The Time Value of Time

By Peter Neuwirth

Have you ever noticed how time seems to go by faster and faster as the years roll on? The lazy summers that used to last forever when you were 10 years old now seem to pass by in a blink of an eye. No sooner have you gotten the garage cleaned out and your spring planting done when it seems like it's time to put up the storm windows and get ready for winter.

You're not alone. In fact, this sense that time's pace is accelerating seems to be a universal element in the human condition.

For years, I've been fascinated by this phenomenon and its implications for what I do: help companies and individuals plan for the future, specifically for retirement. I believe this speeding up of the passage of time explains a lot about what most experts consider to be individuals' "irrational" or "uneducated" decisions in planning (or not planning) for retirement. Not only does the phenomenon—I call it *the time value of time*—and its consequence explain why these decisions are made, but the concept itself can be used as a tool to help individuals with their financial planning.

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No Time Like the Present

To understand the *time value of time*, we must first pose two questions: How fast do we *feel* like time is passing (I'll call this "perceived" time)? How can that speed be measured?

I don't have a scientifically precise answer, but I have, over the years, developed an approximation that seems intuitively correct, is consistent with the perceptions of most of the people I've spoken to, and, most important, seems to work well in practice.

The basic assumption is that the speed at which each year is perceived to pass is proportional to the number of years (measured in the traditional way) one has been alive. For example, under this assumption, a year to a 20-year-old feels twice as long as that same year does to a 40-year-old. That summer you spent as a 10-year-old actually lasted four times as long as a summer seems to last now that you're 40. As it turns out, starting from this simple approximation and applying some elementary calculus we can derive some interesting results.

Before we consider some of those results, though, let's take a step back and review some of the basic concepts in financial planning and then discuss how they might be modified by the *time value of time*.

Most of the financial decisions people make involve time. In particular, in planning for the future, individuals need to decide between the immediate receipt (or payment) of a sum of money and the delayed receipt (or payment) of a (usually) different amount of money. Often, the decision will be complex and involve a nonmonetary benefit (e.g., the acquisition of some material goods, the receipt of some service, or even the use of additional *time* through early retirement). It may also involve some contingent event for which the individual will have to estimate some probabilities (e.g., buying life insurance to protect loved ones against the possibility of your death). But the common thread in all these decisions is the need to choose between something *now* and something *later*.

To see how the *time value of time* can and does influence those decisions, consider the following example.

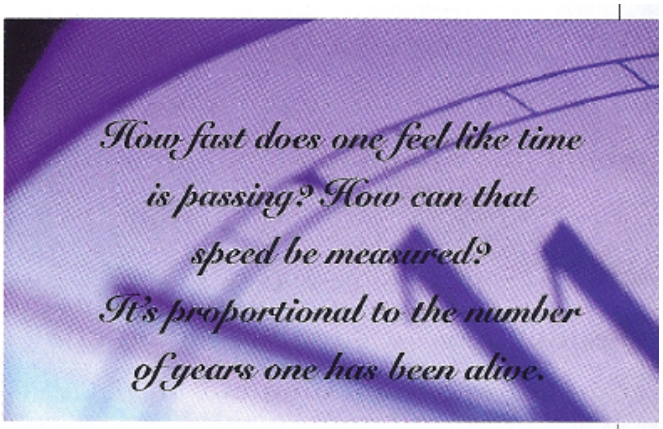
Suppose an unknown benefactor offers you the following choices:

- a $1,000 voucher today to be used for this month's rent, *or*
- a $1,100 voucher 1 year from now to pay the rent.

Assume, in this example, that the voucher can be used only to pay the rent. Looking at the decision the traditional way, most experts will note that two factors may influence your decision to take $1,000 today instead of $1,100 a year from now. Specifically:

- The rent may go up by more than $100 in the next year, so the $1,100 wouldn't be sufficient to pay for a full month's rent. (An alternative formulation of this is that the $1,000 you would save by using the voucher, if invested well, might accumulate to more than $1,100 in a year.)
- It's possible you'll die or fall prey to some other contingency that would render the $1,100 useless.

In combination, these two factors constitute what actuaries and other financial planners call the *time value of money*. But the *the time value of time* provides a *third* reason to prefer the $1,000 today: Even if the $1,100 will buy a full month's rent and you're still around to pay that rent, because time is moving faster, the *month itself* won't last as long as the month of rent that you could purchase today with the $1,000.



Time Waits for No One

In 15 years of consulting with corporate clients, I've been struck continually by how employees, at virtually all levels of pay, education, and status, seem to make choices that are inconsistent with what they "should" do, as measured by traditional financial criteria.

Typically, these decisions take the following forms:

- Employees, particularly younger employees, don't save as much for retirement as experts say they should.
- Employees invest their retirement savings assuming a much shorter time horizon than what's appropriate for their age.
- When given a choice between (1) withdrawing their money from their 401(k), pension plans, and IRAs and (2) deferring receipt until actual retirement, many employees opt to withdraw their funds immediately, despite the stiff financial penalty (i.e., taxes and loss of future investment income) for early withdrawal.

When faced with this sort of behavior, most of my colleagues in the pension consulting field simply encourage their corporate clients to provide more investor education or employee communication programs. Certainly, these programs are important, but I think they miss an important point that only becomes apparent when the *time value of time* is factored into the equation.

Consider, for example, 30-year-old "Sally," who leaves her employer after 5 years of service. When Sally leaves, her employer lets her choose between receiving her retirement plan benefit in a lump sum, which she can then roll over into an IRA (or, more to the point, spend), or leaving the money in the employer's plan and drawing a much larger annuity from the plan when she retires at age 65. The future investment return on that money may be very attractive—essentially guaranteed on a tax-free basis at 30-year Treasury rates for a defined benefit plan, with potential returns that are even higher with a 401(k) plan. Nonetheless, Sally, along with 99 of every 100 employees faced with

the same decision, will take the money and most likely spend it.

I am not persuaded that *all* of these employees are "irrational" or "uneducated." What I believe is that many are factoring (perhaps unconsciously) the *time value of time* into their calculation.

And how much is the *time value of time* actually worth? Well, bearing in mind that all my calculations are based on my initial assumption that time accelerates in strict proportion to one's age, I can derive the following annual "discount" rates for various ages:

Age	Annual Rate of Discount Due to *Time Value of Time*
25	3.8%
30	3.2%
35	2.7%
40	2.4%
45	2.2%
50	1.9%
55	1.8%
60	1.6%
65	1.5%

What does the table tell Sally in particular? That she should defer the receipt of her pension only if the money will accumulate at a rate 3.2 percent higher than the financially "rational" break-even rate. It is beyond the scope of this article to address what this rate might be. (It isn't simply a function of market investment returns; it must also take into account the potential tax, liquidity, and risk factors associated with deferring receipt.)

So, let's just say that a reasonable break-even rate is 8 percent. In that case, Sally should not defer her pension unless the deferred amounts earn at least *11.2 percent* per year. Note that this rate is actually a little higher than the theoretically correct rate, because Sally will age during the deferral period, and, as the table shows, the discount for the *time value of time* decreases with age. However, the point remains valid that the *time value of time* provides a powerful incentive for the immediate use of the funds, as compared with deferring their receipt.

A Prescription for Retirement Savings

This analysis can be extended quite easily to address the question of how much an individual should save for retirement. Clearly, the issues surrounding that decision are more complicated because there are additional variables to consider (e.g., employment prospects, current and future health, target retirement age, other sources of retirement income). Still, the table should at least provide a partial explanation of why savings rates are (1) not as high as they should be and (2) increase significantly with age (as the effect of the *time value of time* and thus the break-even investment return rate decreases).

This concept, and its application to savings rates, resembles in some ways the economic concept of *time preference*, although an in-depth discussion of the relationship between the *time value of time* and *time preference* lies beyond the scope of this article.

Finally, while the case for my next assertion isn't as straightforward as the two examples cited previously, I would argue that the "overly conservative" investment behavior common among employees is also driven, in part, by the unconscious application of the *time value of time.*

To see how this works, consider 45-year-old "Harry," who's sitting down with his financial planner for the first time to discuss how to invest the $100,000 he's managed to accumulate in his company's 401(k) plan. Most financial planners will tell Harry he should be at least 60 percent invested in stocks, and maybe more, because he won't be accessing his money for another 20 years. With that kind of time horizon, the short-run ups and downs of the stock market shouldn't matter to him.

Still, Harry's worried. Something about this advice doesn't feel right. What's bothering him, and what *should* be bothering him, is that he *might* need the money sooner. And *if* he needs it sooner, the notion of the *time value of time* suggests that the cost of not having the money when he needs it—let's say 5 to 10 years from now—is *much* more important than the value of having a somewhat larger amount of money many years hence, after he's retired.

In technical terms, what this means is that using the *time value of time* more heavily weights the value of years in the near future, and it effectively shortens the time horizon used by most people to evaluate the risk/reward of their potential investments.

As Time Goes By

Beyond financial planning, the concept of the *time value of time* has some broader, and perhaps more philosophical, implications. To understand some of these constructs, we need to discuss (briefly) the mathematical foundation underpinning the *time value of time.*

At the beginning of this article, I assumed that a person's perceived rate of the passage of time is in constant proportion to the actual number of years he or she has lived (his or her age).

If this is so, then each increment of perceived time (dt') can be expressed in terms of measured time (t). In fact, (dt') equals dt/t. As already noted, this implies that 1 year to a

40-year-old is perceived to pass twice as quickly as it does for a 20-year-old. If this is true, then a function of actual age (x) can be defined to express one's "perceived" age(x'). That is:

(A) "perceived" age = $x' = \int_1^x dt/t = \ln(x)$

Normalizing equation (A) to have "perceived" age at death equal to actual age at death, we get:

(A1) $x' = \int_1^x (w/\ln\{w\})(dt/t)$

where w equals age at death. When w is a constant[1] then $x'=(w\ln\{x\})/(\ln\{w\})$

One interesting thing we can now do is use Equation (A1) to generate an expression for the proportion of one's "perceived" life that one has lived by the time one has lived to age x. That is:

(B) fraction of "perceived" life to age x =

$$\frac{w/\ln(w)\int_1^x dt/t}{w/\ln(w)\int_1^w dt/t} = (\ln\{x\})/(\ln\{w\})$$

Assuming you can expect to live until about 80, this equation provides the somewhat startling and certainly depressing (but probably reasonable) result that you will have lived approximately 85 percent of your "perceived" life by the time you reach age 40.

Now for the good news. Let's consider your future life and how much of it is represented by the next 5 years. Modifying equation (B), we get:

(B1) fraction of "perceived" life to age x =

$$\frac{w/\ln(w)\int_x^{x+5} dt/t}{w/\ln(w)\int_1^w dt/t} = \frac{\ln(x+5)-(\ln(x)}{\ln(w)-\ln(x)}$$

What this equation illustrates is that if you're 40, the next 5 years represent more than *one-sixth* of the rest of your perceived life (as opposed to the expected 5/40, or one-eighth).

I think these results explain a great deal of human behavior, not just economic behavior, but sociological behavior as well. The forces represented by equations (A) and (B) suggest that individuals are preferentially motivated by short-term concerns for more than just materialistic or selfish reasons. The fact that our perception of the rate of the passage of time changes over time argues in favor of short-term thinking.

In addition, there may be implications for public policy. For example, if 85 percent of one's life is "lived" (as you perceive it) before age 40 (and more than 50 percent is "lived" before age 10), shouldn't more of society's resources be expended to make the lives of our children more fulfilling and worthwhile? And, on the flip side, is it reasonable for society to be devoting such a huge percentage of its resources to the welfare of the elderly?

One might argue that the idea of the *time value of time* suggests that (ignoring for the moment considerations like cash flow and government deficit problems) our Social Security system should be terminated, with all current recipients (and perhaps those close to retirement age) receiving a lump-sum distribution of their "accrued benefit," calculated, of course, at an appropriately high rate of interest.

There's one more implication of the *time value of time* to think about, though it may run counter to conventional wisdom. We tend to dismiss our younger counterparts as impulsive and impatient. And we presume it's experience and the accumulation of knowledge that teach us to be patient and measured in our approach to life's problems. But could it be that the acquisition of patience requires nothing more than living to an age at which the breakneck pace at which time rushes by only makes one's actions *appear* well considered when observed by a younger generation for whom time is merely creeping by? Food for thought.

Time's Up

Much of what's been discussed here could seem depressing—or worse, provide a rationalization for not thinking at all about the future. I take a slightly more optimistic view. For me, the lesson is clear: Live for today, because tomorrow may never come. And even if tomorrow does arrive, the day will surely be gone before you know it. □

[1]Of course, age at death is not a constant but is a random variable that is a function of among other things, current age. I believe that extending the theory of the *time value of time* to accommodate this would be a worthwhile undertaking.