

*Linking Strategic and Tactical Planning
Systems for Dynamic Financial Analysis*

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Linking Strategic and Tactical Planning Systems

For Dynamic Financial Analysis

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Abstract

Total enterprise risk management involves a systematic approach for evaluating/controlling risks within a large firm such as a property-casualty insurance company. The basic idea is to coordinate planning throughout the organization, from traders and underwriters to the CFO, in order to maximize the company's economic surplus at the desired level of enterprise risk. At present, it is difficult to link strategic systems, such as asset allocation, to tactical systems for pricing securities and selecting new products. We propose two solutions. First, we develop a "price of risk" for significant decisions possessing correlated factors. Second, we create a set of dynamic investment categories, called hybrid assets, for use in an asset and liability management framework. We illustrate the concepts via an insurance planning problem, whereby the goal is to optimize the company's surplus.

1. Introduction to Dynamic Financial Planning

Dynamic financial analysis (DFA) assumes that a large financial company can benefit by coordinating its operations across diverse business lines, such as insurance, banking, and investment management. The goal of DFA is to maximize the firm's surplus wealth, while keeping within desired risk tolerances. Several barriers exist to achieving this goal. First, the deregulation of financial markets has not kept pace with the explosion of new products and the merging of businesses. Second, organizational constraints limit the ability of firms to improve profitability. The firm may have the best information regarding risk-adjusted profit, but it may not act fast enough to grow the profitable activities (and shrink unprofitable activities).

A third barrier involves the linkage of information within the firm. In this paper, we describe a systematic approach for linking tactical and strategic planning systems for large financial organizations. The goal is to establish a total integrated risk management system (TIRM). Prominent applications include insurance companies, banks, mutual funds, and pension plans. We propose an approach for transmitting signals from the optimal solution of the strategic system to the individual decision-makers who must carry out the optimal strategy. A key concept is the price of risk, as defined within the context of a dynamic investment strategy. In addition, we develop the concept of a hybrid asset security. These securities involve considerable dynamic intervention, and they serve as benchmarks for the tactical components of the risk management system.

At present, there are a number of successful asset and liability management systems. There has been considerable work on the strategic aspects of asset allocation, for example, in the area of pension planning. See the recent book "World Wide Asset and Liability Modeling," by Ziemba and Mulvey (1998) and the references therein.

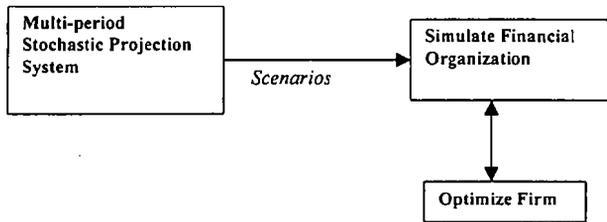
Rung 5:	Total integrated risk management
Rung 4:	Dynamic asset and liability management
Rung 3:	Dynamic asset-only (multi-period)
Rung 2:	Static asset-only portfolios
Rung 1:	Pricing single securities

The Risk Ladder

Figure 1

Economic theory assumes that firms maximize their shareholder value. An enterprise risk management system helps the company achieve this objective in a systematic fashion. We employ strategic planning systems to address critical questions for an institution's long term survival. Some prominent issues include the company's leverage structure, investment for research, the amount of assets in riskier categories, such as growth equity. In addition, transaction and market impact costs may be high when trying to pull out of an activity. Last, there are often autocorrelations in markets, and these intertemporal dependencies should be addressed.

The fundamental approach for analyzing long-term issues is asset allocation (and its extension to asset and liability management – see book by Ziemba and Mulvey). A dynamic financial analysis requires three primary elements (Figure 2). First, we must be able to generate scenarios for the future across a multi-period horizon.



Primary Elements of a Strategic Financial Planning System
Figure 2

1.1. Stochastic Projection System

The purpose of the stochastic model is to estimate the uncertain parameters in the firm-wide simulation. A critical issue is to link the uncertain parameters to a small set of essential economic factors – the driving factors. Figure 3 illustrates the idea. We first estimate factors such as interest rates and inflation over the T-time periods by means of a stochastic difference equation, approximating a diffusion equation. For example, we might use the Ornstein Ulenbeck process for the short interest rates:

$$dr_t = a (r_0 - r_t) + s r_t dZ.$$

This series displays mean reversion to the parameter r_0 , has volatility s , and drift a . These three parameters must be determined by calibration tools (see Campbell et al. 1997, and Mulvey et al. 1996). The White noise term, dZ , represents the standard Normal (0,1) distribution function. Discrete samples are taken from this stochastic equation in order to derive representative set of scenarios. Each scenario depicts a single plausible path for all of the uncertain parameters over the planning period. Employing variance reduction methods, in concert with the stochastic optimization model can reduce the number of scenarios (see Campbell et al. 1997, and Mulvey and Rush 1997).

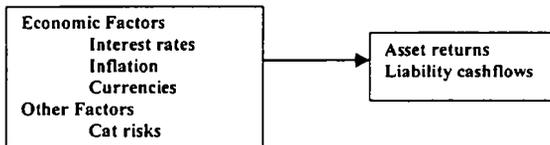


Figure 3
Simulation of Driving Economic Factors

A number of scenario generators exist for projecting economic variables and asset returns. Some prominent examples include Towers Perrin's CAP:Link/OPT:Link (Mulvey 1996), Wilkie's

investment system in the UK (Wilkie 1987, 1995), Frank Russell's VAR (Carino 1994, 1998), and ORTEC in the Netherlands (Boender 1995).

There are several scenario generators for projecting liabilities. For example, catastrophic (CAT) modeling firms (e.g. AIR, Dames and Moore, EQE, RMS, and Tillinghast) estimates catastrophic risks for losses under earthquake and hurricane events. Monte Carlo simulation techniques derive these estimates, whereby the number of scenarios must be a large due to the rarity of the worst CAT events. Over 10,000 scenarios are required in most studies.

Loss ratios for non-CAT lines of business are also modeled in the scenario generators. In many cases, there is adequate historical data on the losses so that estimates can be calculated in a reliable fashion.

1.2. Simulate the Enterprise or Activity

Given the stochastic scenarios, we can simulate the financial organization over the planning period, up to the horizon at period T. For this simulation, we must identify the dynamic decision rules and the market forces that will drive the firm. It is critical to focus on the company's or the investor's surplus. We define surplus wealth as:

$$\text{Market value (assets minus liabilities)} - \text{Present value (goals)}$$

The simulation of the core economic factors over time provides a linkage across business activities. For example, asset returns and liability cashflows are dependent on changes in interest rates and inflation. The degree of overlapping risks depends upon a combination of the decision strategies and the uncertainties. It is often under control of the firm.

1.3. Control and Optimize

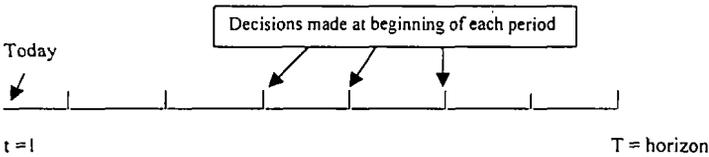
Once a simulation is conducted, we can improve the company's performance by employing stochastic optimization techniques. For example, we can maximize the growth of the company's economic surplus by maximizing the expected utility of wealth, wherein utility equals $\log(\text{wealth})$.

We stress the concept that stochastic optimization algorithms are now feasible and available. We can solve a stochastic program with a large number of decision nodes (tens of thousands), or by means of a set of decision rules (and the resulting solution to the non-convex program.) See Mulvey and Ruszczyński 1995. Next, we define the primary equations for a strategic financial planning system.

1.4 Model Structure

The investment process consists of T time stages. The first stage represents the current date. The end of the planning period, T is called the planning horizon. Typically, it depicts a point in which the investor has a critical planning purpose, such as the repayment date of a substantial liability, or a natural juncture as the annual board of director's meeting. Strategic systems look out over several years or even decades – for insurance companies and pension plans. Tactical systems have much shorter time horizons – weeks, days, or even minutes.

At the beginning of each period, the investor renders decisions regarding the asset mix, the liabilities, and the financial goals. Between time steps, uncertainties take over. For example, the stock market and bond returns occur. As mentioned, we employ a system of stochastic differential equations for modeling the stochastic parameters over time. These relate a set of key economic factors to remaining components, such as asset and liability returns. For an example, see the CAP:Link system (Mulvey 1996, and Mulvey and Thorlacius 1998). The alternative modeling approaches address the integration of the stochastic and the optimization models in a different manner.



The Planning Period ($t = 1, 2, \dots, T$)
Figure 4

The primary decision variables designate asset proportions, liability-related decisions, and goal payments:

$x_{j,t}^s$	investment in asset j , time t , scenario s
$y_{k,t}^s$	liability or product k , time t , scenario s
$u_{l,t}^s$	goal payment l , time t , scenario s .

At each time period, t , the model maximizes its objective function, $f(x)$, by moving money between asset categories, adjusting liabilities, and paying off goals. There are numerous candidates for the objective function; see the next section. In addition, we impose constraints on the process such as limiting borrowing to certain ratios, addressing transactions costs whenever assets are bought or sold, or taking advantage of investment opportunities. There are several modeling approaches for including constraints. Our goal is to find a feasible point, which maximizes a temporal objective function. Since we are dealing with uncertainty in a temporal setting, the optimal solution, like all points, will encompass a set of paths -- trajectories -- for the investor's wealth (or other measures such as surplus wealth). Ranking these paths is the subject of the next subsection.

There are two basic equations for the flow of funds at each time-period, and scenario:

Equation [1] for j^{th} asset category:

$$x_{j,t}^s = (x_{j,t-1}^s + r_{j,t-1}^s) - p_{j,t}^s + q_{j,t}^s (1-t_j) \quad \text{for asset } j, \text{ time } t, \text{ scenario } s.$$

where	$r_{j,t}^s$	=	return for asset j , time t , scenario s ,
	$p_{j,t}^s$	=	sales of asset j , time t , scenario s ,
	$q_{j,t}^s$	=	purchase of asset j , time t , scenario s ,
	t_j	=	transaction costs for asset j .

Equation [2] for the cash flows:

$$x_{j,t}^s = (x_{j,t-1}^s + r_{j,t-1}^s) - \sum_j q_{j,t}^s + \sum_j p_{j,t}^s (1 - t_j) + w_t^s - \sum_k y_{k,t}^s - \sum_l u_{l,t}^s$$

where w_t^s = cash inflows at time t, scenario s,
 cash is asset category l.

The multi-stage investment model avoids looking into the future in an inappropriate fashion. The model cannot optimize over scenarios that do not represent a range of plausible outcome for the future. To prevent this occurrence, we add constraints to the model, called non-anticipatory conditions. The general form of the constraints is:

$$x_{j,t}^{s1} = x_{j,t}^{s2}$$

for all scenarios s1 and s2 which inherit a common past up to time t.

The financial planning system addresses non-anticipatory conditions, either explicitly or implicitly, and special purpose algorithms are available for solving the resulting stochastic optimization model.

In addition to the economic surplus, market value of assets and liabilities, we must address the regulatory environment. The simulation model should set constraints on the regulatory measures, such as STAT and GAAP, while maximizing the economic surplus. This effort requires a *complex set of issues when the model cuts across a multi-national company with many tax and cultural concerns.*

1.5 Financial Objectives

A major element of enterprise risk management involves trading off risks and rewards. It is natural to expect that investments possessing more volatility will often generate greater expected returns than assets with lower levels of volatility. The temporal issue complicates the decision since longer term horizons dictate a longer time span to recoup losses, thus the more volatile assets may be, in fact, safer in terms of contextual risks. An example is the stock/cash comparison: stocks provide higher *expected* returns but are more volatile than cash. We must consider the time horizon in measuring contextual risks.

There are numerous ways to evaluate financial risks, just as there are alternative measures of profitability. We might consider the *chance* of a loss over the next year, such as 15% -- value at risk. Or, we might set a profitability target and evaluate the probability of missing the target. In both cases, risk increases as a function of probability. An improved alternative for evaluating risks is to estimate the full probability distribution of shareholders equity, along with other measures of financial well being for the company. The scenario generators in conjunction with the firm simulation system provide this information.

Calculating these curves requires a comprehensive approach for linking all major activities and uncertainties in a financial organization. Given a distribution, we can evaluate not only risks but

also compare it against reward potential. Typically, we equate reward with expected value. We might be interested in profit or loss over the next year per dollar of allocated capital:

$$\text{Expected profit} = \sum_{s \in S} p_s * z^s \quad (\text{Allocated capital})$$

where p_s is the probability of scenario s ,
 z^s is the profit or loss under scenario s ,
 S is a set of representative scenarios,
 Allocated capital depends upon the loss distribution (VAR).

Comparing alternative distributions on a direct basis can be difficult for most decision-makers. To aid in the process, we can employ the concepts of stochastic dominance. For example, if two cumulative distributions cross only once and the decision-maker is risk averse, she will take the curve with the highest expected value if its variance is less than the alternative. Other dominance tests are possible, but these tests are unlikely to apply in a wide set of circumstances.

There are two primary theories for setting up an objective function under uncertainty. First, we can transform random variables to deterministic values, such as the value at risk or a certainty equivalent. Alternatively, we can fit a classical utility function to the characteristics of the output of the model. An example is to define risk as the volatility of the return of a portfolio. There are numerous variants of each theory.

After 50 years, the von Neumann Morgenstern [VM] theory remains the pre-eminent approach for making decisions in the face of uncertainty. The resulting optimization model can be stated simply as follows:

$$[\text{VM}] \quad \text{Max} \quad E(v(z_T))$$

$$\text{where } E(v(z_T)) = \sum_s p_s * v(z^s)$$

where $v(z^s)$ is the VM preference function

z^s_T = investors wealth under scenario s , time T

p_s = probability of scenario s .

Once the solution of model VM is found, z^* , we determine its certainty equivalent (CE) by computing the inverse function at the recommended solution $CE = v^{-1}(z^*)$. This value represents the exact amount that we would take in order to sell (or buy) the random variable z . While the VM theory is generally accepted as a theoretical measure, there are several difficulties. First, most executives are unable to come up with an acceptable level of risk aversion. Second, the temporal aspects of decision making are ignored in the VM theory. Thus, we are generally unable to decide upon a high-risk asset that will pay off in several years versus a lower returning but safer asset. Generally, we focus on the expected utility at the end of the planning horizon, period T . The intermediate points are constrained to achieving acceptable results.

There are several heuristic approaches to decision making under uncertainty. Two of the most popular are value at risk (VAR), and the risk adjusted return on allocated capital. In both cases, we set a level of confidence in the return distribution as a reference point. Profits and risks are measured with respect to this assumed point. For instance, we might decide that the 1/100 loss point is the reference. Capital allocation rules are then generated by the amount of losses at this point. The concepts are easy to understand. But they can lead to errors since they are not

considering the entire distribution of gains and losses. In addition, these methods do not easily address the issue of overlapping risks.

1.6 Limitations of Strategic Systems for Large Organizations

There are several limitations to the use of a strategic financial planning system within a large financial institution. The first issue involves the lack of detailed information regarding the risks and most importantly overlapping and correlated risks. If the organization could separate activities that are independent of each other, they could allocate capital on a straightforward risk adjusted basis, such as some function of value at risk (VAR). However, during the 1990s, financial organizations are merging diverse activities – traditional banking, insurance, mutual funds, and trust and wealth management. It is difficult to design these operations so that the risks are independent of each other. In addition, we discount projected future cashflows by Treasury interest rates when computing the market value of assets and liabilities. Therefore, even seemingly independent activities are linked by their dependence on interest rate movements.

Second, the asset allocation approach runs into difficulties when portfolio managers do not possess well-defined investment benchmarks, or when the managers stray from the benchmarks. The risks for the individual tactical investors will certainly increase when correlated elements exist in their portfolios. Yet many financial companies decompose their activities into loosely managed divisions; they pay scant attention to overlapping risks. The problem is especially difficult when the issues involve the rare events – tails of the loss distribution. For example, several investors may decide to move into a single asset at the same time, and the asset drops dramatically. In other cases, there is a more subtle relationship between the degree of overlapping risks. The scenario generators should be equipped to handle this factor.

Another challenge occurs when the strategic plan needs modifying. A tactical system can assist in the change of course decisions. Yet, there needs to be close coordination of the affected systems. The tactical system by necessity works at a more detailed level of information, such as individual stocks, as compared with generic asset categories. This offers great opportunities. The prices of risks and target benchmarking can play a pivotal role as we show in the next section.

2. Linking Strategic and Tactical Planning Systems

This section discusses the linkage of the strategic planning system with one or more tactical investment systems. As before, the critical issue entails overlapping risks, across product lines, and investments. We suggest three possible approaches. The first involves the creation of target benchmarks based on hybrid securities. Dynamic asset and liability processes form the hybrids. In the second approach, we generate prices of risks for each product-location, or asset category. We add these prices to the profit calculations for the business units. In the third approach, we track the degree of overlapping risks and allocate capital based on risks. This approach requires a relatively conservative allocation rule or a closely monitored organization.

Figure 5 illustrates the flow of information between the strategic system and the tactical systems. Herein, the target benchmarks and/or prices of risks are sent to the tactical investors – traders, underwriters and asset managers -- along with their capital allocation. A straightforward benchmark might be the Morgan Stanley Capital International Index; the goal is to exceed the benchmark return, while investing under the same risk profile as the MSCI index.

Hybrid securities can play a distinguishing role in the construction of benchmarks for tactical asset managers. A prototypical example is the principal-protected equity bond discussed in the next section. For this example, the asset manager must beat this index over an assigned time-period. The manager has several options. First, he could attempt to replicate the security by following a delta or gamma neutral strategy (Hull, 1997). Alternatively, he could increase the equity proportions in order to gain additional returns, at the costs of additional risks. However, the investor must be careful when taking on increased risks. Here is where the price of risk comes in. The tactical system should evaluate the marginal costs of adding risks by modify the excess profit computations (over and above the target benchmark). The prices of risks should be included in the calculations. In some cases, there is adequate independence of the activities so that overlapping risks can be ignored. Whenever possible, the organizational design should attempt to reduce overlapping risks by setting up units that are independent on a risk basis, such as giving a manager a separate asset category. Alternatively, the tactical manager can simply replicate the target benchmark at a minimum cost, thus eliminating the price of risks requirements.

In a similar fashion, a product manager or insurance underwriter can be assigned a benchmark. An example is the amount of allocated capital for the manager's businesses along with the risk adjusted profit values. As on the asset side, risk profiles should depend on the projected movements of the core economic factors. Moreover, as before, we can compute the price of risk for the activities by referring to the dual variables from the optimal solution to the strategic ALM system. Any decision (investment/product/line) possessing a positive margin profit will benefit the company and is worthy of further analysis. The formula for adjusting profit is:

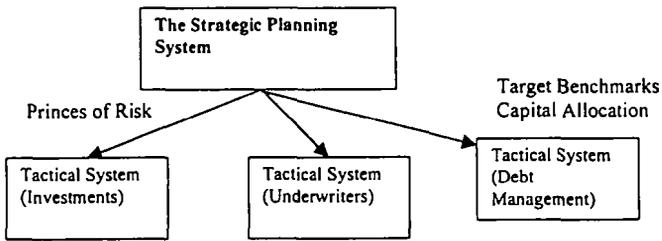
$$profit = net\ revenue - \sum_{s \in S} l_{s,t} * \pi_{s,t}$$

where $\pi_{s,t}$ = optimal dual solution from strategic system,

$l_{s,t}$ = loss under scenario s, time t.

Another approach is to approximate the prices of risks by computing the historical correlations and assume that the profits and losses are derived from a multi-normal or other suitable distribution. Herein, the time horizon is relatively short, one day to several weeks, and the model is generally single period.

We illustrate the prices of risks via a generic tactical tool for insurance underwriters. This system takes in loss estimates for catastrophic events, such as hurricanes and earthquakes, and generates risk adjusted profitability values for the properties in the underwriter's book of business. It also can optimize on the parameters of the book, such as deductibles, identify properties to eliminate, etc., and find the best set of properties when two books are combined. A sample output of the system might show the expected profits displayed per zip-code, adjusted by the prices of risks. The underwriter can quickly gain insights into the relative areas of profitability on a geographic basis.



Risk adjusted profits computed for each tactical system and sent back to strategic system

Figure 5
Coordinating the Strategic and Tactical Planning Systems

3. Empirical Results

In this section, we illustrate the advantages of hybrid securities for a real world strategic planning model involving a large insurance company¹. The goal is to maximize the company's surplus over a five-year horizon. Re-balancing decisions occur annually. We employ the CAP:Link scenario generator for constructing 500 scenarios for the economic factors and the asset returns. Tillinghast-Towers Perrin actuaries performed liability projections under these same 500 scenarios. At each period, the model revises the asset mix, according to the target mix values, pays out the necessary liabilities and taxes, and distributes dividends and interest as appropriate.

Thirteen asset categories were selected by the insurance client. These asset categories form the basis for many asset allocation studies. We include two categories of Treasury inflation protected bonds (TIPs), mid-term and long-term, in addition to the standard assets. These assets protect the insurance company's liabilities against unexpected inflation.

A strategic planning model was developed for the insurance company, in which the company paid out required obligations each year as dictated by the actuarial estimates, under each of the 500 scenarios. The goal was to maximize the company's surplus at the end of the 5-year horizon.

To solve the model, we employed a nonlinear optimization system, called OPT:Link, to generate the surplus efficient frontier at the end of the 5-year planning period. Figure 6 and Table I show the company's surplus expected values and standard deviations for the resulting mixes. Eleven points on the efficient frontier are displayed, from the low risk portfolio consisting of cash and bonds, to the high-risk portfolio consisting of smaller capitalized US stock.

Asset Mix %:	1	2	3	4	5	6	7	8	9	10	11
Cash-U.S.A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Eqty-U.S.A	5.5	7.4	9.0	10.3	11.0	5.6	5.2	5.1	0.2	0.0	0.0
US Real Es	9.0	10.9	11.9	12.4	13.2	16.4	18.1	17.8	12.5	1.0	0.0
High Yld B	10.2	13.9	18.4	22.7	27.4	39.3	42.7	48.2	51.5	54.6	22.5
LT TIPs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MT TIPs	45.8	47.1	41.7	36.0	30.9	17.6	9.8	3.0	0.0	0.0	0.0
Sht G/C	9.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mid G/C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Long G/C	15.7	15.3	11.0	8.2	4.6	0.0	0.0	0.0	0.0	0.0	0.0
US20YrZero	0.0	0.0	0.0	0.0	0.2	2.4	1.8	0.8	0.0	0.0	0.0
US SmCap	0.0	0.1	1.7	4.1	7.1	13.8	16.0	18.2	27.9	37.7	77.5
EAFE	4.4	5.3	6.2	6.3	5.6	5.0	6.6	7.0	7.9	6.7	0.0
WrldBndXUS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Reward	7.3	7.6	7.9	8.1	8.4	9.0	9.2	9.5	9.7	9.9	10.2
Risk	0.3	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.6	0.6	1.0

Table I
Asset Mixes for 11 Selected Points on Surplus Efficient Frontier

¹ The details of the insurance company example are disguised.

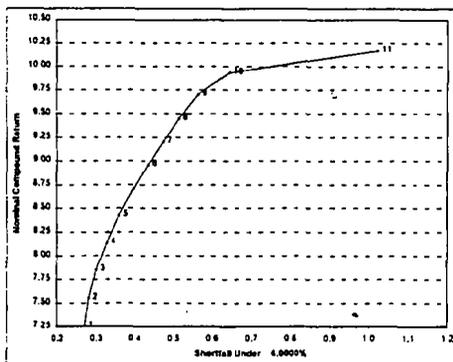


Figure 6
Surplus Efficient Frontier for Sample Insurance Company

Next, we construct two hybrid securities. The first is a dynamic combination of equity and cash, similar to constant proportional portfolio insurance (CPPI). See Perold and Sharpe (1988). The basic idea is to set a minimum level for the asset wealth, which we call the floor. Based on this constant, we compute the difference between current wealth and the floor -- called the cushion. The hybrid security sets the stock/cash proportions equal to a linear function of the cushion value at the beginning of each period. We update the proportions each month (rather than the annual re-balancing carried out in the strategic model). The resulting hybrid stock/cash security is called dynamic-equity-protection (DEP). For the purpose of this study, we established the floor = 100 and the multiplier parameter = 1.1. Figure 7 depicts the compound returns of the DEPs over the five year planning period, as generated by the CAP:Link investment system.

Instead of following a dynamic replication strategy, we can purchase securities with the desired properties. Several mutual fund companies market stock/cash hybrid securities, including Salomon/Smith/Barney, and Merrill Lynch's Mitts. These securities trade on the New York and other stock exchanges. The term of the security is typically five years; they trade as non-dividend paying stocks.

We construct a second hybrid security geared towards the fixed income marketplace. Again, we combine two traditional asset categories. Instead of stock/cash, however, we dynamically allocate between mortgage backs and cash in a proprietary fashion. The mix shifts towards cash when interest rates are dropping, whereas the mix shifts towards bonds when interest rates are increasing. We label this hybrid category MBS, to indicate the association of this strategy with mortgage backed securities. Figure 7 lists the nominal returns for the MBS hybrid over the 5-year horizon.

Compound Returns 1/1/98 Bas

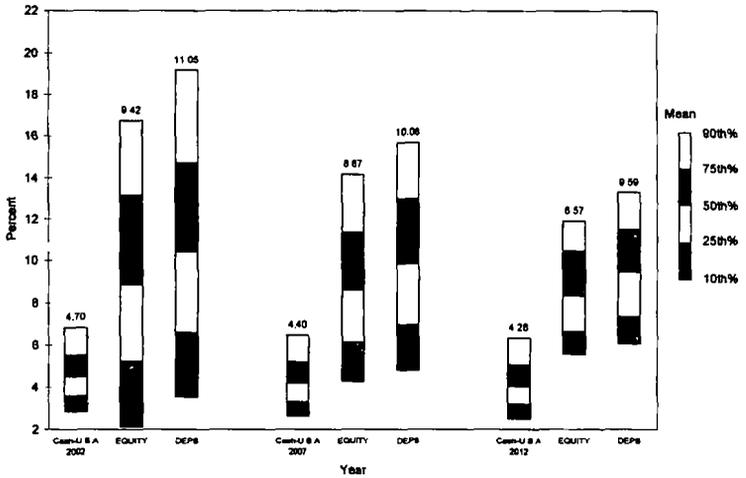
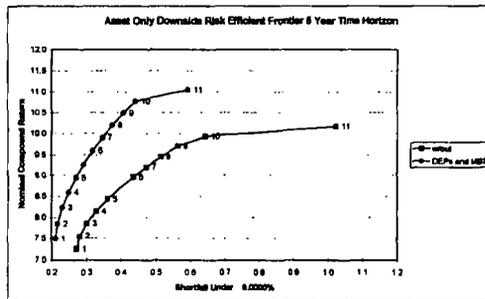


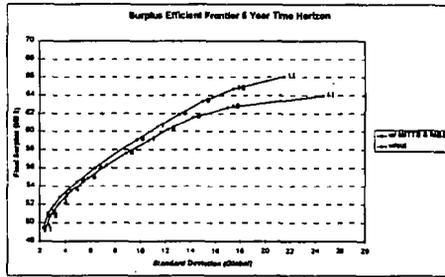
Figure 7
Distribution of Returns for Hybrid Security versus Equities and Cash

We combine the two hybrid securities with the other 13 asset categories and solve the resulting surplus optimization problem. The advantages of the DEP hybrid for risk averse investors can be readily seen in Figure 8. Here, we plot an asset-only efficient frontier with downside risks at the 6% target level. The efficient frontier solutions are considerably improved by adding the DEPs. They give upside gains, but limit the downside losses during downswings in the equity markets.

The surplus efficient frontiers are displayed in Figure 9 and Table 2, with and without the two hybrids. By adding these securities, we improve the surplus returns and reduce the surplus risks. The stock/cash hybrid (DEPs) occurs at the higher risk levels, whereas the mortgage back/cash hybrid (MBS) occurs at the lower risk levels. One of these two assets is present in all of the efficient points. The advantages of the dynamic financial strategy are clear-cut in this real-world case.

Figure 8
Asset Only Efficient Frontiers with and without Hybrid Securities





Surplus Efficient Frontiers with & without Hybrid Securities
Figure 9

Numerous variations on the hybrid security apply to insurance companies and pension plans. The floor and multiplier parameters are available for modifications. Alternatively, we could implement other decision rules, replacing the CPPI strategy with combination strategies. Due to computational bounds for the nonlinear stochastic program, there is a limit on the number of asset categories that can be included in a strategic planning study. Still, we can readily solve models possessing several hundred hybrid securities with high performance PCs in mid-1998. The optimization model can readily accommodate linear constraints on the optimal asset mix, such as lower and upper bounds.

Overall, the hybrid securities give the strategic planning system greater realism. They also can serve as target benchmarks for the tactical systems, in a more innovative manner than the traditional fixed asset mix or weighted indices. The target benchmarks can link to the prices of risks, so that the tactical manager can move away from the benchmark in a manner that continues to optimize the company's surplus wealth. The amount of allocated capital determines the amount of movement that is possible for each tactical manager.

Asset Mix %:	1	2	3	4	5	6	7	8	9	10	11
Cash-U.S.A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Eqty-U.S.A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
US Real Es	6.3	5.6	7.2	4.4	3.6	4.5	5.1	4.6	0.0	0.0	0.0
High Yld B	6.7	8.8	12.0	13.1	15.6	21.6	23.1	26.1	26.7	28.1	0.0
LT TIPS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MT TIPS	22.4	21.4	19.2	13.3	10.9	5.7	0.0	0.0	0.0	0.0	0.0
Sht G/C	8.5	5.7	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mid G/C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Long G/C	7.4	6.2	3.7	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
US20Yr Zero	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MBS US	33.2	31.3	32.2	35.6	31.2	20.1	18.3	11.2	7.1	0.0	0.0
SmCap	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EAFE	1.5	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WridBnd	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
XUS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DEPS	14.0	19.7	25.2	33.1	38.6	48.0	53.4	58.2	66.2	71.9	100.0
Reward Risk	7.5	7.8	8.2	8.6	8.9	9.6	9.9	10.2	10.5	10.8	11.1
	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.4	0.6

Table 2
Selected Points on Surplus Efficient Frontier with Hybrid Securities

4. Conclusions

Enterprise risk management requires a coordinated program of financial planning throughout the institution. Traders and arbitrageurs search out mispriced securities by option analysis and other tools. Portfolio managers attempt to beat popular financial benchmarks via mean/variance optimization. Insurance underwriters aim to exceed risk adjusted profit targets. Pension planners carry out asset allocation strategies to insure the soundness of their assets with respect to the pension liabilities. CFO's identify the optimal leverage factors to maximize shareholder value. In each of these cases, there must be well-defined target benchmarks for the decision-makers. A strategic financial planning system generates these targets.

We have described a systematic technique for combining strategic and tactical financial planning systems. First, we define a price of risk for overlapping risks. These prices depend upon the optimal shadow prices of the strategic system. In the second step, we develop hybrid asset categories, such as the stock/cash example shown in Section 3. We extend traditional asset categories to encompass many forms of embedded options and dynamic investment strategies.

The benchmark targets and possibly the prices of risk are transmitted to the tactical systems. If the tactical manager stays relatively close to the target risk profile, he can ignore the prices of risk and maximize the excess returns. Otherwise, the prices of risks must be considered when the investor decides to take on increased risks. Considering historical correlations can approximate the price of risk, but there is no guarantee that backward looking data will be appropriate for the future.

An example of strategic planning is the capital management strategy for an insurance company presented in the previous section. We showed that the hybrid assets improve the company's risk adjusted returns. The solution to the strategic problem serves as targets for the tactical planning systems.

Applying these techniques will enhance a financial institution's ability to maximize its shareholder value. In addition, enterprise risk management applies to institutions with diverse operations, such as a combined bank, insurance company, and mutual fund. Correlated risks are present in these organizations. Identifying and pricing these correlated risks will be allow the institution to grow its surplus in an optimal fashion, while maintaining the desired level of risks at the enterprise level.

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