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RAROC AS A CREDIT RISK APPROACH[1]

Abstract: Credit risk is one of the most common risks in the world, known for many centuries, but the RAROC model is quite innovative. RAROC (Risk Adjusted Return On Capital) is an answer for shareholders' need for improved performance, especially the maximization of shareholder value. The main point of this article is to show the advantages as well as the limitations of the RAROC approach on the market, with the warning that financial intermediaries cannot rely only on models and could not be sure that even the most sophisticated methods provide them with complete certainty.

Keywords: credit risk, RAROC approach, GARP, risk management.

1. Introduction

Risk is the fundamental element that influences financial behavior. Without it, the financial system would be simplified. In that kind of world, only a few institutions and financial instruments would be needed, and the practice of finance would require relatively elementary analytical tools. Nevertheless, in the real world risk is ubiquitous [Crouchy, Galai, Mark 2001, p. foreword].

This article is concentrated on one type of risk – credit risk – and an approach that helps assess it – the RAROC approach. The financial services industry continues to undergo dramatic changes. Not only have the boundaries between traditional industry sectors such as commercial banking and investment banking being broken down, but competition is becoming increasing global in nature, so that the risk is more and more difficult to describe, to say nothing about measuring and managing. It is needed to think nowadays about financial institutions like risk-management businesses [Saunders, Cornett 2008, p. preface].

2. Credit Risk

Credit risk is the risk that promised cash flows from loans and securities held by financial intermediaries may not be paid in full by the contracting party [Jajuga et al. 2007, p. 203]. In general, financial intermediaries that make loans or buy bonds with

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long maturities are more exposed than financial intermediaries that make loans or buy bonds with short maturities. If the principal on all financial claims held by financial intermediaries was paid in full on maturity and interest payments were made on promised dates, financial intermediaries would always receive back the original principal lent plus an interest return. In that way the lenders would face no credit risk. If a borrower defaults, both the principal loaned and the interest payments expected to be received are at risk. Many financial claims issued by corporations and held by financial intermediaries promise a limited or fixed upside return (principal and interest payments to the lender) with a high probability and large downside risk (loss of loan principal and promised interest) with a much smaller probability. Financial intermediaries earn the maximum return when all bonds and loans pay off interests and principal in full. In reality some loans or bonds default on interest payments, principal payments, or both. The effect of risk diversification is to truncate or limit the probabilities of the bad outcomes in the portfolio of loans. In effect, diversification reduces individual firm-specific credit risk such as the risk specific to holding the bonds or the loans of Enron, while leaving the financial intermediaries still exposed to systematic credit risk, the risk of default associated with general economy wide or macro conditions affecting all borrowers [Saunders, Cornett 2008, pp. 173-175]. Measuring credit risk is becoming more and more important for financial intermediaries, mostly because there is an increasing number of bankruptcies, more competition among banks considering margins on loans, the declining value of real estate in many developed markets (e.g. the subprime crisis in the USA)and the growth of off-balance sheet instruments with inherent risk exposure [McKinsey 1993].

To answer the question why credit risk is such an important issue in banking, a simplified example was constructed. Assume a major building company is asking its house bank for a loan of seven billion euro. In the bank's credit department a senior analyst has the difficult job to decide if the loan will be given to the customer or if the credit request will be rejected. Further assume that the analyst knows that the bank's chief credit officer has known the chief executive officer of the building company for many years, and to make things even worse, the credit analyst knows from recent default studies that the building industry is under heavy pressure and that the bank's internal rating of this particular building company is going down. The analyst should reject the deal based on the information she or he has about the company and the current market situation. An alternative would be to grant the loan to the customer but to insure the loss potentially arising from the engagement by means of some credit risk management instrument (e.g. a so-called credit derivative). As a result, in the banks ought to be implemented clear instructions on how to grant loans and what models have to be used [Bluhm, Overbeck, Wagner 2003, pp. 10-11].

Credit considerations might be thought of as embodying the likelihood of issuers making good on the financial commitments that they have made. The less confident the bank is that an entity will be able to make good on its commitments, the higher
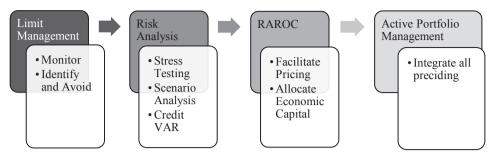
Figure 1. Integrated risk management.

Source: [Crouhy, Galai, Mark 2001, p. 98].

the premium the bank is likely to require compensating for the added risk it is being asked to bear. To analyze these various credit risks, banks often have the benefit of an in-house credit research department. The task of following risk of so many issuers can be daunting. Rating agencies, organizations that sell company specific research, exist to provide a report card of sorts on many types of issuers around the globe. Nevertheless it ought to be remembered that rating agencies like Standard & Poor's gave for Lehman Brothers a couple of months before the default, a rating of "A plus", which was higher than Poland had. Bankers are required to use information on various borrower characteristics called "4 Cs", i.e. characteristics (borrower's reputation), capital (leverage), capacity (volatility of earnings) and collateral. All of these characteristics should have given a better view on the borrower's business and the risk connected with them. It is important for banks to use risk integration that offers all sorts of benefits. Banks can combine the measurement of trading market risk and gap market risk to ensure that market risk is covered completely. It also allows them to rationalize their approach to market and credit risk measurement. Today it is usual to find information about best practice risk management in a bank. Best practice risk management philosophy can be envisioned along the arrows on Figure 1 (Integrated risk management).

3. The RAROC approach

Today, almost all major banks and financial intermediaries have developed RAROC (Risk Adjusted Return On Capital) models to evaluate the profitability of various business lines, including their lending. RAROC is an answer to the demand by stockholders for improved performance, especially the maximization of shareholder value. It is not only about bad news, but is the reason deals are being made, and business invested in. Since this concept was treated as a panacea for the banking industry in the early 1990s, many banks have claimed they use it in risk assessing [Jameson 2001, p. 1]. Banks and other financial intermediaries add value precisely

through their ability to reduce market frictions such as limited information and the possibility of costly renegotiations of troubled credits. A large portion of bank assets are likely to be difficult for the outside investor to value, which could lead to information and agency problems for banks when they would be in a situation that they need to raise external capital [James 1996, pp. 3-5].

In a financial institution, economic capital protects against the various risks inherent in the institution's business risks that would otherwise affect the security of funds. The purpose of economic capital is to provide confidence to claimholders such as depositors, creditors and stakeholders in general. Nevertheless it would be too costly for a financial institution to operate at 100 percent confidence level, the level that would ensure the institution would never default, whatever its future loss might be. As a result, economic capital is set at e.g. a 99 percent confidence level, which means that there remains a probability of 1 percent that actual losses will exceed the amount of economic capital. Economic capital is what really matters for financial institutions and their stakeholders, and RAROC concerns it [Crouchy, Galai, Mark 2001, pp. 529-533]. Major banks use economic capital RAROC figures in accounting all risks, even operational risk, in a very sophisticated way and, what is even more important, to drive decisions across all business areas [Jameson 2001, p. 1]. Whether to enter business could also be based on RAROC calculations. RAROC is used to help determine the potential value that would be obtained if additional resources would be allocated in a new business (in the case of banks if loans would be granted) [Mark, Bishop 2007]. Nowadays many financial regulators, like the US regulators or the Basle Committee on Banking Supervision have been telling all the banks that they must invest in models and robust data for calculating economic risk capital [Jameson 2001, pp. 1-2]. At present RAROC is one of the most widely applied tools of financial valuation around the world, used not only by banks but many different financial institutions to support decisions on portfolio allocation and product pricing [Milne, Onorato 2010, pp. 1-3].

RAROC can be thought of as a Sharpe ratio for business units, including lending. Its numerator is a measure of adjusted income over either a future period (the next year) or a past period (last year). The denominator is a measure of the unexpected loss or economic capital at risk as a result of that activity. See Formula 3.1.

Formula 3.1

$$RAROC = Adjusted\ income\ /\ Capital\ at\ risk,$$

where
Adjusted income = revenues – expenses – expected losses + return on economic capital +/– transfer values/prices.
Capital at risk = capital reserved to cover worst-case loss (minus expected loss) to required confidence threshold (e.g. 95%) for credit, market and other risks.

In this paper we concentrate on the lending terms of RAROC, nevertheless this could be applied to 46 different business units within the bank. The RAROC of a loan is meant to be compared with some hurdle rate reflecting the bank's cost of funds or the opportunity cost of stockholders in holding equity in the bank. The hurdle rate can be the stockholders' returns on equity (ROE) or the weighted average cost of capital (WACC). Usually WACC is less than ROE, especially if debt costs are tax deductible. If RAROC is higher than the hurdle rate then the loan is pointed as value adding, and bank capital ought to be allocated to the activity. Historically that measure has been calculated on a standalone basis, with correlations among activities ignored, the number of activities satisfying the aforementioned equation that RAROC is higher than the hurdle rate, often exceeds the available capital of the bank. It has to take time to raise new equity to fund all valuable projects [Saunders 2007, pp. 151-154].

The RAROC numerator reflects the adjusted expected one-year income on a loan. The numerator, adjusted income is equal to the sum of spread and fees, minus expected loss and operating costs. The spread reflects the direct income earned on the loan, essentially the difference between the loan rate and the bank's cost of funds. The fees ought to be directly attributable to the loan over the next year. In many RAROC models two deductions are made from the spread and fees to calculate the adjusted income. The first recognizes that expected losses are part of normal banking business and deducts these from direct income. The second deduction concerned a loan's operating costs, such as a loan officer's time and resources in monitoring the loan [Saunders 2007, pp. 151-160].

The denominator was historically measured in two ways. The first one was to measure capital at risk as being equal to the maximum change in the market value of the loan over the next year. Starting with the equation:

Formula 3.2

$$\frac{\Delta L}{L} = -D_L \frac{\Delta R}{1 + R_L},$$

where: $\Delta L/L$ – the percentage change in the market value of the loan expected over the next year;

D_L – the Macaulay duration of the loan;

$\Delta R/(1+R_L)$ – the expected maximum discounted change in the credit risk premium on the loan during the next year.

Users of this approach turn to publicly available corporate bond market data to estimate credit risk premiums. Then the risk premium changes of all the bonds traded in that particular rating class over the past year are analyzed. The ΔR is:

Formula 3.3

$$\Delta R = \text{Max} \ [\Delta(R_i - R_G) > 0],$$

where: $\Delta(R_i - R_G)$ – change in the yield spread between corporate bonds of credit rating class "i" and matched duration treasury bonds over the past year.

Considering the worst case scenario, the maximum change in yield spread is chosen, as opposed to the average change [Saunders 2007, pp. 151-160].

Suppose Bank ABC wants to evaluate if it is worth granting Company Z a loan of $10 million with duration of 3 to4 years. Company Z is considered to be an AA borrower. Firstly it is needed to evaluate the actual changes in the credit risk premiums $(R_i - R_G)$ on each of the bonds that have a rating of AA for the past year. It was assumed that there were 600 publicly traded bonds AA and the 99 percent worst case scenario is equal to 6, which means that only 6 bonds out of 600 have a risk higher than the 99 percent worst case. The $\Delta R = 1.5$ percent and current average level of rates (R) is 12%.

$$\Delta L = -3,4 * \$10.000.000 * (0,015/1,12) = -\$455.357,1429 \approx -\$455.357$$

The risk amount is $455.357. To determine if the loan is worth making for a bank, the estimated loan risk is compared with the loan's income, where spread (the difference between the loan rate and the bank's cost of raising funds) is equal to 0,3% and the fees are equal to 0,1% of the lending amount. So the RAROC is as follows:

$$RAROC = [(0,003+0,001) * \$10.000.000]/\$455.357 = \$40.000/\$455.375 = 8,78\%$$

If the 8,87% exceeds the bank's internal RAROC benchmark (based on Bank ABC WACC or ROE) the loan ought to be approved. In any other case the borrower should be asked to pay higher fees and spreads to increase the RAROC. Nevertheless in some cases banks decided not to invest even if RAROC is higher than the hurdle rate (e.g. ROE) because it takes time to raise new equity to fund all projects. So the bank has to decide in which projects it invests [Dermine 1998, pp. 21-27]. Measures like RAROC, ROA and RORAC (return on risk adjusted capital) calculate income in a similar fashion, but they differ in the calculation of the denominator. ROA takes as a denominator assets lent, which ignores the risk of the activity of lending, and RORAC: BIS risk minus based capital requirement.

Most banks have adopted a different way to calculate the denominator of the RAROC equation or capital at risk. The calculation involves experimental modeling based on a historic database of loan defaults. For each type of borrower the adjusted one year income is divided by an unexpected default rate, and the result is multiplied by the loss given default. The unexpected default rate is a multiple of the historic standard deviation of the default rates of such borrowers. The multiple of standard deviation will reflect the desired credit rating of the bank and the actual distribution of losses. It is reported that the Bank of America uses a multiplier of 6 and there are

some banks that would like to achieve AAA status and use 10 as a multiplier [Saunders, Cornett 2008, pp. 328-332].

New research has shown that using a single hurdle rate for all types of exposure is not a good idea, e.g. considering hurdles between equity and debt, similar as in debt for companies with different ratings. This is because of skewness of return distributions. The RAROC hurdle which is good for a debt portfolio, is lower comparing with the hurdle rate for equity portfolio [Milne, Onorato 2010, pp. 2-4]. The model of Froot and Stein allows for the existence of friction in the capital market and decompose the risk of the loan into tradable and non-tradable components. It was assumed that a bank with an existing portfolio has to make a decision to accept or reject a new loan, and the loan size is small compared to the existing portfolio [Froot, Stein 1998, pp. 55-82]. To price the tradable risk the CAPM is used, and non-tradable risk depends on the bank's level of risk aversion. If a bank is risk-averse, it will always hedge its tradable risk because nothing can be earned by taking over this type of risk. The hurdle rate is as follows:

Formula 3.4

$$\mu = g * \mathrm{Cov}(\varepsilon_T, \varepsilon_m) + G * \mathrm{Cov}(\varepsilon_N, \varepsilon_P),$$

where: g – market price risk,

      G – bank's level of risk aversion,

      ε_T – tradable risk of the loan,

      ε_N – non-tradable risk of the loan,

      ε_m – systematic market risk factor,

      ε_P – the non-tradable risk of the entire portfolio.

This model is theoretical rather than practical. The assumptions made are more realistic compared to the CAPM, but unfortunately contain more unknown variables like the risk aversion of the bank [Prokopczuk et al., pp. 8-9].

On the other hand there are voices that it is desirable to have a corporate (or bank) wide identical hurdle rate which reflects the ambition of the investors and the management. But the most important argument for one hurdle rate is the difficulty to estimate the beats for each business unit together with the influence costs coming up from internal "fights" when the hurdle rates are determined. This is the reason why Bank of America uses one corporate wide rate [Zaik et al. 1996, pp. 83-93].

To be successful, the RAROC process must be integrated into the overall risk management process, especially in limits management, risk analysis, business strategies and valuation. It is obvious as well, that the RAROC equation should take correlations and diversification among business line risks, including lending into account. This can be seen by calculating the RAROC from a one factor capital asset pricing model that describes the equilibrium risk-return trade-offs among assets. This theoretical RAROC encloses an adjustment for correlation in its denominator.

There is also a link between RAROC and EVA (economic value added). In lending, EVA requires a loan to be made only if it adds to the economic value of the bank from the shareholders' point of view so that the EVA formula can be directly developed from the RAROC formula [Saunders 2007, pp. 160-162]. As the level of RAROC accuracy has increased over the last few years there is a corresponding requirement for more detailed data. To fulfill that need, data warehouse technology should evolve together with RAROC to provide flexibility and scalability.

Generally Accepted Accounting Principles (GAAP) provides a level playing field in terms of proving a common set of rules to evaluate the health of a company. Next, the banking industry has made advances in terms of the measurement of risk, called generally accepted risk principles (GARP). The latest evolution, beyond GARP, is toward a set of generally accepted capital principles (GACP). RAROC methodology commandments based on GACP are as follows:

- include all business activities and the global operations of the bank;
- strive to implement an RAROC system impervious to arbitrage (including tax differentials);
- be explicit, consistent, and goal congruent with other policies (e.g. transfer pricing, price guidance, performance measurement, compensation, etc.);
- recognize different types of capital, but primary emphasis will be on economic capital;
- use a single risk-adjusted hurdle rate charged as a cost of capital (which shall be broadly consistent with the bank's long-term target return on capital);
- develop and implement an economic risk framework comprising credit risks, market risk (trading and banking book), and operational risks (funding liquidity risk is captured in the transfer pricing system);
- recognize funding and time-to-close liquidity;
- attribute capital as a function of risk and the authority to take risk (e.g. market risk limit);
- economic capital should be based on a confidence level deemed appropriate to achieve target rating;
- promote matching of revenues and risk charges where risks are incurred.

The full cooperation of senior management is essential to implement RAROC on a bank-wide basis. Many modern banks attempt to maximize their risk-adjusted return on economic capital [Crouchy, Galai, Mark 2001, pp. 538-566]. The typical RAROC approach is calculating the risk adjusted return on economic capital, and then comparing this RAROC ratio to a fixed hurdle rate. As it was already mentioned, only activities for which the RAROC ratio exceeds the hurdle rate contribute to shareholder value. Nevertheless, it can result in decisions that adversely affect shareholder value. Adjusted RAROC corrects the inherent limitations of the first-generation method. The new RAROC measure adjusts the risk of a business to that of the firm's equity. It follows that risk-adjusted performance measures change as the risk of the business changes. In other words, maintaining the probability of default

constant is inconsistent with a constant expected rate of return on equity, and vice versa, but an adjusted RAROC measure corrects this problem. An adjusted RAROC (ARAROC) is defined as:

Formula 3.5

$$\text{ARAROC} = (\text{RAROC} - R_F) / \beta_E,$$

where: R_F – the risk free rate;
    β_E – the systematic risk of equity.

It is important to realize that RAROC is sensitive to the level of standard deviation of the risky asset and also to the correlation of the return on the underlying asset and the market portfolio. Moreover, in cases when a fixed hurdle rate is used in conjunction with RAROC, high volatility and high correlation project would be selected. However, the ARAROC measure is insensitive to changes in volatility and correlation [Crouchy, Galai, Mark 2001, pp. 538-566].

RAROC is important as a performance measure because 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 the senior management of a bank must decide on a target debt rating and adjust the capital structure to the chosen target [Turnbull 2002, pp. 215-236]. Most global banks act in this way, especially when they want to acquire or merge with another bank. A good example would be Santander, which acquired BZ WBK and AIG Bank Polska. Several trends in the banking industry seem likely to secure a growing role for such a sophisticated method like RAROC. These include a trend toward integrated risk, capital as well as integration of credit risk and market risk. Nevertheless, we should not forget Professor Avinash Persaud's words:

"Take JPMorgan Chase, or Citibank or Credit Suisse, banks with a very sophisticated approach to risk management… Despite their sophistication, perhaps because of their misplaced sophistication, they have been full and present victims of all of the last cycles. They have lost considerable amounts of shareholders' capital on the dot-com bubble, on Enron, on Worldcom, on Global Crossing and potentially on their syndication of collateralized debt obligations. Yet, they have not failed, perhaps because the market believes they are too big to do so, thereby limiting panic" [Chong 2004, pp. 64-67]. Whatever may be said, RAROC provides a link between the needs of the bank management and the variety of external stakeholders. Additionally, it gives the opportunity to use a common language for risk and measurement that supports each side. Secondly, with the development of data bases on historical default rates and loan returns, credit risk measurements would be more accurate [Altman, Saunders 1997, pp. 1721-1742].

4. RAROC approach limitations

Despite the fact that the RAROC approach has a huge impact on banks and seems to be one of the best approaches in risk assessing, some aspects tends to spoil it. The most important are as follows [Jameson 2001; Artzner et al. 1999; Merton, Perold 1993; Turnbull 2000]:

- Rule-of-thumb risk ratios might be appropriate to a particular portfolio, but they are not linked to the individual entity's actual portfolio or any fundamental model of risk. So they often underestimate or overestimate risk.
- Asset management businesses often come out of RAROC analyses looking favorable, only because the only risk factor is assumed to be operating risk. Because a brokerage earns fees proportional to the assets in its customers' accounts, these profit centres in effect have a market risk position in the underlying funds in which their customers are invested.
- A short-sighted focus on earnings in risk modeling ignores possible changes in value for example, net income simulations for asset management that consider default risk only in credit risk models.
- Risk tends to be measured in each business line in a way that relates to that line's risk control needs. For example, trading value-at-risk might be calculated to the 99th percentile of the distribution over a 10-day period, while an asset management risk measure might look at the effects of a 200 basis point jolt in the markets.
- Poor accounting of risk diversification: it is difficult to work out the interaction of different risks, such as market risk and operational risk, when trying to produce enterprise-wide RAROC numbers.
- The RAROC Value at Risk denominator fails to satisfy sub-additivity, which implies it is possible, when combining portfolios, that the overall VaR of the new portfolio could be greater than the sum of the individual VaRs.

Additionally, on too many occasions in times of crisis like in 2008, rating downgrades have followed the one set of the crisis. Ratings that are used as well in RAROC approaches are meant to be the leading indicators. In the case of the sub-prime crisis, even after clear evidence of the problems in the value of sub-prime mortgage-backed securities, rating downgrades were hard to come by. But when sellers of financial products pay rating agencies for their services, the credibility of the rating ought to stay in the area of investor concern. The systematic bias of rating agencies offering inflated ratings in favor of structured finance products, and large downgrades after the crisis, show that the rating could be a source of market uncertainty rather than a stabilizing factor [Pattanaik 2009, pp. 21-47]. Due to these shortcomings, in developing countries such as in India the RAROC is still an uncommon approach. Only one-third of the banks managers there have developed it [Bodla, Richa 2009, pp. 52-53], nevertheless they are very familiar with other risk measurements.

5. Conclusions

In recent years a revolution has been brewing in the way credit risk is both measured and managed. New technologies have emerged among a new generation of financial engineering professionals who are applying their model-building skills and analysis to this area. Modern risk measurement methods are not new but they go back to the concept of portfolio risk developed by Harry Markowitz in 1952. Modern bank professionals should not forget Robert Merton words: "At times we can lose sight of the ultimate purpose of the models when their mathematics becomes too interesting. The mathematics of financial models can be applied precisely, but the models are not at all precise in their application to the complex real world. Their accuracy as a useful approximation to that world varies significantly across time and place. The models should be applied in practice only tentatively, with careful assessment of their limitations in each application" [Crouchy, Galai, Mark 2001, p. 579]. One example is the recent financial crisis, where in 2009 the Dow Jones Industrial Average (DJIA) index fell 53 percent in value (during the market crash in 1937 it fell 49 percent). Home foreclosures reached a peak in 2009 with 1 in 45 households (almost 3 million properties) in default on their home mortgage. AIG, one of the best insurance companies in the United States, survived only because of a federal government bailout. Major auto makers like Chrysler and General Motors faced imminent danger of default. In 2007, Citigroup, Merrill Lynch and Morgan Stanley wrote off $40 billion due mainly to bad mortgage loans. September 2008 marked a crucial turning point in the crisis, when the US government seized Fannie Mae and Freddie Mac, taking direct responsibility for the firms that provided the funding of new home mortgages. All of these institutions were using RAROC and many more sophisticated approaches but this would not give them the ability to predict future. One of the most famous failures at the beginning of the 21st century would be certainly Lehman Brothers, the 158-year-old investment bank.

After a very reliable analysis of literature and real world examples, it can be said that whatever protection banks use there are always factors that could lead banks to failure. But banks can and have to reduce the risk as much as possible, and modern approaches like RAROC are very helpful in this. The principle that one cannot earn a return over the risk free rate without taking on incremental risk, is still true. The demand for RAROC based measures should increase. Banks ought to be able to produce RAROC-adjusted pricing for dealers before deal capture. This development will maximize the potential from teamwork between traders, originators and risk managers. Credit risk management in banks should be based on [Bagchi 2003, pp. 497-504]: risk identification, risk measurement, risk monitoring, risk control and risk audit. Proper credit risk policies could lead to the success of the whole risk management system. There is always the possibility of moral hazard, but with proper management the risk could be limited [Louberge, Schlesinger 2005, pp. 118-134].

Emanuel Derman thinks that complex financial models have empowered market participants to make increasingly rational investment decisions based on causal relationships between factors affecting securities prices. Models have also contributed to increased aggregate market efficiency, but he asserts that increased reliance on models also induces significant levels of risk, due to their assumptive nature [Warwick 2003, pp. 129-131].

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RAROC W ZARZĄDZANIU RYZYKIEM KREDYTOWYM

Streszczenie: Ryzyko kredytowe jest najpowszechniejszym rodzajem ryzyka, znanym od wielu wieków, jednak model RAROC jest nadal uważany za innowacyjny. RAROC (*Risk Adjusted Return On Capital* – skorygowana ryzykiem rentowność kapitału) jest odpowiedzią na zapotrzebowanie akcjonariuszy oceniających rentowność inwestycji, w szczególności maksymalizację wartości dla akcjonariuszy. Głównym celem artykułu jest przedstawienie zalet oraz ograniczeń stosowania modelu RAROC w podejściu rynkowym oraz wskazanie zagrożeń dla pośredników finansowych, którzy nie powinni polegać tylko na modelach, gdyż nawet najbardziej zaawansowane metody nie eliminują całkowicie niepewności.

Słowa kluczowe: ryzyko kredytowe, model RAROC, GARP, zarządzanie ryzykiem.