Optimizing the Allocation of Capital

by Charles Smithson and Gregory Hayt

This is the fourth in a series of five excerpts from a forthcoming book Managing Credit Risk: Toward a Portfolio Approach to Credit Risk Management by Charles Smithson and Gregory Hayt of Rutter Associates. The final article will appear in the October 2001 issue of The RMA Journal.

Capital allocation has come to encompass all the activities associated with managing a bank’s capital and measuring performance. It has implications for how the institution prices its services internally and externally, how it compensates employees, and how successfully it creates value for shareholders. This article will necessarily narrow the focus to a few key issues facing bankers. First, what are the relevant measures of capital and how are they allocated to business units or transactions? Second, how should the return on capital—or, alternatively, the economic profit of a business—be measured? Those are key inputs to the final question: What tools are used to improve the allocation (optimizing is really too strong a word for actual practice) in order to increase shareholder value?

Definitions of Capital

Broadly defined, capital is simply the residual claim on the firm’s cash flows. For banks and other financial institutions, capital’s role is to absorb volatility in earnings and enable the firm to conduct business with credit-sensitive customers and lenders. Bankers deal with several different definitions of...
capital: equity (or book) capital, regulatory capital, and economic capital (see Figure 1).

Equity capital turns out to be remarkably hard to define in practice because the line between pure shareholder investment and various other forms of liabilities is blurred. For our purposes, a precise definition is not necessary. By equity capital we simply mean the (relatively) permanent invested funds that represent the residual claim on the bank’s cash flows.

Regulatory capital refers to the risk-based capital requirement under the Capital Accord. The purpose of regulatory capital is to ensure adequate resources are available to absorb bank-wide unexpected losses. Although the regulatory requirement is calculated based on the risk of the assets, it was never intended to produce accurate capital allocations at the transaction level. The liabilities that can be used to meet the regulatory capital requirement are more broadly defined than an accounting definition of equity and include some forms of long-term debt, as shown in Figure 1.

Economic capital is defined in terms of the risk of the assets (both on-balance-sheet and off-balance-sheet) as shown in Figure 1. Economic capital is a statistical measure of the resources required to meet unexpected losses over a given period, e.g., one year, with a given level of certainty, say, 99.9%. One minus the certainty level is sometimes called the insolvency rate, or equivalently, the implied credit rating. Since economic capital is determined by the risk of the assets, it is possible for a bank to require more economic capital than it actually has. His situation is not sustainable in the long run. At the business unit level, however, certain businesses (like trading) require relatively little book capital whereas their economic capital is quite large. Since the bank must hold the larger economic capital, it is essential that the unit be correctly charged for its “risk capital” and not just its book capital.

**Measuring Economic Capital**

Economic capital is associated with the volatility of the economic value of the bank or its business units. Unfortunately, this volatility in value frequently cannot be observed, so it is calculated via proxy measures, such as the volatility of earnings or of the value of individual transactions. Banks may measure volatility (unexpected losses) with a “top-down” measure, a “bottom-up” measure, or, more likely, a combination of the two.

**Top-down measures.** The top-down measures employ earnings (or cash flow) volatility to estimate the volatility of the unit’s asset value. These models use historical data on earnings, or a model, to project volatility into the foreseeable future. The volatility of market value can easily be implied from these proxy measures. Top-down measures are most appropriate for high-volume businesses (for example, consumer lending), where transaction level detail is unavailable and the allocation of capital to specific transactions is not required.

**Bottom-up measures.** The bottom-up designations derive from the fact that individual transactions are modeled and then aggregated to arrive at portfolio or business unit capital. Most of the banks that use this approach obtain separate measures of credit risk capital, market risk capital, and possibly operational risk capital, and then sum those to get total capital. The practice of summing those measures assumes that they are perfectly correlated, a conservative but obviously inaccurate assumption.

As shown in Figure 2, most banks employ a Value-at-Risk (VaR) model to estimate market risk capital. In an earlier article in this series, we described the types of credit portfolio models that are being employed to measure credit risk capital. (See “The State of the Art in Credit Portfolio Modeling” in the March 2001 issue of this journal.) In the case of operational risk capital, there is not a generally accepted model, and most measures are ad hoc. Some firms have developed historical databases on operational losses from which a VaR-type operational risk
Bottom-up measurements are employed wherever the ability to assign capital to individual transactions is important, such as in trading businesses and commercial lending.

**Attributing capital to business units.** Without question, banks and other financial institutions are interested in measuring the capital consumed by various activities. The conundrum of capital attribution is that there is no single way to accomplish it. In fact, Nobel Laureate Robert Merton and Harvard Business School Professor Andre Perold make the following observation regarding the capital attribution process:

> Full [attribution] of risk capital across the individual businesses of the firm ... is generally not feasible. Attempts at such a full [attribution] can significantly distort the true profitability of individual businesses.²

However, you should not take this to mean that attribution is impossible. Rather, we think Professors Merton and Perold's warning reinforces a two-part message about attributing capital to individual business activities:

1. There are different ways of measuring the capital consumed by a particular activity.
2. These different measures have different uses.

Perhaps a third message is that the user should be aware of the limitations of each measure, as no one measure is suitable for every application.

The problem in attributing capital is whether (and, if so, how) to assign a portfolio benefit—namely, diversification—to the elements of the portfolio. Practitioners speak about three commonly employed measures of capital: stand-alone, marginal, and diversified. Different firms will calculate these capital numbers differently, but they tend to agree on the idea behind the measures. In Figure 3, we have constructed a stylized example to illustrate how these different capital measures relate to one another.

Our hypothetical bank is comprised of three business units. We have set up this illustration so that the “portfolio of businesses” provides the bank with significant diversification effects: The earnings of Business Unit 1 are only moderately correlated with those of Business Unit 2 ($p_{1,2} = 0.3$) and less correlated with the earnings of Business Unit 3 ($p_{1,3} = 0.1$); and, the earnings of Business Unit 2 are uncorrelated with those of Business Unit 3 ($p_{2,3} = 0.0$).

The volatility of earnings for the bank as a whole is 18.5%; so a “top-down” measure of economic capital for the bank would be 222. What about the amount of capital that would be attributed to the three business units?

Stand-alone capital is the amount of capital that the business unit would require, if it were viewed in isolation. Consequently, stand-alone capital would be determined by the volatility of each unit’s earnings. In our hypothetical bank, Business Unit 1’s asset volatility of 20% translates into stand-alone capital of 80. In the same way Unit 2’s asset volatility of 25% translates to stand-alone capital of 100; and Unit 3’s 40% volatility translates to stand-alone capital of 160. Note that the sum of the stand-alone capital for the three business units is 340. The difference between this sum and the capital of 222 for the entire bank is due to diversification. Stand-alone capital for the individual businesses does not take into account the diversification that the businesses provide to one another.

Because it does not include diversification effects, stand-alone capital is most often used to evaluate the performance of the businesses’ managers. The business unit managers should not be given credit for portfolio effects because they were not under the control of that manager. The weakness of that argument is that the unit is part of a group of businesses and the bank

| Figure 3 | Alternative Economic Capital Measures |
| --- | --- | --- | --- |
| **Capital Measures** | **Stand-Alone** | **Marginal Capital** | **Diversified Capital** |
| **Business** | **Assets** | **Volatility** | | | |
| Bank | 3000 | 18.5% | 222 |
| Sub 1 | 1000 | 20% | 80 | 33 | 45 |
| Sub 2 | 1000 | 25% | 100 | 36 | 56 |
| Sub 3 | 1000 | 40% | 160 | 77 | 121 |
| Total | | | 340 | 146 | 222 |
| Unallocated | -118 | 76 | 0 |

Sub 2 + 3 | 2000 | 23.6% | 189 |
Sub 1 + 3 | 2000 | 23.2% | 186 |
Sub 1 + 2 | 2000 | 18.2% | 146 |

This table follows closely the example in Merton and Perold, although the volatility and correlations are different. For simplicity, capital is calculated as a function of the asset volatility, using the approximation given in their paper. The concepts discussed would apply if a different method of calculating capital were used.
should be careful about encouraging its managers to ignore the interrelationships. As shown later, it is possible to construct scenarios in which businesses that are not profitable on a stand-alone basis add shareholder value within a diversified firm.

Marginal capital measures the amount of capital that the business unit adds to the entire firm’s capital (or, conversely, the amount of capital that would be released if the business unit were sold). Marginal capital is obtained by calculating total bank capital including and excluding the business unit and then taking the difference between the two total bank capital numbers.

It is generally agreed that marginal capital is most appropriate in evaluating acquisitions or divestitures. Marginal capital would not be an appropriate tool for performance evaluation because it always under-allocates total bank capital. And even if the marginal capital numbers were scaled up, the signals sent about profitability are potentially very misleading. (Marginal capital could be scaled up by multiplying each business unit’s capital by 1.52%, the ratio of total bank capital to the sum of the marginal capitals.)

Diversified capital (also referred to as allocated capital) is calculated by multiplying the business unit’s stand-alone capital by the correlation between the unit and the entire bank, including the unit in question. (This means that diversified capital is determined by the standard deviation of the assets of the entire bank and the correlation of the assets of the business unit with total assets.) Units with low correlation obviously receive a greater reduction in their stand-alone capital than do units that are highly correlated.

Diversified measures are sometimes referred to as “portfolio beta” measures because the apportionment of risk is based on the covariance of each business unit with the entire organization in the same way that stock’s beta is calculated from its covariance with the market. Apportioning business capital in this way has intuitive appeal and it is fairly widespread.

Obtaining the correlations required is a challenge. Estimates can be based on historical performance data within the institution and management’s judgment. Conceptually, it is possible to derive estimates for broad classes of activity (for example, retail lending versus commercial lending) by modeling data on the stock prices of other banks.

**Optimization**

Since capital markets are competitive, banks must offer their equity investors (that is, the providers of capital) with a return sufficient to justify their investment, given all the available alternatives. Consequently, capital allocation optimization refers to the process of deploying capital to maximize shareholder value.

**Metrics for comparing business units.** Before we can optimize the allocation of capital, we must measure the return being earned on the capital already employed in the bank. There are two commonly employed metrics for comparing business units on an equal footing: RAROC and economic profit.

RAROC literally stands for “risk-adjusted return on capital.” (Since risk-adjusted return measures are calculated on economic capital, which is itself risk-adjusted, it might more correctly be called “risk-adjusted return on risk-adjusted capital” — RARORAC. But since RARORAC is very difficult to say, we simply call it RAROC.) A commonly used method for calculating RAROC is illustrated in Figure 4.

The denominator is diversified [allocated] economic capital. Since it is a risk-adjusted capital measure, it generally will not match the equity capital invested in the unit. The inclusion of capital for market...
and operational risks is important because a credit business certainly has operational risks and it will likely have some market risk as well. The inclusion of new business capital could be debated. New business risk capital is based on the idea that a business unit cannot operate at its limit; there must be some slack in the capital deployed versus what is available to fund new activities, and this additional capital is reasonably considered “deployed” in the business since it is not available for use elsewhere. In fact, comparing returns with and without new business capital is one metric for measuring how effectively allocated capital is being deployed within the unit.

The numerator represents the economic earnings of the unit. Credit risk enters the risk-adjusted return calculation in the numerator as a provision for expected losses. Expected losses are considered a cost of being in the credit business rather than a risk. Further adjustments are made for allocated costs and taxes. Practitioners differ in the way they treat capital. The more common approach is to give each unit credit for the risk capital deployed, that is, to reflect earnings on the risk capital as if it were invested in a risk-free asset. However, some practitioners keep the return on capital for a central “treasury” function. If RAROC exceeds the cost of capital, then the business unit is contributing to value creation.

Economic profit is a more direct measure of whether a firm (or a business unit within that firm) is creating value for its shareholders. It is expressed simply as revenues (as defined above) minus the cost of capital deployed.

\[
\text{Economic Profit} = \text{Net Operating Profit} - \text{[Economic Capital} \times \text{Reqd Return on Capital]}\]

Up to this point we have alluded to shareholders’ required rate of return without formalizing the notion. Practitioners generally apply a single cost of capital, estimated at the bank level, to all business units. This could be debated on theoretical grounds, but practical considerations lead most institutions to adjust the amount of capital assigned to units based on risk and then apply a bank-wide required return. This return might be estimated using the Capital Asset Pricing Model and the bank’s stock beta and the equity risk premium, but more likely it is a blended rate reflecting the bank’s actual costs of permanent financing, and input from outside sources on equity financing costs.

The advantage of using economic profit over RAROC measures is the direct relationship between economic profit and value creation. While it is true that any division with a RAROC above the cost of capital will also have a positive economic profit, the signals sent by the two measures may conflict with incentive compensation schemes. Figure 5 shows three businesses. All three have positive RAROC and economic profit when measured against their diversified capital requirements. If management is told to maximize RAROC, they have an incentive to reduce resources to businesses 1 and 3, even though that would decrease the overall value of the firm. This is because RAROC takes scale out of the equation, emphasizing percentage results over total results. On the other hand, maximizing economic profit provides incentive to look at the portfolio of businesses.

Figure 5 also illustrates the benefits of diversification. On a stand-alone basis, Sub 3 does not cover its cost of capital; however, because capital costs are reduced for the bank as a whole, it adds value to shareholders.

Optimizing the allocation of capital. The majority of banks employ an informal optimization process, in which decisions about the deployment of capital are made in the light of basic profitability measures such as those in Figure 5. With sufficient information it is possible to formally model the optimization, but this is still asking a lot of the data and of bank managers. (See Baud for a discussion of a formal optimization model.) We will limit our focus to a few informal approaches.

A recurring question is how to treat regulatory capital in an optimization process that theoretically should look only at economic capital. If economic capital always exceeded regulatory capital, we could ignore it—the “constraint” of regulatory capital would be nonbinding. When this is not the case, firms use a variety of ad hoc approaches. One is to impose an explicit charge for regulatory capital in the calculation of economic profit. This explicitly penalizes businesses that require high amounts of regulatory capital in the creation of their economic profit. The higher the “cost” assigned to regulatory capital the greater the penalty. Unfortunately, this also masks real economic value. For example, if one unit is very regulatory capital intensive, but highly prof-
itable on an economic basis, its return will be knocked down in comparison to other lines. But this may be the wrong signal, since the bank may want to figure out how to reduce the regulatory capital requirement or obtain additional capital to grow the otherwise highly profitable business.

Another approach is to work with whatever capital number is larger, that is, calculate economic profit relative to regulatory capital if that exceeds economic capital. This method has some appeal since it charges each business for the larger of the two capital numbers, but it suffers from a “summing up” problem. By taking the larger of the two capitals for each business, the bank will appear to have deployed more capital than it actually has, and the profit calculations will not make sense when aggregated bank-wide.

Short of a mathematical model to tie regulatory capital and economic capital together, bankers can combine elements of both approaches by looking at business units in terms of the benefits, at the margin, of another unit of regulatory capital. Formally this is known as evaluating shadow prices, but intuitively it simply involves calculating the benefit achieved if a constraint, for example, regulatory capital, could be loosened slightly. It applies equally well to other constraints, such as computing capacity or human resources. Shadow prices send the correct signal about where the most value can be created for an additional unit of capital or any other resource.

In an optimal portfolio, the marginal return per unit of risk within the bank will be equal across businesses. That is, taking a unit of capital away from one business and giving it to another will not add additional value to shareholders because the return lost equals the return gained. Bankers can use this concept, along with basic measures of economic profitability, to keep moving the institution in the right direction without resorting to mathematical models.

Rutter Associates’ Website can be found at www.rutterassociates.com

Notes
1 For a full discussion of this approach, see, Matten, Chris, Managing Bank Capital, Second Edition, Wiley, 2000

Other References
Zaik, Edward, John Walter, and Gabriela Kelling, with Chris James, “RAROC At Bank of America,” Journal of Applied Corporate Finance, Volume 9, Number 2, Summer 1996.