How Much is that Investment Worth in Real Money?

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This article is intended for the educated layman. It was written as part of a continuing series of articles on a variety of investment topics.

A bird in the hand is worth two in the bush.

So, if 1 bird in the hand is worth 2 birds in the bush, that means that 1 bird in the bush is worth ½ = 0.5 of a bird in the hand.

This avian metaphor represents the essence of all financial valuation.

To translate from birds to money: A fistful of cash that you hold now is worth more than the same amount of cash awaiting you in the future. And so, you multiply cash in the future by an appropriate **discount factor** to determine what it's worth now. For those birds, the discount factor was 0.5. To revert to a financial example: If I want to know the value, today, of a U.S. government treasury bill that will pay me $10,000 one year from now, I multiply that amount by a discount factor of, perhaps, 0.99 (which is financially more realistic than 0.5). In short, I'd pay $9900 now for a promise of $10,000 in one year, because $9900 in the hand is worth $10,000 in the bush.

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At first blush, this idea may seem simple and even obvious from experience. But it's extremely potent and underlies all of financial theory and most of financial practice. It can often be translated into mathematics and ramified through powerful calculations. In this essay, I'll draw out and explore some of its consequences. It has been implicit in some of my earlier essays.

Now, don't rush ahead of me. If you're thinking that this is all about inflation, because inflation makes future prices greater than current prices, you're on the right track, but you're complicating the issue. We'll get to inflation another time. Right now, we're considering a happy world without inflation. And if you recognize that the discount factor is related to interest rates, you're also right, but bear with me; we'll get to interest rates a few pages on.

Recall that the value of an investment is determined by its ability to generate cash. As I wrote before:

> Everything comes down to the ability of an investment to generate cash now and in the future, because cash gives you the ability to buy stuff.

For example, a stock represents the ability of the company that issued it to generate cash in the future, either in actual dividends or in earnings that the company could convert into dividends, in whole or in part, should it decide to do so.

Even when there will be no dividends or interest payments, as when we buy gold bullion, we're purchasing the prospect of being paid cash in the future, because we're hoping to sell the investment for cash.

How to travel in financial time

In order to determine the current value of a stock, a bond, or a gold ingot, we have to measure the future cash that it will produce and figure out what it is worth now. We convert future cash into its current value by means of discount factors. One might say that the future is a foreign country, and the discount factor is the exchange rate between the country of the future and the country of the present.

But the future is not one big undifferentiated "overseas." It is a world of different countries. There is the country one year in the future, and the country two years in the future, and so on. And there are exchange rates among them, as well as a different exchange rate between each of them and the present.

Alas, there comes a point when all analogies fail or must lie in Procrustes' bed. Pardon me while I stretch this analogy. Unlike geographic countries, future years are laid out sequentially, and so the discount factors have a regularity that is not observed in world currencies: It is a general tendency, almost (but not quite) amounting to a rule, that the further away the future, the smaller the discount factor. So, for example, if the discount factor for the country one year in the future is 0.99, the discount factor for the country five years in the future might be 0.95, and the discount factor for the country ten years in the future might be 0.90.

Whence arises the discount factor? Who sets it? In some contexts, an authority sets it by fiat; in other contexts, a buyer and a seller negotiate it; and in yet others, the free market determines it, just as exchange rates usually result from free economic transactions between the peoples and businesses of countries. When that happens, it's not so much that the buyers and sellers have in mind a discount factor (although they may), as that they are haggling over current prices. And because [current price] = [future price] x [discount factor], anyone who knows both the current price and the future price can calculate the discount factor with elementary-school arithmetic.

Risk again

No one who has taken on board the essence of my earlier essays will be astonished at being told that risk has a role in valuing future cash flows. Risk insinuates itself into the discount factor. Imagine the hagglers negotiating the current price of a lump of cash to be paid in the future. If the buyer thinks there's uncertainty whether it will be paid in whole or in part, he's going to insist on a lower current price, which means a lower discount factor. So the discount factor actually comprises two elements: one reflecting the distance in time, and the other reflecting the idiosyncratic risk that the full future cash payment won't come through at the time agreed.

Let's reconsider the example I gave at the outset, of a U.S. government treasury bill that will pay me $10,000 one year from now. Let's say, instead, that this is the personal I.O.U. of an unemployed drinking buddy with poor dietary habits and a desperate need to pay for some dental work. Depending on my generosity, the applicable discount factor might be very far from 0.99; instead, it might be something more like 0.7. That is, I'd pay (or, to put it another way, lend) $7000 now for a promise of $10,000 in one year. There would be a basic element of 0.99, representing the discount factor for an absolutely safe loan for one year, minus an element of 0.29 to compensate for the huge risk that I will not receive the full $10,000 in one year's time stipulated in the I.O.U.

The key to all financial valuation: Unlocking the value of investments

The idea that the current value (or as we say in finance, the **present value**) of something is equal to the future cash it will generate, with each lump of future cash multiplied by an appropriate discount factor (which itself incorporates a risk component) is a way of seeing the world, but it is not a theory. It is not open to question. It is a truism, an identity, or a definition. It is always and everywhere the case, just as [income] – [expense] = [profit or loss] is always the case. The rub, however, is that the values of the terms are often, or even usually, unknowable, at least with any precision. They may be unknowable even in principle.

At least in theory, then, the value of a stock should be determined by the following grand equation:

$$\begin{bmatrix} present \\ value \end{bmatrix} = \begin{bmatrix} 1st \\ dividend \end{bmatrix} x \begin{bmatrix} 1st \\ discount \\ factor \end{bmatrix} + \begin{bmatrix} 2nd \\ dividend \end{bmatrix} x \begin{bmatrix} 2nd \\ discount \\ factor \end{bmatrix} + \begin{bmatrix} 3rd \\ dividend \end{bmatrix} x \begin{bmatrix} 3rd \\ discount \\ factor \end{bmatrix} + \ldots + \begin{bmatrix} final \\ sale \\ price \end{bmatrix} x \begin{bmatrix} final \\ discount \\ factor \end{bmatrix}$$

where the dividend may not be the actual dividend, but, rather, the payment that the company could potentially make. And the final sale price equals, for the future buyer, the sum of all the future cash flows thenceforward that she, in turn, expects to receive, multiplied by the appropriate discount factors.[1]

I may seem to be implying the absurdity that, to calculate the value of a stock, you have to know every cash flow and every discount factor. If, however, you can justify certain simplifying assumptions—for example, that all the dividends are equal, or that they grow at a constant rate—there are some wonderfully uncomplicated mathematical formulæ that allow you actually to perform these calculations. Some analysts do, indeed, estimate the value of a stock in this fashion; they refer to the combination of assumptions and formulæ as **dividend discount models**, and they compare the results with the stocks' prices, to decide whether the stocks are undervalued or overvalued.

For bonds, the same calculations require less distortion of reality, because the cash flows—the coupon payments, and the final price, at the maturity date—are known; they're set by contract. And the discount factors, in the case of bonds, can be determined fairly closely. (I won't go into this, but it basically amounts to there being good information that an investor can look up that approximates closely both the basic discount factor component and the component that compensates for risk.)

Although this works pretty well for bonds, the confection of assumptions making up the dividend discount models is rather too large for most analysts to swallow. No one, truly, feels comfortable assuming that all cash flows in the future will be equal, or that they will grow at a constant rate[2], and there is some hocus pocus in setting appropriate discount factors. The reckoning of the risk component amounts to one of the grand arcana of finance. Financial analysts therefore come up with various workarounds. And for something like gold, which generates only one future cash flow—when it's sold—the present value formula, while still theoretically correct, is absolutely useless in practice.

For stocks, and indeed for nearly all other investments,[3] the problem with our grand equation is that we don't know the cash flows, and we don't know the discount factors. Therefore, we don't know the value of a stock. We know only its price.

In my previous essay, "How Professionals Select Investments," I outlined in broad strokes how fundamental analysts go about valuing a stock in order to compare value to price. Their efforts amount to ways of getting around, over, through, and underneath the equating of value with cash flows multiplied by discount factors. If the analysts can identify stocks whose prices seem to be exorbitantly high or pitifully low when compared with their estimated values, then they're allowing a wide safety margin for getting wrong their forecasts of future cash flows and their (almost always implicit) discount factors. And

[1] This idea should be obvious, but every obvious idea develops in a historically contingent context, and the idea that this is what a stock is worth was first published by John Burr Williams in the 1930s.
[2] There are dividend models that assume two, three, or four growth rates at different periods the future, but these are still gross oversimplifications.
[3] Except bonds that don't default and are held to maturity.

some of their tools, like the ratio of price-to earnings (the P/E ratio), or the ratio of price-to-free-cash-flow, are actually mathematically equivalent to crude dividend discount models. I'll spare you the mathematical proof.

Once you accept that all valuation is a matter of summing the present values of future cash flows, you see that there is a simple common idea underlying all financial analyses.

Interest rates and the time value of money

Economists have a name for the concept we have been exploring: the **time value of money**. Many a student has been anaesthetized by lectures on the mathematics of the time value of money, which, because of its importance, are usually administered at the start of every course in finance. (I know; I've been a teacher as well as a student of the stuff.) The mathematics of the time value of money pervades our lives at every level, from the personal to the global. It underlies the calculation of mortgages and the estimates of our country's ability to sustain its national debt.[4]

If you are wondering, in light of the importance of the time value of money, where the discount factor has been all your life, the answer is that you're familiar with it by its other name. It is just the interest rate in a friendly guise. It's not exactly the interest rate turned upside down, but it's pretty close to that. By looking at the interest rate dressed up as a discount factor, you can see more clearly how the interest rate affects values. When interest rates go up, the discount factors go down, and when interest rates go down, discount factors go up. That means, accordingly, that when interest rates go up, values (that is, *present* values) go down, and when interest rates go down, values go up.

It may be worth noting, as an aside, that in cultures that forbid the charging of interest, such as Islam and pre-modern Christianity, the discount factor is by fiat set equal to 1. That is, one bird in the hand is deemed to be worth one bird in the bush.[5]

Our concern here, though, is how the time value of money affects our understanding of investing. While, on the one hand, it is the foundation on which rests the valuation of investments, it is also, on the other hand, the framework for understanding how investments grow.

That's because interest rates and returns are pretty much the same thing, both mathematically and economically.

The time value of money and investment returns

[4] There is a three-page appendix to this essay, available upon request, that introduces the mathematics of the time value of money, should you wish to know a little more.

[5] Because only the most primitive economy could function under such a rule, these cultures have employed legalistic subterfuges to permit *de facto* discount factors that are not necessarily equal to 1.

To the extent there is a difference between returns and interest rates, it is primarily legal and contextual. Interest rates tend to be fixed by contract and arise in the context of bonds, leases, mortgages, and insurance products, whereas returns just happen. So, for example, with a mortgage, a bank makes an investment in you, and you have a legally binding obligation to pay the bank interest on its investment. Or you buy a bond, and the payments you receive (from the government or from the corporation that issued the bond) are contractually binding. That's why we don't call stock dividends "interest," even though they're analogous to the coupon payments from a bond; companies aren't contractually obligated to pay dividends.

We saw in the essay "How to Think about Returns" that there are two kinds of returns: a return from income (interest payments or dividends) and a return from changes in price. And the **total return** comprises both of them. The total return from any investment subsumes the return that is the income. And because economic life is messy, prices in the future generally don't turn out as expected, and the return from price changes is difficult to predict.

Consequently, the reason that the discount factor has an element that compensates for risk is that either the interest rate component of the discount factor or the price change component, or both, has elements that compensate for risk. For example, the more risky that bonds are, the higher the interest rates that they pay. That's why the genteel name for junk bonds is "high-yield" bonds (where "yield" is almost synonymous with interest rate.) And that's why U.S. government bonds pay the lowest interest of all; they have the least risk of default or of not paying out according to schedule.

At the same time, not all risks are necessarily accounted for in the discount factor. The discount factor may not, for example, incorporate an adjustment for a risk that is easily avoided. Because I'm not in the business of making loans to poor credit risks, I may give my drinking buddy the benefit of a much larger discount factor than I ought if I'm to compensate myself for his unreliability.[6]

When we try to learn from our investment misfortunes or from a great investor's success, we look back at historical returns. But though the numbers are distinct, the lessons are obscured by a dense fog of indeterminacy. History will show that either or both of two things turned out better or worse than expected: the cash flows, and the discount factors. And we can seldom tell which.[7] Moreover, when the cash flows turn out not as expected, it may not be the consequence of faulty investment expectations, but the manifestation of their inherent risk. (For example, if you say, "The cash flow is very uncertain, but my best guess is that it will be $100, and it will almost certainly be between $75 and $125," and it

[6] In particular, some risks that can be shed through diversification may not reduce the discount factor. We'll consider the concept of diversification in a later essay.

[7] The timing could be off, too, which is often what happens when there's a lack of liquidity. But mistaken timing can be viewed, alternatively, as having a zero cash flow at the appointed time, and a much larger cash flow when none was expected.

turns out to be $115, was your expectation wrong? Not necessarily, because you specified the uncertainty.) A fair discount factor would have accommodated the risk. So even when a successful investor can point to cash flows that were much larger than few investors except him expected, we can't be absolutely certain whether we should credit him with percipience or regard him as merely lucky.

But occasionally, as Thoreau cryptically observed, "some circumstantial evidence is very strong, as when you find a trout in the milk." An observant and clever investor will sometimes forecast either the cash flows or the risk component of the discount factors to be so different from the consensus estimates, and do so with such accuracy, that only the peevish will attribute her success to mere luck. Michael Lewis, in his new book, The Big Short, chronicles several recent such trout in the milk, exceptional investors who saw with great clarity during the latter half of this last decade that the discount factors being applied to bonds backed by subprime mortgages were far larger than the riskiness of those mortgages could justify.

The time value of money can even make a certain kind of sense of technical analysis, the forecasting of returns from the patterns in past prices.[8] The patterns that technicians claim to see in the very short term, if real, presumably aren't the result of rapidly changing forecasts of future cash flows; rather, they can more plausibly be interpreted as patterned changes in the discount factors, as investors' demands to be compensated for risk change with regularity. This might suggest to a sophisticated "quant," who has a deep understanding of investment risk, ways of taking advantage of the patterns.

In the first part of my essay "How to Think about Risk and Return at the Same Time," I described a sort of metaphysical understanding of the financial cosmos, where "we live in a slowly expanding universe of financial rewards and risk, where risk is in flux and can be shifted but never destroyed." That holistic view, regardless of whether you share it, has a basis that cannot be gainsaid in the time value of money.

N.B.: A three-page appendix that introduces the mathematics of the time value of money is available upon request, in digital format or on paper.

[8] I described technical analysis in my previous essay, "How Professionals Select Investments," *Newsletter*, January 2010.