



Finding 'a' When You Know F: the Sinking Fund Factor

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Finding "a" When You Know F: the Sinking Fund Factor

INTRODUCTION (repeated): Solving DCFF for its different elements

In Reading III, D we saw how the Compound Growth Factor (CGF) may be solved for its different elements. We saw that equations do not show causation: causation must be inferred from other information. Equations do show necessary relations, so you can find the unknown from the known.

That was just a warmup. Here we begin the process of doing the same thing for the DCFF. Up to now, we have focused mainly on valuation, where present value (P) is the unknown. From here on we focus on new uses for the DCFF, where P is known, and we use it to find something else.

As a reminder, here is the DCF equation:

$$P = a \frac{1 - I^{-n}}{i} \quad (1)$$

Solving the CCFF for "a"

Sometimes you need to know how much to set aside regularly in order to meet a future payment or need. Then you solve the CCFF for a.

$$a = F \frac{i}{I^n - 1} \quad (1)$$

The ratio on the right of (1) is called the Sinking Fund Factor, SFF. It is used to determine the annual payment necessary to meet a known future need. Such a fund is called a "sinking fund."

For example, nuclear generating stations need to be removed for burial in remote locations at the end of their lives (about 25 years), and the anticipated cost is enormous. The Nuclear Regulatory Commission, expecting that the owners may plead poverty when the time comes, requires them to set aside in trust an amount each year which, invested at compound interest, will meet the anticipated need.

The amount required, a in (1), depends on three speculative forecasts: F, n, and i. a is obviously an increasing function of F, and a decreasing function of n. How about i? If you were

SCE, arguing to hold down a , you would obviously argue for a lower value of F , and a higher value for n . Would you argue for a higher or lower value of i ?¹

Many nuclear plants are falling offstream well before 25 years, as well. The combined result of having underestimated F , overestimated n , and overestimated i means that the balance in the protective sinking fund is much too low to cover the decommissioning costs.²

Some debts come due all at once, in what's often called a "balloon" payment. The lender has what's called a "redeemable" note or bond: your balloon is his redemption.³ To meet that future debt, you invest a regular amount. The fund you put the money in is called a "sinking fund."⁴ Some state constitutions require the state to set up a sinking fund every time it borrows (unless the debt is fully amortized).

SFF is also used to decide between competing resource uses. E.g., in Northern California there are lands which can grow timber or graze sheep. A timber harvest of \$10,000/acre, 60

¹A higher value of i . This makes a lower. This figures: if your principal earns more interest, you need less principal to reach a given F . You may be sure the nuclear industry has been very aware of this factor. If you want to become a cynic, you should listen to their "engineering" consultants argue gravely for the use of low i -values for such sinking funds, then turn around and argue for high i -values as their guaranteed rate of return on equity capital. To become even more cynical, you should see some of our public representatives fall for it.

²Who will pay to clean up the mess? It is a sure bet that Congress will be asked to - using taxpayer money. This may all seem like esoteric theory to you, but you may be sure that some people will be hard at work to slough off the cost onto you.

³That's not a theological term, although the concept of redemption originated in debt, which is as old as human society. Not to be sacrilegious, the bondholder feels better knowing that his redeemer liveth. Actually, though, originally it was the debtor who was redeemed. He redeemed his body, or the bodies of his family, from debt slavery.

⁴It's an unfortunate term: you want this fund to float and rise, not sink.

years in the future, cannot compete for the land against the rental from sheep at \$10/year, unless the interest rate is below 8%. The sheep must pay only \$7.98 a year to be worth as much as that \$10,000, waiting 60 years in the future. Looks incredible, but figure it out: another example of the power of compound interest.

SFF is very sensitive to i . Cut that rate from .08 to .04, and now the sheep must pay \$42.02 a year or more to compete with the timber. That's 5.27 times as much as before. A 50% drop in i has resulted in a 427% rise in the required sheep rental. That's an arc- ϵ of $-427/50$, or -8.54 , a high rate of sensitivity indeed.

The SFF discounts the future a lot more heavily than does the PIPO discounting factor. For example, discounting at 5% per year, \$20 due at the end of 6 years is worth \$14.92 today. That is almost exactly the same as the PV of \$100 due at the end of 40 years. However, the a -value of the first option is \$2.94, while that of the 2nd option is only 82¢. You can see algebraically that the effect of n in the denominator is leveraged by subtracting a constant, 1, from I^n .

This means that when we come to choosing proper performance standards for investments, we will have to decide whether to max PV - the simple rule the textbooks love - or max a . They lead to different results, and apply in different circumstances. That is something to look forward to. Let's get used to what we have on hand, first.

Let's pause here for breath, and sum up. We now have the DCFF in four different forms: straight; the IPF; the CCFF; and the SFF (1). We have seen these are all just different arrangements of the same basic equation: if you know one, you know'em all. This is why I told you to master the original DCFF: a little bit goes a long, long way, and we're not done yet.

Things get a little trickier after this, though, so be sure you are thoroughly on top of what we have done so far. Review; work problems. Then pump yourself up, jog in place, and here we go on the next lap!