Supply Contract and Portfolio Insurance

Applying Financial Engineering to Institutional Timberland Investment

Runsheng Yin and Bob Izlar

ABSTRACT

The long-term growth of institutional timberland investments depends on the ability of timberland investment management organizations (TIMO) to deal effectively with securitization, leveraging, arbitraging, supply contracting, portfolio insurance, tax efficiency enhancement, and other issues. Financial engineering holds great promise for many of these issues. This study applies financial engineering techniques to two cases–supply contract and portfolio insurance. We believe that the potential benefits of these and other applications can be great.

Keywords: economics; industry

Institutional timberland investments by pension funds, insurance companies, and others have increased substantially since the 1980s. In general, most institutional timberland investments are placed and managed through timberland investment management organizations (TIMO). In 1986, only six TIMOs existed, running commingled funds with total assets of less than $100 million; this amount grew to $600 million by 1990 (Zinkhan 1990). By 1992, assets held by the five major TIMOs—Forest Investment Associates, John Hancock, Prudential Timber, Resource Investments International, and Wachovia Timberland Investment Management—had risen to $2.04 billion. By 1997, these firms remained the largest TIMOs while the industry swelled to 11 companies with total assets estimated at about $6 billion (Caulfield 1998). During 1998–99, another significant expansion in timberland transactions occurred, with at least $2 billion in industrial timberland assets added to institutional holdings (Hancock Timberland Investor 1999). One recent estimate puts the number of TIMOs at about 20 (Turner 1999).

In the context of portfolio management, timberland is viewed as a class of asset with relatively low price volatility and low price correlation with other financial assets (Binkley et al. 1996). As a result, investment portfolios with a timberland exposure can offer a higher level of return for a given level of risk. In addition, timberland can generate superior long-term cash flows because it delivers very high operating margins, yet requires relatively small capital reinvestment (Zaret 1998). However, the recent surge of interest in institutional timberland investments has much to do with their historical returns. According to the timberland index compiled by the National Council of Real Estate Investment Fiduciaries, the 10-year (1987–96) average cumulative total return for institutional timberland investments was 21.4 percent per year, outperforming the S&P 500 index at 18.0 percent.

Several factors have driven this excellent performance (Lutz 1999; Turner 1999). First, internal financial stress and external performance pressure have caused integrated forest products firms to shed part of their timberland assets to generate cash and earnings improvement. Second, induced by the recent consolidation and globalization, asset realignment and operation concentration (on manufacturing and marketing) have led many firms to downsize their timberland holdings, particularly their nonstrategic assets. Meanwhile, pension funds and other investment institutions, growing in size and desiring greater diversification, have made their capital available to take advantage of these timberland buying opportunities. In addition, the spotted owl listing and ensuing federal harvest reductions in the Pacific Northwest resulted in spectacular timber price hikes throughout the United States in the early 1990s, which in turn greatly benefited and thus encouraged further institutional investments. Con-

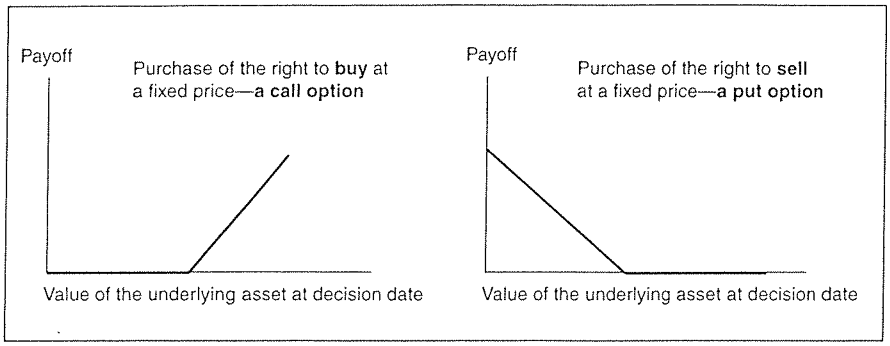


Figure 1. **Illustration of the payoffs of put and call options.**

sequently, timberland has now been accepted by financial institutions as a viable investment-grade asset class (Page 1998; Salomon 1999).

Nevertheless, the timberland investment industry is facing some tough challenges to its long- term growth. For instance, to take up more assets shed by integrated companies, TIMOs must be able to mobilize a greater amount of capital resources, implying that private placements alone may be inadequate and that they must reach out to the investment community for public equity. Further, as TIMOs assume a larger role in timber supply, it behooves them to explore economies of scale in land management and to actively engage in intensive silvicultural practices (Turner 1999). In particular, two issues of concern are: (1) how to facilitate the transfer of industrial timberland to institutional investors and (2) how to maintain attractive portfolio performance over time.

A look at recent timber market dynamics can shed some light on the importance of these two issues. At the beginning of 1990 the average price of domestic Douglas-fir saw logs (#2) in the Pacific Northwest was only about $360 per thousand board feet (mbf) (Arbor-Pacific Forestry Services, Inc. 1999). By June 1992 it had climbed to $510 per mbf and quickly shot up to $850 per mbf by May 1993. After further fluctuations, the saw log price stabilized at around $700 per mbf during much of 1994–96. However, the collapse of international forest products markets caused by the financial crisis in Asia led the price to dive to about $400 per mbf in late 1997 and 1998. Similarly, timber prices in the South have witnessed tremendous changes since the early 1990s (*Timber Mart–South* 2000). Price movements such as these can lead to great opportunities for both integrated companies and institutional investors. At the same time, they can generate huge uncertainties, which may cause integrated companies to hesitate when considering the transfer of their timberland to institutional investors, and create challenges to institutional investors to maintain their superior performance.

The objective of this article is to address these two issues with the aid of financial engineering techniques. We will approach the issue of timberland transfer from the perspective of supply contract and, likewise, the maintenance of attractive performance by TIMOs from the perspective of portfolio insurance. Portfolio insurance is easy to understand: It can be detrimental, perhaps even devastating, for an investor to absorb the impact of dramatic price drops. Similar to investments in other asset classes, investments in timberland need portfolio protection to deal with price volatility and reduce exposure to market downturns.

Comparatively speaking, however, our knowledge of the relevance and structure of supply contract is limited. Although forest products companies have shown their willingness to cut back their timberland holdings and purchase a larger portion of their wood fiber in the open market, they are concerned about their long-run wood consumption. Specifically, they worry about the uncertainty of future supply and price volatility associated with spot markets. As a result, to date few integrated producers have made a wholesale separation of their fee land. Some refer to this as "ingrained bias to own or control timberland" (Zaret 1998, p. 2). However, for those firms with annual wood consumption in the millions of tons, this concern is legitimate and their desire for reliable delivery and predictable prices reasonable. On the other hand, TIMOs, though eager to take up timberland from integrated companies, may not necessarily want to commit themselves to supplying wood to these companies on a regular basis. They fear that if they do so, their control and pricing of the assets could be compromised.

Long-term contract cutting rights have the potential to overcome control issues (Page 1998; Zaret 1998; Lynn 2000). A timberland sales agreement could be designed to include a long-term fiber supply contract to facilitate the transfer of industrial timberland to institutional investors and make the transaction more attractive to both parties. In fact, supply contract has been adopted by some firms seeking to divest timberland. For example, while Plum Creek Timber Company agreed to purchase 905,000 acres of central Maine timberland from Sappi Fine Paper North America for $180 million, it simultaneously entered into a 40-year fiber supply agreement with Sappi (Anonymous 1998). When Kimberly-Clark and Smurfit-Stone put their timberland up for sale last year, they also sought supply agreements with potential purchasers (Donegan 1999). More recently, Plum Creek Timber Company and The Timber Company, a separate operating unit of Georgia-Pacific Corporation, decided to merge and create the world's preeminent pure timber company (Georgia-Pacific Corporation 2000). According to the announcement, "Plum Creek will assume a 10-year wood supply agreement between Georgia-Pacific and The Timber Company, ensuring continued access to fiber for Georgia-Pacific's manufacturing facilities and providing Plum Creek with a stable, long-term customer for The Timber Company's southeastern timberlands." It is even claimed that this transaction "represents a major departure from the traditional ownership and operating philosophies of integrated forest products manufacturers."

This discussion leads us to the ques-

Other Applications of Financial Engineering

Some other applications of financial engineering are briefly discussed below. It should be noted that, more often than not, these applications are made in combination.

Securitization is the process of creating asset-backed securities, in which a firm can remove nontraded assets from its balance sheet by packaging them in a convenient form and selling the packaged securities in a financial market. For example, instead of being privately held, a TIMO's timberland may be securitized by way of a master limited partnership (MLP) or real estate investment trust (REIT). This way, the TIMO is transformed into a public enterprise. As institutional timberland investments expand, private placements alone may not be adequate, and securitization becomes necessary for TIMOs to reach out to the broader investment community. In addition, securitization can make the operation of an institutional timberland business more transparent to investors and thus put the conduct of timberland managers under closer scrutiny. Presumably, this will benefit investors. In addition, securitization facilitates the use of derivative markets and offers a benchmark measure of performance. A drawback of timberland securitization is that it may lead to a closer link between stock prices of timberland and other securities, offsetting the current characteristic of low correlation between prices of timberland and other assets.

Tax efficiency of an investment vehicle is determined by its tax effect on its initial formation and as an ongoing enterprise. Because integrated forest products companies are subject to double taxation—corporate income tax as well as personal income tax on dividends—analysts generally believe that industrial timberland in its current holding form (or even some restructured forms, like spin-off and letter stock) are tax inefficient as an ongoing business (Lynn 1998; Zaret 1998). In contrast, investors in MLPs and REITs are only liable for single taxation—personal income tax. So, MLPs and REITs are viewed to be more tax-efficient investment vehicles. An added advantage of timber RIETs is that if stumpage sellers have owned the timber for one year or more, which generally is the case, then sale proceeds are taxed at capital gains rates (Snyder 1998). Because the capital gains tax rate is now limited to 20 percent, the effective tax burden of REITs can be even lower than that of MLPs. So, some analysts argue that tax minimization could prove to be the most significant value driver of timberland investment instrumentation (Zaret 1998). It should be noted, however, that REITs carry some restrictions with regard to capital structure and operation.

Leveraging is the use of debt to magnify investment returns. The driving force of leveraging is the fact that debt and equity operate differently. In general, equity is paid with dividend, whereas debt is served with interest. It could be the case that the interest rate is lower than the rate of return to investors. Even if this is not the case, investors may benefit from stock appreciation over time, while creditors face a fixed principal. Moreover, interest expenses for debt are tax deductible, and this lowers the levered firm's taxable income and, consequently, its taxes. With a given amount of operating income, reduced taxes imply earnings available to equity holders. Therefore, prudent leveraging and effective management may increase equity returns. Nonetheless, leveraging is risky. As the amount of debt increases, the probability that the firm will be unable to meet its financial obligations also increases. Caution and diligence should be taken when considering leveraging.

Arbitrage is a transaction based on the observation of the same asset or derivative selling at two different prices. It involves buying the asset or derivative at the lower price and selling it at the higher price. Timberland arbitrage means that a TIMO buys timberland when timber markets are weak and sells timberland when markets are strong. Certainly, if timber markets are fully efficient, it is impossible to make profits from arbitrage. However, timber markets may not be fully efficient, in which case arbitrage opportunities exist. Careful analyses will reveal these opportunities.

tion, How does one structure a supply contract and portfolio insurance scheme? The answer: financial engineering techniques. Our task here is to illustrate the applications of financial engineering to these cases. In so doing, we hope that the article also will introduce financial engineering to the forestry community.

Financial Engineering at a Glance

Before we proceed to supply contract and portfolio insurance, a brief account of financial engineering is useful. According to Mason et al. (1995), financial engineering is the process of tailoring financial instruments and organizational structure to improve the profitability of intermediaries' customers. The two interrelated central tasks of financial engineering are to manage risk and create customized financial products and services. Risk management involves identifying the sources of risk, evaluating the strategic advantage of bearing risk, creating financial instruments (e.g., futures, swaps, and option contracts) to transfer risk, and using financial markets to value and shed risk. These innovations have made it possible for business entities to hedge against the uncertainties of currency exchange rates, interest rates, and basic commodity prices, and to engage in a variety of business practices. Mason et al. (1995) argued that financial engineering can improve economic performance by (1) meeting demands for "completing the markets" with expanded opportunities for risk-sharing, risk-pooling, hedging, and intertemporal or spatial transfers of resources that were not available; (2) lowering transaction costs or increasing liquidity; and (3) reducing "agency" costs caused by either asymmetric information between trading parties or incomplete monitoring of their agents' performance.

Option is one of the fundamental concepts of financial engineering. An option is a contract that gives its holder the right to buy or sell an underlying asset at a fixed price. Broadly speaking,

Option Valuation and Parameter Calibration

The value of an option, $\Omega(S, \tau, E)$, depends on factors like the risk-free interest rate (r), current asset price (S), exercise price (E), price volatility (s), and its time duration (τ). For an American call option:

$$\Omega(S, \tau, E) = SN(d_1) - Ee^{-r\tau}N(d_2)$$

where d_1 is defined as $(\ln[S/E] + [r + 1/2\sigma^2)\tau]) / \sigma\sqrt{\tau}$, d_2 is defined as $d_1 - \sigma\sqrt{\tau}$, and $N(.)$ is the cumulative standard normal distribution function (Black and Scholes 1973).

While an American option can be executed anytime up to its expiration, a European option can be executed only at the point of expiration. Since most timberland-related options can be executed anytime up to their expiration, they are American options and the formula is appropriate for their valuation. However, it is necessary to take account of the asset appreciation resulting from price growth and biological growth.

Once we have valued a call option, we can derive the worth of a put option from the put-call parity, which shows the relationship between a call option and a put option (Hull 1997). Because the price cap (K_U) of the supply contract in figure 2 corresponds to the exercise price of the short call and the price flooring (K_L) is the same as the exercise price of the long put, K_U and K_L can be calibrated in the process of valuing the short call and long put. Ideally, K_U and K_L should be determined in such a way that the loss to the timber buyer caused by upward price movement is close to the benefit to the seller caused by downward price movement.

In practice, these price levels are determined by negotiation between the involved parties. The party who is more informed about the valuation technique and its underlying parameters will be in a better bargaining position.

there are two types of options: put and call (Hull 1997). A *call* option on an asset gives the owner the right to buy the asset by paying a preset price (the exercise price). A *put* option gives the owner the right to sell the asset at a preset price. An option contract is flexible; its holder is not obligated to purchase or sell anything. Thus, to exercise an option is to exercise the right to buy or sell the underlying assets. *Figure 1* (p. 40) shows that put and call options feature different payoff structures. A call option is executed only if the market price of the asset exceeds the exercise price, and a put option is executed only if the market price falls below the exercise price.

In addition to supply contract and portfolio insurance, other financial engineering techniques can be applied to timberland investments. For a discussion see "Other Applications of Financial Engineering," p. 41.

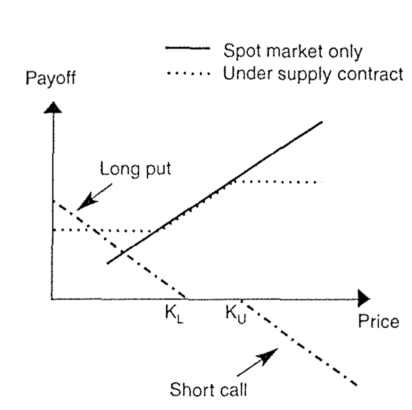
Supply Contract

The solution to concerns involved in transferring industrial timberland to institutional investors hinges on a remarkably simple piece of financial engineering, once the two parties realize that a common ground can be found by sharing the risk of future timber price movements. Just as a timber user may not be willing to accept extraordinarily high prices, a timber seller may not be willing to accept very low prices. Within a certain range, both would allow the market to perform. The timber user, concerned about high extremes, could write the supplier a capped price support guarantee. Under the guarantee, if timber prices fall below a designated "price flooring" level during the contractual period, the timber user would make compensating payments to the seller. With this support, the timber supplier would seize a bottom-line of its revenues and profits should the market decline. In return for the guarantee, the timber supplier would pay the user if timber prices exceed a designated "price ceiling" level over the contractual period. Although the timber supplier would end up sacrificing part of the upside market potential, it is also obviated from the downside pressure. Furthermore, Zinkhan (1995) noted, this type of contract could be customized according to the quantity, time period, price index, and settlement terms specified. (For more details on these concepts, see "Option Valuation and Parameter Calibration.")

Figure 2 shows that this solution, called a *collar* (Chance 1998), is a combination of a call option and a put option. The collar enables both parties to accomplish their strategic goals in an environment of great uncertainty about future timber prices and supplies. The provision guarantees the timber user a steady, long-term supply of wood, and it guarantees the timber supplier a steady, long-term supply of money. By preserving operating control and facilitating timberland transactions, this type of arrangement gives TIMOs a chance to expand significantly so they can explore scale economies in land management and wood production. For forest products firms, their long-term cutting rights will be maintained from spinning off their timberland completely. Therefore, designed properly, the collar can be a win-win solution.

In addition, to accommodate multiple fiber users, a TIMO may structure contracts in different ways. For example, a fiber user may be assured of a fixed volume at a fixed price; it may choose a fixed volume at a price tied to a timber price index; or it may require the delivery of a fixed volume at a price tied to a price index and capped at a predetermined level *(fig. 3)*. Given the range of variables, each supply contract could be structured under a nearly infinite set of specific conditions. No matter how the contract is structured, wood users would, in effect, pass their risk on to the TIMO. But realizing that it would have to manage its timber supply contracts on a long-term basis, the

TIMO could carefully develop a hedging strategy to minimize its exposure to market risks. Of course, this means that it must invest in facilities and personnel to eliminate mismatches between assets and liabilities and ensure that fluctuations in timber prices do not jeopardize its business. This way, the TIMO can differentiate a commodity product (timber) without taking undue risks. Clearly, from the perspective of financial engineering, opportunities exist for both parties to profit by managing the risks they both experience.



NOTE: A call option gives its holder the right to *buy the underlying asset by a certain date for a* certain price. Similarly, a put option gives its holder the right to sell the underlying asset by a certain date for a certain price. The price in the contract is called the "strike price" or "exercise price"; the date in the contract is called the "expiration date" or "exercise date." The party that agrees to buy assumes a long position, and the party that agrees to sell assumes a short position.

A collar is a combination of a cap and a floor in which the purchaser of the cap (at K_U) also sells a floor (at K_L) or the purchaser of the floor also sells a cap. The sale of the cap or floor reduces the cost of protection and forgoes gains if the price moves in that party's direction.

***Figure* 2. Illustration of the collar solution to a timber supply contract.**

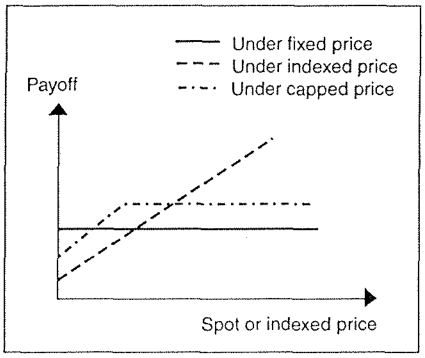


***Figure* 3. Illustration of alternative marketing strategies.**

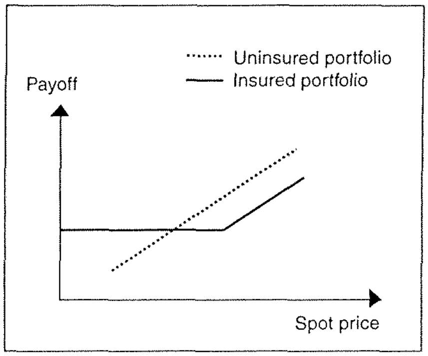


***Figure 4.* Illustration of portfolio insurance.**

Portfolio Insurance

In a volatile market environment, if no protective steps are taken a TIMO's asset value can plummet in a matter of months. For instance, without any protection the asset value of a TIMO in the Pacific Northwest could have lost as much as 40 percent in 1997 alone. A careful analysis of the timber price increase in the Pacific Northwest during the early 1990s reveals that both domestic and export log prices were forced upward by the spotted owl debate and ensuing federal decision to phase out timber harvests from public land (Yin, in press). Further, domestic log prices were also driven by the export market in the 1990s; log prices doubled, from \$700 mbf to \$1,400 mbf (Arbor-Pacific Forestry Services, Inc. 1999). If this price hike was a one-time event inflated by international demand and consumers' concerns about uncertain future supply in the region, then domestic log prices might not have sustained their high level over the long run. So protecting the investment portfolio against potential market downturn is a necessity.

To be sure, timberland as a portfolio asset can diversify away *systematic risk* (risk associated with the market or economy as a whole) and make the portfolio more efficient. However, *intrinsic risk* (risk related to factors specific to the asset) remains. Several protective measures could be taken in anticipation of possible downward price movements. Of course, a TIMO might time the disposition of the asset to coincide with price peaks, or reduce the risk of price decline by buying insurance against losses. A more common and useful measure would be to negotiate a long-term selling contract when the market condition is attractive. This is known as a *forward contract,* an agreement between a timber buyer and seller on a price today for a later transaction. It can be structured similarly to the supply contract discussed earlier. However, unlike an option, which carries the right but not the obligation to go through with a transaction, a forward contract imposes the obligation to ultimately commit to the transaction.

In addition, one could reduce the risk of price decline by buying insurance against losses. Insurance permits the owner of an asset to retain the economic benefits of ownership while eliminating the uncertainty of possible losses. In principle, the owner of any asset can eliminate the risk of loss while retaining the benefit of ownership by purchasing a put option. During the term of this option, the owner has the right to sell the asset at a fixed (exercise) price. Thus, any losses on the asset are truncated at this level, as shown in *figure 4.* Moreover, based on the put-call parity (Hull 1997), the purchase of a call option is economically equivalent to owning the asset and insuring its value against loss by purchasing a put option. So, an option, whether a put or a call, is a fundamental security that serves the central risk management function of insurance.

A problem arises here, however, in that privately held institutional timberland is not publicly traded, thus limiting its derivative options. The only way to protect the underlying asset against value losses from downside price movement is *cross-hedging*—hedging the risk of one asset with another closely related asset (Chance 1998). *Hedging* is a transaction in which an investor seeks to protect a position or anticipated position in the spot market by using an opposite position in derivatives. The profit from hedging is simply the change in the basis—the difference between the spot price and the futures or forward price. The question then is to determine which assets are closely correlated with timberland in their price movements. Lumber futures traded on the Chicago Mercantile Exchange can be a potential choice for this cross-hedging; however, their correlation with timber prices should be examined to see if better alternatives exist. In any case, retaining the upside while deleting the downside of asset ownership is not free. The fee or premium paid for insurance simply substitutes a sure loss for the possibility of a larger loss. Further, cross-hedging involves greater *basis risk*—uncertainty regarding how the basis will change.

Closing Remarks

Financial engineering can be used by nonfinancial as well as financial institutions to advance their core business goals. Likewise, some of the concepts and techniques are applicable not only to institutional investors but also to industrial companies. Indeed, numerous examples of successful applications of financial engineering to commodity trading exist. Enron Capital & Trade Resources (ETC), a subsidiary of Enron Corporation of Houston, is one such case. ECT's recent success in trading natural gas and other commodities can be attributed in part to its ability to create a line of product and service options by using financial engineering (Tufuno 1996; Coy 1999). After natural gas was deregulated in the 1980s, ECT's managers envisioned the creation of a "gas bank" that would serve as an intermediary between buyers and sellers, allowing both to shed unwanted risks. Focusing on buyers, ECT's marketers reasoned that bundling methane molecules, reliable delivery, and predictable prices into a single package would define a clear product line and communicate the company's unique skills. Further, by giving the package a distinctive name, they could perform the seemingly impossible trick of creating a brand name for methane. Accordingly, ECT developed a family of products called EnFolio Gas Resource Agreements—natural gas supply contracts that could be customized according to consumers' specifications. ECT's president credits real option thinking and techniques with helping the firm transform itself from a US natural gas pipeline company into an international trader dealing with commodities including gas, electricity, water, paper and lumber products, and, most recently, telecom bandwidth (Coy 1999).

In sum, the growth of institutional timberland investments depends on whether TIMOs can deal in a timely, effective manner with the various issues they face. With its potential to reduce costs of existing activities and aid development of new products and services, financial engineering holds great promise.

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departments

Woodland Light by Laura Breitman, Warwick, New York. Fabric collage. Courtesy of the artist.

about the cover...

This intricate collage is made entirely from small fragments of fabric. To capture the range, depth, patterns, and light she wants to achieve, Laura Breitman block prints much of the fabric before beginning the collage. She applies hundreds, and sometimes thousands, of fabric fragments into each collage, imagining each fragment to be a brush stroke.

also inside...

ducation, and a conservation ethic to benefit society.