

Bank and Business Performance Measurement

STUART M. TURNBULL

Given the objective of maximizing the wealth of existing shareholders, this paper discusses some of the issues that arise in attempting to measure the performance of individual businesses within a bank. The paper describes two return measures – return on assets within a business and the return on the ‘equity’ of an individual business – and discusses the appropriate bench-marks. The paper ends with a discussion of the cost of unused allocated capital and the appropriate performance metric.

(J.E.L.: G30, G31).

1. Introduction

Creditworthiness is a cost of doing business for a bank.¹ The credit rating on a bank’s debt affects not only the cost of funds for a bank but also its ability to access different markets. Consequently, senior management of a bank must decide on a target debt rating and accordingly alter the capital structure of the bank. The bank’s equity provides the buffer or economic capital for the bank to maintain its desired level of creditworthiness.

The economic capital of a multi-business bank is less than the aggregate economic capital of the individual businesses on a stand-alone basis, due to the externality of risk sharing. This is commonly referred to as the *portfolio effect*. The question of determining the ownership of the economic benefits arising from the externality of risk sharing underlies the difficulty in deciding how to allocate economic capital and the difficulty of measuring the performance of businesses within the bank. A business on a stand-alone basis may be unprofitable due to high capital requirements while, within a bank, it may enhance the wealth of existing shareholders due to the presence of other businesses with off-setting risks. In this case, how do we measure the performance of the business? The benefits to the bank arise not from the business itself, but from the portfolio effects. Should the bank be the owner of this benefit, or do the individual businesses have ownership?

¹ While we use the word bank, our comments apply to any financial institution.

Each business within the bank contributes towards the overall risk of the bank. Senior management within the bank faces a number of challenging issues. First, given the current allocation of capital to each business within the bank, how should it measure performance of individual businesses, recognizing that each business affects the overall creditworthiness of the bank? Second, how should the bank decide on what businesses to enter/grow or to exit/reduce? Third, given an allocation of capital across the businesses within the bank, how we should we measure the performance of a business if it does not fully utilize its allocated capital?

For performance measurement, practitioners have used the risk adjusted rate of return on capital (RAROC) as a performance metric. The risk part of this measure is the economic capital for the business, which is usually defined as the amount of economic capital required by a business so that it does not affect the creditworthiness of the bank. Ignoring any theoretical issues for the moment, in practice, there are a number of practical difficulties. First, should the measure of economic capital include the portfolio effect or not? Second, should the measure of economic capital be used for creditworthiness, as advocated by the recent BIS report (2001), or should economic capital be used as a performance measure? In other words, even the basic rationale for economic capital is often contentious. The difference in the value of economic capital used as a solvency measure and as a performance measure can be substantial.

In determining whether to add or eliminate a particular business from the bank's portfolio, a marginal approach is often used for determining the economic capital. The standard assumption is that the business is 'small' in comparison to the existing portfolio. If this is not the case, the whole nature of the bank and its capital structure are affected, implying that determination of the marginal effects is problematic. Merton and Perold (1993) show that simply aggregating the marginal economic capital of individual businesses underestimates the total economic capital and the error can be substantial. The full allocation of risk capital across individual businesses is generally not feasible. Notwithstanding this, banks employ two general approaches to allocating economic capital: the top-down approach and the bottom-up approach.

In the top-down approach, economic capital is first determined at the top of the bank and then allocated to the individual businesses. At no point in the process is reference made to the stand-alone economic capital of the business. The economic capital for any business incorporates the benefits of any portfolio effects. The implicit assumption is that the economic benefits of the portfolio effect are owned by the individual businesses. In the bottom-up approach, economic capital is first determined on a stand-alone basis. The economic capital at the top of the bank is determined and a proportionality factor is defined that equates the aggregate stand-alone economic capital and the economic capital at the top of the bank. For each business, the capital

allocated depends on the stand-alone capital and this proportionality factor. In both approaches, portfolio effects are fully allocated to the businesses.

Let $EC(t)$ denote the bank's total amount of economic capital at time t and $EC_j^A(t)$ the amount of economic capital allocated to business j , $j = 1, \dots, n$, where n is the number of businesses within the bank. Given the total economic capital $EC(t)$, we can define $w_j(t)$ as the proportion allocated to the j th business, where

$$(1) \quad EC_j^A(t) \equiv w_j(t)EC(t)$$

All of the bank's economic capital is allocated to the different businesses:

$$(2) \quad EC(t) = \sum_{j=1}^n EC_j^A(t)$$

which implies that

$$(3) \quad 1 = \sum_{j=1}^n w_j(t)$$

If expression (3) is the only constraint, then there are an infinite number of ways to allocate capital.²

Given the objective of maximizing the wealth of existing shareholders, this paper discusses some of the issues that arise in attempting to measure the performance of individual businesses within a bank. Practitioners usually employ a RAROC methodology for performance measurement. Unfortunately, the usual application of this methodology is flawed, as shown by Crouhy *et al.* (1999). This paper avoids the pitfalls of RAROC. It describes two return measures: return on assets within a business and the return on the 'equity' of an individual business and discusses the appropriate bench-marks. The paper ends with a discussion of the cost of unused allocated capital and the appropriate performance metric.

In section 2, we describe the two standard approaches to allocating economic capital: the top-down approach and bottom-up approach. The traditional RAROC approach to performance measurement and its limitations are described in section 3. A new approach to performance measurement is presented in section 4. The cost of unused economic capital and performance measurement is addressed in section 5.

² A simple method is to allocate economic capital equally across all businesses:

$$w_j(t) = 1/n$$

This method is usually rejected, as the capital allocation is independent of the risk of the business. Bock (2001) describes six different allocation methodologies.

2. Standard Approaches to Allocating Economic Capital

This section describes the two standard approaches to allocating economic capital: the top-down approach and the bottom-up approach.

2.1. Top-down Approach

Here we describe two top-down approaches.

Method 1

This method is based on marginal economic capital. Let EC_{-j} denote the economic capital for the bank when business j is excluded. The marginal economic capital for business j is defined by

$$(4) \quad MC_j(t) \equiv EC(t) - EC_{-j}(t)$$

where $EC(t)$ is the economic capital for the bank. The aggregate marginal economic capital is given by

$$MC(t) = \sum_1^n MC_j(t)$$

We define

$$(5) \quad w_j(t) \equiv \frac{MC_j(t)}{MC(t)}$$

assuming that aggregate marginal economic capital is different from zero: $MC(t) \neq 0$. The total marginal economic capital is unlikely to be zero for a bank with several businesses. The economic capital allocated to the j th business is given by expression (1), using expression (5).

The difficulty with this method is that of determining the marginal economic capital for a business. If a business is large relative to the existing assets of the bank, then the inclusion/exclusion of the business will affect the bank's capital structure and its creditworthiness. The standard implicit assumption is to ignore such effects. Merton and Perold (1993) show that simply aggregating the marginal economic capital of individual businesses underestimates the total economic capital:

$$MC(t) \leq EC(t)$$

Method 2

This method is based on the variance of the return on the business. Let $V_j(t)$ represent the current value of the j th business and define the return by the random variable R_j , such that

$$V_j(t+1) = V_j(t)R_j$$

The total value of the bank at time $t+1$ is

$$V(t+1) = \sum_1^n V_j(t)R_j$$

and the variance is

$$\sigma_v^2 \equiv \text{var}[V(t+1)] = \sum_{j=1}^n V_j(t) \sum_{k=1}^n \sigma_{j,k} V_k(t)$$

where the covariance between returns is denoted by $\sigma_{j,k} = \text{cov}(R_j, R_k)$. Let

$$\begin{aligned} w_j(t) &= V_j(t) \sum_{k=1}^n \frac{\sigma_{j,k} V_k(t)}{\sigma_v^2} \\ (6) \quad &= \frac{\text{cov}[V_j(t+1), V(t+1)]}{\text{var}[V(t+1)]} \end{aligned}$$

which satisfies (3). The economic capital allocated to the j th business is given by

$$(7) \quad \text{EC}_j^A(t) = w_j(t)\text{EC}(t)$$

where $w_j(t)$ is given by (6).

This approach measures the ‘beta’ of the business.³ It calculates the covariance of the return on the business with the return on the bank’s own portfolio. It can be estimated using either Monte Carlo simulation or analytic approximations. Note that the economic capital allocated to a business can be positive or negative. While expression (6) is intuitive, it presumes that economic capital is proportional to the second moment of the distribution. If the probability distribution describing the future value of the portfolio is normally distributed, then this is reasonable. However, if the distribution is skewed, then there is less appeal to using the second moment for capital allocation.⁴

³ This methodology is sometimes referred to as Delta SD.

⁴ The same approach could be applied using the third moment, fourth moment etc., assuming such moments exist.

2.2. Bottom-up Approach

Here we first start at the business level and work our way to the top of the bank. Let $EC_j^{SA}(t)$ denote the stand-alone economic capital for business j . The total amount of stand-alone economic capital is

$$(8) \quad EC^{SA}(t) = \sum_{j=1}^n EC_j^{SA}(t)$$

Method 3

We define a term that equates the top-down economic capital for the bank, $EC(t)$, to the total stand-alone economic capital, $EC^{SA}(t)$. Let $a(t)$ be defined by

$$(9) \quad a(t) \equiv \frac{EC(t)}{EC^{SA}(t)}$$

Note that this proportionality factor is the same for all businesses. The economic capital allocated to business j is given by the stand-alone economic capital for the business multiplied by the proportionality factor:

$$(10) \quad E\hat{C}_j(t) = a(t)EC_j^{SA}(t)$$

The aggregate capital allocated is

$$(11) \quad \sum_{j=1}^n E\hat{C}_j(t) = a(t)EC^{SA}(t) = EC(t)$$

implying that capital is fully allocated.

A disadvantage of this approach is that the proportionality factor $a(t)$ in (9) is independent of the particular business. Attributed economic capital is proportional to the stand-alone economic capital.

3. Traditional RAROC Performance Measurement

We know from the work of Merton and Perold (1993) that full allocation of the risk capital across individual businesses is generally not feasible. Any decision on full allocation will be arbitrary, given the inability to correctly identify the ownership of the portfolio effect. The approach adopted by many banks is to treat each business in the bank *as if* it is a separate entity with its own balance sheet, its own debt and equity. The equity represents the economic capital of the business. The return on the equity within the business is viewed as the appropriate measure of performance. The implicit assumption is that

maximizing the return on equity for individual businesses is consistent with maximizing the return on equity for the bank as a whole.

3.1. The Rate of Return on Equity

There are two common ways to construct the ‘balance sheet’ of a business within the bank. The methodology to allocate the economic capital is taken as given. In the first approach, the capital structure of the business is determined such that the probability of default for the business is at some specified level. The balance sheet is shown in Figure 1. The second approach is to assume that the risky assets of the business are totally financed with debt. The equity within the business represents the economic capital and provides a buffer so that the probability of default over a specified horizon is within some specified level. This approach is commonly associated with the usual application of the RAROC methodology. The balance sheet is shown in Figure 2. In this

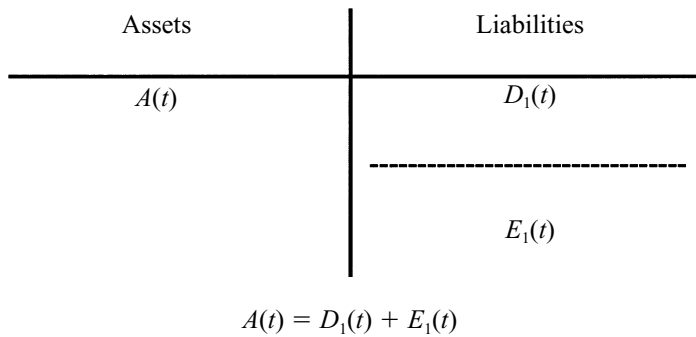


Figure 1: The Balance Sheet for an Individual Business – Risky Assets Funded with Debt and Equity

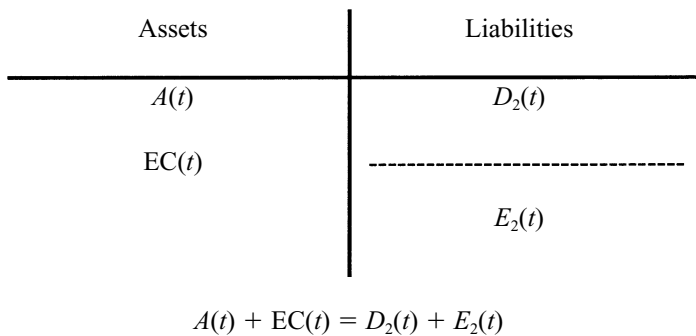


Figure 2: The Balance Sheet for an Individual Business – Risky Assets Funded with Debt, Economic Capital Funded with Equity

approach the economic capital is implicitly assumed to be invested in default-free assets and the income generated by these assets accrues to the business.

In either approach, the aggregate amount of debt and equity in the businesses is, in general, different from the bank's debt and equity levels. This raises the question of whether the assumption of maximizing the rate of return on equity for individual businesses is consistent with the objective of maximizing the wealth of the bank's existing shareholders.

The expected rate of return on the equity of each business is calculated and compared to the bank's required rate of return on equity.

3.2. *The Relevant Bench-mark*

The implicit assumption is that economic capital in a RAROC framework correctly compensates for risk. Hence the risk adjusted returns for different businesses can be directly compared and the relevant bench-mark is the bank's required rate of return on equity. But is economic capital an appropriate measure of risk? This question is addressed in Crouhy *et al.* (1999), who show that the RAROC risk adjusted rate of return is *not* independent of risk. It does not adjust for systematic risk. The intuition behind their result is that, in the usual application of RAROC, the economic capital is approximately proportional to standard deviation, implying that the relevant risk measure is standard deviation. The greater the standard deviation, the more risky the asset and the greater the economic capital. We know from the work of Sharpe (1964) that, while standard deviation may be appropriate for measuring the risk of a portfolio, for an individual asset the relevant risk measure is systematic risk – the covariance with the market portfolio. Shareholders can diversify their portfolios and are concerned about risk that cannot be diversified. Idiosyncratic risk can be diversified, implying that standard deviation, which incorporates idiosyncratic risk, is not the appropriate risk measure. There are three important implications that follow from the Crouhy *et al.* paper.

First, if we use a fixed bench-mark such as the required rate of return on the bank's equity as the hurdle rate, we run the risk of accepting unprofitable projects with expected returns above the hurdle rate, while rejecting profitable projects with expected returns below the hurdle rate. The relationship between the risk of a project and the minimum expected rate of return necessary to compensate investors for the risk is referred to as the *security market line*. Any project has positive net present value if its expected rate of return is above the security market line. This is shown in Figure 3. Second, the objective of maximizing the risk adjusted rate of return is not necessarily consistent with maximizing the wealth of existing shareholders, the stated objective of many banks. It is necessary to determine a hurdle rate that correctly reflects the risk of the business. Third, transfer pricing methodologies that use the RAROC risk

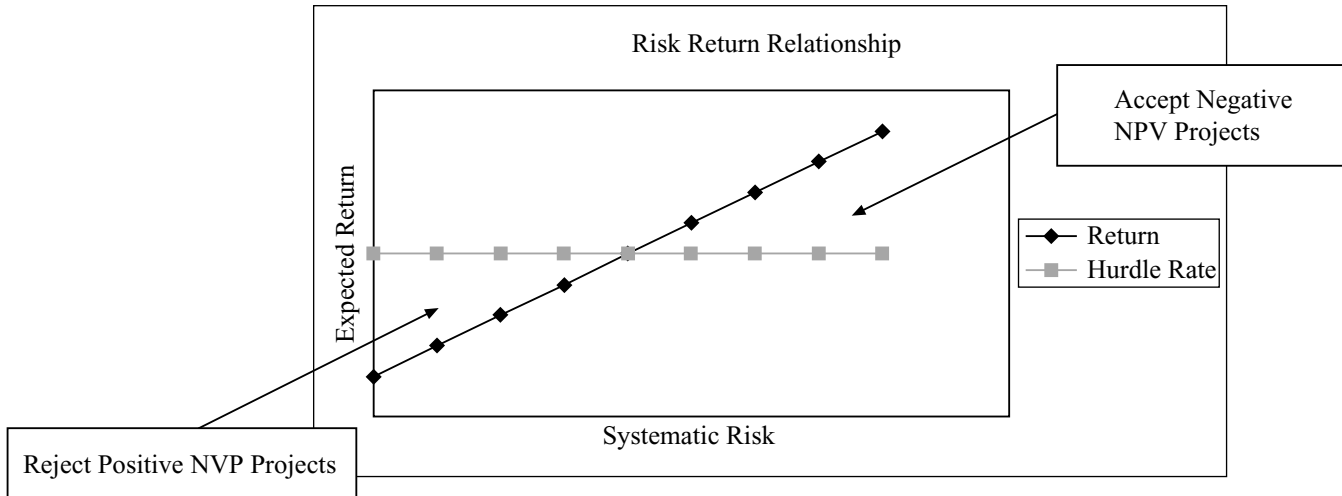


Figure 3: A Fixed Hurdle Rate – Accept a Project if the Expected Rate of Return is above the Required Rate of Return on Equity

adjusted rate of return methodology are not EVA neutral, as shown in the Appendix.

If a business adds value to a bank, the adjusted net present value methodology described in Turnbull (2000) will be positive. This methodology is consistent with objective of maximizing the wealth of existing shareholders. Cash flows with different risk profiles are discounted at different rates. The methodology is not myopic, unlike the usual application of RAROC. The methodology considers the present value of all the cash flows over the life of the business. It takes into account the time profile of economic capital and the costs associated with economic capital. The adjusted net present value (NPV) of each business informs management whether a business adds value to the bank, given its usage of economic capital. It directly answers the question of whether a business is enhancing the wealth of existing shareholders.

4. Performance Measurement

We want to determine whether a particular business has generated a realized return that more than compensates for the level of assumed risk. There are two issues that must be addressed. First, the business is part of the bank and this may affect the business's operations, its ability to access markets and the cost of funding operations. All of these factors may affect the cash flows of the business and the return on the 'equity' of the business. We can extract from the effects of funding costs by considering the return on assets of the business. To extract from other possible franchise effects is not easy. The second issue is the allocation of the portfolio effect. The full allocation of the portfolio effect implies that the economic capital of any business depends on the performance of other businesses within the bank. For example, if the activities of a particular business increases the economic capital of the bank, this will affect the allocation of economic capital and the return on equity to all businesses. To avoid any arbitrary allocation of the portfolio effect, the stand-alone economic capital can be used for each business.

We consider the stand-alone economic capital for the business, but we use the cash flows of the business without making any estimation of the possible franchise effects on these cash flows, implying an inconsistency. We are seeking to measure the performance of the business abstracting from any portfolio effects arising from the attribution of economic capital and, consequently, use the stand-alone economic capital. However, we are unable to extract from any possible franchise effects.

Among practitioners, there is much confusion about the role of capital. Is the primary role of economic capital for the protection of the solvency of the bank, as stressed in the recent BIS (2001) report? Or, is the primary role of economic capital for performance measurement? This confusion has arisen

because of the failure to understand the basic and inherent limitations of the RAROC methodology. The differences in the two views can be substantial.

Consider a merchant banking business. The bank made an investment, its only investment, of 10 million last year. One year later the investment is worth 100 million.⁵ In determining the current amount of economic capital, should the initial investment of 10 million be used as the reference point or the 100 million? From a solvency view, the initial investment is the relevant benchmark, while if the asset is marked-to-market and re-financed with debt, the current market value of 100 million is used as the basis. Traditional RAROC type of performance measures will give dramatically different results, depending on whether economic capital is determined on a solvency basis or on a mark-to-market basis.⁶

4.1. The Rate of Return

We define two rates of return. The first rate of return ignores economic capital so as to avoid any distortion caused by the attribution of capital and assumptions about the cost of funding the investment. The present value of the cash flows generated by the assets of the business is denoted by the symbol $PV_A(0)$. Let I_A denote the cost of the investment in the assets of the business. The net present value of the investment is

$$(12) \quad NPV(0) = PV_A(0) - I_A$$

The end of the performance horizon is denoted by $t = T_H$. Over this period, the business generates net cumulative cash flows denoted by the symbol $C(0)$.⁷

Rate of Return on Assets

The first rate of return is defined by

$$(13) \quad R_A(t) = \frac{C(0) + PV_A(T_H)}{PV_A(0)}$$

where $PV_A(T_H)$ denotes the present value of the cash flows generated by the assets of the business at the end of the horizon excluding any reference to economic capital.⁸ This definition is in keeping with the balance sheet shown in Figure 1.

⁵ Suppose the investment was made in a technology stock prior to the technology bubble. The value of 100 million reflects the value prior to the burst of the bubble.

⁶ Some people have suggested using a convex combination of the two measures.

⁷ Intermediate cash flows generated over the period up to the horizon are assumed to be reinvested at the risk free rate of interest.

⁸ This should include the NPV of any new investments made at $t = T_H$.

Rate of Return on Equity

The second rate of return is a measure of the rate of return on the ‘equity’ of the business. It considers the cash flows to the ‘equity’ of business and so it is *net* of the cost of funding of the investment. This necessitates some assumption about the level of debt financing. We could, in theory, assume a balance sheet for the business of the form described by Figure 1. The difficulty with this approach is that of determining the amount of debt financing. A common assumption is to assume a balance sheet of the form described by Figure 2, where the risky assets of the business are funded via debt financing provided by the bank to the business. The business is charged an interest rate that may reflect the average duration of the business. This interest rate depends on the credit rating of the bank. The use of this rate is appropriate if economic capital for the business is defined so that the business has the same credit risk as the bank. The only implicit equity financing is for the investment in the economic capital. Any income generated by the economic capital is attributed to the business. Let the symbol I_E denote the equity investment in this business:

$$(14) \quad I_E = EC(0)$$

where $EC(0)$ is the amount of economic capital allocated to the business at time zero. Any business/project is assumed to have a term structure of economic capital $\{EC(t)\}$, where $EC(t)$ is the expected economic capital at time t .⁹

The present value of the cash flows to the ‘equity’ of the business is denoted by the symbol $PV_E(0)$, the present value of the cash flows generated by economic capital by $PV_{EC}(0)$, and the present value of the funding costs by $PV_F(0)$, where

$$PV_E(0) = PV_A(0) + PV_{EC}(0) - PV_F(0)$$

The adjusted net present value of the investment is

$$(15) \quad NPV(0) = PV_E(0) - I_E$$

The second rate of return is defined by

$$(16) \quad R_E(T_H) = \frac{C_E(0) + PV_E(T_H)}{PV_E(0)}$$

where $PV_E(T_H)$ denotes the present value of the cash flows to equity at the end of the horizon;¹⁰ and $C_E(0)$ denotes the net cumulative cash flows to equity over the horizon. This definition of the rate of return differs from the usual application of a RAROC type of return that usually only considers the cash

⁹ See Turnbull (2000) for details.

¹⁰ This should also include the adjusted NPV of any new investments made at $t = 1$.

flows over the horizon and hence is myopic in nature. Expression (16) considers the present value of future cash flows.

4.2. *The Relevant Bench-mark*

The rate of return in (13) is the rate of return on the assets of the business and the rate of return defined by (16) is the rate of return on the ‘equity’ of the business. For each rate of return, we want to establish a relevant bench-mark and compare the performance of the business against this bench-mark. The second rate of return measure is complicated by the presence of economic capital and the leverage generated by the debt financing. These factors affect not only the numerator and denominator of the rate of return, but also the risk characteristics.¹¹

We want to measure the performance of the business against a bench-mark rate of return on a reference asset that has the same risk. From the view point of shareholders, risk is defined in terms of risk that cannot be diversified away – systematic risk. Readily identifiable measures of systematic risk for many businesses are often difficult to measure. A second definition of risk that is common in the corporate world and underlies the foundations of RAROC, is that of total risk.¹² There are difficulties with such a measure; from a theoretical viewpoint, investors have the ability to diversify risk and corporations should only be rewarded for bearing non-diversifiable risk. Note that this argument does not depend on the validity of the capital asset pricing model.¹³

The capital asset pricing model provides theoretical guidance. It relates the systematic risk, as defined by the covariance between asset return and the return with the market portfolio, to the equilibrium expected rate of return. This relation is referred to as the security market line. In theory, one measures the systematic risk, or beta, and from the security market line determine the required rate of return. This provides the relevant bench-mark.

In practice, there are many difficulties. First, the empirical evidence for the capital asset pricing model is weak, though there is much evidence relating asset returns to market indices. The second difficulty is that of measuring non-diversifiable risk of a business, when the business has no traded equity. If there is a firm in the economy whose assets closely mirror those of a particular business, then market data for this firm can be used to estimate a required hurdle rate for the business, after adjusting for differences in leverage. If such a surrogate does not exist, then some proxy must be found. Perhaps the

¹¹ We can always express the rate of return on equity as a weighted sum of the rate of return on the risky asset, the economic capital and the debt financing.

¹² Total risk is defined as the sum of non-diversifiable risk plus idiosyncratic risk. The specific or idiosyncratic risk can be diversified.

¹³ For a discussion, see Ross (1976).

revenues from a business can be correlated to market observables and, from this, the systematic risk for the assets of the business estimated.¹⁴

Once we have an estimate of the non-diversifiable risk, then we relate this measure to the required rate of return. We can then compare the rate of return with the required rate of return to judge whether the business has provided a superior, adequate or inferior rate of return. Given the difficulties of estimating a reliable measure of non-diversifiable risk, an alternative approach is to classify the businesses within the bank as belonging to one of, say, three possible groups: low risk, average risk and high risk. We relate these measures to a reference index and, accordingly, scale. This is depicted in Figure 4. For each group, it is necessary to estimate the hurdle rate. We pick a reference index. Businesses that are classified as average risk are expected to earn the return on the index. Businesses that are classified as low (high) risk are expected to earn a lower (higher) return than the index. How much lower (higher) is a question that is often answered by professional judgement.

4.3. The Rate of Return on the Bank's Equity

The stated objective of senior management of most banks is to maximize the return to (existing) shareholders. The return on the bank's equity can be measured.¹⁵ For performance purposes, we want to proportion this return to the individual businesses. Stated in a different but equivalent way, we want to identify the winners and losers in the bank's portfolio of businesses. For each business, we have calculated a rate of return on the 'equity' of the business.

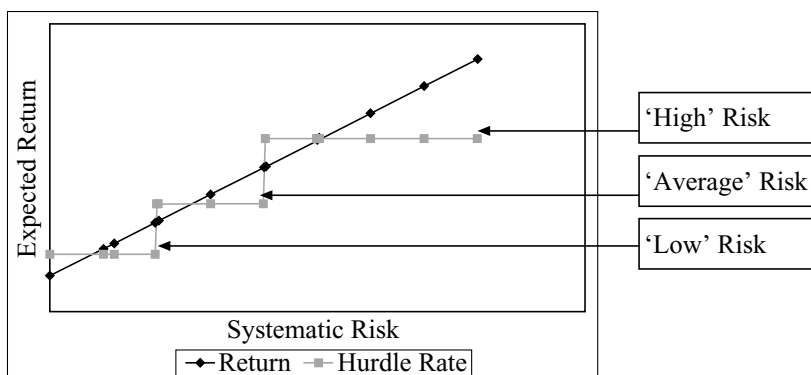


Figure 4: Approximating the Required Rate of Return with a Series of Hurdle Rates.

¹⁴ See Brealey and Myers (2000, chapter 9) for discussion.

¹⁵ Most banks report ROE numbers based on accounting numbers, without reference to market returns that shareholders experience.

The amount of equity allocated to a business depends on the economic capital. Unless the portfolio effect has been fully allocated, then the sum of the economic capital allocated to individual businesses will differ from the economic capital of the bank. Also, the amount of debt financing attributed to each business will differ from the total amount of debt financing by the bank. To avoid these problems, we consider the rate of return on the bank's assets.

Data from the equity market is used to calculate the bank's required rate of return on equity and, from this, the required rate of return on the bank's assets can be calculated.¹⁶ Let R_B^A denote the required rate of return on the bank's assets, and R_j^A denote the required rate of return on the assets of the j th business, $j = 1, \dots, n$. Let V_j^A denote the market value of the assets of the j th business, $j = 1, \dots, n$, and V_B^A denote the market value of the assets of the bank's assets, where

$$V_B^A \equiv \sum_{j=1}^n V_j^A$$

Let

$$w_j^A \equiv \frac{V_j^A}{V_B^A}$$

For consistency, we must have that the weighted average of the required rates of return on the assets of the individual businesses equals the required rate of return on the bank's assets:

$$(17) \quad R_B^A = \sum_{j=1}^n w_j^A R_j^A$$

Both the return R_j^A and the weight w_j^A provide management with useful information. A return R_j^A may be 'good' though have little effect on the overall return if the size of the business is small.

5. The Cost of Unused Capital

The bank determines its optimal mix of businesses so as to maximize the wealth of existing shareholders and the bank determines its capital structure in keeping with its desired level of creditworthiness. The bank's equity is identified as the bank's economic capital, implying that the expected return on equity is identical to the expected return on capital. Let $EC(t)$ denote the total amount of capital for the bank at time t . The balance sheet for the bank is

¹⁶ The required rate of return on the bank's assets is a weighted average of the required rates of return on the bank's debt and equity. In the absence of market data, an estimate must be made for the required rate of return on the bank's debt.

$$(18) \quad A(t) = D(t) + EC(t)$$

The expected dollar return to shareholders is

$$(19) \quad [1 + \bar{R}_B^E(t)]EC(t)$$

where the expected rate of return on equity is denoted by $\bar{R}_B^E(t)$.

The bank having determined its optimal mix of assets, has an expectation about the size of each business. Let the symbol $A_j(t)$ denote the expected size of the j th business. The bank allocates economic capital to its different businesses. Let $EC_j^A(t)$ denote the amount of economic capital allocated by the bank to business j , $j = 1, \dots, n$. Capital is assumed to be fully allocated to each business.

In this section, we examine the performance metric for businesses that utilize less than their allocated capital. We consider two different assumptions about the capital structure for each business. In the first case, the risky assets of the business are funded with debt and equity. The equity is the economic capital for the business. In the second case, the risky assets of the business are totally funded with debt. Equity is provided strictly for the purpose of supplying the required economic capital.

Case 1: Risky Assets Funded with Debt and Equity

The asset size of the j th business is $A_j(t)$. It is deemed that the business requires economic capital $EC_j^A(t)$. This infers a capital structure for each business described in Figure 1, where the allocated capital is the ‘equity’ of each business and the amount of debt financing is $D_j(t)$, where

$$(20) \quad A_j(t) = D_j(t) + EC_j^A(t)$$

The expected rate of return on the assets of business j , $\bar{R}_j^A(t)$, is a weighted average of the cost of debt, denoted by the symbol $\bar{R}_j^F(t)$ and the required rate of return on ‘equity’ of the business, $\bar{R}_j^E(t)$:

$$(21) \quad \bar{R}_j^A(t)A_j(t) = \bar{R}_j^F(t)D_j(t) + \bar{R}_j^E(t)EC_j^A(t)$$

The expected dollar return to the ‘equity’ of the j th business is

$$(22) \quad [1 + \bar{R}_j^E(t)]EC_j^A(t)$$

This becomes the bench-mark to judge the performance of the business, irrespective of the capital the business actually uses.

There are many obstacles to implementing this approach. First, is the determination of the level of debt financing, $D_j(t)$. It is not clear how we infer the appropriate level of debt for the particular business. Second, is the assumption that capital is fully allocated, which implies that individual businesses benefit from the portfolio effect. The method of allocation is

arbitrary, as it is not possible to identify the appropriate ownership of the benefits. Consequently, any measure of performance of an individual business is biased. This also means that maximizing the expected return on capital for each business is not necessarily consistent with maximizing the wealth of existing shareholders.

Third, is the performance metric if the business does not invest all of its capital in the risky assets of the business. Let $A_j^U(t)$ denote the actual investment in the risky assets and $D_j^U(t)$ denote the amount of debt financing. The unused economic capital is denoted by the symbol $EC_j^{Un}(t)$. The realized rate of return on the 'equity' of the business, $R_j^E(t)$ is

$$(23) \quad R_j^A(t)A_j^U(t) + r(t)EC_j^{Un}(t) = R_j^F(t)D_j^U(t) + R_j^E(t)EC_j^A(t)$$

where we assume that unused economic capital is invested in a short-term default free asset generating a return of $r(t)$. The difficulty with this approach is the determination of the amount of debt financing, $D_j^U(t)$. The bank allocates economic capital $EC_j^A(t)$ with the assumption that the business will undertake business so that its asset level is $A_j(t)$ and debt level $D_j(t)$. If this plan is not followed, then some assumption must be made about the financing of the assets and the amount of unused economic capital.

Case 2: Risky Assets Financed with Debt

An alternative approach, that addresses the issue of financing, is to assume that the risky assets of each business are totally financed by debt, $A_j(t) = D_j(t)$ and the economic capital is financed by equity. In this case, the 'balance sheet' is as described in Figure 2:

$$(24) \quad A_j(t) + EC_j^A(t) = D_j(t) + EC_j^A(t)$$

The economic capital $EC_j^A(t)$ is assumed to provide a buffer for the business to maintain a required degree of creditworthiness. The economic capital is assumed to generate an income $r(t)EC_j^A(t)$, irrespective of whether the business fully utilizes its allocated capital. This assumption will shortly be relaxed. The required or expected rate of return on equity is given by¹⁷

$$(25) \quad \bar{R}_j^A(t)A_j(t) + r(t)EC_j^A(t) = \bar{R}_j^F(t)D_j(t) + \bar{R}_j^E(t)EC_j^A(t)$$

Expression (25) provides a bench-mark rate of return to judge the performance of the business. If the business does not use all of its capital the realized rate of return on equity, $R_j^E(t)$, is

¹⁷ Note that, in (23), only the unused economic capital is invested in a default free asset to generate income. The risky assets are financed with debt and equity and the capital structure altered to maintain the required degree of creditworthiness. In (25), risky assets are totally financed via debt and the 'equity' provides the implicit financing for economic capital.

$$(26) \quad R_j^A(t)A_j^U(t) + r(t)EC_j^A(t) = R_j^F(t)D_j^U(t) + R_j^E(t)EC_j^A(t)$$

There are also many obstacles with this approach. First, the total level of implied debt financing of the individual businesses exceeds the level of debt for the bank. The aggregation of the inferred capital structures of the businesses does not match that of the bank. This follows directly from the assumption that the risky assets of each business are debt financed. The second complication is the allocation of the portfolio effects. To avoid the inherent arbitrariness of any allocation methodology and to achieve a more informative description of the performance of the individual business, the stand-alone economic capital, $EC_j^{SA}(t)$, $j = 1, \dots, n$, for each business can be used.

In (26), we assumed that the business received the income from the economic capital of $r(t)EC_j^A(t)$, irrespective of whether the business fully utilizes its allocated capital. We now relax this assumption. Suppose the assets of the business are less than those allocated $A_j^U(t) (< A_j(t))$. The stand-alone attributed capital $EC_j^U(t)$ is based on the utilized assets. The cash flow to equity is

$$(27) \quad R_j^A(t)A_j^U(t) + r(t)EC_j^U(t) - R_j^F(t)D_j^U(t)$$

Given (27), we need to determine the relevant bench-mark to judge the performance of the business.

Given the nature of the business, let $R_j^{BM}(t)$ denote the bench-mark rate of return for the risky assets of the business. In measuring the performance of the business, the assumed asset size is used, $A_j(t)$, along with the assumed level of debt, $D_j(t)$. The bench-mark rate of return on equity, $R_j^{BME}(t)$, is given by

$$(28) \quad R_j^{BM}(t)A_j(t) + r(t)EC_j^{SA}(t) = R_j^F(t)D_j(t) + R_j^{BME}(t)EC_j^{SA}(t)$$

where $D_j(t) = A_j(t)$ and the bench-mark cash flow to equity is

$$(29) \quad R_j^{BM}(t)A_j(t) + r(t)EC_j^{SA}(t) - R_j^F(t)D_j(t)$$

The business generates superior performance if, comparing (27) and (29),

$$(30) \quad R_j^A(t)A_j^U(t) + r(t)EC_j^U(t) - R_j^F(t)D_j^U(t) > R_j^{BM}(t)A_j(t) + r(t)EC_j^{SA}(t) - R_j^F(t)D_j(t)$$

If the business fully utilizes its allocated capital, so that $A_j^U(t) = A_j(t)$, implying that for economic capital $EC_j^U(t) = EC_j^{SA}(t)$, then the above expression simplifies to

$$(31) \quad R_j^A(t) > R_j^{BM}(t)$$

as $D_j^U(t) = D_j(t)$. This bench-mark is independent of assumptions about the level of debt financing.

The business may be penalized if it does not fully utilize its allocated capital.

In this case, for the business to have superior performance, we must have, rearranging (30),

$$R_j^A(t)A_j^U(t) - R_j^{BM}(t)A_j(t) > r(t)[EC_j^{SA}(t) - EC_j^U(t)] - R_j^F(t)[D_j(t) - D_j^U(t)] \quad (32)$$

This can be written in the form

$$(33) \quad R_j^A(t)A_j^U(t) - R_j^{BM}(t)A_j(t) > r(t)EC_j^{Un}(t) - R_j^F(t)D_j^{Un}(t)$$

where

$$EC_j^{Un}(t) = EC_j^{SA}(t) - EC_j^U(t)$$

denotes the unused economic capital, and

$$D_j^{Un}(t) = D_j(t) - D_j^U(t)$$

denotes the unused debt attributed to the business. If the return of the asset equals the bench-mark return, $R_j^A(t) = R_j^{BM}(t)$, then we have

$$(34) \quad R_j^A(t)A_j^{Un}(t) + r(t)EC_j^{Un}(t) < R_j^F(t)D_j^{Un}(t)$$

The above expression has an intuitive interpretation. The business performs well by saving money in not fully utilizing its allocated capital. The left side is the additional income that would be generated by removing the under-utilization and the right side is the additional cost of financing the increased usage. The costs are greater than the income.

6. Summary

This paper discusses some of the issues that arise in attempting to measure the performance of individual businesses within a bank. The paper discusses two return measures: return on assets within a business and the return on the 'equity' of an individual business and also discusses the appropriate benchmarks. The paper ends with a discussion of the cost of unused allocated capital and the appropriate performance metric.

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Appendix: Transfer Pricing

Let ROE_t denote the expected rate of return in period t on the economic capital in the business, EC denote the economic capital, and k_E^* the required rate of return on the equity of the business. The expected economic value added is

$$(A.1) \quad (ROE_t - k_E^*)EC$$

where $(ROE_t \times EC)$ is the expected cash flow to equity shareholders in period t , and $(k_E^* \times EC)$ denotes the required cash flow necessary to generate the required rate of return for the investment. If (A.1) is positive then the business adds value by generating a return in excess of that required.

It is assumed that the business lasts for m periods. The present value of the transfer payments described by (A.1) is given by

$$\begin{aligned}
 \text{PV} &= \sum_{t=1}^m \frac{(\text{ROE}_t - k_E^*)\text{EC}}{(1 + k_E^*)^t} \\
 \text{(A.2)} \quad &= \sum_{t=1}^m \frac{\text{ROE}_t \text{EC}}{(1 + k_E^*)^t} + \frac{\text{EC}}{(1 + k_E^*)^m} - \text{EC}
 \end{aligned}$$

where we use the identity

$$\text{(A.3)} \quad \text{EC} \equiv \sum_{t=1}^m \frac{k_E^* \text{EC}}{(1 + k_E^*)^t} + \frac{\text{EC}}{(1 + k_E^*)^m}$$

Let R_t denote the expected RAROC rate of return in period t , and k_B denotes the required rate of return on the Bank's equity capital. The expected transfer payment in period t is

$$\text{(A.4)} \quad (R_t - k_B)\text{EC}$$

The present value of the transfer payments is estimated by discounting the expected cash flows using the required rate of return on the bank's equity, k_B

$$\text{(A.5)} \quad \text{P}\hat{\text{V}} = \sum_{t=1}^m \frac{(R_t - k_B)\text{EC}}{(1 + k_B)^t}$$

Use of the bank's required rate of return on equity as the discount rate is justified on the grounds that the economic capital for the business is chosen such that the probability of default for the bank over some specified horizon is not altered by the business. Consequently, it is assumed that the RAROC rate of return has the same risk as the equity of the bank.

Assuming that the expected RAROC return correctly measures the expected return on the economic capital of the business, that is $R_t = \text{ROE}_t$, then (A.2) can be written in the form

$$\text{(A.6)} \quad \text{P}\hat{\text{V}} = \sum_{t=1}^m \frac{\text{ROE}_t \times \text{EC}}{(1 + k_B)^t} + \frac{\text{EC}}{(1 + k_B)^m} - \text{EC}$$

where we use the identity (A.4).

By comparing expressions (A.2) and (A.6), we observe that a RAROC-based transfer pricing methodology causes systematic bias. If $k_E^* > k_B$, the transfer payment methodology will over-compensate the business:

$$\text{(A.7)} \quad \text{P}\hat{\text{V}} > \text{PV}$$

If $k_E^* < k_B$, the transfer payment methodology will under-compensate the business:

$$\text{(A.8)} \quad \text{P}\hat{\text{V}} < \text{PV}$$

The transfer payment methodology is not EVA neutral. It over-compensates 'high' risk projects and under-compensates 'low' risk projects.

The discount rate, k_B , reflects the required rate of return on the bank's equity. It is a weighted average of the required rates of return on the different businesses within the bank. In general, the required rate of return on any particular business will differ from the average required rate of return: $k_B \neq k_E^*$ and, consequently, the commonly employed application of a RAROC-based transfer pricing methodology results in systematic bias. It will over-compensate 'high' risk businesses and under-compensate 'low' risk businesses.