:

TIME PERIOD (YEARS)	DISCOUNT FACTOR
1	.909
2	.826
3	.751
4	.683
5	.621

alanhargreaves.com

Calculating Net Present Value

A simple example

The Project

You intend to invest $50,000 in a new service that you forecast will generate revenues of $20,000 pa. After costs of $5,000, you will net $15,000 pa. That's a return of 30% pa. Not bad you say.

Time Value

However, you are tying up money which could earn income elsewhere, and because of TVM the $15,000 pa you will generate will be worth less each year

The Discount

You therefore have to apply a discount rate to the $15,000, equal to the amount it could have earned elsewhere, or at least a rate equal to your cost of capital or your WACC.

Let's examine each step …

alanhargreaves.com

The amount invested

NPV: Step One

First, you will invest the money at time zero. Once invested, it is gone and represents a negative cash flow. For the purposes of calculating NPV then, it has a negative present value. At time zero, it has earned nothing and no discount rate applies. As a result, we begin to build our example as below.

TIME PERIOD	CASH FLOW	DISCOUNT FACTOR	PRESENT VALUE
0	-$50,000	0	-$50,000

Using a discount rate

NPV: Step Two

As forecast, the project generates $15,000 in Year 1. However, TVM states that if we had had that $15,000 the beginning of the year, we could have made a return on it. Therefore, its present value is less, subject to that return, which, in our example is an interest rate of 10%. In NPV calculations, that return is called the discount rate. You can use various numbers for the discount rate. It might be your RoC, or the Risk-Free Rate or any rate that you think reflects the risk involved (1).

One of the most sensible rates to use is your Weighted Average Cost of Capital, or WACC. This means that for the project to make sense, it must make a return which is greater than what your capital costs. Again, common sense.

For this example, we will assume your WACC is 10%. In that case, at the end of Year One, the present value of your $15,000 of income is actually $13,636.

TIME PERIOD	CASH FLOW	DISCOUNT FACTOR	PRESENT VALUE
0	-$50,000	0	-$50,000
1	$15,000	.909	$13,636

alanhargreaves.com

Applying the discount rate

NPV: Step Three

We then repeat the procedure for Year Two. But now there will be two years to factor into the Year 2 cash flow of $15,000 and it will have to be reduced by a greater amount (as per our earlier table of discount factors). This process is then repeated for each of the years you choose to forecast. As you can see, the present value of the annual income drops away considerably over the period.

TIME PERIOD	CASH FLOW	DISCOUNT FACTOR	PRESENT VALUE
0	-$50,000	0	-$50,000
1	$15,000	.909	$13,636
2	$15,000	.826	$12,396
3	$15,000	.751	$11,269
4	$15,000	.683	$10,245
5	$15,000	.621	$9,313

alanhargreaves.com

Calculating the NPV

NPV: Step Four

The last step is the simplest. Add up the amounts in the PV column, netting off the initial negative cash flow of the investment, and see what the result is. In our example, the outcome is a positive Net Present Value of $6,861.

TIME PERIOD	CASH FLOW	DISCOUNT FACTOR	PRESENT VALUE
0	-$50,000	0	-$50,000
1	$15,000	.909	$13,636
2	$15,000	.826	$12,396
3	$15,000	.751	$11,269
4	$15,000	.683	$10,245
5	$15,000	.621	$9,313
		NPV =	**$6,861**

What does this mean?

NPV: Step Five

In our example, the project does not generate a positive NPV until the fifth year. However, in that year the exercise produces an outturn of $6,861. At that point, that is the actual value of the project in today's dollars. What can we say about that?

- The project has recovered its investment plus some.
- Because we used the firm's WACC, it has earned more than the cost of its capital.
- It has therefore created value.
- It needed to perform at the forecast level for 5 years in order to achieve that.

NPV calculations have a sobering effect on our view of what we have to do to run a profitable business and create value. In our example, the NPV would have been negative if the annual dollar return fell to, say, $12,000 (see next page for example.)

Nonetheless, the outcome of the calculation shows us in clear dollar terms whether a project is worth undertaking. It has to add value. It is also very useful for comparing different investments. The rules of thumb however, are straightforward:

- If NPV is negative, the project will destroy value
- If NPV = 0, the result will be break even
- If NPV is positive, the project will create value

Negative NPV destroys value

Assume our project is not going to produce such strong returns. Say our forecasts suggest it will only generate $12,000 per annum. As the table below shows, the total of its present values is minus $4,510. It actually destroys value rather than creates it.

TIME PERIOD	CASH FLOW	DISCOUNT FACTOR	PRESENT VALUE
0	-$50,000	0	-$50,000
1	$12,000	.909	$10,909
2	$12,000	.826	$9,917
3	$12,000	.751	$9,015
4	$12,000	.683	$8,196
5	$12,000	.621	$7,451
		NPV =	**-$4,510**

alanhargreaves.com

The Internal Rate of Return (IRR)

Why zero NPV is the benchmark

By this time it is clear that everything depends on the discount rate. We may change the forecasts, or the reality may turn out to be different, but whatever those numbers are, NPV rises or falls subject to the discount rate. This is clear if we return to our example and change the discount to 15.24% rather than our original 10%. In that case, the discount factor changes in line with the higher rate and the NPV falls to zero, as shown below. This rate is known as the Internal Rate of Return, or IRR. It is the rate at which NPV equals zero.

TIME PERIOD	CASH FLOW	DISCOUNT FACTOR	PRESENT VALUE
0	-$50,000	0	-$50,000
1	$15,000	.868	$13,017
2	$15,000	.753	$11,295
3	$15,000	.653	$9,802
4	$15,000	.568	$8,506
5	$15,000	.492	$7,380
		NPV =	**0**

alanhargreaves.com

What does the IRR tell us?

In some ways the IRR is the inverse of the NPV calculation. It tells us exactly what the investment will earn in percentage terms after adjusting for the time value of money. Where the NPV showed us a result in present value terms of $6,861, the IRR shows us what sort of return that represents in terms of a compound rate. It is similar to a yield on the investment.

In the case of our example, that return is equal to 15.24%. This is significantly higher than our stated WACC of 10%.

This gives us a shorthand way of expressing the relationship to the cost of capital with which we have already become familiar. Again it is common sense. If the IRR is greater than your WACC, (that is, the return on the money, adjusted for time, is greater than the cost of the money), the project will be profitable. Therefore, if

- IRR<WACC, value is destroyed
- IRR=WACC, break even
- IRR>WACC, value is created

The IRR is the most common reference tool for making financial decisions.

recharge workshop

For more information, visit my website www.alanhargreaves.com

Hi, I'm Alan Hargreaves. I specialise in simplifying complex business problems. In over 35 years as a business executive, I have never found an issue that cannot be addressed through identifying the essential but simple steps required to make any problem manageable. It might be your career, your firm, your team or your strategy. It doesn't matter. All hurdles can be lowered through dispassionate analysis, and all executives can embrace simple processes to take them forward.
Using these techniques, I have helped hundreds of people through the various stages of their business or career development. It may be the challenge of taking on new responsibilities; it could be the task of managing a business you have created yourself; it may be handling a difficult team in the midst of major change. I use a straightforward combination of key principles to get results: collaboration, adaptation, simplification and action. You can contact me anytime at alan@alanhargreaves.com.

alanhargreaves.com