Compound Interest -- the Bottom Line

Albert Einstein once described compound interest (or growth) as "the greatest mathematical discovery of all time" according to Burton Malkiel's widely acclaimed book, *A Random Walk down Wall Street*. With such a striking observation in mind, here are a few examples of the power of compounding that show just how formidable the equation $S = (1+i)^n$ can be:

Despite a relatively flat stock market for the past dozen years or so, the total holding period return on the S&P 500 index for the 50 years ending in 1999 was 58,828%. That's equal to a gain of $588,280 on an initial investment of $1,000. Such impressive performance is largely due to the reinvestment (compounding) of corporate earnings (resulting in higher dividends and stock prices) and the reinvestment (compounding) of those dividends by far-sighted investors.

Meanwhile, for investors in long-term corporate bonds (to whom neither the reinvestment/compounding advantage of retained earnings, nor of leveraged earnings due to corporate borrowing, apply) the total holding period return for the same 50 years was 1,713%. This results in a ratio of 34.3 to 1 in favor of stocks. The compound annual rates of return, however, were 13.6% for stocks and 6.0% for bonds, for a woefully misleading ratio (at face value) of 2.3 to 1. (We'll have more to say about this anomaly later.)

To cite another example, in a 2008 column in *Newsweek*, former Treasury Secretary Lawrence Summers was quoted as predicting that a typical Chinese citizen would experience a "10,000%" (or 100 fold!) rise in living standards during one lifetime. Since life expectancy in China stands at 72, this implies a real compound annual growth rate of 6.6% in output. Of course, China has been growing at a much faster rate for the last two decades. Still, given that China's GDP in 2010 was $6 trillion, a literal extrapolation of Mr. Summers' conjecture would imply China's real GDP in 2082 will reach $600 trillion.

Meanwhile, if the American economy continues to grow at a 2.1% annual rate, as projected by the Trustees of Social Security in their annual report (versus 3.5% historically), our constant dollar GDP will reach $66 trillion by 2082, versus $15 trillion today. Not to worry, however, because if the American economy were to grow at 2.1% for the next 1,000 years, it would reach $15,555,216,397,857,300,000,000 in constant dollars by 3011 regardless of how well China performs. Just to be clear, **that's 1,061,065,239 times the size of 2010's GDP** of **$14.660 trillion.** Parenthetically, $1 growing at 2.1% becomes $32,574 in 500 years. And $32,574 squared results in $1,061,065,239 in 1,000 years. Which brings us to a critical, but little known, fact about compound interest:

- For any compound annual rate of return, when the number of years an investment of $1.00 is held is DOUBLED, the ending value of that investment is SQUARED. For example, at a 10% annual return an investment of $1.00 becomes $6.73 in 20 years, $45.26 in 40 years and $2,048.40in 80 years.

- For a given number of years, if the compound annual rate of return is DOUBLED, the ending value of a $1.00 investment is approximately SQUARED. Thus, $1.00 compounded at a 5% rate for 40 years becomes $7.04 and at a 10% rate for 40 years grows to $45.26.

These relationships go a long way toward explaining the "magic" of compounding. Of course, the classic example of the invincible power of compounding is world population growth which has steadily climbed from 1 billion in 1800 to 7 billion at present. Best estimates today are that the compound annual rate of population growth stands at 1.14%, which implies a doubling every 61 years. Many factors are involved but the most tension would seem to be between medicine and technology for saving lives, on the one hand, and birth control for preventing them on the other. Although the world's population growth rate is trending slightly downward, the UN estimates that by 2100 the earth will have 10 billion inhabitants.

Thus, as recently noted in *The New Yorker*, "…that there must be some limit to population growth is hard to argue with. The question of how many people the earth can support over the long or even medium term remains, at this point, open. As we sail past the seven-billion mark toward eight, nine, or ten billion, we should, sooner or later, arrive at an answer." Meanwhile, a worldwide decline in fertility rates, due to broader use of contractepives, must be in the works since sexual activity shows no sign of becoming less popular. Otherwise, if world population were to continue to compound at a 1.14% rate in just 200 years there would be 68 billion people on earth to be clothed, sheltered and fed.

In a 1930 essay, *Economic Possibilities for Our Grandchildren*, John Maynard Keynes paid tribute to the wonders of compounding by observing that "the power of compound interest over 200 years is such as to stagger the imagination." Later on he noted "If capital increases, say, 2% per annum the capital of the world will have increased by half in twenty years, and seven and a half times in a hundred years. Think of this in terms of material things – houses, transport and the like…I would predict that the standard of life in progressive countries one hundred years hence will be between four and eight times as high as it is today … [and] it would not be foolish to contemplate the possibility of far greater progress still.

Of course Keynes was right and his prophesy is still bearing fruit. But now the entire planet is aware of the possibilities for growth that compounding entails and it is the stated objective of governments everywhere to harness its energy to their national

advantage. What all of this means in terms of future depletion of the earth's resources, energy consumption, greenhouse gases and climate change, is too depressing to contemplate. But unless something (unknowable) intervenes to curtail the "greatest mathematical discovery of all time," it's a virtual certainty a few centuries from now Keynes' "grandchildren" will inherit the wind.

Meanwhile the power of compounding has more mundane implications for some near-term concerns such as the viability of the Social Security trust fund. Thus, given recovery to a 3.5% long-term economic growth rate for the American economy, Social Security's solvency for the next 75 years would be secure. But as things now stand, Social Security is projected to become insolvent in 25 years when the trust fund runs out of government bonds to present to the U.S. Treasury (i.e., the American taxpayer) for redemption.

Needless to say, the trust fund would be in a lot better shape if Congress had shown more faith in corporate America and invested a portion of the Social Security surplus in common stocks (given their compounding advantages over bonds) as virtually every state and most federal trust (or pension) funds do. Indeed, Robert Ball (Social Security Commissioner under three presidents), Paul Samuelson, and many other notable observers are on record as recommending such a course. (Moreover, stock investments have the added advantage that their sale, or redemption, takes place on market exchanges and do not depend on a taxpayer bailout that redemption of a Treasury bond requires.)

But, of course, Congress used the surplus instead to mask deficit spending while it stuffed "special issue" government bonds into the trust fund. Meanwhile, since the Social Security reforms of 1983 (that created the surplus in the first place) the S&P 500 has had a total holding period return of 1,400% *through 2010* – with the usual help from its resilient partner, compounding.

Thus, a need to digest its extraordinary gains from 1983 to 2000 could *partly* explain the market's weaker performance thereafter. But, of course, there has also been a torrent of negative news raining down on the market since then that has exacted a heavy toll. Needless to say, how or when this wall of worries will recede is beyond the scope of this paper. Eventually, however, the market will have to accommodate a rising tide of corporate earnings that are growing exponentially over time.

Eugene Hawkins
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