

**RISK-ADJUSTED PERFORMANCE MEASURES AT BANK  
HOLDING COMPANIES WITH SECTION 20 SUBSIDIARIES**

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### **Abstract**

Risk-adjusted performance measures (RAPM) have been one of the catchphrases of financial services industry over the last decade or so. These measures allow financial managers to determine which lines of business are profitable by comparing their risk-adjusted return against an appropriate measure of cost of capital. As a result, these measures can be used as a guide for efficient asset allocation, performance evaluation, and capital structure decisions in complex, multidivisional financial institutions. Despite their promise, these measures are difficult to construct because of the lack of precise information on the profitability and risk of various business lines, particularly in nontraditional banking activities. This study derives and compares stand-alone measures of performance with the portfolio-based risk-adjusted measures using a unique detailed data set for a sample of domestic bank holding companies (BHCs) that combined traditional commercial banking with investment banking activities between 1990 and 1999. The evidence found here shows that stand-alone performance measures can lead to results substantially different from those of the portfolio models. This study also examines the composition of optimal BHC portfolios consisting of traditional and nontraditional banking units and shows that there are gains from diversification.

*Keywords:* Risk-adjusted return on capital (RAROC), Value at Risk (VaR), bank portfolio analysis

*JEL classification:* G21, G24, G28

## **RISK-ADJUSTED PERFORMANCE MEASURES AT BANK HOLDING COMPANIES WITH SECTION 20 SUBSIDIARIES**

### **1. Introduction**

One of bank management's main objectives is to maximize risk-adjusted profitability subject to the bank capital constraint. Owing to the recent passage of the Gramm-Leach-Bliley Act of 1999 (the Financial Services Modernization Act), banks today provide a variety of financial services beyond traditional commercial banking, such as insurance, securities underwriting, consumer finance, and mortgage banking, and they continue to move into other lines of nonbank. Therefore, the objective of profit maximization relies upon determining which lines of business generate the highest risk-adjusted returns so that more of bank resources can be allocated to such business units.

One way to accomplish this objective is to minimize the risk of each activity in which a bank participates and then aggregate these risks over the entire organization. Such an approach, referred to as a stand-alone approach, is problematic because it ignores the portfolio diversification effects within a company. Financial market practitioners and regulators have long emphasized the interdependent nature of risks within an organization as a motivation to develop portfolio (or consolidated) models of risk. These models allow bank management to identify concentrations of risk and opportunities for diversification on a company-wide basis. To measure the risk contribution of a unit to the entire organization, the models take into account the stand-alone volatility of a business line as well as the correlation between an individual business line and other units within the organization. Portfolio-based models provide a more reliable way to determine the amount of capital necessary to support various business lines and the overall leverage for the bank and closely link

capital charges to the organization's risk exposures, resulting in a more efficient allocation of capital (Cumming and Hirtle, 2001).

Despite the high level of interest in risk-adjusted capital allocation models, so far only the largest banks are known to have implemented them (Treacy and Carey, 1998). There are computational and information systems barriers to implementing these models. One of the biggest challenges arises from the need to assess measures of performance that are comparable across business units, especially when organizations are involved in a wide range of financial activities. This is especially difficult when some of bank products and services do not have own balance sheet and income statements either due to their limited marketability, or the lack of explicitly attributed direct equity support, or data confidentiality. The dearth of reliable data resulted in many previous studies that relied on an imperfect hypothetical merger methodology to estimate potential benefits of bank expansion into nonbank activities. Another challenge arises from the need to assess consolidated risk of a multidivisional financial services provider, because diversity often means that models must consider a variety of risk types to construct meaningful measures of risk-adjusted performance. Risk-adjusted performance measures (RAPM), and risk-adjusted return on capital (RAROC) in particular, were created to address these challenges by evaluating risk-adjusted return and allocated-risk capital at complex banking organizations. The concept is to identify a measure of return generated by a line of business and compare that return to the allocated capital.

The goal of this paper is to examine RAPM in banking, measures that are used as a guide for efficient asset allocation, performance evaluation, and capital structure decisions in complex, multidivisional financial institutions. In this paper, traditional (stand-alone) measures of performance are contrasted with the risk-

adjusted measures of performance for the sample of domestic bank holding companies (BHCs) that engaged in both commercial banking and investment banking activities from 1990 through 1999. Unlike previous studies that relied on the hypothetical-merger analysis to examine potential benefits of diversification arising from bank expansion into investment banking activities (Wall and Eisenbeis, 1984; Boyd and Graham, 1986; Boyd and Graham, 1988; Boyd, Graham, and Hewitt, 1993; Allen and Jagtiani, 1996; Saunders and Walter, 1996; Reichert and Wall, 2000), this study uses a fundamentally different approach based on a unique detailed micro data set for BHCs with securities affiliates (also known as Section 20 affiliates) operating in the U.S. from 1990 through 1999.<sup>1</sup> This approach allows us to capture potentially important synergies within established, integrated production processes that studies of unrelated firms cannot capture. To my knowledge, only two studies use such data: an unpublished study by Boyd and Pithyachariyakul (1981) and Kwan (1998). However, these studies conduct separate analyses of risk and return without deriving risk-adjusted performance measures (RAPM). Landskroner, Ruthenberg, and Zaken (2005) estimate RAPM using actual banking financial statements, but the study is conducted using a small number of universal banks in Israel. No similar studies were conducted for the U.S. market.

The present paper describes and estimates alternative forms of RAPM and discusses the appropriateness of each measure in assessing BHCs' performance. The main empirical finding of this paper is that traditional "stand-alone" performance measures lead to results substantially different from those of the portfolio models.

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<sup>1</sup> Section 20 subsidiaries are subsidiaries of bank holding companies that were authorized by the Federal Reserve to conduct bank-ineligible securities activities. Historically, Section 20 of the Glass-Steagall Act of 1933 expressly prohibited banks from any affiliations with organizations engaged in the underwriting, sale, or distribution of stocks, bonds, debentures, notes, or other securities.

When the true correlation between a prospective investment and an existing portfolio is nonzero, the traditional performance measures may lead to incorrect management assessment of prospective or past investment decisions.

This study also examines BHCs' optimal portfolios, consisting of commercial banking and investment banking components derived from the efficient frontiers. Similar to Landskroner, Ruthenberg, and Zaken (2005), I find evidence of gains from diversification as indicated by the composition of optimal portfolios. The evidence presented in this paper has important implications for bank regulators. Reliable measures of performance and diversification gains help regulators to evaluate the appropriateness of allowing banks to engage in nontraditional bank activities and may prove to be quite important in answering the question of why banking organizations were so eager to move into these activities.

The remainder of the paper is organized as follows. Section 2 describes the types of risk-adjusted performance measures used in portfolio models of credit risk and discusses the relationship between them. Section 3 describes the sample of BHCs involved in securities underwriting activities between 1990 and 1999. Section 4 follows with an empirical implementation of RAPM for the sample of domestic BHCs and discusses main findings. Section 5 compares predictions of the risk-adjusted models with optimal allocations based on the efficient-frontier methodology and actual BHCs' portfolios, and Section 6 concludes.

## **2. Risk-Adjusted Performance Measures**

Risk-adjusted performance measures, or RAPM, have been one of the catchphrases of the banking industry over the last decade or so. The term embraces a

number of concepts and has been given different definitions, but all RAPM techniques have one thing in common: they compare risk-adjusted return against an appropriate hurdle rate that reflects the bank's cost of capital or the opportunity cost to stockholders in holding equity in the bank.<sup>2</sup> Risk-adjusted return on capital (RAROC) is usually derived by dividing risk-adjusted income by the total amount of economic capital, where economic capital is measured on the basis of the potential loss of value over a given period of time at a certain confidence level, or the Value at Risk (VaR).<sup>3</sup> In terms of performance, we hypothesize that when banks allocate scarce resources, business units earning a return in excess of a risk-adjusted opportunity cost of equity are candidates to receive additional resources, while those earning less than the opportunity cost of equity are candidates for corrective action (Kimball, 1998). In other words, in a multidivisional setting, those business units that earn higher risk-adjusted return should be allocated higher levels of investment.

## **2.1. Risk-Adjusted Performance Measures in Banking**

There are several approaches to measure risk-adjusted performance: the stand-alone and the portfolio approaches. The description and relationship between risk-adjusted performance measures used for this study are summarized in Table 1.

We measure reward against various risk measures: standard deviation of returns in a

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<sup>2</sup> Landskroner et al. (2005) describes the four most commonly cited RAPM models: RORAA (return on risk-adjusted assets), RAROA (risk-adjusted return on assets), RORAC (return on risk-adjusted capital), and RAROC (risk-adjusted return on capital). The differences between the last two measures are often blurred; both are aggregated under the acronym RAROC, which I use in this study.

<sup>3</sup> Some models define the hurdle rate as ROE, while others define it as the risk-free rate or as some measure of the weighted-average cost of capital (Saunders and Allen, 2002). By incorporating the opportunity cost into the managers' decision-making and using economic rather than accounting profits, banks hope to align managerial behavior more closely with shareholders' interests.

stand-alone approach and systematic risk in a portfolio approach. We also include Jensen's alpha, which measures the performance of the business unit relative to expectations derived according to the CAPM.

Under the stand-alone methodology, the risk of each activity in which a bank participates is expressed in terms of the volatility of its returns without accounting for correlation between banks' activities. The theoretical risk-adjusted return is derived from the one-factor capital asset pricing model (CAPM), which assumes that all assets are tradable and the opportunity cost of holding capital in the bank is the return on the market portfolio (James, 1996; Crouhy, Turnbull, and Wakeman, 1998).<sup>4</sup> Following Matten (2000), Landskroner, Ruthenberg, and Zaken (2005), and Bodie, Kane, and Marcus (2005), the stand-alone risk-adjusted return on each activity  $i$  is based on total economic capital or Value at Risk (VaR),  $\sigma_i$ . This measure is the simple Sharpe ratio or the reward to variability ratio (RVAR), which can be expressed as:

**Equation 1**

$$RVAR_i = \frac{NI_i - NI_{f_i}}{\sigma_i},$$

where

$$NI_i - NI_{f_i} = \frac{1}{T} \sum_t^T (NI_{it} - R_f E_{it})$$

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<sup>4</sup> From the one-factor CAPM, the theoretical RAROC is equal to the excess return on the market per unit of market risk (the market price of risk) and is equal to the hurdle rate,

$$\frac{R_i - R_f}{\rho_{im} \sigma_i} = \frac{R_m - R_f}{\sigma_m},$$

where  $R_m$ ,  $R_i$ , and  $R_f$  are the market return, return on a risky asset  $i$ , and the risk-free rate of return, respectively;  $\sigma_m$  = the standard deviation of the market return;  $\sigma_{im}$  = covariance between the returns on asset  $i$  and the market portfolio  $m$ ;  $\rho_{im}$  = correlation between the

where  $NI_i$  and  $\sigma_i$  are the average earnings and the standard deviation of earnings from the activity  $i$ , respectively;<sup>5</sup>  $E_{it}$  is the average equity investment in activity  $i$ , measured as the total equity capital from the call reports, consolidated BHC reports, and Section 20 subsidiaries' reports;  $R_f$  is the risk-free rate of return on U.S. Treasury bills;  $NI_{f_i}$  is average earnings in the risk-free activity derived from activity  $i$ , defined as  $R_f * E_{it}$ , and can be thought of as an opportunity cost of capital invested in  $i$ .

CAPM assumes that all tradable risks are diversified away. Applied to banks, this would mean that a bank can frictionlessly hedge *all* risk in the capital market and thus should have no reason for risk management. However, this may not be the case because bank divisions do not usually have market-determined valuations.<sup>6</sup> Therefore, to apply traditional finance measures of risk-adjusted performance to banking organizations and their business components, we need to treat a BHC, rather than the market portfolio, as a benchmark portfolio.

Another problem with using the stand-alone measurements is that they do not take into consideration the effects of diversification that arise in situations when the returns on the individual business activities are less than perfectly correlated. Such activities will tend to dampen the fluctuations in returns for the bank as a whole, so that the total risk of the bank will be less than the sum of the risks of the individual

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returns on  $i$  and the market portfolio;  $\beta_i$  is the market risk of the risky asset  $i$  (Saunders and Allen, 2002).

<sup>5</sup> It is common in the banking literature to use earnings instead of rates of return to evaluate RAROC (Landskroner, et al., 2005). Income comprises net interest income (the difference between interest income and interest expense), noninterest income, realized gains (losses) on held-to-maturity and available-for-sale securities, minus provision for loan and lease losses, and minus noninterest expense.

<sup>6</sup> See James (1996) for the discussion of this model. Froot and Stein (1998) developed a framework for capital budgeting that is based on the objective of profit maximization but also incorporates risk management and the fact that some risks cannot be hedged away. They derived a two-factor CAPM, in which they decomposed total risk into a tradable (market) risk component,  $m$ , such as currency and interest rate risk, and a nontradable (illiquid) risk component,  $p$ .

stand-alone business components. In effect, the business units will tend to act as “partial natural hedges” for each other, reducing the need for equity capital (Kimball, 1998). To incorporate the effect of diversification, the portfolio-type measures are used. One such measure is the reward to volatility (RVOL) or the Treynor ratio and it is measured by the excess return evaluated against the portfolio’s internal systematic risk. Thus, the ratio considers an individual activity’s contribution to the overall BHC (portfolio) performance.

**Equation 2**

$$RVOL_i = \frac{NI_i - NI_f}{IVaR_i},$$

where

$$IVaR_i = \frac{\partial VaR_p}{\partial \sigma_i} * \sigma_i = \frac{\sigma_{i,p}}{\sigma_p} = \beta_{ip} \sigma_p$$

where *IVaR* is the incremental Value at Risk, defined as the marginal effect on *VaR* of adding a new instrument or business unit to an existing portfolio.<sup>7</sup>  $IVaR_i = \beta_{ip} VaR_p$ , where the coefficient  $\beta_{ip}$  is the systematic risk of asset *i* in the portfolio *p*. Given that some assets of BHCs or business units are nontradable, the relative risk contribution of each line of business is calculated as an internal beta, defined as the ratio of the covariance between the business unit’s and BHC’s returns to the variance of the BHC’s returns.

Finally, the last portfolio-type risk measure used in this study is an application of the Jensen’s alpha ( $\alpha_i$ ) or economic value added, EVA. This measure

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<sup>7</sup>  $VaR = \alpha \sigma_p$ , where  $\alpha$  is a factor defined by the probability with which the actual loss may not exceed the VaR and  $\sigma_p$  is the standard deviation of earnings on the institution’s portfolio over a specified period. *IVaR* for each business division can be written as a semi-elasticity

indicates how earnings of activity  $i$  compare to those of the overall BHC portfolio (the “benchmark”) based on an “internal” CAPM.<sup>8</sup>

**Equation 3**

$$A_i = NI_i - [NI_{fi} + \beta_{ip} (NI_p - NI_{fi})]$$

and Jensen’s  $\alpha_i = \frac{A_i}{E_i}$ , where  $E_i$  is the average equity investment in the activity  $i$ ,

defined above;  $NI_p$  are the average earnings of the “benchmark” BHC portfolio calculated as the earnings of activity  $i$  assuming a rate of return equal to BHCs’ ROE,

$$\text{i.e., } NI_p = \frac{1}{T} \sum_t E_{it} * ROE_{BHC} \text{ and } \beta_{ip} = \frac{\sigma_{ip}}{\sigma_p^2}.$$

In its applications in banking, EVA is a performance measure of the amount by which adjusted earnings exceed or fall short of the opportunity cost of the capital involved. Thus, if  $\alpha_i$  is positive and significantly different from zero, then an activity should be undertaken because it has a superior risk-adjusted performance compared to that of the BHC’s portfolio. EVA is an increasingly popular performance metric because, as it has been argued by the proponents of this measure, it explicitly incorporates the opportunity cost of equity capital into performance measurement and managers’ incentive systems (Uyemura, Kantor, and Pettit, 1996).

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$\frac{\partial \alpha \sigma_p(\sigma_i, \sigma_j)}{\partial \sigma_i} * \sigma_i$  for business units  $i \neq j$ , which represents a change in VaR of the bank’s overall portfolio due to an additional instrument  $i$ .

<sup>8</sup> Expressed in terms of rates of returns,  $R_i - R_{fi} = \alpha_i + \beta_{ip} (R_p - R_f)$ , where  $R_i$  is the ROE on the activity  $i$ ;  $R_f$  is the risk-free rate of return; and  $\beta_{ip} = \frac{\sigma_{ip}}{\sigma_p^2}$ ;  $R_p$  is the return on equity for a BHC (“benchmark”) portfolio or a hurdle rate of return for RAROC <sub>$i$</sub> .

### 3. Sample Selection

This study estimates risk-adjusted performance measures for the sample of BHCs that were authorized by the Federal Reserve to conduct bank-ineligible securities activities (Section 20 activities) from 1990 through 1999. Proprietary accounting data for BHCs' subsidiaries consist of annualized financial statements for domestic BHC subsidiaries engaged in ineligible securities underwriting and dealing (FR Y-20 reports<sup>9</sup>) and annualized FDIC Call and Income Reports for commercial bank subsidiaries controlled by the same holding companies. The sample period is from 1990 – the first year FR Y-20 data were collected – through the end of 1999, when passage of the Gramm-Leach-Bliley Act allowed a qualified BHC to convert into a financial holding company and not file the FR Y-20 reports. As a result, BHCs that remained after 1999 were no longer representative of companies involved in securities activities.<sup>10</sup>

Balance-sheet data were averaged over the quarters in which Section 20 subsidiaries reported, to derive an annual figure for Section 20 firms and their consolidated top-tier parent companies. For example, if for any reason (such as later establishment date or an earlier exit) a Section 20 affiliate did not report for a full year, the averages for Section 20 *as well as* for their consolidated bank holding companies were adjusted to reflect this. Income information was matched to Section 20 data by the date reported on the Y-20. For each BHC, the Y-9C reports have a

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<sup>9</sup> Financial Statements for a Bank Holding Company Subsidiary Engaged in Bank-Ineligible Securities Underwriting and Dealing are filed with the Federal Reserve. This report is filed by all bank holding companies for each subsidiary that engages in bank-ineligible securities underwriting and dealing, and it is not available to the public. Confidentiality of individual reports is preserved by data aggregation.

<sup>10</sup> BHCs that converted to the FHC status continued to file the Consolidated Financial Statements reports (FR Y-9C), but were no longer responsible to provide detailed information on their separate Section 20 affiliates, thus limiting the type of analysis that can be performed on the data.

unique code that identifies a BHC over time and allows firm-level calculations. In cases of mergers and acquisitions, the acquiring BHC's code was maintained and the target was dropped from the sample.

#### 4. The Main Findings

Tables 2 through 4 calculate various risk-adjusted measures described above to compare the performance of the consolidated BHCs and their business components during the period between 1990 and 1999. The main interest of the analysis of performance is the rankings of BHC portfolios, how a specific activity performed relative to a BHC portfolio, as well as how a specific activity performed relative to other activities in which a BHC is involved.<sup>11</sup>

First, we compare the performance of BHCs, or total investment, during the sample period 1990-1999. The risk-adjusted RVAR rankings are different from ROE rankings (column 1 and column 2) in Table 2.<sup>12</sup> The performance of the overall BHC is affected by how heavily the company is involved in various activities and the performance of these business units. For example, a company that ranked first according to the traditional ROE measure invested more than 90 percent of its assets in commercial banking (compared to the average of 62 percent for the whole

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<sup>11</sup> It should be noted that the Treynor (RVOL) measure and the EVA measure are reported only on an activity basis because these measures are based on internal systematic risk, which cannot be compared across companies (Landskroner et al., 2005). Inter-company comparisons and rankings of the individual activities are performed using total risk (Sharpe) measure. The Sharpe measure (RVAR) and the Treynor measure (RVOL) for entire BHCs are identical because of the property that the sum of individual divisions' incremental Value at Risk, *IVaR*, equals the overall BHC's Value at Risk, or  $\sigma_p$ . Jensen's alpha, which uses an internal risk approach to measure earnings above the benchmark portfolio, is by definition equal to zero in the case of the entire BHC portfolio and, therefore, not reported in the table.

<sup>12</sup> The distribution-free Spearman rank correlation coefficient between nontraditional (column 1 in Table 2) and traditional (column 2) rankings for BHCs is 0.5. The correlation coefficient of zero is rejected at the 0.05 level, but not at the 0.01 level.

sample). This company's auspicious performance can be attributed to its relatively good performance in both banking and Section 20 activities. On the other hand, the company that ranked last according to the RVAR measure performed poorly compared to the average for all BHCs in both the commercial banking and securities underwriting activities. Five securities subsidiaries had negative RVAR measures, suggesting that these activities generated an average rate of return below the risk-free rate. A closer examination reveals that these companies were newer entrants in the securities underwriting business, which may explain their lackluster performance.

Because the majority of companies were heavily involved in traditional commercial banking activities, the RVAR rankings of BHCs and commercial banking – columns 5 and 3, respectively, in Table 2 – yield similar results. The Spearman rank correlation between these RVAR measures is 0.88. In contrast, the rank correlation between RVAR of BHCs (column 5) and RVAR of Section 20 activities (in column 4) is only 0.1, suggesting only a weak relationship between these measures. This occurs because the correlation between the earnings of the securities activities and BHCs is low. These results point importantly to the fact that the effects of diversification cannot be ignored and should receive careful attention in the risk-adjusted performance calculations.

Because the Treynor and the EVA performance measures are portfolio-type metrics based on the systematic risk, which both depend on the internal correlations, it is useful to examine the intrabank correlations among activities that determine the internal systematic risk. Specifically, the correlation between earnings of commercial banking units and earnings of the consolidated BHCs is high, approximately 0.7 for the group as a whole. In contrast, the correlation between securities activities and commercial banking is negative but not statistically different from zero. This result is

consistent with evidence of diversification benefits that arise when BHCs expand into nontraditional business lines (Saunders and Walter, 1994; Kwan, 1998; among others). By offering many products that are imperfectly correlated, banks may improve the risk-return frontier.

Table 3 and Table 4 compare the performance of the component activities of BHCs, taking into consideration systematic risk, where systematic risk is evaluated in reference to each portfolio. According to the system averages, performance of securities subsidiaries was superior to that of commercial banking subsidiaries, measured by the Treynor (RVOL) metric.<sup>13</sup> These findings contradict results based on the stand-alone Sharpe ratios that suggested that performance of commercial banking activities was superior to that of securities underwriting. This result shows a problem with using the stand-alone measures in management decision-making because such measures tend to ignore correlations between a prospective asset acquisition (an activity expansion) and an existing portfolio. The higher the correlation, the more activities expansion would add to overall portfolio risk and the higher the expected (required) return needed to make the expansion attractive. Note that the required return for expansions that reduce risk (activities that are less than perfectly correlated) is less than the existing expected portfolio returns. In the case where the correlation between activities is low or negative, the traditional performance measures overestimate the required return and may lead to *incorrect* decisions not to expand into new activities. Recognizing the omission of traditional ratios, portfolio-based performance metrics are increasingly becoming more popular among decision makers.

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<sup>13</sup> EVA measures for banking and securities activities were not statistically different from zero, suggesting that neither of these activities significantly outperformed the BHC portfolio.

## 5. Implications of the RAROC Performance Measures

This section compares predictions of the RAROC-based models with predictions of the optimal structure of BHC investments based on the efficient-frontier methodology. The mean-variance efficient frontier methodology is related to RAROC-based models in that when BHCs manage risk-return tradeoff subject to capital constraint, they solve for optimal capital allocation. The process involves estimating how much risk each business activity contributes to the total risk of the BHC, and thus to its overall capital requirement. Capital held by the BHC is then allocated across business activities. Such an integrated risk management approach forces each business line to internalize its own risk-taking behavior and should lead to more efficient bank capital allocation.

The optimal allocation of BHCs' activities is determined by the Markowitz portfolio selection model, in which each activity of BHC is treated as an individual security in a holding company "portfolio." The optimization problem can be written as:

### Equation 1

$$\underset{w}{Min} \sigma_{BHC}^2 = \mathbf{w}' \mathbf{\Omega} \mathbf{w}$$

subject to

### Equation 2

$$\mathbf{1}'\mathbf{w} = 1$$

$$\mathbf{w}'\boldsymbol{\mu} = \mu_{BHC}$$

### Equation 3

$$w \geq 0$$

where  $\boldsymbol{\mu}$  is a vector of returns;  $\boldsymbol{\Omega}$  is a covariance matrix; and  $\mathbf{w}$  is a vector of portfolio weights allocated to banking, securities, and other activities. When one of the assets is risk-free, the constraint becomes  $\mathbf{w}'\boldsymbol{\mu} + (\mathbf{1} - \mathbf{w}'\mathbf{1})R_f = \mu_{BHC}$ . Given the expected returns, variances, and covariances of assets in the portfolio, the efficient frontier can be derived by changing the target expected return on the portfolio. The objective is to maximize the slope of the tangent (capital allocation) line from the risk-free return to the efficient frontier.<sup>14</sup> I compare optimal asset allocations with the actual asset allocations in commercial banking, investment banking (Section 20 activities), and other activities to examine deviations from the optimal. The findings are discussed below.

Before we proceed, it is important to define “other” activities. In the context of this study, “other” is defined as the residual of BHC total assets and the sum of commercial banking and Section 20 activities. The category “other” may include insurance; data processing and information services; asset and capital management; business, sales, and consumer finance activities; mortgage banking, and so forth. Unfortunately, a further disaggregation of business lines across BHCs is constrained by data availability for BHCs during the sample period.

The optimization was performed in two parts: for long-term and short-term horizons. In the long-term problem, I assume that the bank is permitted unlimited changes in its portfolio mix. However, in the short-term, the possibilities for portfolio changes are limited. I specify 20 percent as the maximum change in the investments

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<sup>14</sup> I used Mathematica to solve for optimal portfolio allocations that satisfy the Kuhn-Tucker necessary conditions for portfolio weights, namely, the weighted average of securities’ returns has to equal the average BHC return and the sum of weights has to equal one. Also, I impose a no-short-sales constraint (for methodology, see Huang and Crooke, 1997). I used the the annualized monthly averages for the three-month Treasury bills for  $R_f$  over the 1990-1999 period (source: Haver).

mix because that is the actual average level of change that banks exhibited between 1990 and 1999. In both cases, optimization is performed subject to the no-short-sales constraint (the weight of each activity in the overall portfolio is greater than or equal to zero).

The results of calculations of optimal and actual portfolio allocations for the short-term and long-term horizons are presented in Table 5 and Table 6, respectively. Table 5 also reports actual changes in the portfolio composition between the two sub-periods: 1990 through 1994 and 1995 through 1999. The analysis is limited to BHCs that reported continuously during the entire period to ensure that there are enough time-series observations to perform long-term optimization. Observing continuously reporting entities over a longer period of time avoids the difficulties with examining institutions that were either unsuccessful in the securities business and exited earlier in the period or entered the business later and did not stay long enough to reap the benefits of product-line expansion. I also exclude BHCs with the proportion of “other” activities greater than 50 percent of consolidated BHCs’ assets to focus the analysis on BHCs with significant investment in traditional banking activities. The final data set is a balanced panel of 12 BHCs that participated in all three types of activities between 1990 and 1999 and that had more than half of their assets invested in traditional banking activities.

First, Table 5 shows that in the short run, with limited possibilities for changes in the portfolio mix, in order to maximize the ratio of excess return to the volatility of return, BHCs in this sample should slightly reduce their commercial banking activities, by 2.3 percentage points, and basically leave the securities activities at the current level. In the long run, however, as depicted by Table 6, BHCs should reduce their commercial banking activities from the average of 74 percent of

the total BHCs' assets to approximately 61 percent. At the same time, they should increase their investment in securities activities from 4.4 percent of total assets to 22.4 percent. Despite the fact that commercial banking was a major and, in general, profitable activity during the 1990s, the recommendation for a long-term horizon may be indicative of overinvestment in this business area. Similar results were reported by Landskroner, Ruthenberg, and Zaken (2005) for the sample of Israeli banks.

The discrepancy between short-term and long-term optimal allocations may exist because of the possible slow and costly adjustment in the banks' portfolio allocation. Researchers have documented costs that banks incur from excessive shrinking or expansion of their portfolios, particularly in loan markets. Sharpe (1990) uses an information asymmetry explanation to show that severing long-term customer relationships in lending markets is costly for banks.<sup>15</sup> On the other hand, an excessive growth of a (loan) portfolio may also be costly, since banks may be forced to lower their credit standards to accept more borrowers.

Second, as evident from the table, there are gains from diversification as manifested in the nonzero optimal allocation in all feasible activities. In the long run, an average BHC in the sample should allocate 61 percent of its portfolio to commercial banking activities, 22 percent to securities activities, and 17 percent to the remaining nonbank activities. In the short run in Table 5, such large fluctuations are difficult to achieve; therefore, the corresponding allocations are 71 percent, 4 percent, and 25 percent, respectively. Third, with only a few exceptions, the optimal direction of change for the long-term allocations to securities activities is consistent

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<sup>15</sup> According to that theory, a bank may incur initial losses as it lends to new firms. But in the process of lending, a bank becomes privy to information not available to others, which allows it to capture rents generated by older customers.

with that based on RAROC measures. Recall from Table 4 that the EVA performance measure, which adjusts for the correlation between activities, suggests that the performance of Section 20 subsidiaries was superior to that of traditional commercial banking activities. Thus, the direction of change in which companies should channel their investments is consistent with the results of risk-adjusted performance measures, i.e., banks will maximize their shareholders' returns by allocating more resources to better-performing business divisions.

Fourth, in the majority of cases, the actual change in BHCs' portfolios between the first and second halves of the 1990s was consistent with the changes needed to optimize BHCs' performance. Banks took advantage of diversification by investing in all activities. In terms of the actual changes in allocations, BHCs increased their portfolio allocation to commercial banking and securities activities during the 1990s. All but one company followed the long-run optimization path for securities activities. Four BHCs followed the optimization path and reduced allocation to commercial banking between 1990 and 1999. Of those, three BHCs experienced a significant increase in return on equity between the two sub-periods. In contrast, a company that ranked fifth among all BHCs followed the optimization path for the commercial banking activity, but not for the securities activities. That company was the only BHC to experience a decline in performance between the two sub-periods.

In sum, both the short-term and long-term optimization results indicate that BHCs in this sample should reduce their investment in commercial banking and increase their investment in securities underwriting activities. The discrepancy in the magnitude of change between short-term and long-term horizons probably arises owing to the costly adjustment in the banks' portfolio composition. The results are

also consistent with those derived using the risk-adjusted performance metrics, which suggest that companies should invest more heavily in activities that exhibit better performance.

## **6. Conclusions**

This study simultaneously addresses the issue of bank expansion into nontraditional lines of business and the advantages of using portfolio-based risk-adjusted performance measures (RAPM) in banking. The Financial Services Modernization Act of 1999 has formally allowed domestic bank holding companies to convert to financial holding companies status to take advantage of greater integration in financial services industry by offering an expanded choice of products to their customers. But even prior to 1999, some BHCs in this country have (on a limited basis) participated in nontraditional banking activities. This paper focuses on BHCs that offered securities underwriting services through their Section 20 affiliates during the period between 1990 and 1999 to examine whether these companies were able to enjoy diversification benefits. Furthermore, this study applies superior portfolio-based risk-adjusted performance measures, in particular risk-adjusted return on capital (RAROC), to examine how complex, multidivisional banking institutions should evaluate the performance of their diverse business lines. It has been argued by many researchers that using RAPM in banking leads to more efficient asset allocation and capital charges that more accurately reflect banks' true risk exposures.

Empirical evidence on risk-adjusted performance presented in this paper indicates that these measures: 1) are different from the traditional stand-alone performance metrics, especially when the correlations between banks' various

activities are nonzero; 2) they are consistent with optimal allocation of capital derived from the optimal portfolio theory, particularly in business units in which economies are not exhausted; and 3) the derived composition of the optimal portfolios shows that BHCs can take advantage of potential gains from diversification by allocating their resources to nontraditional banking activities, such as securities underwriting. In view of recent bank deregulation and the resultant expansion of banking organizations into nonbank activities, growing consolidation in the financial services industry, and the current review of bank capital requirements, the results of this study are of particular relevance to bank management and regulators.

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**Table 1 Relationship Between RVAR, RVOL, and EVA Measures**

Performance Measure	Definition	Relationship to Jensen's Alpha	Relationship to Sharpe Ratio in a Well-Diversified Portfolio $\beta_i = \frac{\sigma_i}{\sigma_m}$
Jensen's Alpha (EVA)	$\alpha_i = R_i - [R_f + \beta_m (R_m - R_f)]$		$(SR_i - SR_m)\sigma_i$
Sharpe Ratio (RVAR or reward to variability ratio)	$SR_i = \frac{R_i - R_f}{\sigma_i} = \frac{(R_i - R_f) - \beta_m (R_m - R_f)}{\sigma_i} + \frac{\rho_{im}}{\sigma_m} (R_m - R_f)$	$\frac{\alpha_i}{\sigma_i} + \rho_{im} SR_m$	
Treynor Ratio (RVOL or reward to volatility ratio)	$TR_i = \frac{R_i - R_f}{\beta_i} = \frac{(R_i - R_f) - \beta_m (R_m - R_f)}{\beta_i} + \frac{(R_m - R_f)}{\beta_m}$	$\frac{\alpha_i}{\beta_i} + TR_m$	$SR_i \sigma_m$

This table describes the relationship between active performance measures for banks: the standard Sharpe ratio, SR (RVAR=reward to variability), Treynor ratio, TR (RVOL=reward to volatility), and Jensen's measure,  $\alpha$  (EVA=Economic Value Added).  $R_i$  and  $\sigma_i$  are the average rate of return and the standard deviation of return on the activity  $i$ , respectively;  $R_m$  is the return on the reference market portfolio (the reference portfolio has the standard deviation of  $\sigma_m$ );  $R_f$  is the risk-free rate of return (such as the Treasury bill rate);  $\rho_{im}$  is the correlation coefficient between portfolio  $i$  and the market.  $\beta_i = \frac{\sigma_{im}}{\sigma_m} = \frac{\rho_{im}\sigma_i}{\sigma_m}$  is the internal beta. The

decision rule: superior performance requires a positive  $\alpha_i$  in all three measures. The ratio of  $\alpha_i$  to  $\sigma_i$  shows how much a portfolio outperforms the benchmark market portfolio. The ratio of  $\alpha_i$  to  $\beta_i$  for portfolio  $i$  gives an improvement in the Treynor's measure relative to the passive market portfolio.

Source: a variant of this table appears in Bodie, Kane, and Marcus (2005).

**Table 2 Reward to Variability (RVAR) Measure for BHCs with Section 20 Subsidiaries, 1990-1999**

RVAR (Sharpe Ratio) Rank	ROE Rank	RVAR (Sharpe Ratio) Banking	RVAR (Sharpe Ratio) Section 20	RVAR (Sharpe Ratio) BHC
(1)	(2)	(3)	(4)	(5)
1	2	5.315	0.302	5.485
2	7	2.289	0.305	4.188
3	1	2.383	1.708	3.432
4	15	2.591	1.086	3.319
5	10	1.950	0.170	2.870
6	4	3.454	-0.430	2.799
7	16	2.438	-0.118	2.215
8	6	1.455	0.935	1.984
9	5	1.270	0.522	1.651
10	14	2.184	-1.176	1.614
11	8	1.235	0.715	1.501
12	12	0.813	0.949	1.213
13	9	0.591	0.067	0.999
14	20	1.898	-1.146	0.966
15	13	1.053	0.462	0.966
16	19	0.633	0.417	0.912
17	3	0.720	0.829	0.867
18	18	0.165	0.279	0.860
19	17	0.789	0.577	0.785
20	11	0.487	-0.006	0.748
<b>Average</b>		<b>1.68</b>	<b>0.32</b>	<b>1.97</b>

The first two columns present rankings based on RVAR and the traditional ROE measures.

$$RVAR_i = \frac{NI_i - NI_{f_i}}{\sigma_i}$$

where  $NI_i$  is the average earnings from activity  $i$ ;  $\sigma_i$  = standard deviation of earnings in  $i$ ;  $NI_{f_i}$  is average earnings in the risk-free activity attributed to activity  $i$  and is equal to  $R_f * E_{it}$ , where  $R_f$  is the risk-free return on a Treasury bill and  $E_{it}$  the average equity investment in activity  $i$ . The rank correlation between column 1 and column 2 is 0.5 and equals zero at the 1% significance level. The rank correlation between column 3 (RVAR of banking units) and column 5 (RVAR of BHCs) is 0.9 and significant, while the correlation between column 4 (RVAR of Section 20) and column 5 (RVAR of BHCs) is 0.1 and insignificant. Several outliers were deleted from the sample because of either large deviation from the mean or a small number of observations.

**Table 3 Reward to Volatility (RVOL) Measure for BHCs with Section 20 Subsidiaries, 1990-1999**

RVAR (Sharpe Ratio) Rank (1)	ROE Rank (2)	RVOL (Treyner Ratio) Banking (3)	RVOL (Treyner Ratio) Section 20 (4)
1	2	-15.958	0.303
2	7	2.982	0.386
3	1	2.522	2.855
4	15	3.236	1.279
5	10	2.347	0.430
6	4	3.530	1.066
7	16	2.438	-0.148
8	6	1.548	1.297
9	5	1.347	0.683
10	14	2.507	1.783
11	8	1.299	1.077
12	12	0.839	1.373
13	9	0.618	0.106
14	20	1.995	50.628
15	13	1.340	0.579
16	19	0.643	1.930
17	3	2.275	1.233
18	18	0.220	0.683
19	17	0.792	0.882
20	11	0.497	-0.019
<b>Average</b>		<b>0.851</b>	<b>0.936*</b>

The first two columns present rankings based on the reward to variability (RVAR) and the traditional ROE measures.

$$RVOL_i = \frac{NI_i - NI_{fi}}{IVaR_i} = \frac{NI_i - NI_{fi}}{(\sigma_{ip} / \sigma_p)}$$

where  $NI_i$  is the average earnings from activity  $i$ ;  $\sigma_i$ =standard deviation of earnings in  $i$ ;  $NI_{fi}$  is average earnings in the risk-free activity attributed to activity  $i$  and is equal to  $R_f * E_{it}$ , where  $R_f$  is the risk-free return on a Treasury bill and  $E_{it}$  the average equity investment in activity  $i$ . Several outliers were deleted from the sample because of either large deviation from the mean or a small number of observations.

**Table 4 Economic Value Added (EVA) Measure for BHCs with Section 20 Subsidiaries, 1990-1999**

RVAR (Sharpe Ratio) Rank	ROE Rank	EVA (Jensen's Alpha) Banking	EVA (Jensen's Alpha) Section 20
(1)	(2)	(3)	(4)
1	2	0.158	0.016
2	7	-0.027	0.022
3	1	-0.054	0.159
4	15	0.030	0.122
5	10	0.004	0.021
6	4	0.110	-0.081
7	16	0.051	-0.002
8	6	-0.003	0.224
9	5	0.110	0.149
10	14	0.034	-0.081
11	8	0.002	0.074
12	12	-0.005	0.149
13	9	-0.019	0.003
14	20	0.105	-0.059
15	13	0.059	0.201
16	19	-0.007	0.050
17	3	0.055	0.076
18	18	-0.004	0.076
19	17	0.024	0.077
20	11	0.018	-0.002
<b>Average</b>		<b>0.032</b>	<b>0.06</b>

The first two columns present rankings based on the reward to variability (RVAR) and the traditional ROE measures.

$$EVA_i \equiv A_i = NI_i - [NI_{fi} + \beta_{ip}(NI_p - NI_{fi})]$$

where  $NI_i$  is the average earnings from activity  $i$ ;  $NI_{fi}$  is average earnings in the risk-free activity attributed to activity  $i$  and is equal to  $R_f * E_{it}$ , where  $R_f$  is the risk-free return on a Treasury bill and  $E_{it}$  the average equity investment in activity  $i$ ;  $NI_p$  is the average earnings of the BHC (benchmark) portfolio.  $\beta_{ip}$  is the systematic risk of asset  $i$  in the portfolio  $p$  and

equals to  $\frac{\sigma_{ip}}{\sigma_p^2}$ . Superior performance over the benchmark requires a positive value of

Jensen's alpha. Several outliers were deleted from the sample because of either large deviation from the mean or a small number of observations.

**Table 5 Optimal and Existing Composition of the BHC Portfolios, Short Term**

Rank (from previous tables)	Optimal Investment			Actual Investment			Change in Portfolio Composition that Optimizes Sharpe Ratio		Actual Change Between 1990-1994 and 1995-1999	
	CB	Sec 20	Other	CB	Sec 20	Other	CB	Sec 20	CB	Sec 20
4	70.0	2.3	27.7	74.9	2.0	23.1	-4.9	0.3	5.2	2.1
5	59.0	20	20.0	75.0	25.0	0.0	-16.0	-5.0	-4.5	4.0
8	83.9	0.1	16.0	79.0	0.1	20.0	4.9	0.0	15.6	0.0
11	74.3	1.0	24.7	78.6	0.8	20.6	-4.3	0.2	31.0	0.6
12	78.8	0.2	21.0	82.0	0.2	17.8	-3.2	0.0	41.0	0.0
13	81.5	6.5	12.0	84.5	5.0	10.0	-3.0	1.5	29.0	4.0
15	56.2	1.8	42.0	62.9	1.5	35.0	-6.7	0.3	-6.0	2.1
16	76.8	3.8	19.4	80.0	3.0	16.0	-3.2	0.8	8.0	0.5
17	65.8	0.9	33.3	71.8	0.8	27.0	-5.9	0.1	-28.0	0.1
18	68.3	1.6	30.0	60.0	1.0	39.0	8.3	0.6	-25.0	0.6
19	74.7	8.5	16.8	71.9	7.1	21.0	2.8	1.4	5.0	-0.7
20	67.0	0.0	33.0	64.1	6.7	29.2	2.9	-6.7	32.0	4.1
<b>Average</b>	<b>71.4</b>	<b>3.9</b>	<b>24.7</b>	<b>73.7</b>	<b>4.4</b>	<b>22.4</b>	<b>-2.3</b>	<b>-0.5</b>	<b>8.6</b>	<b>1.4</b>

This table compares the estimated optimal and actual portfolio composition of BHCs that operated commercial banking units (CB) and Section 20 affiliates (Sec 20) from 1990 through 1999 and reports changes in the portfolio mix needed to achieve the optimal allocation for the short-term horizon. The optimal allocation of BHCs' activities is determined by deriving efficient frontiers and solving for optimal portfolios for each BHC separately and for the group as a whole. In the short run, the possibilities of change in banks' positions are limited to 20% from the original portfolio composition. The table also reports actual changes in the portfolio composition between the two sub-periods: 1990-1994 and 1995-1999. The rankings are based on the Sharpe ratio (RVAR=the reward to variability). Calculations were performed for BHCs that reported continuously during the sample period and whose "other" activities (those activities besides commercial banking and investment banking) constituted less than 50% of consolidated BHCs' assets (a total of 12 BHCs).

**Table 6 Optimal and Existing Composition of the BHC Portfolios, Long Term**

Rank (from previous tables)	Optimal Investment			Actual Investment			Change in Portfolio Composition that Optimizes Sharpe Ratio	
	CB	Sec 20	Other	CB	Sec 20	Other	CB	Sec 20
4	65.3	15.4	19.3	74.9	2.0	23.1	-9.6	13.4
5	67.6	0.0	32.4	75.0	25.0	0.0	-7.4	-25.0
8	92.3	0.0	7.8	79.0	0.1	20.0	13.3	-0.1
11	64.8	32.6	2.6	78.6	0.8	20.6	-31.0	31.8
12	33.2	44.0	22.8	82.0	0.2	17.8	-48.8	43.9
13	52.5	47.9	0.0	84.5	5.0	10.0	-32.4	42.9
15	38.1	36.0	25.9	62.9	1.5	35.0	-24.8	34.5
16	56.9	21.4	21.6	80.0	3.0	16.0	-23.1	18.4
17	48.3	46.9	4.8	71.8	0.8	27.0	-23.5	46.1
18	60.0	9.7	30.4	60.0	1.0	39.0	0.0	8.7
19	80.8	15.1	4.1	71.9	7.1	21.0	8.9	8.0
20	64	0.0	36.0	64.1	6.7	29.2	0.0	-6.7
<b>Average</b>	<b>60.9</b>	<b>22.4</b>	<b>16.7</b>	<b>73.7</b>	<b>4.4</b>	<b>22.4</b>	<b>-12.8</b>	<b>18.0</b>

This table compares the estimated optimal and actual portfolio composition of BHCs that operated commercial banking units (CB) and Section 20 affiliates (Sec 20) from 1990 through 1999 and reports changes in the portfolio mix needed to achieve the optimal levels in the long run. In the long run, unlimited changes in the composition of a bank portfolio are allowed. The discrepancy between short-term (in Table 5) and long-term optimal allocations may exist because of the possible slow and costly adjustment in the banks' portfolio allocation (see text).