The Evolution of Portfolio Insurance

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The financial product known as portfolio insurance was born the night of September 11, 1976. Hayne Leland had recently returned from France, and had been lamenting the weakness of the dollar. Ronald Reagan played a bit role: As governor of California, his administration saw a substantial reduction in the real income of academics. Lifestyles were in danger, and it was time for invention.

On September 11, Leland was wondering what product might have appeal to the financial community. He recalled conversations with his brother, a principal in an investment management firm. His brother mentioned that after the decline of 1973-74 many pension funds had withdrawn from the stock market, only to miss the subsequent rally in 1975. "If only insurance were available, those funds could be attracted back to the market," he had said.

So portfolio insurance seemed a product that would have considerable appeal. The only problem was how to provide it. Clearly, the parallels with regular insurance were limited. While the form of an insurance contract might look familiar—an assured value in return for a premium—the manner in which it would be provided would have to be quite different. In contrast with houses, when one portfolio burns down, virtually all others are likely to follow suit. So "risk pooling," the typical method of insurance, was not appropriate for portfolio insurance.

Although no expert in options theory at the time, Leland suddenly realized that insurance was equivalent to a put option—not on a stock, but on an entire portfolio. In 1976, however, exchange-traded put options did not exist. (When they were introduced the following year, they were limited to a few stocks, and had short maturities.)

At this point Leland's background as an academic provided an advantage. Three years earlier, Fischer Black and Myron Scholes had written a key paper on the pricing of options.[1] This paper used a local arbitrage argument to derive option prices in an environment where stock prices followed a logarithmic, continuous-time random walk. Over a very short time period, Black and Scholes showed that a call option could be perfectly hedged by a negative stock position. Since the resulting hedge position was riskless, it must return the riskless rate. This requirement produced a partial differential

[1] F. Black and M. Scholes, "The Pricing of Options and Corporate Liabilities," *Journal of Political Economy* 81, No. 3 (May-June 1973), pp. 637-659. Robert Merton extended the Black-Scholes model in many important ways in his paper, "Theory of Rational Option Pricing," *Bell Journal of Economics and Management Science* 4, No. 1 (Spring 1973), pp. 141- 183.

equation which had to be satisfied by the value of the option. The solution to the equation is the celebrated Black-Scholes formula.

In wrestling to understand fully the Black-Scholes approach, Leland had come to realize that the local arbitrage argument used by Black and Scholes to price options could be extended to actually create options. Rather than create a risk-free return by dynamically hedging an option with stock, as in Black-Scholes, why not reverse the process and create an option by dynamically hedging the stock with a risk-free asset?

Arbitrage means that there are two ways of doing the same thing. If an option were desired, either the option could be purchased, or it could be created by a dynamic strategy which involved just the underlying stock and a risk-free asset. And an option could be created on a portfolio of stocks as easily as on a single stock—for any desired strike price or time to expiration. At that moment, Leland realized portfolio insurance could be provided![2]

A sleepless night of excitement gave rise to a further revelation: Leland really didn't know much about options at all! Exactly what was the appropriate hedge ratio? Would short positions be needed? And how could the problem be put on a computer to implement easily the shifting of equities to Treasury bills and vice versa?

Fortunately, Leland knew he didn't have to look far. Mark Rubinstein, a colleague in the finance group at Berkeley, had recently become both an options expert and a computer nut. Recognizing the importance of the emerging field of options, Rubinstein had just published what proved to be an important paper in the development of option pricing theory. Moreover, carried away by his enthusiasm for the emerging possibilities for stand-alone computing, he had nervously just purchased a desktop IBM 5100 computer, containing a grand maximum of 64K of core memory with a 200K cassette tape drive for $20,000.

Rubinstein was convinced that Leland's ideas could be implemented, in part because he had used the same principles to hedge positions as a market maker with a seat on the options floor of the Pacific Stock Exchange. However, he was concerned about two potential problems. First, he was worried that the transactions costs created by the frequent trading required by the dynamic strategy could prove excessive. Second, he was then in the process of preparing an economic justification for exchange-traded index options to be submitted to the SEC by the Philadelphia Stock Exchange.

If this proposal were approved, he feared that it would not be necessary to use dynamic trading strategies to manufacture portfolio insurance when this insurance could be purchased directly in the form of exchange-traded index puts. Nonetheless, Rubinstein's

[2] At the same time a professor at the University of British Columbia, Michael Brennan, and his student, Eduardo Schwartz, published a related paper entitled, "The Pricing of Equity-Linked Life Insurance Policies with an Asset Value Guarantee," *Journal of Financial Economics*, Vol. 3 (June 1976), pp. 195-213.

own SEC report demonstrated his belief that index options (exchange-traded or manufactured) would prove to be an invaluable tool for investors.

Thus, on September 12, a verbal agreement was made to form Leland-Rubinstein Associates. The objective was to develop the technique and appropriate software to provide portfolio insurance. It was clear to both that this was to be done as a part-time activity. While it was directly relevant to the field of finance, neither Leland nor Rubinstein wanted portfolio insurance to be the sole focus of their time or research interests.

Progress was not particularly rapid, as other academic responsibilities took their toll. The cloud of exchange-traded index options continued to cast its shadow. Also worrisome was the problem for insurance posed by random volatility.

But the concerns abated for two reasons. First, the Philadelphia Stock Exchange's proposal was turned down—ostensibly because of the new feature of cash settlement on exercise, but also, we believe, because the Securities and Exchange Commission and the Commodities Futures Trading Commission had not yet resolved which was to have regulatory power over such instruments.

Second, we came to realize that most institutional funds would prefer longer-term protection—and indeed, our programs increasingly are of three-to seven-year duration. Since exchanges only make money from turnover, it would only pay them to list options with high trading volume and these would likely have short maturities. (Subsequently, with some irony and luck, it turned out that the phenomenal success of these relatively short-lived index options has provided a useful set of instruments for the long-term insurance programs if carefully rolled-over in conjunction with other securities.)

Yet another reason to prefer the dynamic approach was the fact that most institutional portfolios were unique, and contained bonds and other securities besides stocks. Options on bonds and stocks separately would prove an inefficient way to protect such a portfolio.

A remaining problem was random volatility. The Black-Scholes formula assumes that the volatility of the underlying asset remains constant over an option's horizon. But even a cursory familiarity with the behavior of stocks, as well as stock indexes, suggests that this is not a realistic assumption. In the depression, the S&P 500 index had annual volatilities exceeding 30%. During most of the 1960s, the index had annual volatilities of less than 15%. Hedging based on a 15% volatility could be disastrous if the actual volatility turned out to be 30%. We felt this problem had to be solved before portfolio insurance could be marketed.

During the summer of 1978, while working in France, Leland saw a possible resolution to the volatility problem. The Black-Scholes formula had several arguments: the strike price, time-to- expiration, the interest rate, and the variance of the stock return. But time and variance always entered as a single term, multiplied together. This meant that if the variance were higher, all pricing and hedging would remain identical if the time period

were shorter! With a little more math, Leland realized that exact insurance could be provided, if what was insured was a total volatility, which could be expressed as a predetermined number of moves of the underlying portfolio. At the same time, Rubinstein had been working on a binomial approach to option valuation and hedging, which could be interpreted in much the same way.

So Leland-Rubinstein Associates' first product was portfolio insurance for a given number of moves of the underlying portfolio. Our sales presentation contained an example in which protection was provided for five moves (any combination of ups and downs) of 5%. The protection was good until the maximum number of moves had occurred. By specifying the term of the insurance in this manner, we did not have to worry about excessive costs or mishedging. Increased volatility would simply result in quicker expiration, at which point (we hoped) the client would renew his policy.

When Rubinstein first programmed this new approach, the historical simulation results were disappointing. Errors often exceeded an unacceptable 5%. But a programming error was found, and suddenly, simulation errors dropped to less than 0.1%. Turnover was not excessive. We knew we were on our way!

To demonstrate that the system worked in the real world, Rubinstein actually used the system on his own account, shifting money between Vanguard's Index Fund and Money Market Fund. The experiment was a complete success and formed the basis for results later reported in *Fortune* magazine (June 1980).

Barr Rosenberg, a colleague at Berkeley and a pioneer in applying financial theory to portfolio selection, wrote a very supportive introductory letter to institutional money managers. It was now 1979. Leland made a swing to several major Eastern and Midwestern banks, giving seminars about the ideas behind portfolio insurance. Several expressed interest; scheduled 1-hour meetings turned into half-days.

Leland went home and eagerly waited for the phone to ring. It never did. In our quickly diminishing naiveté, it was difficult to understand why such an appealing idea as portfolio insurance would not be immediately picked up by someone. It seemed if we didn't run into the stone wall of disbelief that it was possible to create portfolio insurance, we ran aground on the old conservative argument: "If this is so good, why isn't someone already doing it?" Worst of all were the silent types who would nod with approval and apparent understanding during our whole presentation, but never tell us their reservations. As familiar as this response may be to many salespeople, this was new to us academics who never had to go far among our colleagues to find an argument.

It soon became evident that while we did not doubt our technical expertise or the viability of the product, we just weren't—either by temperament or by the time available—going to succeed at marketing. We needed an individual with the background to understand the technical aspects of portfolio insurance, while at the same time having the ability to market the product professionally. It was then, in late 1980, that we made our first "sale" to John O'Brien.

O'Brien had years earlier formed O'Brien Associates, the first firm to provide analytical services for portfolio managers based on MPT. Concerned by the shift to competitive commissions and its impact for soft-dollar-funded services, O'Brien moved to A. G. Becker, where he was vice president in their pension fund services research group. (O'Brien Associates continued under the name Wilshire Associates.)

Leland and Rubinstein met O'Brien at a seminar run by the Berkeley Program in Finance; a casual description of portfolio insurance led to more serious discussions about the possibility of a joint venture. Characteristically, standing on his faith in the power of a good idea and his ability to sell it, O'Brien was willing to give up his safe and comfortable position at Becker and throw in with us. An agreement was reached in the fall of 1980 and Leland O'Brien Rubinstein Associates, Inc. (now mercifully known as LOR) was incorporated in February 1981 with three principals, two part-time secretaries, one computer, and no clients.

Within a month, however, we had our first client. MidContinent Capital Management, headed by John Mabie, insured a $500,000 account for six moves of 4%. Funds were moved between Treasury bills and an actively managed portfolio. The account delivered as promised, and protection lasted almost exactly the planned six months.

O'Brien's marketing plan included an emphasis on fund sponsors, as contrasted with money managers. He felt that portfolio insurance allowed sponsors to regain the risk control of their entire portfolio. Managers typically held only a portion of a sponsor's funds. Insuring a small fraction made little sense; furthermore, it seemed a conflict of interest for managers to offer insurance when their product was often predicated on "beating the market."

O'Brien's plan for attracting sponsors worked well, and by the end of the first year our assets under management were up to $135 million. But simultaneously, we had our first major problem. MidContinent's second program, also for six moves of 4%, did not last the six months which average volatility would imply. The market fell with higher-than-average volatility. The program delivered as promised—but the moves had expired more quickly than projected—the program was completed after only four months. And, while providing protection against losses as we had expected, the program's early termination had unsettled the client.

The first of many research projects was launched: How to provide insurance for fixed time periods when volatility was random, without violating minimum returns and limiting the variability of upside costs. The resulting product clearly had more market appeal than the previous (and to us, more elegant) random-horizon model—the model that convinced us to offer the product in the first place. It was not the only lesson we've learned about the marketplace since 1976!

The business grew rapidly. Soon our success, our willingness to risk explanation of our procedures even to potential competitors, and publication of a pedagogic article in the

Financial Analysts Journal[3] inevitably took its toll: We had our first competition from two well-established firms. Ironically, neither firm met with much success but inadvertently helped to legitimize the product in the minds of many firms who later became our customers.

Although the business continued to grow, we were always burdened by two major problems. First, the shifting of stock to Treasury bills, and vice versa, was in many cases opposed by money managers. It was disruptive to their investment process, they said. Second, it was difficult to coordinate the shifting of funds when there were many managers. All had to agree to work with the system, and a way of deciding how much each manager needed to sell needed to be worked out.

Both of these problems were solved with the development of the index futures markets. Shorting index futures is the equivalent of selling a portfolio of stocks, and investing the proceeds in a short-term Treasury bill. Thus hedge positions could be increased by shorting index futures, and decreased by removing these positions. Portfolio insurance based on futures does not interfere with money managers (indeed, they need not even know the program is in place). The liquidity of the futures markets, and low cost of transacting compared with stocks, made the protection of very large programs feasible for the first time.

Our first account using index futures was started in March 1984. As of the end of 1986, roughly 80% of the dollar value of LOR accounts was protected using futures. While offering many advantages, there are some subtleties to using futures, including proper attention to the basis, and the use of appropriate fixed-income futures for long-run programs.

In 1983, we began to attract large money managers as licensees. Because our software was soon transferred from the IBM 5100 to its successor, the IBM/PC, its portability meant that our product could be used in a truly distributed computing environment. Our software allows certain functions to be performed locally and others to be performed on a PC-based time-sharing system run out of our offices in Los Angeles (with a complete backup system in New York in case California falls into the sea).

Through the offerings of licensees, two of our original goals dating back to our 1976 discussions have been realized. One licensee, Wells Fargo Investment Advisors, uses the product to insure part of its extensive index fund. Another licensee, Aetna Life and Casualty, uses our service to guarantee minimum rates of return on equity investments, and backs this guarantee with their corporate assets.

[3] M. Rubinstein and H. Leland, "Replicating Options with Positions in Stocks and Cash," *Financial Analysts Journal* 37, No. 4 (July-August 1981), pp. 63-72. [Added Note: This article was reprinted in the 50th Anniversary Issue of the *Financial Analysts Journal* (January/February 1995), having been selected as one of the 22 best articles out of the 3,200 published in the *Journal* during its 50 year history.]

Not least, the term "portfolio insurance"—which we coined but were at first reluctant to use in a commercial environment because of its potentially misleading implications—has become generic.

The sophistication of portfolio insurance users has grown as rapidly as the product itself. Currently, more than 75% of LOR accounts are not run with traditional Black-Scholes hedging. Rather, time-invariant or "perpetual" programs are used. These programs have the advantage that there is no fixed expiration date: The program can be left in force as long as the client wishes. And, in another development, sponsors are realizing the advantage of programs that protect a fund's surplus. Portfolio insurance is being applied to many different classes of assets besides equities; fixed-income and international investments are growing areas of application.

An early criticism of portfolio insurance was that it reduced return as well as reducing risk. But users are discovering that portfolio insurance can be used aggressively rather than simply to reduce risks. Long-run returns can actually be raised, with downside risks controlled, when insurance programs are applied to more aggressive active assets. Pension, endowment, and educational funds can actually enhance their expected returns by increasing their commitment to equities and other high-return sectors, while fulfilling their fiduciary responsibilities by insuring this more aggressive portfolio. Compared with current static allocation techniques, annual expected returns can be raised by as much as 200 basis points per year.

The future looks as exciting as the past. LOR has always maintained that it is in the Dynamic Asset Allocation business, of which portfolio insurance is but one product. Dynamics can be used to mold a set of returns to virtually any feasible investor objective. It can be used to manage the risks of corporate balance sheets as well as investment funds. As such, it may represent the most significant advance to date in the science of financial engineering.