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Reflections

The Investment Value of an Idea

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The first step in appraising investment value is translating what we know today about an asset into implications for its future. And the way an idea evolves is fundamentally different from the way either a plant or a brand franchise evolves. The cash flow of each of the three "asset classes" has its own time pattern.

For example, every capital good—lift truck, engine lathe, backhoe, power loom—embodies a solution to a particular problem. From the date of its manufacture until it arrives at the scrap yard, a capital good embodies the solution—the same idea (or set of ideas). As soon as a better solution becomes available, manufacturers will stop making the old capital good. But the examples already in service will continue for many years, even after the solution they embody becomes the marginal solution—even after they cease to be scarce and, hence, to contribute to their user's investment value.

But what about the value of the *idea* embodied in the capital good? Does it belong to the user or the manufacturer? Consider what happens when the buyer drives a new car—a capital good—away from the dealer. If its secondhand value exceeds what he paid for it, then at least the part of the value of the innovations embodied in the car belongs to the new owner. But if, as folklore suggests, the price goes down, then the new owner has paid at least full value for those innovations. Does the same thing happen to new tankships? New airliners? If so, then the *ideas* from which a new model derives its value belong to the seller (i.e., the manufacturer).

Why Ideas Are Risky

The value of the idea to the manufacturer ends with the arrival of an idea that solves the same problem better, faster, or cheaper. More often than not, it will be spawned by a different technology, developed by a different company.[1] But the better idea does not actually "arrive" when the metaphorical bulb lights up in the inventor's head. The challenger does not displace the current champion until the challenger's development is complete.

Consider fusion. Like fission, it produces no carbon dioxide and, hence, no global warming. But unlike fission, it is allegedly safe (no Three Mile Islands or Chernobyls) and clean (no radioactive waste to store under Yucca Mountain). Twenty years ago, scientists estimated that fusion was ten years away from completing its development. Today, scientists are still estimating that fusion is ten years away from completing its development. Until then, manufacture of fossil-fuel generating plants will continue. And the implications for global warming are dire. As they raise the standards of living for their vast populations, China and India are rapidly increasing energy consumption.

The value of an idea lasts only until a better idea—completely developed—arrives. No one knows when that will occur, but we can calculate the probability that the challenger will arrive in a given year.

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Ideas with potential investment value go through four stages:

1. *Research.* Does the idea have enough economic potential to warrant the investment to make it practical? If so, it enters Stage 2.
2. *Development.* Although George Stephenson's steam locomotive was patented in 1815, the Stockton and Darlington Railway in England did not begin operations until 1830. Although Rudolf Diesel's version of the internal combustion engine was invented in 1893, it did not begin to replace the steam locomotive until the late 1920s.
3. *Application.*
4. *Death,* which occurs suddenly when a better idea is fully developed. When manufacturers stopped making (and railroads stopped buying) steam locomotives, the value of Stephenson's idea ended.[2]

A sword of Damocles hangs over every valuable idea. The probability that the sword will fall in any given future year is, of course, an investment judgment. (Do ideas change faster in the fields of biotechnology and software than they do in certain gray-belt industries?) This article spells out ways in which the consensus judgment regarding the mortality rate enters into the market price of the idea—and into its systematic risk.

When Will the New Replace the Old?

Fusion, monoclonal antibodies, and fuel cells are ideas with huge economic promise. When will they be fully developed? Nobody knows. They represent a risk to current, fully developed technologies, but the risk they pose is actuarial.

We can express this ignorance with a number—a probability that development will be completed in a given year. Because the completion of the rival's development is the death knell for the established technology, the two events have the same probability. For the old technology, it is a mortality rate.

Consider the present value of the current technology's rent in Year 10: If the challenger's development is completed in Year 9, then that rent contributes nothing to the present value. But, of course, we do not now know when the challenger will arrive. So, we reduce the Year 9 value of Year 10's rent by the factor

$$1 - \gamma,$$

where γ is the mortality rate (the probability that the challenger completes commercial development in any given year). The Year 9 value will not contribute to the Year 8 value, however, if the challenger's development is completed in Year 8, and so on. Therefore, the *expected* value of the reigning champion one year hence is its *market* value—call it v—discounted by the probability that the challenger *does not* complete development:

$$(1 - \gamma)v.$$

Table 1 demonstrates a useful approximation for small values of γ.

Table 1. Accuracy of Approximation for Small Values of γ

γ	$e^{-\gamma}$	$1 - \gamma$
0.10	0.9048	0.90
0.15	0.8607	0.85
0.20	0.8187	0.80
0.25	0.7788	0.75
0.30	0.7408	0.70

Let ρ be the market discount rate for such ideas. If the expected value of the champion one year hence can be approximated by

$$(1 - \gamma)v \approx e^{-\gamma}v,$$

then its market value now is

$$e^{-\rho}(1 - \gamma)v \approx e^{-(\rho+\gamma)}v.$$

If the economic rent enjoyed by the champion is f a year, its value now is

$$\begin{aligned} v &= f\int_0^\infty e^{-(\rho+\gamma)t}dt \\ &= \frac{-fe^{-(\rho+\gamma)t}}{\rho+\gamma}\Bigg|_0^\infty \\ &= \frac{-f}{\rho+\gamma}(0-1) \\ &= \frac{f}{\rho+\gamma}, \end{aligned}$$

so the practical effect of adding the mortality rate to the market discount rate is to increase the rate at which future scarcity rents are discounted back to the present.

Consider the case in which the market discount rate is 10 percent and the mortality rate for the current champion is 10 percent. **Table 2** shows the present value of a dollar of future economic reward, discounted at 20 percent over the intervening years.

As the reader can see, it hardly matters whether we impose an arbitrary cutoff at Year 32—or, for that matter, at Year 16. The chance that the current champion will survive every future challenge is slim indeed. But we allow for that consideration when we "discount" for both appropriate capital-market discount rate ρ and mortality rate γ.

Table 2. Value of $1.00 of Economic Reward (market discount rate = 10 percent, mortality rate = 10 percent, discount of 20 percent)

No. of Years Hence	Discount Factor
1	$0.8187
2	0.6703
4	0.4493
8	0.4493
16	0.0408
32	0.0017

Growth Companies

In their important 1961 paper, Merton Miller and Franco Modigliani argued that mere growth does not create any incremental value for investors unless the added assets are worth more than they cost. But Miller and Modigliani were probably thinking about conventional investment assets.

Unless a challenger successfully completes its development in the interim, the expected value of the idea next year will be roughly the same as the value this year. So the investor's expected reward is simply this year's economic rent on the idea and the investor's rate of return is

$$\frac{f}{v} = \frac{\rho + \gamma}{f} f$$
$$= \rho + \gamma.$$

But this return is bigger than the return on conventional assets with the same market discount rate.

The explanation is simple: This return is the rate of return on the idea until it is successfully challenged. In hindsight, a company that derives its value from ideas that have survived previous challenges will appear to have a very exciting track record. Until its ideas are overtaken by better ideas, such a company will outperform normal companies. Are ideas the only legitimate source of the growth in "growth" companies?

Systematic Risk

Valuable ideas apparently contain an extra element of *specific* risk. But what about their *systematic* risk? Adding the mortality rate to the market discount rate increases the sensitivity of the discounted value to short-term prospects for the economy. To simplify the math, assume the following:

1. There are no rents from the idea in hard times.
2. Development of potential competitors continues.

So the idea's present value depends on how long hard times are expected to last. Under these circumstances, Panel A of **Table 3** shows the discount factors for a range of values for γ. Panel B provides the corresponding values of a benefit stream of $1.00 a year when it is subjected to discounts for both (1) an undelayed benefit stream subject to the indicated ρ and γ and (2) delaying the benefit stream the indicated number of years.

Table 3. Idea's Present Value in Hard Times of Various Duration (ρ = 0.10)

γ	1 Year	2 Years	4 Years	8 Years
A. Discount factors				
0.10	0.82	0.67	0.45	0.20
0.15	0.78	0.61	0.37	0.14
0.20	0.74	0.55	0.30	0.09
0.25	0.70	0.50	0.25	0.06
0.30	0.67	0.45	0.20	0.04
B. Discount factors: Benefit stream of $1.00 a year				
$0.10	$4.10	$3.35	$2.25	$1.00
0.15	3.12	2.44	1.48	0.56
0.20	2.47	1.83	1.00	0.30
0.25	2.00	1.43	0.71	0.17
0.30	1.68	1.13	0.50	0.10

As the reader can see, the investment value of an idea can be very sensitive to the immediate prospects for prosperity. The short term is more important in valuing ideas than it is in valuing plant.

More generally, let t be the number of bad years the consensus expects. Then, for the present value of an economic rent of $1.00 a year, we have

$$v = \frac{e^{-(\rho+r)t}}{\rho + \gamma}$$

and

$$\frac{dv}{dt} = -(\rho + \gamma)\, v,$$

and for the effect of a change in consensus t on the idea's rate of return,

$$\left(\frac{1}{v}\right)\left(\frac{dv}{dt}\right) = -(\rho + \gamma).$$

But expectations regarding a change in the market's estimate of t affect most asset values to some degree. And when unforeseen events change these expectations, the result is *systematic risk*.[3] So γ, which measures the idea's *specific* risk, also has a big impact on its systematic risk. Because a portfolio of ostensibly unrelated ideas will have a large element of systematic risk that cannot be diversified, lenders will want to be able to reach other assets.

To summarize:

- The risk of sudden death can be incorporated into estimates of investment value by simply adding the appropriate mortality rate to the market discount rate.
- Ideas for which the Damoclean sword has not yet fallen will reward investors with rates of return higher than the market rate. Shares of their corporate owners will behave like growth stocks.
- An idea will exhibit more systematic risk than conventional investment assets with the same value. Because it cannot be diversified away, this risk places special burdens on the owner's capacity for risk bearing.

Wealth Borrowers and Wealth Lenders

Obviously, one household's liability is another household's asset. Only slightly less obvious is that one household's ownership of government debt is some other hapless household's future tax liability. When the balance sheets of all the households in society are summed, the lendings and borrowings cancel, leaving only the real assets. It follows that the total wealth available to bear the risk in these assets is identically equal to their total value.

The function of wealth is to bear society's investment risks. The other contributors to a business enterprise—workers, suppliers, bankers, and so on—will not contribute until they are satisfied that the business's equity is big enough to insulate them from risks they are not paid to bear. If an asset has sufficiently small value in relation to its risk, society will require the bearer of its risk to have other sources of wealth—assets whose value is larger in relation to their risk.

The equity in a levered corporation is an indication of the value available to protect lenders from the risk in its assets. The high degree of leverage in real estate suggests that the value in buildings is large in relation to their risk. It frees up the remainder of the value to bear other risks. But most real estate is mortgaged, and most publicly owned corporations are levered. The implication is that some other asset must exist whose risk is larger in relation to its value. If corporate and real estate assets are lenders of risk-bearing wealth (i.e., wealth *lenders*), where are the wealth *borrowers*?

Entrepreneurial Risk

A study released in January 1967 titled "Technological Innovation: Its Environment and Management," often referred to by the short name "The Connor Report" (named for John Thomas Connor, who was U.S. Secretary of Commerce from January 1965 to January 1976), sought to identify the new ideas in the first half of the 20th century that had created the most jobs (Connor 1967). It found that "the most important inventions come from independent inventors—that is, from somebody's garage or basement. "The Connor Report" listed 31 such inventions, including Xerography, the Polaroid camera, power steering, the automatic transmission, Kodachrome, the vacuum tube, air conditioning, rockets, streptomycin, penicillin, and the helicopter.

John Heaton and Deborah Lucas (2000) estimated the value of new ideas currently in development at approximately $10 trillion. This number may seem big in comparison with the value of stocks, but there are, of course, a lot of garages and basements—many attached to houses with mortgages. What is special about what Heaton and Lucas called "entrepreneurial risk" is the high ratio of risk to value. Ideas have a higher ratio of risk to value than conventional assets—plant and brand franchises—with the same market discount rate.

Households have assets with a lot of value in relation to their risk—value that is potentially available to lenders—as long as they do not incorporate. But without the limitation on liability conferred by incorporation, proprietors are cautious about their spending, preferring to develop an idea in the basement or the garage.

Realizing the economic potential of an idea may require manufacturing facilities, raw materials, work-in-progress and finished goods inventories, accounts receivable—in other words, a lot of relatively conventional, low risk-to-reward assets. When a venture has accumulated enough of the low risk-to-reward assets to reduce its overall risk-to-reward ratio sufficiently, it is at last ready for incorporation—which obviously has to precede its IPO.

Notes

1. Can the owner of the currently valuable technology invent its successor? Baldwin-Lima-Hamilton Corporation made great steam locomotives. How did they fare with diesels? Curtis-Wright Corporation's turbo-compound radials powered the fastest piston-engine airliner. How did Curtis-Wright fare with jet engines? How did IBM fare with operating system software? Bell Labs with printed circuits? Professor Lynn Stout of the UCLA Law School has pointed out a serious *agency problem* that works against the owner of today's solution providing tomorrow's solution: The human capital of the corporation's staff is invested in the old technology. To speed the arrival of the new technology may not be in their interest, even if it is in their employer's interest.
2. Steam continued in active service until 1960 in certain Class I railroads.
3. When the systematic risk increases, ρ increases—and we are off to the races.

References

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