

MANAGING THE CORPORATE BUSINESS PORTFOLIO

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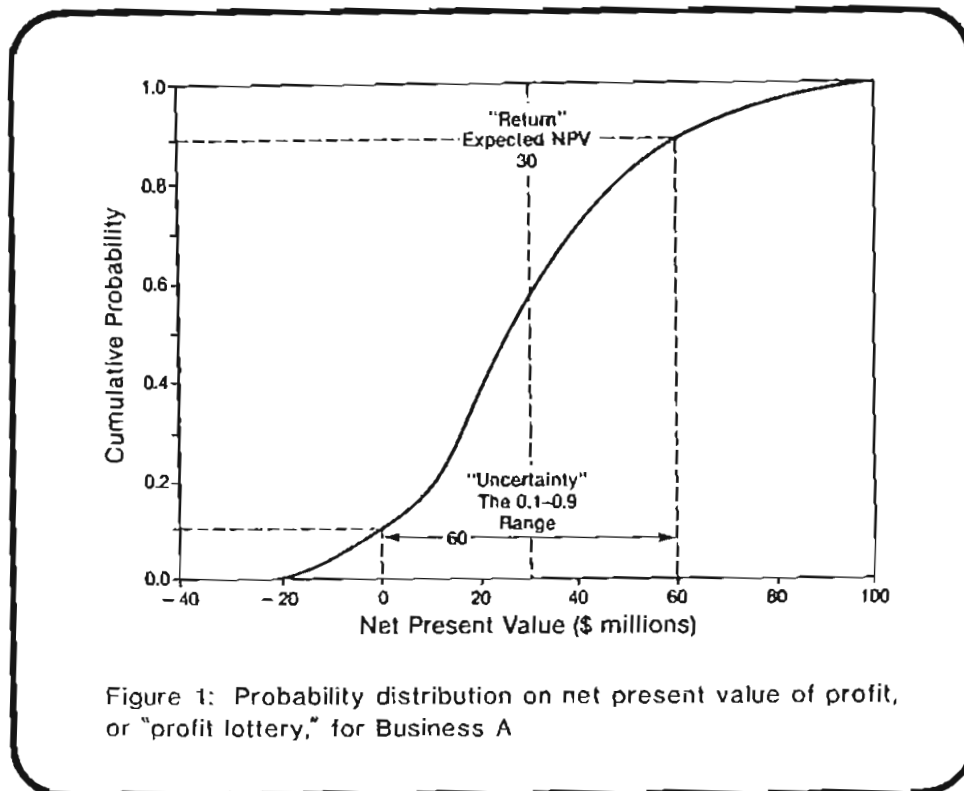
An important aspect of managing the modern corporation requires selecting and giving direction to a "portfolio" of business activities that will provide a balance of risk and return. Although quantitative methods have been developed during the last two decades to manage portfolios of common stocks, these methods have provided little help to the business executive, because a business portfolio differs from a stock portfolio in several important ways. The composition of the portfolio is perhaps the most important difference. Whereas a stockholder can compose his portfolio by combining small shares of many stocks, a business executive cannot do this in composing his business portfolio. To achieve economies of large-scale production or dominant market share, he must select a fairly small set of economically-sized business activities. In addition, the business executive does not have the stockholders' flexibility to easily adjust his portfolio: the executive must live with his decisions for a much longer time.

In this paper, we shall develop some new methods for balancing risk and return in the corporate business portfolio. We will define risk and return measures and show how executives can use them to build and manage a sound corporate portfolio. Since these measures are based on some key concepts of decision analysis, we will review them here. We will use simplified methods to develop graphic tools that give insight into the management of business risk. However, should they be needed in a particular application, more accurate methods are available to treat the same issues.

INDIVIDUAL BUSINESS DECISION ANALYSIS

Decision analysis of an individual business area incorporates three major factors: complexity, time, and uncertainty [1]. Complexity is treated by carefully constructing a business model that reflects all key issues. Time is usually treated by constructing a dynamic model that can project future cash flow or earnings, which is then discounted to produce a net present value of cash flow or earnings. This net present value is the primary measure of a business's value. The analyst then tests the sensitivities of the model to determine the crucial uncertainties the business faces. These crucial uncertainties are described by assessing probability distributions for them from experts on each subject.

These assessments of uncertainties on the crucial factors are combined to produce a probability distribution on the net present value, which we call the "profit lottery." A typical profit lottery is illustrated in Figure 1. The cumulative form of the probability distribution shows the probability that the net present value will not exceed (i.e., be less than or equal to) any given amount. For the example of Figure 1, there is a 0.1 probability (10 percent chance) that the net present value will be less than zero and a 0.9 probability (90 percent chance) that the net present value will be less than \$60 million. This means that there is an 80 percent chance that the net present value will be within the zero to \$60 million range.



For the purposes of this paper, we shall define the return measure (or more simply "return") as the expected (or mean) net present value. The return would, therefore, be the "fair bet" to place on the profit lottery if risk were not of concern. Unless a business provides a hedge against other corporate uncertainties, this measure of return should be the corporation's upper limit on the value of this business. A corporation wishing to avoid risk would value the business at a lesser amount, as we shall see later.

To deal with risk, we also define an uncertainty measure (or "uncertainty") as the difference between the 90th percentile and the 10th percentile of the profit lottery. The profit lottery illustrated in Figure 1 has a return of \$30 million and an uncertainty of \$60 million. A fundamental result of decision theory is that the risk associated with a profit lottery is approximately proportional to the square of its uncertainty [2]. If we use this risk measure (or "risk" for short), it is appropriate to trade off risk and return in proportions that represent the business's aversion to risk. Note that this also means it is not inappropriate to trade off proportions, uncertainty, and return in a linear manner. Since proving this would require a mathematical digression, we will not present it here [3].

If we plot risk and return as a point, such as that of business A in Figure 2, we can express a corporation's trade-off of risk and return by a straight line with a slope defined as the corporation's "risk tolerance." Tracing this line down to the return axis yields a point called the "certain equivalent." This point represents a business having zero risk that the corporation would see as equivalent to business A (in the sense of an exchange or minimum selling price). In fact, any business along the risk tolerance line passing through the point for business A would be equivalent to business A and would have the identical certain equivalent. It is easy to see that a lower risk tolerance (slope) would weigh the risk more heavily and result in a lower certain equivalent, while a higher risk tolerance would do the opposite. An infinite risk tolerance would be represented by a vertical slope resulting in a certain equivalent equal to the return only, an attitude we call "risk neutral."

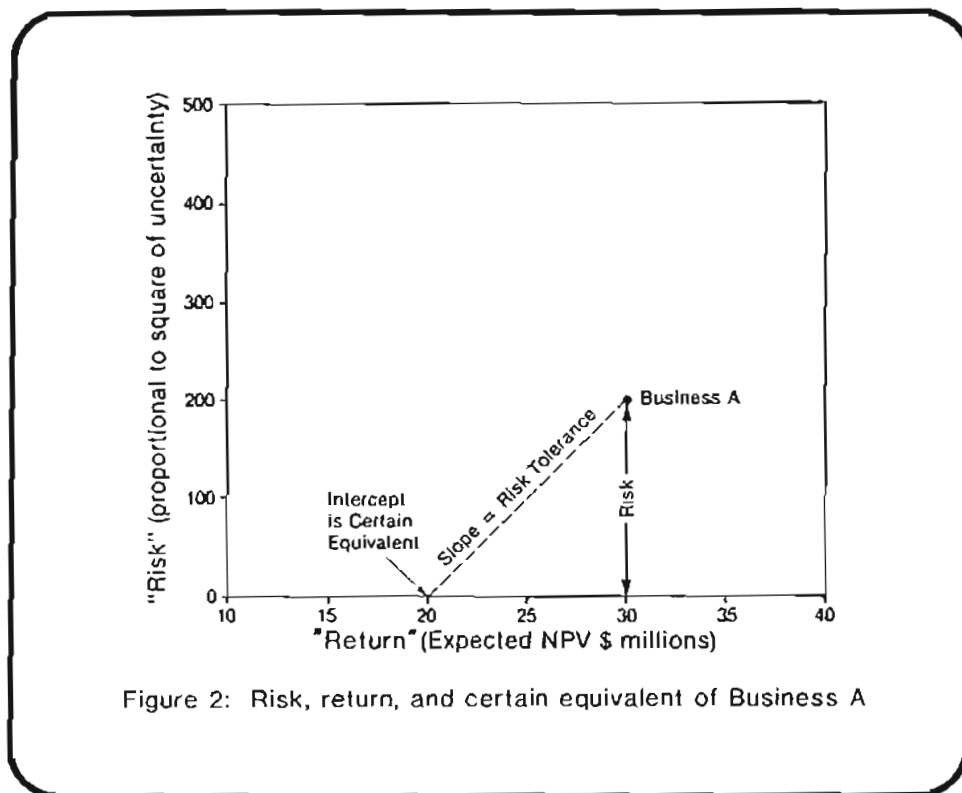


Figure 2: Risk, return, and certain equivalent of Business A

In this example, business A has a certain equivalent of \$20 million. This can be viewed as a deduction of a \$10 million risk penalty from the \$30 million expected value. In fact, the geometry of the straight-line trade-off does exactly this. In word equations,

$$\text{certain equivalent} = \text{expected value} - \text{risk penalty}$$

where

$$\text{risk penalty} = \frac{\text{risk}}{\text{risk tolerance}}$$

or

$$\text{certain equivalent} = \text{expected value} - \frac{\text{risk}}{\text{risk tolerance}}$$

We can give further meaning to the risk tolerance by applying the graphic analysis to several independent ventures [4], as illustrated in Figure 3. If we construct a line from the origin of the graph with a slope equal to the risk tolerance, it divides the graph into "accept" and "reject" regions. Any business to the right of this dividing line will have a positive certain equivalent, while any business to the left will have a negative one. Also, the ratio of risk to return for any business to the right of the dividing line will be less than the risk tolerance, and that of any business to the left of the dividing line will be greater than the risk tolerance. Thus, the risk tolerance can be interpreted as the maximum tolerable ratio of risk to return. In practice, one way to establish the risk tolerance is by questioning corporate executives about the acceptability of a set of ventures. Their answers, which they may have to adjust for consistency, form the risk tolerance dividing line.

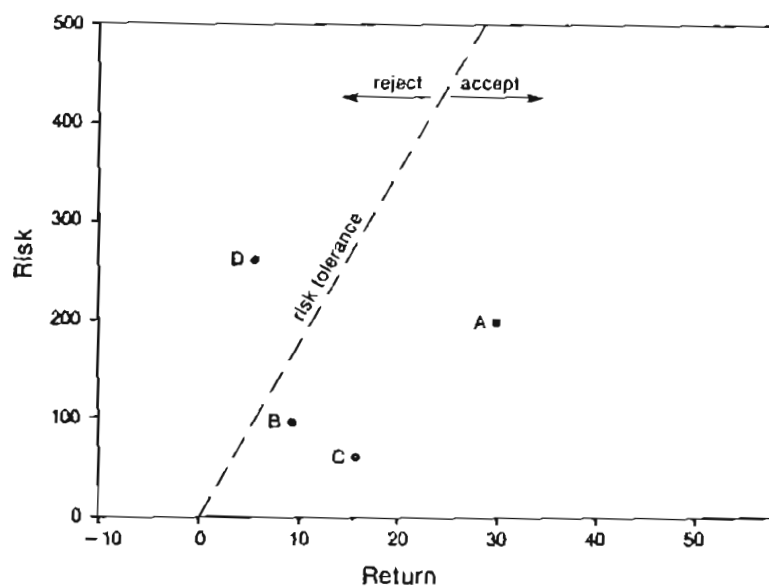
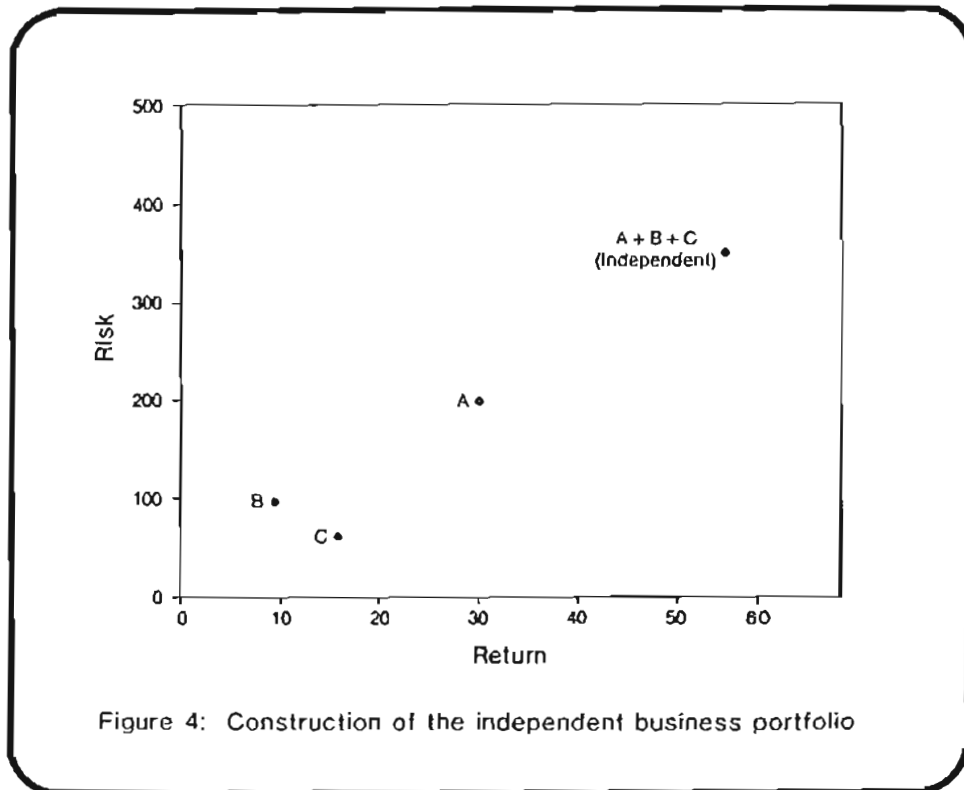


Figure 3: Accept and reject regions defined by the risk tolerance

BUSINESS PORTFOLIOS

Decision theory also shows us that the risk and return of independent ventures, or business areas, may be added together to form the risk and return for the portfolio they compose. Figure 4 shows an example of three independent business areas combined into a portfolio. This independent portfolio serves as a reference point for other situations.



The business areas could have return synergies or dissynergies, for example, resulting from the sharing of common facilities or the competing for common facilities, that cause the sum of their returns to be greater or less than that of the independent point shown in Figure 4 (without changing the sum of their risks). Figure 5 illustrates these possibilities.

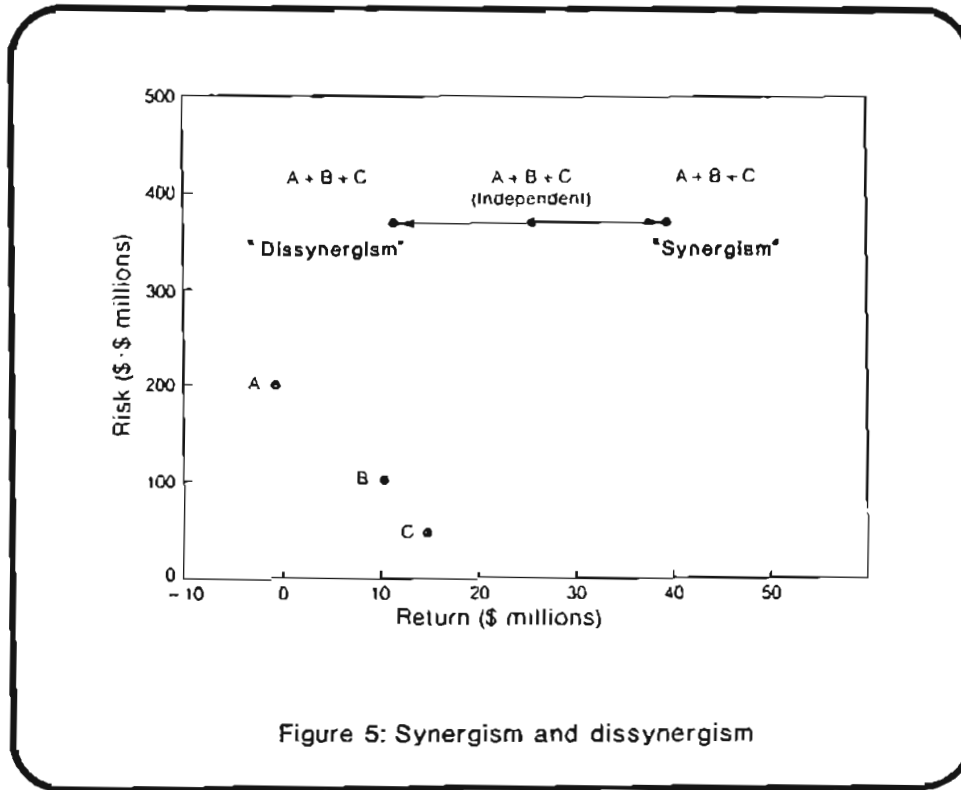


Figure 5: Synergism and dissynergism

Also, the business areas could be influenced by the same or related uncertainties, making their profits either positively or negatively dependent (without changing the sum of their returns). If the business area profits tend to rise and fall together, this increases the portfolio risk. We call this effect "risk concentration." If the business area profits tend to go in opposite directions, this decreases the project risk. We call this effect "risk compensation." Figure 6 illustrates these two possibilities.

Dealing with return synergies and dissynergies primarily requires examining common resources and other common factors. Dealing with risk concentration and compensation requires thoroughly understanding the influence of uncertainties on all the business areas. The remainder of this paper will pursue the treatment of risk.

ANALYZING PORTFOLIO RISK

We will illustrate some methods for treating risk with an example based on a real but disguised case. The organization chart for a successful diversified energy company called "Lamarco" [5] is shown in Figure 7. Historically, Lamarco was a gas transportation utility business. To reduce its dependence on one business, it recently undertook a major diversification program. Unfortunately, it could not tell if it had diversified enough.

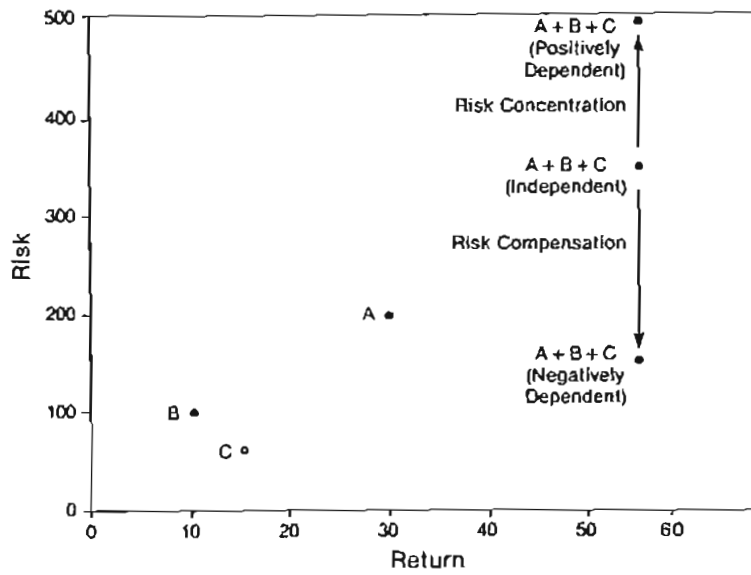


Figure 6: Risk concentration and compensation

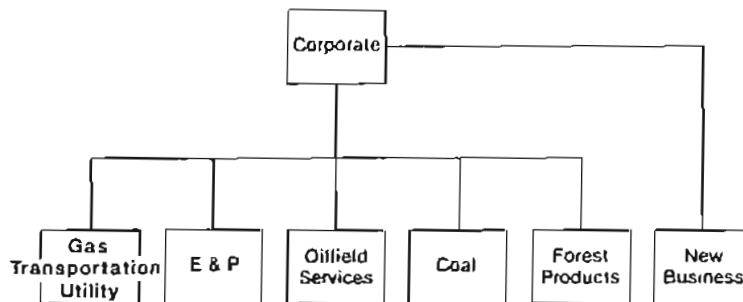


Figure 7: Lamarco's organization chart

Each of Lamarco's businesses was analyzed to determine its risk and return. These are plotted in Figure 8. As expected, the businesses having higher returns also have higher risks.

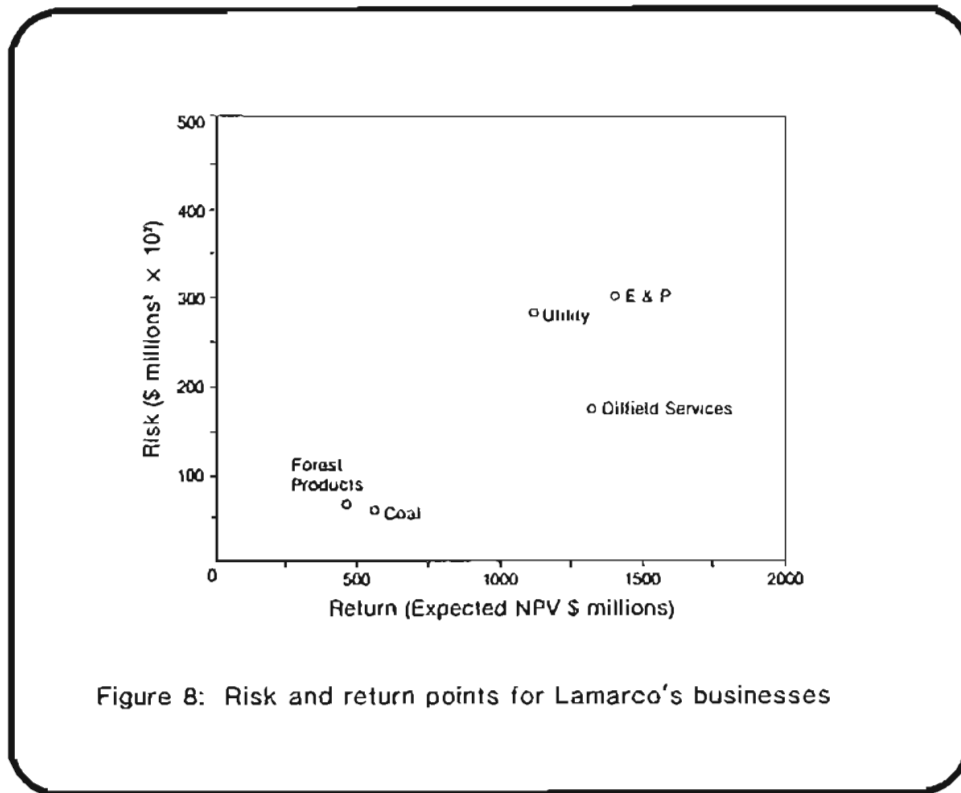


Figure 8: Risk and return points for Lamarco's businesses

Analyzing the sources of uncertainty for each business revealed several common uncertainties. The most critical ones were oil price, inflation, and regulation. In addition, each business had independent uncertainties that were unrelated to the other businesses. The critical uncertainties are portrayed in a simplified probability tree in Figure 9. You can see that each uncertainty can take on two values in each situation. More values could be used if additional details were required. Probabilities of each value are written near each branch point of the tree, and overall scenario probabilities are obtained by multiplying the three probabilities along the paths defining each scenario.

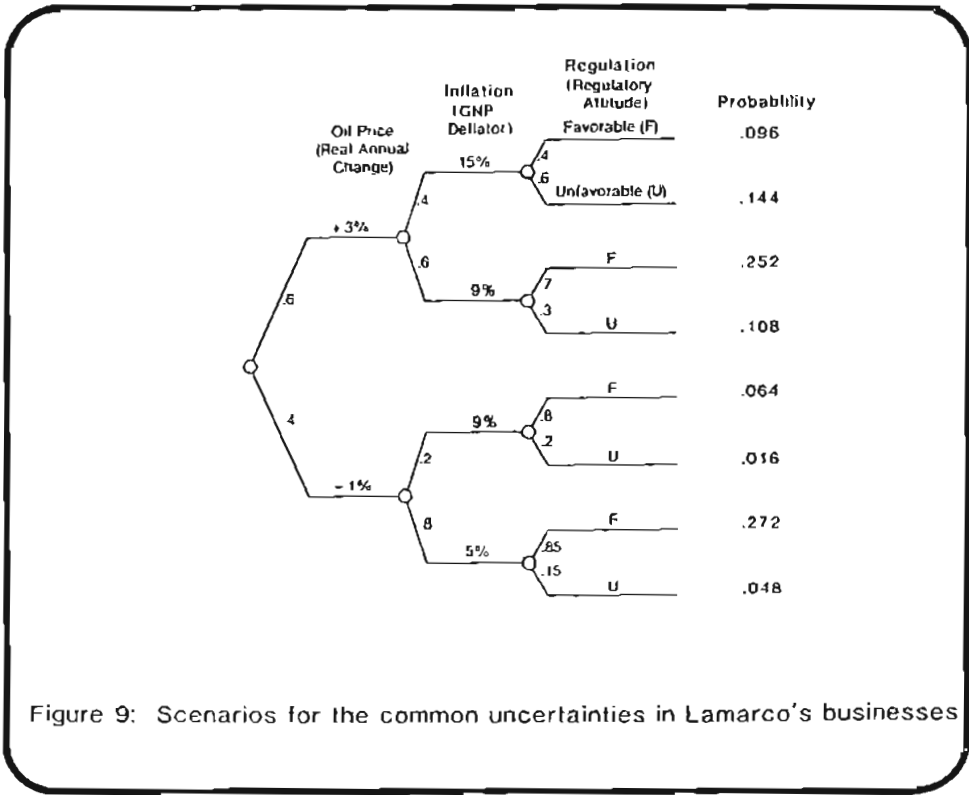
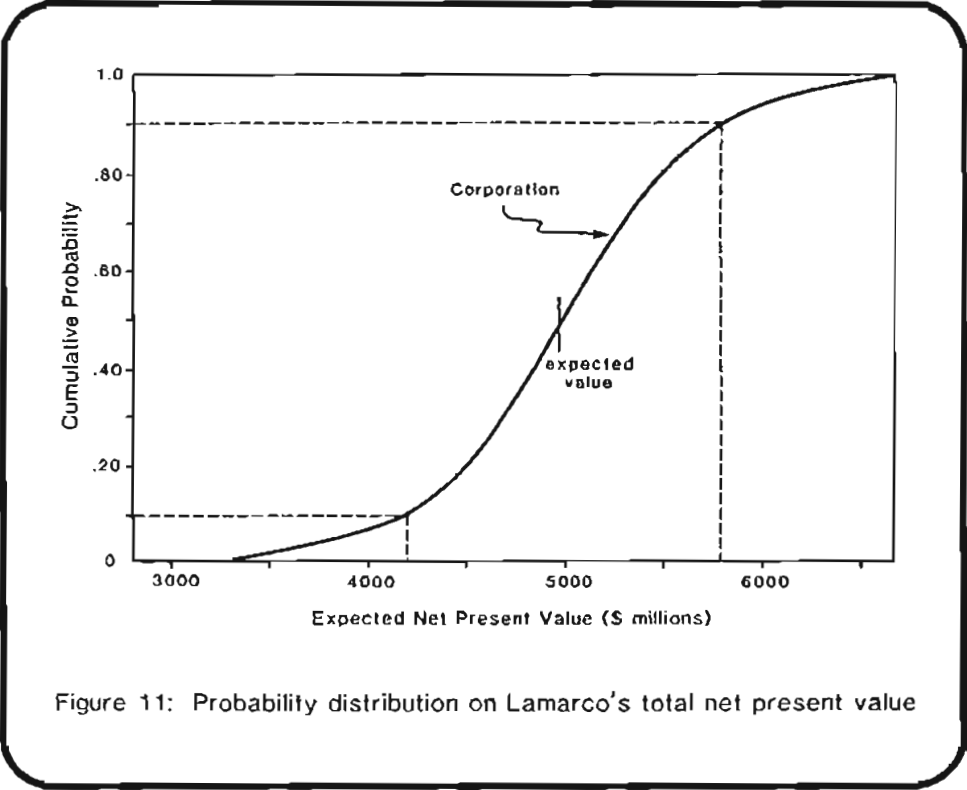
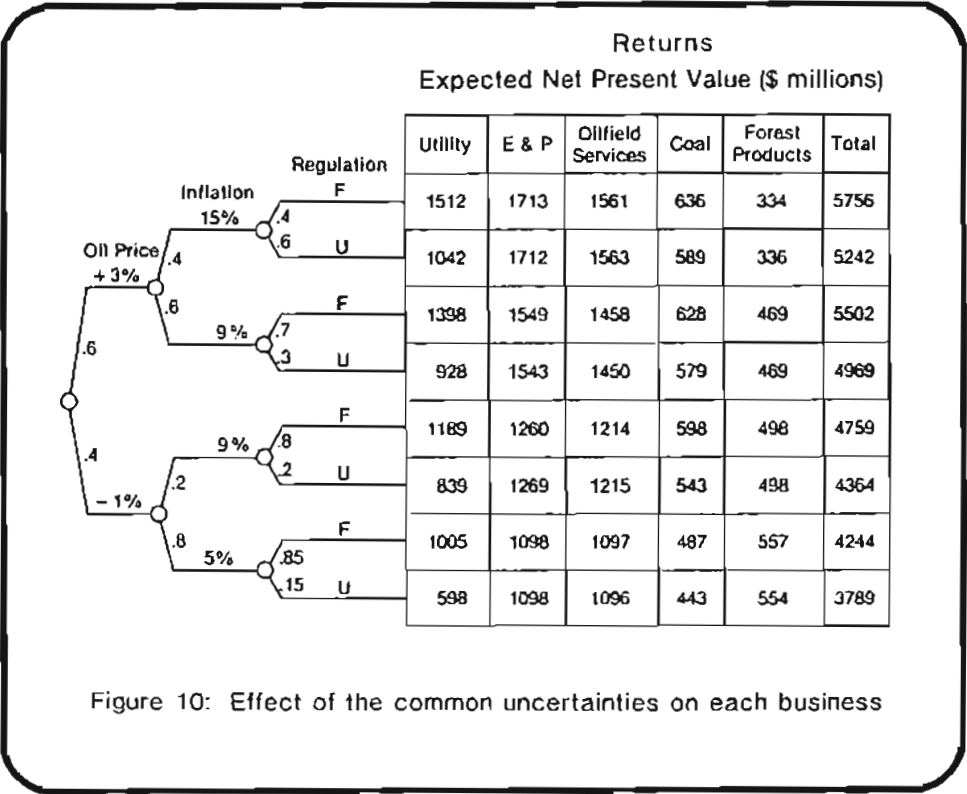


Figure 9: Scenarios for the common uncertainties in Lamarco's businesses

The analysis of each business was carried out for each of the common scenarios. The returns of each business and of the total portfolio are shown for each common scenario in Figure 10. We can easily see risk concentration among the first four businesses; for example, all their returns are very high for the first scenario. We can also see a little risk compensation produced by the forest products business, which has its lowest return under the first scenario and its highest under the seventh scenario. By doing further analysis, we can use the common uncertainties to determine the probability distribution on total profits, which is shown in Figure 11. When the risk and return of the total corporate profit is plotted, as seen in Figure 12, we see a case of high risk concentration.

Lamarco faces much more risk than a corporation made up of similar independent businesses. In fact, the corporate ratio of risk to return is higher than that of any of the individual businesses. A few computations produce the comparisons seen in Figure 13. Although Lamarco's diversification had successfully lowered its exposure to regulatory treatment, the diversification had also increased its exposure to inflation and oil price uncertainties. These observations create new strategic challenges for reshaping Lamarco's corporate portfolio.



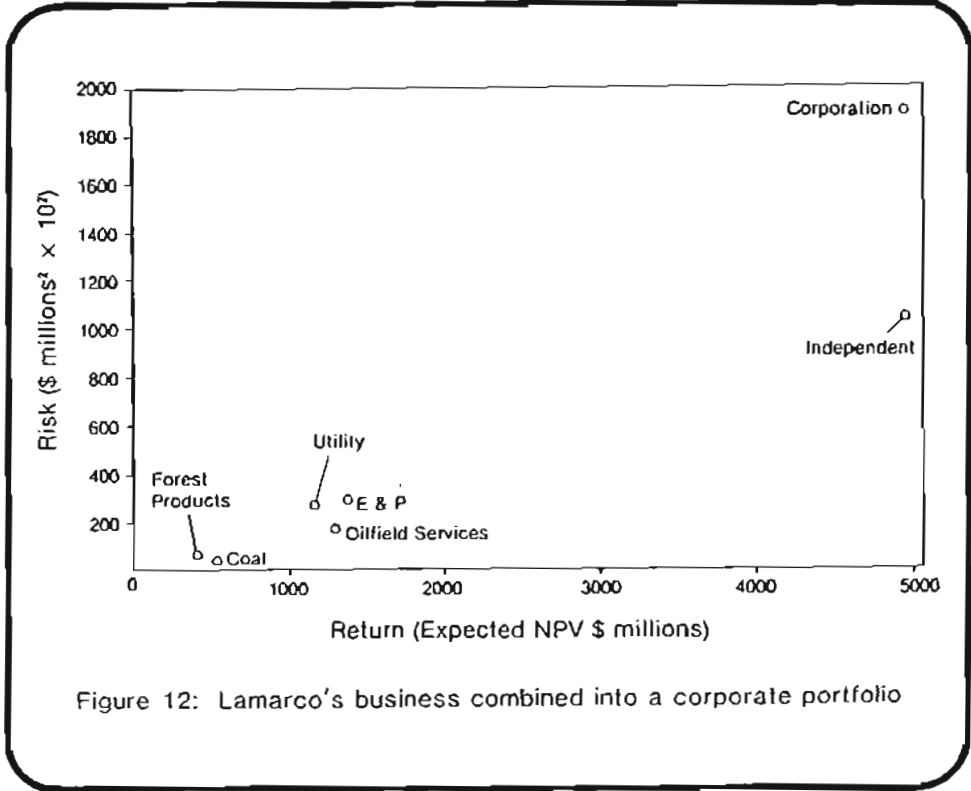


Figure 12: Lamarco's business combined into a corporate portfolio

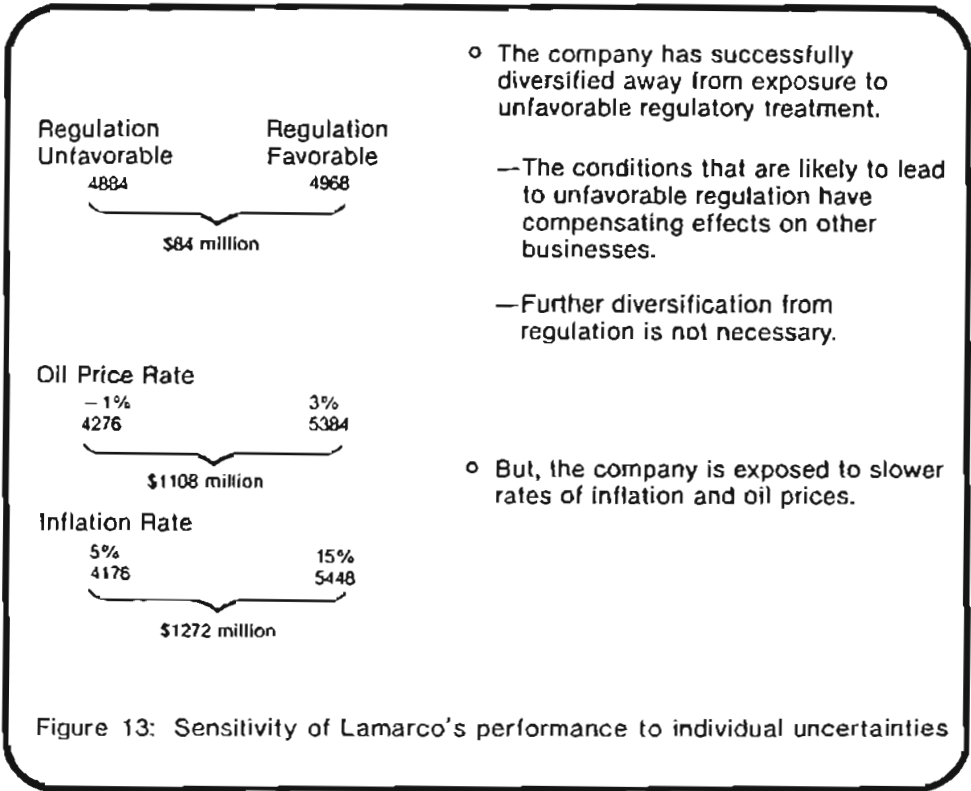
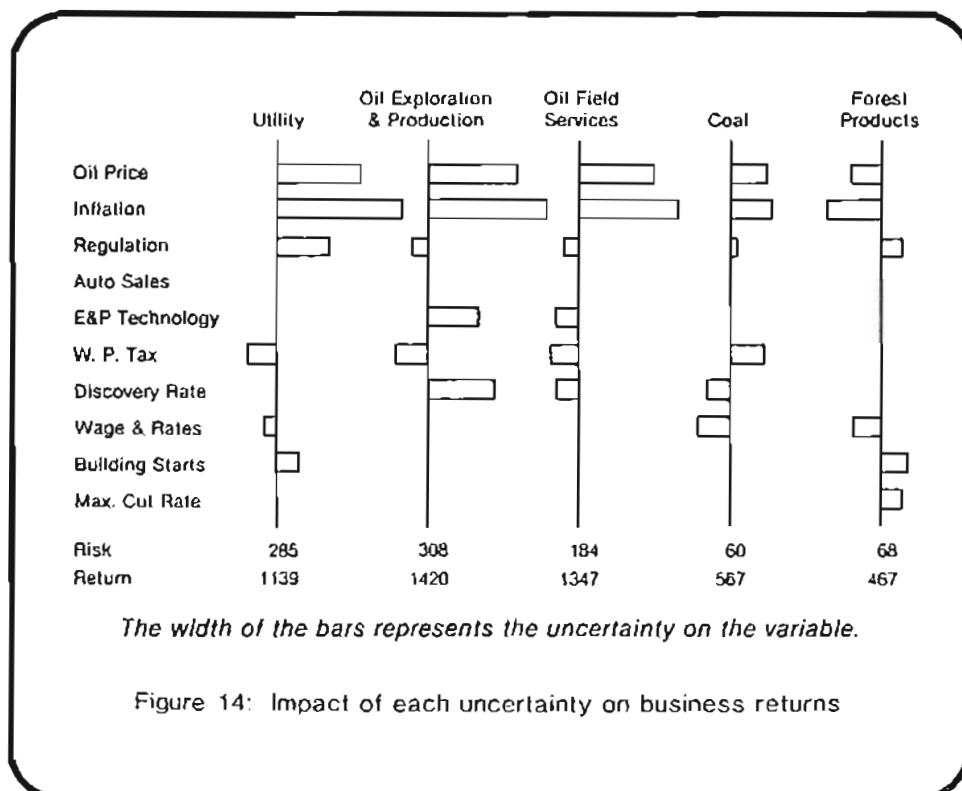
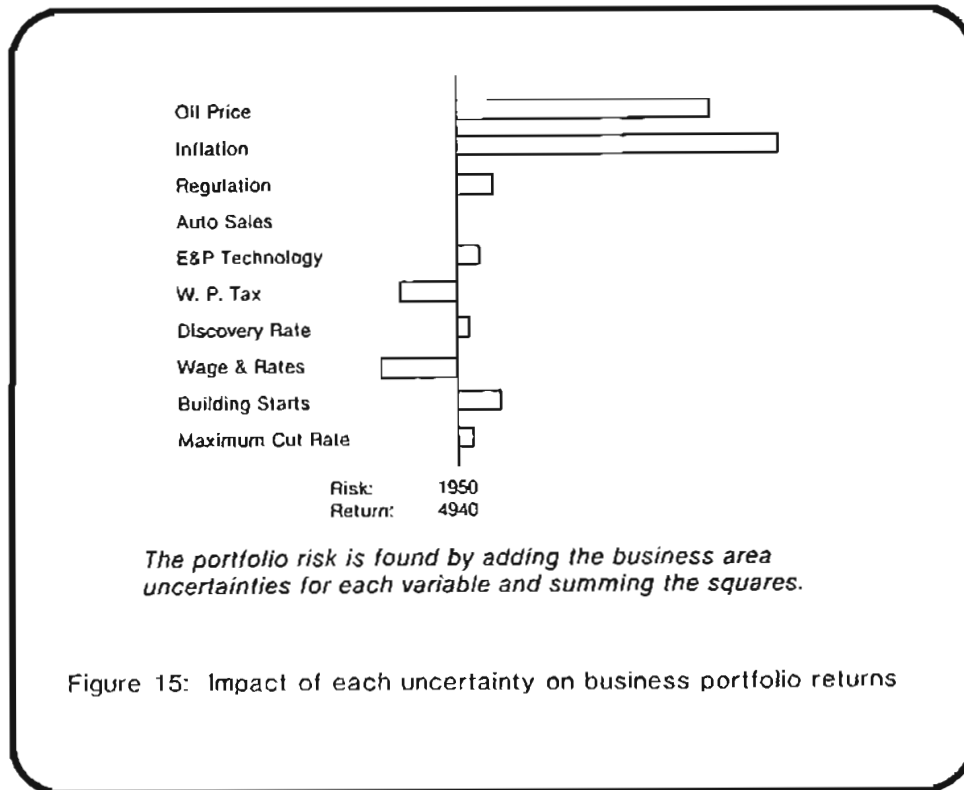


Figure 13: Sensitivity of Lamarco's performance to individual uncertainties

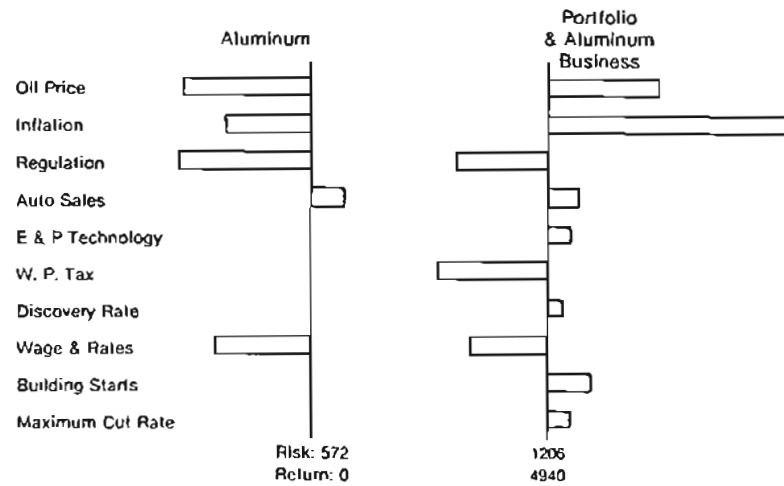
We can gain additional insight into portfolio development strategy by understanding the quantitative impact of the underlying uncertainties producing the risk (and risk concentration). Figure 14 shows the impact of the crucial uncertainties on each business. The width of the bars is proportional to the impact on returns as each uncertainty is varied from its 10th percentile to its 90th percentile. If returns rise with this variation, the bar is plotted to the right, and if returns fall, the bar is plotted to the left. The risk of any business area, which is listed (along with the return) below the bar, is approximately proportional to the sum of the squares of each uncertainty bar in the column [6].



Since we are dealing with a case of risk concentration (non-independence), we cannot simply add the risks across business areas. However, we can add the uncertainty bars to form an uncertainty profile of the total business portfolio, which is shown in Figure 15. In adding these bars, some uncertainties tend to concentrate (e.g., oil price and inflation) while others tend to compensate (e.g., regulation). This addition and cancellation is the source of risk concentration and compensation, which can be dramatically seen in Figure 15. Most importantly, this process lets us graphically see the risk problems of the portfolio. In Lamarco's case, oil price and inflation uncertainties are clearly creating most of the corporate risk.



Once we understand the sources of business risk, we are in a good position to create ways of reducing it. In the Lamarco case, we would challenge Lamarco executives and their analysts to come up with ways to reduce this risk while maintaining the returns. One possibility would be to manage each business in ways that reduce oil price and inflation risk in return for increased risk exposure to the less dominant uncertainties (or even a calculable amount of reduced return). Another possibility would be to create or acquire a new business having risk-compensating characteristics. In Figure 16, for example, we see the effect of adding a hypothetical aluminum business that has negative sensitivity to oil price and inflation. If we assume that Lamarco buys the aluminum business for its expected present value, it would have zero net return. However, it would still be valuable to Lamarco in reducing risk. Figure 17 shows the potential acquisition on a risk-return plot. Adding the aluminum business reduces the risk to about that of the independent case without giving up any return. As a result, it increases the certain equivalent by about \$400 million.



The returns are expected to be negligible. Does such an acquisition make sense?

Figure 16: Effect of adding an aluminum business to Lamarco's portfolio

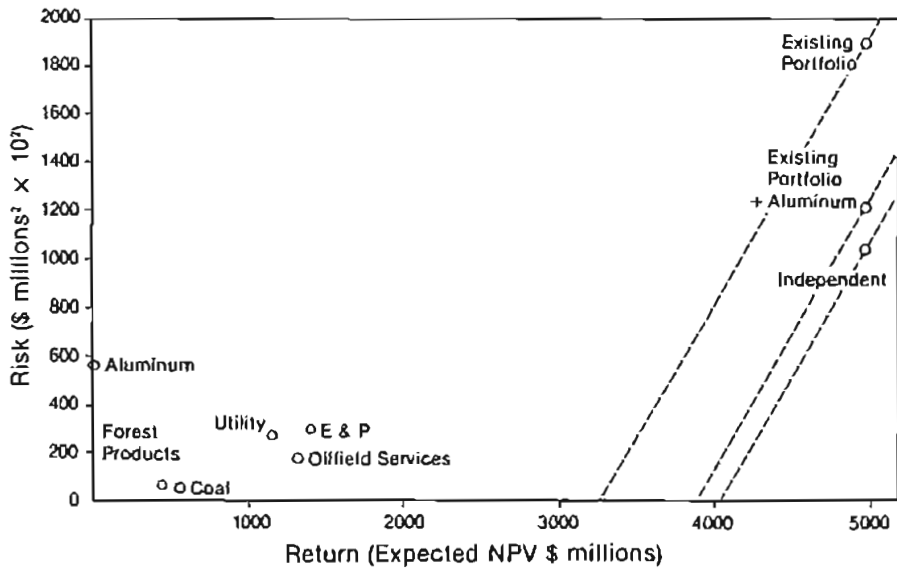


Figure 17: Reduction in risk due to a potential aluminum business acquisition

Lamarco could also consider divestitures. Figure 18 shows how Lamarco's corporate portfolio would change if each business were divested by giving it away. If it were sold at a specific price, this amount would have to be added to the return, thus shifting its point to the right. Depending upon buying and selling prices, divesting coal, acquiring an aluminum business, or possibly doing both could considerably improve Lamarco's situation. These graphic methods stimulate creativity and allow quick screening of ideas for developing better corporate portfolios.

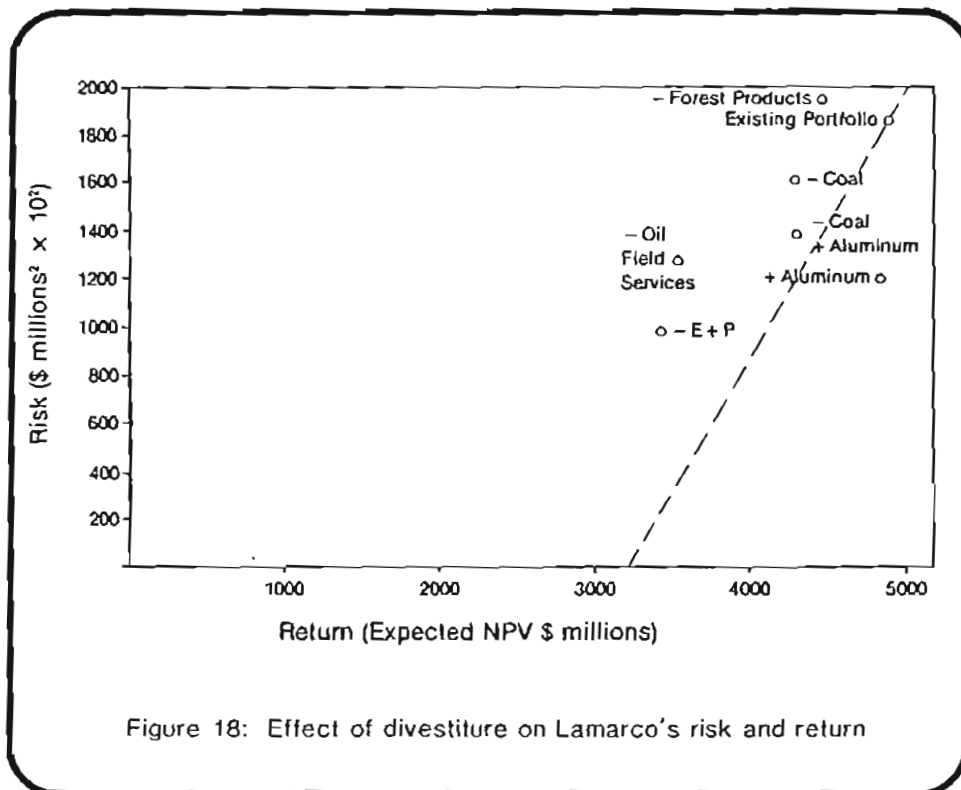


Figure 18: Effect of divestiture on Lamarco's risk and return

CONCLUSIONS

We have shown a new method for managing the trade-off of risk and return in the corporate business portfolio. This method incorporates graphic displays that identify the sources of business risk and shows how business units combine to either concentrate or compensate risk. The insight developed from a business portfolio analysis allows the executive to give better direction to each business unit and to plan acquisitions and divestitures that enhance the risk-return ratio for the whole corporation.

FOOTNOTES

1. Ronald A. Howard, "Decision Analysis: Applied Decision Theory," Proceedings of the Fourth International Conference on Operational Research, Wiley-Interscience, New York, 1966, pp. 55-71.
2. The risk measure is technically defined as one-half of the variance of the profit lottery. For most "ordinary" profit lotteries, the risk measure will be approximately one-thirteenth of the square of the uncertainty measure.
3. An example furnishes some intuitive justification. Suppose we could invest in some multiple, M, of the profit lottery of Figure 1. Then, we would have

$$\text{return} = 30 \times M,$$

$$\text{uncertainty} = 60 \times M,$$

$$\text{risk} = 3600 \times M^2,$$

$$\frac{\text{uncertainty}}{\text{return}} = \frac{60 \times M}{30 \times M} = 2,$$

$$\frac{\text{risk}}{\text{return}} = \frac{3600 \times M^2}{30 \times M} = 120 \times M$$

Since the ratio of uncertainty to return is constant, a corporation using this ratio that liked the original profit lottery would be led to invest in any multiple of it, an absurd result. However, the ratio of risk to return increases as M increases. For a sufficiently high value of M, the corporation using this ratio would limit its investment because it would see that the risk to return ratio would exceed its ability to tolerate risk for a sufficiently high value of M. Intuitively, we would prefer the second ratio.

4. By independent ventures, we mean that the corporation could independently accept or reject each of the ventures, and that knowledge of specific results from any of the ventures would not influence our opinion (profit lottery) for any of the other ventures or other holdings of the corporation: that is, they are probabilistically independent.
5. The author would like to acknowledge Terry Braunstein for carrying out the "Lamarco" case that provided the stimulus for this work.
6. If the uncertainties are correlated, products of the uncertainty bars multiplied by the appropriate correlation coefficient should be added into the sum of squares. Also, this approximation assumes an approximately linear profit model.