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Bank Performance Indicators

Assessing how Risk-Adjusted Performance Measures compare to traditional metrics in predicting banks stock performance

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Abstract

A key indicator for bank performance is Return on Equity. This measure can be considered as flawed as it is highly impacted by a bank's leverage and does not account for the risk profile of a financial institution. In this study I will assess alternative bank performance metrics such as RORAC, RAROC, RARORAC that account for the risk of the return when computing the performance of the financial institution. The research aims to appraise, in the setting of a financial institution, how risk-adjusted performance indicators relate to stock performance relative to ROE and how these alternative metrics deliver more precise risk information to investors, promoting the overall maximization of the shareholder value. From this point of view, the study conveys useful findings favouring an enhanced allocation of financial resources.

1. Introduction

Traditional measures, such as ROE and ROA,[1] commonly employed as the main methodology to evaluate banking performance, are accounting-based and rely on items from financial statements. While these categories of indicator have numerous advantages, including ease of computation and reliance on available historical data, they also present some limitations. Pires (2015) stresses how these indicators omit the time value of money in their computation and do not account for operational risk. In addition, these metrics are characterized by a strong discrepancy between accounting and economic realities, and therefore are considered inappropriate to evaluate how the financial institution is creating value for its shareholders (Pires, 2015). Considering that the primary goal of banks is to enhance their overall value while upholding the desired balance between the registered financial outcomes and risk exposures, engaging in the balance sheet operations and off-balance sheet activities necessitates establishing a proper level for risk (Boda, 2017). Therefore, the so-called Risk-Adjusted Performance Measures, from now on also referred as RAPM, have manifested as solid tool. The application of risk-adjusted performance measures reflects a growing recognition of the importance of risk management in banking operations. Studies have shown how these metrics can influence bank stock returns, serving as indicators of financial health and risk management efficacy. Fiordelisi and Molyneux (2010) encounter a meaningful correlation between risk-adjusted performance measures and financial institution stock prices, pointing that these indicators offer valuable information to investors about a bank's risk-adjusted profitability potential. The bridge between risk management practices and shareholder value is fundamental in understanding the relevance of risk-adjusted performance measures. Banks that properly manage risk exposure not only protect themselves from eventual losses but also favour sustainable growth, enhancing shareholder value. Risk-adjusted performance measures embody this dynamic by providing a metric that balances return and risk, supplying a more accurate reflection of a bank's performance in the context of its risk profile. In the framework of banks, the RAPM indicators, seek to enhance traditional valuation metrics for lending portfolio and/or business lines profitability by identifying the risk component related to uncertain factors (Michetti, 2013). Consequently, RAPM are computed as the ratio between risk-adjusted profitability and risk-adjusted capital or economic capital and rely on the rule that shareholder value is produced when the gains resulting from invested capital are higher than risk- and time-adjusted costs of capital (Pires, 2015).

[1] Respectively Return on Equity and Return on Assets.

RAROC and RORAC indicators for example provide a more comprehensive illustration of the actual performance of banks. Therefore, not only internal management and equity investors but also external institutions are strongly interested and involved in the implementation of these alternative metrics. I believe these alternative indicators, accounting for the exposure of banks, should provide investors with more detailed and precise information about the risk profile and financial health of a financial institution, acting as the primary signal of survival or distress during economic and financial crises. From this reasoning, risk-adjusted indicators convey more adequate information to shareholder, enhancing their investment decision making process. Therefore, I expect that risk-adjusted metrics are more related with stock performance of banks rather than traditional performance measures, namely in this study the ROE. In this circumstance, one of the objectives of this study is to understand if the risk-adjusted performance metrics could result in an effective tool to comprehensively compute, evaluate, and compare the market performance of a bank, and if it is consistent with the concept of shareholder value maximization and value-based management.[2] On the other hand, the potential alternative hypothesis claims that the risk-adjusted indicators do not explain stock returns, and indirectly shareholder's value, better than the return on equity, and the set of traditional performance indicator in general. Nevertheless, in this last scenario, the risk adjusted performance metrics could enhance the shareholder value if jointly considered with traditional performance measures,[3] not by predicting stock returns, but by enriching the information set available to investors during their investment decision making process.

The empirical research centred on a sample of 29 banks from the United States and Europe over a ten-year period divided in quarters, between 2014 and 2023. On one hand the empirical analysis confirmed that ROE remains a statistically significant predictor of stock price changes, consistent with its long-standing use in financial analysis. This aligns with the fundamental value strategy where investors rely on accounting-based metrics to assess a company's profitability and make investment decisions. On the other hand, contrary to expectation, the lack of significance of RORAC did not show a statistically significant relationship with stock price changes in the regression analysis. This could be attributed to the limited sample size or the incomplete integration of RAPMs into market practices. Below in the document, it is explained why, even

[2] Young and O'Byrne (2001) discuss the advantages and disadvantages of value-based management, covering both implementation and conceptual issues, with an evident focus on performance measurement.
[3] From this perspective, I would suggest also considering the risk-adjusted performance indicators if the alternative hypothesis is true, as they can enhance the investment decision-making process and facilitate the assessment of the financial institutions' ability to provide shareholder value.

if the findings do not highlight a statistically significant association between RORAC and changes in stock prices, risk-adjusted indicators are still noteworthy for various stakeholders in the banking industry, including bank management, investors, and regulators.

The remainder of the thesis is structured as follows. In the first two chapters, Literature review and Theoretical background, I present the current state of the literature regarding the ROE and the RAMP and the existing theoretical background of both the traditional set of performance indicators and the risk-adjusted indicators, adding also a small but interesting in depth-analysis of the impact of the risk-adjusted indicators on the banks' governance dynamics. In the Empirical analysis section, I present the methodology, the data, and the sample used to execute the study, going into details of the data collection and investigation. The thesis concludes by discussing the result of the panel-OLS regression, and by assessing potential implications or limitations of the study for further examination of the matter in the future. Finally, the reader can find the Appendix with all the relevant information, data, calculations, and results obtained from the analysis.

2. Literature review

2.1 *RAPM Literature review*

The economic literature extensively discusses issues associated with the implementation of the risk-adjusted performance measures to evaluate the efficiency of businesses, including banks. (Merton & Perold, 1993; Stulz, 1996; Matten, 2000; Perold, 2001; Tumasyan, 2009). Matten, C. (2000) introduces the conceptual groundwork for risk-adjusted performance measures in the banking sector. Matten highlights the limitations of traditional performance metrics like ROE that fail to account for the risk associated with generating returns.[4] This early discussion on RAPMs sets the stage for understanding the evolution and importance of measures such as Return on Risk-Adjusted Capital, Risk-Adjusted Return on Capital, and Risk-Adjusted Return on Risk-Adjusted Capital (respectively RORAC, RAROC, and RARORAC). This foundational work provides the historical and theoretical context for the development of risk-adjusted performance indicators, emphasizing why these measures are necessary for a more accurate assessment of bank performance.

[4] Risk in finance can be described as the likelihood of gaining returns or bearing losses from an investment, or as Howells and Bain (2008) discuss, risk is the probability that the realized returns could differ from the expected ones.

At the beginning of the new millennium, mounting competitive forces have compelled banks to strategically prioritize delivering profits to their shareholders. Consequently, the assessment of the drivers of bank performance and their correlation with stock prices has gained growing significance. Beccalli, Casu, and Girardone (2006). extend and enrich this literature integrating in it the relationship between share prices and efficiency measures, with specific reference to the banking sector. Beccalli et al. indicate that variation in cost efficiency is mirrored in variation in stock prices. This result implies that stocks return of cost-efficient financial institutions are likely to outpace their inefficient competitors. Fiordelisi and Molyneux (2010) expand the existing literature by evaluating the impact of multiple factors on the production of shareholder value in European banking and by assessing the causality of these elements in the stock performance. The authors find that cost and revenue efficiency are statistically significant contributors of economic profits and shareholder value and are positively related to bank performance. In particular, economic profits present a positive relation with sales efficiency, and EVA (economic value added)[5] is positively linked to cost efficiency.[6] Fiordelisi and Molyneux additionally detects a positive relation between financial institution debt exposure and economic profits, while not finding any link with economic value added.[7] Akhtaruzzaman, Chiah, Docherty, and Zhong (2021) four key findings show that the negative association between bank risk-adjusted profitability and stock returns is explained by the low-risk anomaly. Indeed, the higher profitable banks are riskier than the lower profitable ones. Consequently, the inverse relationship between profitability and abnormal bank stock returns is concentrated within large banks. Akhtaruzzaman et al. demonstrate that a zero-investment portfolio that takes a long (short) holding in the most (least) profitable banks exhibit a time-series return configuration that is in line with the low-risk anomaly.[8] In contrast, Hashimzade and Thornton (2021), after precisely presenting the empirical formulas to compute RAROC, RORAC and RARORAC, explain how the mathematical expressions of the RAPM ensure that a firm with a lower exposure to business or market risk factors and a stable level of return will have larger risk-adjusted returns. Furthermore, the paper

[5] The EVA of a firm describes "the incremental return that the investment earns over the market rate of return" (Sharma and Kumar, 2010, p.2). In simple words, EVA deducts from the net operating profit the opportunity cost of all the funds committed in the company.
[6] This finding shows the association among efficiency and bank performance cannot be properly evaluated excluding how rapid actions pay off and produce externalities.
[7] This last finding could be explained by positive causality between financial leverage and the cost of capital, where larger financial leverage boost economic profits, however counterbalanced by greater opportunity costs of capital.
[8] The low-risk anomaly, as demonstrated by Baker, Bradley, and Wurgler (2011), challenges the common empirical proposition that risky stocks deliver higher returns compared to low-risk stocks, based on the historical U.S. stocks returns. Baker et al., defining risk both as volatility and as beta, and considering both small and large caps, find that low risk consistently outperformed high risk.

defines the denominator of the ratios, the economic capital, as the factor that attributes to the bank capital the consequences of the risk-taking tendencies of the firm. Hashimzade and Thornton describe the economic capital as "the level of capital a bank needs to handle unexpected losses during a particular time period within a decided confidence interval" (p. 242). Kang and Poshakwale (2019) propose a new capital allocation model for financial institutions that expands Buch, Dorfleitner, and Wimmer (2011) model which considered a static setting in time. Kang and Poshakwale build a multi-period model accounting for the time change in risk and forecasted profit and provide empirical findings regarding the consequences on the RORAC from the internal capital distribution. Kang and Poshakwale deduce an optimal way to distribute capital to different business divisions with the goal to maximize RORAC. Surprisingly, the findings of the paper highlight that bank with total assets size higher than the median, exhibit larger improvements in the RORAC. Financial institutions can register better RORAC by distributing capital to more cost-effective business units that do not substantially boost the overall risk.

Interestingly, part of the literature focus fall within the framework of financial crises. Janoudi (2014) concludes that during period of crises, liquidity, insolvency, and credit risks, have large and favorable consequences on bank expenses and margins inefficiencies, indicating that financial institutions that uphold lower level of risk outperform their competitors during period of crisis. According to Janoudi, similarly to the above mentioned Beccalli et al. (2006) and Fiordelisi and Molyneux (2010), adjustment in expenses and margins efficiencies, considering simultaneously also capital and size, result to have a favorable and substantial impact on bank stock performance in the European Union. Petersen and Schoeman (2008) declare that profitability and solvency concerns of a banking systems are strictly associated. Specifically, the paper emphasizes that asset-liability management by financial institution must be considered while determining the levels of equity shareholders should commit. Consequently, bank directors must tackle banking decisions and equity policy at the same time. Banks tend to maintain lower levels of equity and higher levels of debts to fund their investments due to larger expenses associated with raising investor's capital (Janoudi, 2014). From this perspective, Arnold (2008) affirms that issuing new shares as a tool to raise new equity capital is more expensive than receiving loans due to both larger direct costs and higher required rate of return (cost of equity versus interest rate). In addition, banks prefer to hold less capital because of the negative relationship between ROE and equity capital, as discussed by Mishkin and Eakins (2012).

This literature review highlights the evolving landscape of bank performance measurement and underscores the importance of integrating risk considerations into financial analysis. Moreover, asset-liability risk management must be carried out simultaneously while determining the levels of equity shareholders should commit based on the offered risk-adjusted returns. After challenging periods of financial crises, mounting competitive forces and heightened regulatory scrutiny have compelled banks to strategically prioritize delivering profits to their shareholders. Consequently, the assessment of the drivers of bank performance and their correlation with stock prices has gained growing significance. From this perspective, researchers, the shift towards risk-adjusted performance measures opens new avenues for exploring the relationship between risk management, financial performance, and stock returns. Empirical studies investigating this relationship can further elucidate how these measures influence investor behavior and market perceptions, contributing to a deeper understanding of financial markets. This study contributes to the existing literature by directly assessing the causality between the risk adjusted performance indicator, namely RAROC, and the stock performance of a sample of banks. In this framework, the main objective of this research is to investigate the association between the implementation of the risk adjusted metrics and the equity investor value maximization. For this reason, it is assumed that stock returns will proxy the shareholder value creation.

2.2 ROE Literature Review

ROE is an internal performance indicator of shareholder value, computed as the ratio between net income and the average shareholder equity during the fiscal year. Return on Equity is one of the most used metrics of performance, since it directly appraises the return of a shareholder's financial commitment to the firm, and it is easy to compute for analyst and regulators as it relies on widely available information. (European Central Bank, 2010).

Damodaran (2007) assess performance and efficiency accounting measure as Return on Capital (ROC), Return on Equity and Return on Assets, highlighting that they allow to calculate the share of return of a certain accounting category of the balance sheet. However, most importantly, the author states that it is mandatory to obtain a reliable appraisal of returns on investments, and so consequently points out risk as fundamental factor that cannot miss in the evaluation. Damodaran is one of the first to underscore the limits of the ROE as financial indicators. According to European Central Bank (2010, p.5), also referred as ECB, "the commonly employed ROE measure may not be sufficient to characterize banks' performance and ROE

could be considered more as a relationship tool to communicate between financial institutions and financial markets rather than a performance benchmark". The ECB report points out the main limitation of the ROE, specifically it is not risk sensitive, and define it as a "not a stand-alone performance measure" (p. 20) that does not include most types of risks, such as the proportion of risky assets and the solvency profile of the bank, the risk associated with the production of value and the quality of the assets.[9] In addition, ROE is a short-term indicator that does not account for bank's long-term plan, as it is back looking. Its drawbacks are more pronounced during uncertainty and its results could be misleading or even manipulated. The alignment of the risk profile with the organizational structure and business model emerges as fundamental when evaluating an institution's ability to achieve future performance. In this context, long-term indicators based on economic capital and financial planning models within banks may gain larger significance. For example, risk-adjusted return indicators, like RAROC, provide for a more informed assessment of performance and may benefit from increased transparency and clearer communication with stakeholders and regulators. Furthermore, seems quite difficult to understand which level of Return on Equity could be considered adequate for a bank. As highlighted by the European Central Bank, after the financial turmoil of the 2008, this topic has been quite controversial among investors, banking directors, and regulators. After the significant losses during the financial downturn and the substantial government intervention, there was little evidence for financial institutions for coming back to previous level of ROE (higher than 20%), which were deemed unsustainable for the post crises. From this point of view, the ROE decomposition might have been valuable in evaluating banks' performance under favorable conditions, but this method has been evidently unacceptable in a more volatile economic context, as seen during the subprime crisis, where fluctuations in the financial indicator were solely attributed to operational performance, hindering our comprehension of the potential balance between risk and return in performance (European Central Bank, 2010). Consequently, the 2008 crisis has proven the inadequacy of the ROE in discriminating the most successful banks in terms of sustainability of their performances from others.

Admati, DeMarzo, Hellwig, and Pfleiderer (2013) highlights how increasing equity capital requirements could be a concern for bank's investors as this increase could lower their returns. In particular, the researchers argue that the banks' Return on Equity is lowered by higher equity

[9] In addition is crucial to consider the capital risk, which is extremely relevant in the context of financial institutions and can be defined as the risk that the market value of assets falls below the market value of liabilities (Casu et al., 2006).

capital requirements, damaging the shareholders' interests. This reasoning assumes that ROE is a good indicator of a bank's performance. However, since ROE (or any simple indicator of the bank's performance) neither adjust for scale nor account for risk, there are many potential drawbacks associated with this assumption. When comparing different capital structures, assessing the profitability through the ROE can be especially problematic. The focus on ROE has therefore led to much confusion and imprecision about the effects of capital requirements on shareholders' value. Finally, Admati et al. conclude that "bank equity is not socially expensive, and high leverage at the levels allowed, for example, by the Basel III agreement, is not necessary for banks to perform all their socially valuable functions and likely makes banking inefficient" (p. 2). Better capitalized banks experience fewer irregularities in lending choices and that would enhance overall performance. Pursuing high gearing does not suggest that this is socially optimal.

3. Theoretical Framework

3.1 RAPM

Over the last three decades, the organizational structure of major financial institutions has transformed evolving in a decentralized organizational structure with separated and almost autonomous business units. In this new framework, some issues regarding performance indicators, risk management, and resource allocation have emerged (Kimball, 1998). Therefore, financial institutions realized the necessity for new methods to assess and analyse the performance of various business units. Innovative approaches were implemented to address issues such as allocating capital and setting hurdle rates for businesses with varying levels of risk. Thanks to advancements in management accounting, financial institutions have effectively established performance benchmarks based on risk for various business divisions, preventing resources from being wrongly allocated to risky investment that seem attractive (Kimball, 1997). Punjabi and Dunsche (1998) analyze commercial banks and how the assessment of risk and distribution of capital by RAPMs is especially relevant for them, as they are needed to secure substantial financial buffers to cover the exposure of their portfolios of commercial and industrial lending products and services. An appropriate RAPM model produce a solid performance metric that link profitability to risk contribution in a portfolio of investments or divisions. Moreover, Punjabi and Dunsche assert "the availability of capital and competitive forces in lending markets are forcing financial institutions to develop expertise with higher value-added products to make

overall customer relationships profitable" (p. 2). The authors explain how precise assessment of each product's contribution to a portfolio outcome is crucial to build an integrated strategy for optimizing shareholder value-added. In this context became fundamental to implement accurate RAPM: indeed, if not properly assessed, RAPM may lead to incorrectly formulated transaction evaluation and decision-making process. From this point of view the Punjabi and Dunsche state that "the trend toward more effective portfolio management leads to the transformation of RAPMs from a reporting function to an action-based tool" (p. 2) and then conclude that "for sustained, tangible value to be generated, RAPMs must be championed by senior management and utilized on an organization-wide basis for relationship and product management" (p. 2).

Accordingly, to the conventions, RAPMs have been exploited to perform a reporting function, however a sharpen urge for RAPMs prompt asset selection and continuation, performance evaluation, compensation, and strategic designing. The main purpose of RAPM is to equip managers with a uniform set of indicators of performance to allocate the economic profitability of divisions with multiple type of risk and multiple capital requirements. As per Zaik, Walter, Retting, and James (1996), the primary aim of this category of measures, was to emphasize the risk associated with the bank's lending portfolio and the level of equity investments required to limit the bank to a defined probability of loss. Crouhy, Turnbull, and Wakeman (1999) believe that RAROC properly compensates for variation in risk, and therefore that decisions grounded on RAROC results are in line with maximizing the shareholders' value. Specifically, RAROC regulate the risk of a division to that of a bank's equity. Hence, when a bank is contemplating an investment in a venture, it can associate the RAROC of the division to the required rate of return from investors, and if the RAROC is higher than the required rate of return the investment in the venture will add value to the bank (Crouhy, Turnbull, & Wakeman, 1999). Zaik et al. affirm "The goal of these risk-based capital allocation systems is to provide a uniform measure of performance that management can use to compare the economic as opposed to the accounting profitability of businesses with different sources of risk and capital requirements" (p. 83).

RAROC methodology distribute capital for risk management and performance evaluation purposes. In the first context the primary objective is to distribute capital to specific division consistently with the bank's optimal capital structure, which can be identified as the relation between equity and assets that minimizes the bank's average cost of financing (Zaik et al., 1996). In the second context, RAROC methodology allocate capital to bank's divisions assessing the risk-adjusted rate of return and of each of them and determine the specific division's contribution

to shareholder value. From this perspective, the risk-adjusted return on capital could be exploited as more reliable assessment of performance rather than Return on Equity.

3.2 RORAC Theoretical Framework

In this paragraph the study specifically focuses on one of the most important risk-adjusted indicators. Perz (2010) underscore that global banks develop and implement their own systems for computing these metrics, as there is no single universal way of calculating them. The authors, among several findings, conclude that Risk adjusted analysis let banks to comprehensively evaluate the ratio of undertaken risk to the financial results obtained by financial institutions. However, Perz also highlights some issues that arise when external institutions try to compute the risk adjusted indicators. It is very difficult to have access to the proper data needed to carry the calculation process the economic capital from various types of activity and calculate the expected level of losses. The general formula that to calculate RORAC is as follows:

$$Net\ Profit\ /\ Risk\ Adjusted\ Capital^{10}$$

Risk-adjusted capital, the denominator, could be computed using several methodologies according to both economic literature and business practice. The author multiplies the ratio between the economic capital of the business unit and the economic capital for the entire bank by the shareholders' equity of bank. Perz interpret the formula and affirms that "the total available shareholders' equity is allocated among the various activities of the bank in such proportion as the ratio of the economic capital devoted to the specific economic activity to the economic capital for the entire bank" (p. 68). Therefore, the financial institution assigns the equity to every one of its units relative to the risk that is acquired in them. The numerator of the formula subtracts from the return both administrative expenses and expected loan losses, according to the likelihood of loan recovery if the borrower default (Punjabi and Dunsche, 1998). In addition, to record the component of any operation financed by the bank's equity, a capital benefit is reintegrated.[11] Punjabi and Dunsche (1998, p.19) conclude "the resulting risk-adjusted return can be characterized as "economic profit" since it is the revenue earned above and beyond the compensation for risk".

[10] In the empirical analysis the denominator is denoted as "Risk weighted Asset".

[11]When a financial institution finances an operation exploiting its own equity, it is reasonable to account for the benefit resulting from the use of this equity rather than external financing. The capital benefit represents this economic advantage.

3.3 RAROC Theoretical Framework

The set of risk-adjusted performance indicators include also the RAROC, from many considered the most important and the most implemented. Measures associated with the underlying level of risk if banks' activity can be included among economic measures of performance. According to Kimball (1998), banks could successfully run their business if directors' balance complex trade-offs between growth, return and risk, supporting the implementation of risk-adjusted metrics. The risk-adjusted return on capital, computed in generic terms as the expected result over economic capital, empowers banks to distribute capital to specific business divisions depending on their specific business risk. As a performance evaluation instrument, it then allocates capital to business divisions in accordance with their expected economic value added (European Central Bank, 2010)**.** The theoretical RAROC can be obtained from the one component CAPM model as the abnormal excess return on the market per unit of market risk (European Central Bank, 2010). The RAROC framework was formulated for the first time in the 1970s by a task force associated with the Bankers Trust. As per Zaik et al. (1996), the primary aim of this category of measures, was to emphasize the risk associated with the bank's lending portfolio and the level of equity investments required to limit the bank exposure to a defined probability of loss. Today, RAROC is recognized as an indicator that aids decision-making within financial institutions, and its primary purpose is to guarantee that the return on operations aligns in accordance with the assessed level of risk (Pires, 2015). RAROC serves various purposes, including optimizing capital allocation and evaluating the profitability across different business segments. The complexity of computing this indicator stems from outlying its components rather than the intrinsic mathematical formula. The original formula proposed by Bankers Trust is illustrated below:

$$RAROC = Risk\ Adjusted\ Return\ /\ Equity\ Capital$$

Prokopczuk, Rachev, Schindlmayr, Trück (2007) investigate this formula and claim that expected loss (deducted from return in the numerator) is not risk-adjusted. Moreover, the paper aims to adjust the denominator by substituting equity capital with economic capital. Prokopczuk et al. suggest a new formula:

$$RAROC = \ Adjusted\ Income\ /\ \ Capital\ at\ Risk$$

Economic capital, also known as risk capital, which in this case is presented in the denominator, include the risk of the portfolio of assets of the bank from its debtholders' standpoint (Ozdemir, Cubukgil, and Xia, 2014). Ozdemir, Cubukgil, and Xia (2014, p.259) define economic capital as the amount of equity capital needed to guarantee that "the probability of default of the financial institution is low enough so that its debtholders are willing to extend credit to the financial institution". According to M. Prokopczuk et al., economic capital is determined by the amount of funds required to ensure bank's viability considering the most challenging scenario possible, in contrast with viewing economic capital as the mandated regulatory capital, or as the equivalent equity capital.[12] In this context, the Value at Risk (VAR) model is proposed as representation of the economic capital, accounting for market risk, credit risk and operational risk (Pires, 2015). The VAR can be defined as the level of capital needed to shield the bank from unexpected losses with a certain level of statistical confidence or probability over a certain period. (Hull, 2018).

$$RAROC = Adjusted\ Income\ /\ Value\ at\ Risk$$

The numerator identifies the adjusted expected return from one period financing, and could be computed with the following formula (Pires, 2015):

$$Adjusted\ Income = Spread + Fees - EL - OC * (1 - T),$$

where spread is the distance in basis point between bank's cost of debt (the funding cost faced by the bank for financing business operations) and credit interest rate (the interest rate earned on loans), fees is the amount charged for granting credit and providing the service, expected loss (EL) is the product between the exposure at default (the total value exposed to the default), the probability of default (PD, the likelihood that a borrower will default on their obligations within a specified time frame), and the loss-given default (LGD, the percentage of the total exposure that will be lost if the borrower defaults, after accounting for any recovery rate) and represent the anticipated loss over a certain period due to a default of an asset in the portfolio (Hull, 2018),

[12] According to Hull (2018), the Economic Capital (EC) is more conservative of the Regulatory Capital, as it is the result an institute's own estimate, based on internal models that could differ from those implemented for computing the regulatory capital. In this context, the Economic Capital, employed as a buffer able to absorb severe unexpected losses in one year time horizon, is consistent with the concept of Value at Risk (Hull, 2018). As prescribed by the Basel II/III/IV , the EC can be determined through a bottom-up approach, computing the required capital separately for each type of risk, for each type of business unit, aggregating to bank level, and finally allocating it back to each business unit, resulting in a diversification benefit (Hull,2018).

while finally operating costs (OC) is the costs paid by the banks for supporting the entire process of financing (Pires, 2015).

To synthesize the numerator, we could consider the revenues as the first two factors and deduct from it the expected losses and the realized costs. To conclude, RAROC can be summarized as a tool that guide directors in capital and portfolio performance management, in the process of deal acceptance/rejection criteria, and in assessing sustainable and valuable level of risk-taking. From this perspective, RAROC is not only exploited for performance analysis, but also for budgeting purposes, as the management can assess the returns provided by a business unit or a project and compare them with the level of risk they entail. This allows managers, considering how much each unit contributes to the overall risk of the bank, if the capital allocated to the unit is worth the risk.

3.4 RARORAC Theoretical framework

Considering both the return and the capital in a risk-adjusted way, the RARORAC goes a step further compared to RORAC and RAROC. Michetti (2013, p. 2) defines RARORAC as "an indicator measuring efficiency in value creation as a function of risk". According to Schwerdt and Von Wendland (2010) the RORAC and the RAROC don't capture entirely the risk profile of an investment or business unit of a financial institution, as they adjust for risk only the return or only the economic capital, not both simultaneously. On the other hand, the RARORAC combines RAROC and RORAC and consider in parallel the risk associated to the returns of an investments or a business division (the numerator) and to the economic capital distributed (the denominator) (Michetti, 2013). From this perspective the indicator facilitates the decision between mutually exclusive investment opportunities or allows to assess the economic outcome of each business division compared to its risk contribution. Michetti state "RARORAC rewards those enterprises operating prudent management and risk differentiation of their business, while it penalizes those showing a low asset quality due to the use of the leverage effect on returns in high-risk activities, or adverse selection situations" (p. 3).[13]

[13] According to Michetti (2013, p.3), neglecting multiple type of business risks, such as "social, political, regulatory, reputational, environmental, and other intangible risks" may trigger wrong managerial decisions.

3.5 RAPM Drawbacks

Literature ascertains some drawbacks of these indicators and is in part critical of them as a tool to measure performance. Firstly, it is difficult to calculate RAROC or RORAC as they strongly rely on internal data difficult to access and obtain. Consequently, the risk adjusted performance measures are widely used as an internal tool, but few studies have been found that uses risk adjusted performance to classify the banking sector and/or predict failures, highlighting scarce external implementation of these tools (Sharma, Shebalkov, & Yukhanaev, 2016). Moreover, it seems that these alternative metrics may be suitable for assessing statistical risk that derives from credit operations. Conversely, it may be less pertinent for assessing the value-at-risk (VAR), which remains an imperfect indicator of market risk, that derives from market-related operations (European Central Bank, 2010). Schroeck (2002, p.244) gives us hint about the how RAROC is static affirming "RAROC is a single-period measure, since economic capital is usually calculated at the one-year horizon, such as risk-adjusted return, which is also determined during such period". However, we must consider that many of the banking activities are officialized over multiple years, therefore a dynamic indicator is needed. On the other hand, computing RAROC on a multi-period basis could be very complex. This interesting issue has been studied in detail by Marrison (2002).

3.6 The role of RAPM in Banks' Governance

As assessed by European Central Bank (2010), in the context of corporate governance, embracing a comprehensive and long-term oriented indicator of performance may be the starting point towards enhancing the cooperation between the banks' executives' directors and shareholders, associated with the coherence among economic outcomes, business strategy and risk management issues. According to Young and O'Byrne (2001, p.6) the increasing relevance of value creation for the shareholder emerged from different social and economic pressures such as: "Globalization and deregulation of capital markets; the ending of capital exchange control; advances in information technology; more liquid securities markets; improvements in the capital market regulation; overall changes in saving and investing options; and, lastly, expansion of institutional investment". Perz (2010) highlights the reason behind the wide implementation of these indicator by commercial banks. The author identifies as main factors both the growing pressure from equity investors to optimize the value creation (mainly through higher efficiency) and dynamic expansion of bank conglomerates with specific business division considered as single profit centers. Pires (2015) underscore that, following the value-based management theory

of Young and O'Byrne, creating value for shareholders should be the managers' main objective, and that all performance indicators implemented by directors should be aligned with shareholders' objectives and interests. In this context risk-adjusted performance indicators could represent the right tool for financial institution to undertake business decisions that are in line with the maximization of the shareholder's value, providing information on a certain risk level borne by investors for a specific level of returns. Risk adjusted performance measures describe the return to bank' shareholders produced by an asset, or a division of the business, associated with the required risk capital. Comparing the RAROC to the cost of equity, which is also defined as the hurdle rate, enables a bank to assess if an asset or a division of the business is generating or destroying value for its shareholders. From this perspective, as Ozdemir et al. (2014) stresses, the RAROC can be considered as a fundamental indicator to guarantee that shareholders' value is maximized during the decision-making process (acceptance or refusal) of a deal. When a division specific RAROC is above the required rate of return, the division is creating value for equity investors. On the contrary, if a division specific RAROC is lower than the required rate of return, the bank's division is destroying value for equity investors (Zaik et al., 1996). However, according to Zaik et al. (1996) maximizing equity investors value means that a bank's all new investments exceed the cost of capital.

Ozdemir et al. stress that the risk-adjusted indicator could be exploited to design proper incentive system able to align interests between principals and directors. One concern that arise in this framework regards managers compensation: if directors are rewarded only according to ROE or RAROC results, they are likely to avoid value-enhancing investments that will decrease their compensation. To not encounter this issue and construct a proper incentive scheme for directors, performance should be analysed following the "residual income or economic profit of the activity" (Zaik et al., 1996, p.7). According to Zaik et al. "economic profit is calculated as earnings (net of taxes, interest payments, and expected credit losses) less a charge for the cost of equity capital" (p. 7). The primary aim of this computation is to present an indicator of the value added by a specific unit or operation. From this point of view directors' compensation incentives should be grounded on the value added related to a particular unit or operation. The concept of value added could also be helpful in determining additional subsequent expanding investment. Also, Saita (1999) links these indicators with incentive and compensation, differentiating

between situations in which RAPM measures synthesize all the elements that can be considered enough to assess performance and others in which other factors must be considered.[14]

3.7 Conclusion drawn from the Literature Review and Theoretical Framework.

After meticulously investigating the existing literature, and after carefully analysing the theoretical framework of both the traditional and the risk-adjusted performance indicators, the model is implemented to test the following hypothesis:

Hypothesis 1:

- Null Hypothesis (H0): *There is a significant relationship between return on risk-adjusted capital and stock price changes.*
- Alternative Hypothesis (H1): *There is no significant relationship between return on risk-adjusted capital and stock price changes.*

Hypothesis 2:

- Null Hypothesis (H0): *RORAC predicts stock price changes better than ROE.*
- Alternative Hypothesis (H1): *ROE predict stock price changes better than RORAC.*

4. Empirical Analysis

The empirical analysis aims to analytically investigate the relation between performance indicators, in particular RORAC and ROE, and understand which set of key metrics, if risk adjusted or traditional, better explain and predict the shareholder returns and is more related to the stock prices of the banks in the sample.[15] The Panel - Ordinary Least Squares (OLS), the methodology employed, is the regression analysis for our data sample and empirical analysis in this thesis.[16] The model comprises two independent variables, quarterly Return on Equity and

[14] On one hand, if the business division are judged because of used capital at risk, RAPM can be implemented properly as performance indicator to settle compensation. On the other hand, if capital at risk is determined by the directors, the division is evaluated on distributed capital at risk, and not on the exploited one, influencing the reliability of the RAPM measure. (Saita, 1999).

[15] In this study, stock prices and stock returns are assumed to be a reliable and direct proxy of shareholder returns. In this context, De Wet en Du Toit (2007) conclude that return on equity does not show significantly strong relationship with shareholder returns and shareholder value creation. From this perspective we enhance the literature by investigating not only traditional performance indicators but also risk adjusted ones.

[16] The regression analysis was performed using Python.

Return on Risk-Adjusted Capital, and one dependent variable, quarterly stock price percentage change. Additionally, several control variables are incorporated in the model to account for potential confounding factors that may affect the relationship between the independent and dependent variables. By incorporating control variables into the model, I aim to enhance the accuracy and robustness of the regression analysis, and to rule out eventual interferences of these variables with the relationship between independent and dependent variables. These control variables were chosen based on theoretical considerations with the objective to neutralize the influence resulting from market variables and market forces.[17] For instance, the Beta is inserted to neutralize the systematic non-diversifiable market risk related to stock returns; the local benchmark index, which is the S&P 500 for US-listed stocks and EURO STOXX 50 for EU-listed stocks, is added to account for specific positive or negative market trends that could indirectly or directly affect stock performance.

The Panel-OLS regression is a statistical method used to estimate the relationship between the dependent variable and one or more independent variables by minimizing the sum of the squared differences between observed and predicted values (Vidoni & Politecnico di Torino, 2023). In our model, we seek to understand how changes in ROE and RORAC impact the stock price of the examined banks, and which set of performance measure is a better predictor of the shareholders' value. The set of variables implemented in the model also includes several control variables related to the bank's profitability, solvency, and market value. Because of numerous predictors executed in the regression, it is fundamental to verify for multicollinearity exploiting the Variance Inflation Factor (VIF). This measure summarizes how much the variance of a regression coefficient is enlarged due to the collinearity among the independent variables.[18] In this analysis, multicollinearity is not a severe issue as the VIF (Appendix E.) are all around one and two and do not exceed the threshold. Consequently, there is no need to correct for multicollinearity. In the Appendix C. the Panel-OLS regressions is provided with its estimation

[17] The most relevant control variables are: Beta, to neutralize market risk related to stock returns; local benchmark index, which is the S&P 500 for US-listed stocks and EURO STOXX 50 for EU-listed stocks, to account for specific positive or negative market trends that could indirectly or directly affect stock performance; interest rates, which strongly influence the financial institution business as a whole, considering separately the interest rates set by the Federal Reserve (Fed) for US based banks, commonly known as the "Federal Funds Rate", and those set by the European Central Bank for European based banks, where the main interest rates are known as the "main refinancing operations rates"; Net income to account for the operating profitability of the bank, in particular the full year net income is assumed to be equally split among the quarters; Market Cap, interpreted as the market value of equity and a proxy of the size of the financial institution.

[18] Values above ten are problematic and suggests that the independent variable is strongly correlated with other independent variables in the model, making difficult to assess the true effect of the predictor on the dependent variable.

summary, which is discussed in detail in chapter five of this thesis. Going further into details, the reader can find the specification of the model below. The equation of the model is the following:

$$SPC_{it} = B_0 + B_1\, ROE_{it} + B_2\, RORAC_{it} + B_3\, Beta_{it} + B_4\, NI_{it} + B_5\, LCR_{it} + B_6\, LBI_{it} + B_7\, IR_{it} + B_8\, \frac{D}{E_{it}} + B_9\, MC_{it} + \varepsilon_{it},$$

where SPC is the quarterly change in stock prices of bank *i* at time *t* and the dependent variable, ROE is the quarterly return on equity and one of the independent variables, RORAC is the quarterly return on risk-adjusted capital and the other independent variable, Beta is the measure of a stock's volatility in relation to the market and one of the control variables, NI is the quarterly net income and one of the control variables, LCR is the quarterly liquidity coverage ratio and one of the control variables, LBI is the quarterly performance of the local benchmark index and one of the control variables, IR is the quarterly interest rates and one of the control variables, MC is the market capitalization and one of the control variables, D/E is the quarterly debt to equity ratio and one of the control variables.

4.1 Data and Sample

Most of the relevant inputs for the model have been extracted from FactSet database and converted in an Excel file, including all the important basic information that build up the data summary which describe the general characteristics of the selected financial institutions, and the dependent, control and independent variables. In contrast to the target and the predictor variables, not all the control variables are collected from FactSet. For instance, the ECB interest rates and the US Federal Funds Rates, have been retrieved respectively from the official ECB database and from FRED database, assuming as proxy for UK based banks interest rates the US Federal Funds Rates. The Excel dataset includes all the data collected from FactSet by downloading income statements, balance sheets, regulatory capital, and “snapshot”, which include general data such as beta or market cap. As a result, the extensive Excel dataset consists of approximately 40 sheets that needed to be managed and reassessed to obtain the proper panel data with all relevant inputs and variables for the regression analysis.

FactSet provides both the annual return on risk weighted asset and the annual return on equity, however, for the sake of completeness and precision, the ratios of the former have been computed

exploiting the formula highlighted previously in the text, which divides the Net income by the Risk weighted asset, while the latter have been directly downloaded.[19] The resulting ratios match with those of the database, confirming the reliability of the method used to calculate the RORAC. Finally, the ratios are disaggregated in quarterly data to ensure a proper and linear comparison with quarterly stock price changes.[20] Despite the literature review introducing multiple risk-adjusted indicators, the empirical analysis includes only the RORAC, omitting for example the RAROC. The risk-adjusted return on capital indicator requires data collection from various disparate sources, which denote the same item differently or employ inconsistent terminology. This variability could have potentially influenced the calculations making them potentially imprecise. Additionally, RAROC numerator adjust the income for the risk, deducting from the returns the Expected Losses (EL), which are internally calculated using internal methodologies that vary across financial institutions and do not follow a specific universal model imposed by the regulators. Therefore, also from this point of view, this variability could have potentially negatively influenced the calculations making them inconsistent among the sample. Furthermore, the EL is not always publicly disclosed, nor is it commonly found in annual reports or risk reports that are usually published separately, further complicating its inclusion in the analysis. On one hand, for practicality, simplicity, and short-term alignment[21], the model could have assumed that the expected losses would have been equal to the realized losses, easily observable on the income statement and annual reports of the banks. This assumption hypotheses that the observed losses during the last fiscal year would have been the worst-case scenario also in the near future. In short time periods, expected and realized losses may be similar, especially under constant portfolio quality and stable market conditions. On the other hand, due to loss variability and unforeseen events, realized losses can deviate significantly from expected losses. For the same reasons, if we consider a long timeframe, as in our case, the difference between expected and realized losses can become substantial. Therefore, to not hamper the reliability of the study, and the consistency in the independent variable, I decided to focus solely on RORAC for its relative simplicity and availability of data. This way ensures a more feasible and transparent empirical examination, without losing any effectiveness of the analysis for the purpose of this thesis. The numerator, the net income, as highlighted above, is easily available

[19] Data have been collected and organized using Excel sheets. In cases where certain outputs were unavailable on FactSet, but the corresponding inputs were available, I utilized Excel to compute these outputs (e.g., Roe).

[20] Specifically, the annual ratios are assumed to be constant trough the quarters until the end of the year. Consequently, asset and liabilities included on the balance sheet, and shareholders' equity, are assumed to be constant through the year, while accounting for all the changes the last day of the fiscal year.

on the income statement and annual reports, while the denominator, risk-weighted asset, is provided by the FactSet database under the section “Regulatory Capital”. Avoiding making assumptions, enable the model to accurately evaluate how effectively capital is used relative to the risks assumed, reflects the true risk-adjusted performance, and provide also interesting insights into the risk management practices of the institution.

Beyond performance indicators, FactSet provide historical stock prices and stock prices changes, giving the user the possibility to customize the period, the timeframe, and the layout of the numbers. Quarterly percentage changes in stock prices are exploited to compare market returns with performance metrics.[22] In this framework, quarterly changes are preferred over annual changes because they deliver numerous advantages. Firstly, quarterly data offer more frequent update on the variable of interests, enabling a more detailed analysis of changes over time. This enlarged frequency provides us with an increased amount of data, improving the reliability of the model, and allowing for a more comprehensive and accurate analysis. Secondly, this frequency can highlight short-term fluctuations, market dynamics, and patterns that may influence the variables and may be missed when using annual data. Furthermore, quarterly intervals provide the right balance between capturing short-term fluctuations and maintaining a sufficiently long-time frame for meaningful analysis. Later in the document, the number of the entities in the sample is considered as one of the potential limitations. In this context, the quarterly data, enlarge the data available for the study, counterbalancing this possible limitation.

The sample includes thirty-five banks and financial institutions from both United States and Europe,[23] and the data are collected from the first quarter of 2014 to the last quarter of 2023, for a total of 10 year and 40 quarters. From the 35 banks selected, the data of 29 are implemented in the model, as some relevant inputs were missing or was not possible to obtain them from other datasets,[24] or computing them independently from the database was not sufficiently reliable. Although the sample size is apparently not extensive, I am confident that the 29 selected banks enable a representative and valid empirical analysis.[25] I am convinced that this could be the

[22] Percentage changes are utilized to enable an optimal comparison with performance indicators. Selecting absolute numbers could have been imprecise and unsuitable for this purpose.
[23] The list of the banks is provided in the appendix. Geographically, the sample is evenly balanced, with no disproportionate emphasis on American or European banks. Within the Europe, banks belong to most of the countries, ensuring diversity within the sample from this perspective as well.
[24] Some banks were not disclosing risk weighted asset, not enabling the computation of the RORAC.
[25] From this perspective, the absolute size of the sample is relatively interpreted as follows: when examining financial institutions, 29 is deemed sufficiently high for analysis. In a different context, such as the US and EU consumer goods industry, a sample size of 29 firms may not be considered sufficiently large.

opportunity to identify some interesting relationships during the covered period. The time range selected is considered optimal and enough to validate the results, as in 40 quarters multiple market scenarios happened. Banks faced different fluctuations in performance indicators and stock returns, consequently, from this perspective, the analysis is enhanced as we test the relation between the independent variables and the dependent variables in several market context.[26] The components of the sample have been selected without following any specific parameter or criteria apart from the geographic provenance and the status of being public and listed on a stock exchange.[27] Therefore, the sample shows variety in the basic characteristics of the banks, such as market cap, share price, debt over equity and dividend yield. Anyway, the regression analysis considers this variety and properly addresses it, also implementing several control variables. In the following section, the reader can get more technical insight regarding the sample and the financial institutions included in it. The data summary paragraph below, briefly introduce the main characteristics of the banks included in the sample.

4.2 Data Summary

The data summary, which has been assembled thanks to FactSet database, provide a broad description of the financial institution included in the sample (Appendix A.), at a certain point in time, namely at the closing date of 2023. The variables inserted in the study illustrate the market value, the profitability, and the solvency of each financial institution. The sample appears to be diversified from every variable inserted in the data recap, indeed the averages are influenced by numerous outliers. Interestingly, also those firm belonging to the same country seem to present different and contrasting features. Firstly, the Market Cap, or market value of equity, is considered as a proxy of size summarizing the price of the underlying security and the volume of share outstanding available to the market. The average Market Cap is around $86 billion. However, the sample values could be very different as the highest value is around $523 billion (JPM-US), while the lowest value is $7 billion (BMED-IT). From this perspective the sample, noticeably varies and differ. As regards the dividend yield, the sample average is around 5%, while the maximum is 8.9% (ISP-IT) and the minimum is 1.6% (SAB-ES). The comprehensive data summary is presented in the appendix, outlying the balance sheet characteristics, as total asset and liabilities, the market valuation multiples, as price to book and price to earnings ratios

[26] For instance, before the Covid-19, the interest rate environment was markedly different from the current one. In the former, interest rate fluctuated near zero, sometimes were even becoming negative. In contrast, in the latter case, we are witnessing high level of interest rate around 5% in US, presenting a completely a different scenario.
[27] Both commercial and investment banks have been considered for the study, and for those financial institutions that operate with both businesses, no separation has been made, considering the bank as a unique business division.

and earnings per share, the capital adequacy, as CET 1 and Tier 1 ratios,[28] and the profitability ratios, as ROE and ROA, and the efficiency metric.

5. Findings and Discussions

The followings paragraphs aim to present, interpret, and discuss the result of the empirical analysis. Further, implications and limitations of this studied are provided to assess the contribution of the thesis to the current literature and to stimulate future investigations and analysis of this relevant topic.

The starting point of the empirical research is a simple OLS regression (Appendix B.) model which inadequately explain the changes in stock prices within our sample, as evidenced by the low R-squared and Adjusted R-squared values. Specifically, ROE coefficient is significant and positive suggesting that an increase in ROE is associated with a positive change in the stock price. However, the RORAC coefficient is not statistically significant, as the p-value is well above 5%.[29] From this perspective it is important to consider additional variables or more advanced estimation methods to enhance the model. Consequently, a set of control variables are considered, and a panel data is built.

The Panel-OLS[30] regression (Appendix C.) present a moderate but still good level of explanatory power as approximately 51% of the variation in the dependent variables is explained by the independent variables included in the model, as indicated by the R-squared value of 0.5100 and the Adjusted R-squared of 0.5053.[31] The F-statistic of 116.69 and a p-value of 0.0000 implies

[28] As highlighted by Grant (2024), CET1 (Common Equity Tier 1) represents the first layer of regulatory capital, immediately absorbing losses. Tier 1 comprises CET1 and AT1 (Additional Tier 1), being the wider financial core. CET1 is a proxy of bank solvency, indicating the capital strength. Tier 1 capital is formed as CET1 plus AT1. CET1 includes a bank's core capital, and common shares, retained earnings, and other comprehensive income.
[29] The results regarding the independent variables are properly discussed and interpreted in the next regression as are similar and have similar implications.
[30] The Panel-OLS regression incorporates fixed effects to account for individual-specific characteristics of each bank over time that could influence stock price movements. Through this approach the model can correct for unobserved heterogeneity among financial institutions, essential for obtaining more accurate and reliable insights into the relative effectiveness of ROE and RORAC in explaining stock price changes within our sample of banks. Pooling, on the other hand, would treat all the financial institutions as if they have the same underlying characteristics, eventually leading to biased estimates, especially when dealing with a diverse sample consisting of multiple banks with unique operational contexts. In addition, this first Panel-OLS does not correct multicollinearity.
[31] The Adjusted R-squared is not included in the appendix but has been calculated with Python.

that the model is statistically significant and at least one coefficient is different from zero: the F-statistics is also robust to model specification errors. Although the F-test for Poolability has a high p-value of 0.9219, suggesting that there are no significant differences between entities and revealing that the poolability of the model is acceptable, the model incorporates fixed effect. Focusing on the variables, the ROE coefficient, as before, is statistically significant (p-value = 0.0010), suggesting that increases in ROE are linked with an increase in stock prices. This result is predictable as the ROE represent and synthetize the traditional set of performance indicators, which are exploited from several decades from regulators and potential investors to evaluate, both backward and forward-looking, the profitability of a company and the value that it could deliver to its shareholders. Consequently, this metric has been, and will be, considered for years a relevant factor during the investment or disinvestment decision making process,[32] significantly reflecting the movement of the stock prices of the financial institutions within the sample. Furthermore, the ROE can be defined as an accounting-based performance indicator as it is computed by extrapolating from the income statement the inputs of its formula. Most of the investors follow the fundamental value strategy, which aims at identifying the intrinsic value of the listed company. In this context, the investigation of the balance sheet and its accounting performance metrics is relevant to pursue the purpose of the fundamental value strategy and contribute to explaining the rationale behind the positive and statistically meaningful ROE coefficient resulting from the Panel-OLS. From this perspective, the Net income constitutes a substantial portion of the return associated with the ROE, serving as the numerator of its formula.[33] Companies report their earnings to the market on a quarterly basis. These reports can largely influence the stock price depending on if they succeed or fail to meet investors and analysts' expectations. Therefore, one would expect this independent variable to exhibit a statistical significance and a positive relation to stock price changes.[34] Despite the soundness of this reasoning, the p-value equals 0.1192. This outcome can be clarified recalling one underlying assumption of the sample, namely that yearly net income is evenly distributed among quarters. However, earnings can fluctuate during the year depending on numerous factors and on the general economic environment: these fluctuations can be heavily reflected in the stock price due to the same rationale highlighted above regarding market expectations. Leving out these

[32] In our context, investment and disinvestment refer to buying, accumulating, and selling shares in the stock market.
[33] ROE is the ratio between Net income and shareholder equity of the year before.
[34] In the financial markets is quite common to observe an upside trend in the stock price of a company which has beaten the expectation of the analyst, and vice versa.

fluctuations could be the reason why the relationship between Net income and stock price is not significant.

On the other hand, the RORAC coefficient is not statistically significant (p-value = 0.2823), indicating that variations in RORAC are not significantly associated with changes in stock prices. The deviation of this outcome from the initial study expectation is noteworthy. Initially, it was anticipated that RORAC, which summarize in this Panel-OLS the set of risk-adjusted performance indicators, would be more representative than ROE in assessing the bank's ability to generate returns and value for its shareholders.[35] This anticipation stemmed from the fact that RORAC accounts for the risk investors engage in when investing in the assets that generate returns, being more comprehensive and accurate than accounting-based ratios such as ROE and ROA. However, this expectation is not observed in the Panel regression results.

The absence of statistical significance in the relationship between RORAC and stock price change could be caused by the sample size, therefore a larger sample size might be necessary to detect a significant relationship, or by potentially omitted variables, therefore there could be some other significant variables impacting the change in banks' stock prices that were not included in this regression model. However, from this perspective, the lack of statistical significance does not threat neither the reliability of the model nor the theoretical background introduced the first section of the thesis.[36] A possible interpretation of this outcome is that RORAC, and in general RAPM, has not yet been fully integrated into investment decision-making processes and therefore is not fully priced by the market. Consequently, it does not directly mirror the market fluctuations in the stock prices of financial institutions within the sample. Access to Risk-Adjusted Performance Measures is not as straightforward as access to ROE, as the former are often computed through internal procedures and not always publicly disclosed in the market. Moreover, their interpretation is not as immediate and transparent, and require a knowledgeable interpretation and understanding. Furthermore, risk-adjusted performance indicators are closely linked to intrinsic risk characteristics of the financial institutions, and are based on internal risk assessment, which are considered by regulators rather than by market dynamics. In this scenario, exploiting the risk-adjusted indicators in the financial

[35] Recalling that in this study, changes in the stock price is assumed to be a proxy of shareholders' value.
[36] The RORAC, and the RAPM in general, still can be interpreted as being more comprehensive and accurate ratios than accounting-based metrics, such as ROE and ROA, in delivering relevant information upon the profitability of the bank to stakeholders.

market context can became common during financial crises or turbulent economic environments, replacing traditional performance metrics, and gaining relevance in the investment process of investors and stakeholders.

As regards the other variables, such as Beta 5Y average and Market Cap, they show varying levels of significance.[37] For instance, Local benchmark index has a p-value of 0.000, indicating a statistically significant relationship with stock prices. This result is particularly expected given that the average beta of the sample is around 1.2, pointing that the stocks tend to move simultaneously with the market. Additionally, there is a high correlation between stock prices and the Local Benchmark Index, as shown in the correlation table in Appendix D. Generally, stocks are highly influenced by the market conditions and as consequence by the changes in price of the local benchmark index: this explains the reason why of the statistically significant relationship between the control variable with the stock prices changes.

Those control variables, such as Interest rates, Liquidity Coverage ratio, and Leverage Ratio that are more related to the risk-adjusted returns and to the financial institution peculiar business,[38] and that are expected to have at least a slightly significant relationship with stock prices of the banks within the sample, have instead a high p-value, and therefore not a meaningful statistical association with the dependent variable. This finding is in line with what previously discussed and observed in the RORAC coefficient and p-value. In this context, these factors rarely are accurately priced from the market, and therefore, they are not fully reflected in the stock performance, as they only indirectly influence the bank's stock value. However, I deemed important to add these control variables in the model because of the relevance and the impact they have in the banks specific business, as highlighted in note 30. Interestingly, observing correlation table (Appendix D.) we can notice that correlation factors are low among all the combinations, unless between the two predictors of interest, and between the dependent variable and local benchmark index, as pointed out above. Intuitively, the two main predictors are computed through similar formula, indeed the numerator is equal, while the denominator start from the same ground, therefore some degree of correlation was expected. Not surprisingly,

[37] Intuitively, the Market Cap is the value of a single share, times the volume of shares outstanding in the market. Therefore, is strictly related to the stock price changes. This explains the significant and positive relationship.
[38] Specifically, banks are heavily exposed to interest rates as their profit are obtained mainly through financial intermediation by borrowing and lending money, and through the net interest margin, which is the difference between the interest earned on assets and the interest paid on liabilities. Moreover, interest rate can impact the balance sheet by affecting the market values of Assets and Liabilities. Therefore, banks must monitor and manage liquidity and credit risk.

liquidity coverage ratio (LCR) and leverage ratio are negatively correlated, as the because the strategies to increase one can decrease the other. Maintaining sustainable levels of LCR requires substantial reserves of high-quality liquid assets (Hull, 2006), which are less risky and thus reduce leverage.[39] Conversely, increasing leverage often implies taking on more risky and less liquid assets, decreasing the LCR. This trade-off reflects the balance the banks must maintain between liquidity, risk, and profitability. To conclude, these findings have an impact on the current literature that is assessed in the next paragraph.

5.1 Implications

The findings of this thesis have multiple noteworthy implications for various stakeholders in the banking industry, including bank management, investors, and regulators.

The research emphasizes the relevance of incorporating risk-adjusted performance measures in assessing financial institution performance. Accounting-based metrics like Return on Equity or Return on Assets, while valuable and representative of the bank' profitability, do not consider the risk exposure of banking operations and investments. By adhering to RAPMs such as RAROC and RORAC, bank managers can secure a more complete understanding of their firm's risk-adjusted profitability. This can improve decision-making phases associated to lending, investment, budgeting, and risk management monitoring and implementing strategies. Banks should improve their risk management models by embracing RAPMs more extensively, adjusting for example more regularly the capital allocation. Furthermore, financial institutions should enhance the transparency, delivering more detailed disclosure on their risk-adjusted metrics and their computational processes. In this context, the lack of significance in the relationship between the RORAC and the stock price changes, do not undermine the relevance of RAPMs as driver of shareholders' value. Even if not correctly priced by the market, risk-adjusted metrics are a robust and reliable set of instruments at the disposal of banks' management for benchmarking risk-adjusted performance against industry standards and peers, producing properly informed decision-making, and enhancing transparency and regulatory compliance.

This thesis provides useful insights for potential investors aiming to estimate the financial health and performance of banks. Traditional performance metrics, non-mirroring the underlying risk

[39] Due to the sub-prime financial crisis, new regulations have been issued, such as Basel III, which have incentivized banks to respect a threshold level of liquidity coverage ratio.

framework, eventually lead to suboptimal or inappropriate investment decisions. Investors can exploit RAPMs to make more informed decisions, thereby optimizing their investment portfolios and enhancing returns. This shift towards risk-adjusted analysis is in line with the broader objective of maximizing shareholder value. From this perspective, regulators and policymakers should encourage not only banks but also potential shareholders to adopt RAPMs within the banking sector. By promoting transparency and better risk management practices, RAPM enable stakeholders to have access to more comprehensive and precise information. The study contributes to the academic literature by empirically appraising the efficacy of RAPMs in evaluating bank performance. It unlocks the course for future studies to investigate the integration of these indicators with other traditional performance ratios. In this context, aligning incentive structures and compensation schemes for the management (i.e. board of directors) and employees with RAPMs, can stimulate the decision-makers to integrate into the strategic planning a balanced concern between profitability and risk. These considerations are in line with the bank' sustainable growth and long-term orientation, two fundamental pillars for promoting the shareholder value creation. In this framework, the lack of statistical significance in the relationship between the RORAC and the stock price changes, do not undermine the relevance of RAPMs as driver of shareholders' value. Even if not properly priced by the market, RAPMs are still a solid and valid set of tools at the disposal of investor when considering a potential equity contribution. Indeed, RAPMs can deliver insights into the efficiency and prudence of the investment strategies employed, ensuring that the returns align with their risk tolerance and investment goals.

To conclude, during the literature review, it has been noted that there is a large volume of papers describing RAPMs and their theoretical implications, but few conducts empirical analyses to derive practical implications or to extrapolate the benefits of their application for stakeholders of banks. Furthermore, the few empirical studies that exist are not primarily focused on Western countries such as Europe and the USA, but rather on regions such as Asia or Africa, or on individual countries within these regions. Therefore, this study can contribute to the current literature by providing one of the first investigation that aims at determining how the embracement of risk-adjusted performance metrics supplies a more nuanced and accurate assessment of bank performance, in line with the objectives of shareholder value maximization and value-based management. By reducing the gap between traditional metrics and risk management, this study examines how the RAPMs can provide a solid structure for determining

the true performance of financial institutions in a dynamic economic environment and opens also the gate for further analysis.

5.2 Limitations

The limitations of this study have not compromised the validity and the reliability of its results, and do not threaten its potential contribution to the literature. Nevertheless, acknowledging the limitations of this investigation may suggest and stimulate new and future empirical research, which can in turn enrich the existing literature.

Firstly, the main drawback of this study is the sample size. Augmenting the number of financial institutions in the regression, adding from ten to thirty entities for example, could enhance how the model fit the data and yield more significant results, potentially resulting in a clearer appreciation of the relationship between the predictor and the target variables. From this perspective, the current sample is diverse in terms of general characteristics and potentially representative of the global banking population: expanding the number of banks would have implied to include smaller financial institutions, complicating the data collection due to the limited availability of information on risk-weighted assets and regulatory capital. However, the data collected focuses heavily on a group of banks operating within Western economic contexts, adhering to specific regulations related to their operational headquarters, and sharing similar corporate governance structures, such as Anglo-American or European ones. From this point of view, the model could benefit not only from just a random expansion but also by including financial institutions from Eastern world or South American economic environments. Consequently, the outcome of the regressions could be strengthened in terms of significance, providing more comprehensive insights into risk-adjusted indicators as predictors of changes in stock prices. To conclude, would be interesting to develop a model focusing on financial institutions from a specific region, again for example including only Eastern banks, compare those results with these one, and ultimately build a unified model with an integrated sample.

An ulterior possible point of discussion of this study regards the period of the data in the model. The selected data frame of ten years, from 2014 to 2023, includes time frames of economic stability and global crises, such as the COVID-19 pandemic, which caused a significant spike in interest rates because of a skyrocketing inflation, and the subsequent Russo-Ukrainian conflict, which triggered multiple disruption in the supply chain of energy. On one hand, this specific

time frame allows for the analysis of banks' financial performance across different economic scenarios and market trends. On the other hand, constructing a model grounded on such a diverse timeframe might yield less reliable results due to fluctuating and inconsistent data. These variations in data, are triggered by banks' operational responses to different macroeconomic scenarios, and have delayed consequences on performance indicators, not synchronised with the origin of their implementation. In this framework, centring the study on a shorter period, not characterized by extreme fluctuations, could refine the reliability and significance of the results, returning outcomes more representative and indicative of the relationship between the independent and the dependent variables. Additionally, model improvements might be even more pronounced in a data frame centred during a financial crisis period, where risk and solvency indicators are usually under the spotlight of regulators, and under continue review. Consequently, risk-adjusted performance indicators could be more closely scrutinized by investors, resulting in a more significant relationship as predictors of stock price changes.

Furthermore, some observations and reflections can be made regarding the model's variables. While ROE is the most reliable accounting-based performance indicator, effectively representing the traditional set of performance indicators, in the model can be enriched by introducing also the RAROC. Although both RORAC and RAROC are risk-adjusted performance measures, RAROC presents unique characteristics, especially in the numerator of its formula, which could improve the model's significance. RAROC adjusts net income for expected losses, providing a more precise metric of potential bank division performance. However, computing the expected losses can be remarkably challenging, as they are not always disclosed by banks in reports or annual statements, and they are derived from internal models, which may also vary between institutions. This study could have assumed expected losses to be equal to realized losses, which are easily observable in annual reports ad income statements. Nevertheless. this assumption would have simplified the RAROC in a way that it would have been like the RORAC. These last observations represent an additional limitation of this thesis that could stimulate future empirical analysis. To conclude, a new model could also consider replacing RORAC with RAROC or other RAPMs, maintaining two predictor variables of interest and one target variable, considering that the control variables seem solid and adequate and do not seem to require any substitution or addition.

Lastly, rather than a limitation of this study, I would highlight a two potential improvement that were not necessary in this thesis. Because of numerous predictors executed in the regression, it

is fundamental to verify for multicollinearity exploiting the Variance Inflation Factor (VIF). On one hand, in this analysis, multicollinearity is not a severe issue as the VI factors are all around one and two and do not exceed the threshold. On the other hand, it could be important to address the multicollinearity even if it impacts only partially the regression result. Consequently, the Frisch-Waugh-Lovell (FWL) theorem could be implemented. The FWL theorem simplifies the estimation of coefficients in multiple regression models and represents a method to isolate the effect of a subset of explanatory variables on the dependent variable, controlling for the presence of other variables (Davidson et al., 2004)[40]. Even when Variance Inflation Factors (VIFs) are low, using the FWL theorem can still be beneficial for clarity and interpretation. It aids in understanding the unique contribution of each variable to the dependent variable, simplifies the model, and enhances statistical robustness, ensuring that the estimated effects of ROE and RORAC are not confounded by the presence of other control variables and providing in this context a clearer understanding of the determinants of bank performance. Furthermore, in this analysis, heteroscedasticity[41] is not a severe issue as computed by implementing the Breusch-Pagan (BP) test. On the other hand, it could be important to address the heteroscedasticity even if it impacts only partially the regression results. One potential improvement of this study is to implement a model that corrects for the heteroscedasticity, as the Generalized Least Squares (GLS), which is a model used to address heteroscedasticity by transforming the data such that the modified error terms have constant variance, providing unbiased estimates. Another way to account for heteroscedasticity is the robust standard errors that adjust the standard errors of the regression coefficients. The latter is easier to implement rather than the GLS model but do not necessarily improve the efficiency of the coefficient estimates as GLS does.

6. Conclusions

Traditional measures, such as ROE and ROA, commonly employed as the main methodology to evaluate banking performance, are accounting-based and rely on items from financial statements. While these categories of indicator have numerous advantages, including ease of computation

[40] Through the FWL theorem the coefficients of a subset of the predictors can be obtained by regressing the residuals collected by regressing the dependent variable on the control variables and the predictors of interest on the control variables (Frisch et al., 2021).
[41] Heteroscedasticity emerges when the variance of the errors in a regression model is not constant, which can undermine the statistical results obtained from the study.

and reliance on available historical data, they also present some limitations. Traditional indicators do not provide a comprehensive view of performance, ignoring the risk undertaken for a specific level of return. Therefore, the so-called Risk-Adjusted Performance Measures have manifested as reliable tool. The application of risk-adjusted performance measures reflects a growing recognition of the importance of risk management in banking operations. Banks that properly manage risk exposure not only protect themselves from eventual losses but also favour sustainable growth, enhancing shareholder value. Risk-adjusted performance metrics embody this dynamic by providing a metric that balances return and risk, supplying a more accurate reflection of a bank's performance in the context of its risk profile. Therefore, not only internal management and equity investors but also external institutions are strongly interested and involved in the implementation of these alternative metrics. The economic literature extensively discusses issues associated with the implementation of the risk-adjusted performance measures to evaluate the efficiency of businesses, including banks. However, only few investigates the application of this set of performance metrics within market dynamics or aims to derive practical implications or seeks to extrapolate the benefits of their application for banks stakeholders. Consequently, this study opens the gate for future research, and intends to contribute to the current literature by offering one of the first research that assesses how the embracement of risk-adjusted performance metrics supplies a more nuanced and accurate evaluation of bank performance, in line with the objectives of shareholder value maximization and value-based management. The absence of statistically relevant association between RORAC and stock prices motivate future research to find relevant and practical implications, given the strong theoretical foundation.

This study contributes to the literature by delivering empirical evidence on the role of RAPMs in determining bank performance. This thesis aims to investigate the effectiveness of risk-adjusted performance measures such as RORAC, RAROC, RARORAC, compared to traditional performance metrics like ROE in predicting bank stock performance, and specifically quarterly stock price changes. The empirical research centred on a sample of 29 banks from the United States and Europe over a ten-year period divided in quarters, between 2014 and 2023. The findings underscore the consistent and stable relevance of traditional indicators like ROE while also pointing to the potential advantages of integrating RAPMs for a more nuanced evaluation of financial institutions. On one hand the empirical analysis confirmed that ROE remains a statistically significant predictor of stock price changes, consistent with its long-standing use in financial analysis. This aligns with the fundamental value strategy where investors rely on

accounting-based metrics to assess a company's profitability and make investment decisions. On the other hand, contrary to expectation, the lack of significance of RORAC did not show a statistically significant relationship with stock price changes in the regression analysis. This could be attributed to the limited sample size or the incomplete integration of RAPMs into market practices. Additionally, the less straightforward interpretation and the internal nature of the model and procedure used to compute RAPMs, may hinder the visibility and the use among investors of this set of performance indicators. Furthermore, some control variables, such as the Local Benchmark Index, showed significant relationships with stock prices, highlighting the strong influence of market conditions on bank stock performance. However, other control variables like Interest Rates and Liquidity Coverage Ratio did not exhibit significant associations, suggesting that they may not be fully reflected in stock prices and investment decision-making process from investors. From this perspective, this result confirms the null or incomplete integration of RAPMs into market practices. Moreover, it is important to underline that certain variable, centred on the risk orientation of the bank, are less commonly disclosed or complex to find as not included in the most easily available document, such as the income statement. Despite the lack of significance of RORAC, RAPMs can still represent a well-founded set of tools at the disposal of various stakeholders in the banking industry, including bank management, investors, and regulators. Specifically, RAPMs can deliver insights into the efficiency and prudence of the investment strategies employed, ensuring that the returns align with their risk tolerance and investment goals. Financial institutions should continue to consistently consider risk-adjusted indictors while evaluating investment alternatives or budgeting decision-making processes. Banks' management should be concerned about these measures as their implementation can directly and indirectly stimulate investors to properly price risk exposure into financial markets and markets dynamics.

The conclusions of this study do not suggest that RAPMs are not valid predictors of bank stock performance, despite the findings of this empirical analysis. The limited literature available on the subject, and the lack of additional studies that support or refute the results obtained here, imply that further research is necessary to precisely and confidently determine whether RAPMs can be considered effective predictors of bank stock performance. Nonetheless, the results of this empirical analysis reject both null hypotheses previously formulated in the thesis, indicating a greater complexity in integrating these tools into market valuations, and pointing out that there is no significant relationship between RAPMs and stock price changes and that RORAC does not predict stock price changes better than ROE.

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Appendix

A. List of financial institutions

Intesa Sanpaolo; UniCredit; Wells Fargo; BNP Paribas; Banco Santander; Banca Mediolanum; Deutsche Bank; ING Groep; Credit Agricole; Nordea Bank Abp; Caixa Bank; DNB Bank; JPMorgan Chase; Morgan Stanley; Banco de Sabadell SA; UBS Group; HSBC Holdings; Goldman Sachs Group; Societe Générale A; Danske Bank; Bank of America; Citigroup; Banco Bilbao Vizcaya Argentaria; State Street; Capital One Financial; M&T Bank; Fifth Third Bancorp; U.S. Bancorp; PNC Financial Service Group

B. OLS Regression Results: Simple Regression

	Dependent variable: y_simple	
RORAC	0.1	
	(0.18)	
ROE	0.25**	
	(0.11)	
Constant	-1.07	
	(0.87)	
Observations	1,160	
R2	0.01	
Adjusted R2	0.01	
Residual Std. Error	15.67	(df = 1157)
F Statistic	5.90***	(df = 2; 1157)
Note:		*p<0.1;**p<0.05;***p<0.01

C. Panel-OLS Regression Results: Estimation Summary

Panel-OLS Summary	
Dep. Variable	Price Change
No. Observations	1160
R-squared	0.5100
R-squared (Within)	0.5100
R-squared (Overall)	0.2372
Log-likelihood	-4425.6
F-statistics	116.69
P-value	0.0000
F-statistics (robust)	116.69
P-value	0.0000
Distribution	F(10,1121)
Time Periods	40
Entities	29

Dependent variable: Price change					
Parameter	Std. Err.	T-stat	P-value	Lower CI	Upper CI
Constant	353.89	0.2054	0.8373	-621.67	767.04
ROE	0.1515	3.3137	0.001	0.2047	0.7992
RORAC	0.3423	-1.0758	0.2823	-1.0398	0.3034
D/E	0.0651	1.8527	0.0642	-0.0071	0.2483
Market Cap	3.983E-05	2.3562	0.0186	0.0000157	0.0002
Int. R.	0.3535	-0.8577	0.3912	-0.9969	0.3904
Liquidity Cov. Ratio	0.0215	0.1531	0.8783	-0.0389	0.0455
Net income	0.0005	-1.5594	0.1192	-0.0002	0.0002
Local Benchmark Index	0.0378	30.854	0	1.0916	1.2398
Quarter	0.2968	0.4196	0.675	1.3232	2.4888
Year	0.1764	-0.2656	0.7906	-0.393	0.2993

F – test for poolability	0.6465
P-Value	0.9219
Distribution	F(28,1121)

D. Panel-OLS: Correlations

	Price Change	ROE	RORAC	Local Ben. Index	Net income	Liquidity Cov. Ratio	Market Cap	Int. R.	D/E
Price Change	1.000	0.099	0.072	0.691	0.043	0.003	0.046	0.001	0.056
ROE	0.099	1.000	0.596	0.040	0.270	0.229	0.105	0.231	0.047
RORAC	0.072	0.596	1.000	0.086	0.243	-0.060	0.399	0.241	0.375
Local Ben. Index	0.691	0.040	0.086	1.000	0.040	-0.005	0.048	0.037	0.078
Net income	0.043	0.270	0.243	0.040	1.000	-0.231	0.404	0.183	0.238
Liquidity Cov. Ratio	0.003	0.229	-0.060	-0.005	-0.231	1.000	-0.318	-0.009	-0.593
Market Cap	0.046	0.105	0.399	0.048	0.404	-0.318	1.000	0.114	0.207
Int. R.	0.001	0.231	0.241	0.037	0.183	-0.009	0.114	1.000	0.137
D/E	0.056	0.047	0.375	0.078	0.238	-0.593	0.207	0.137	1.000

E. Panel-OLS: Variance Inflation Factors

Variable	VIF
Constant	953,502.28
ROE	1.997
RORAC	2.390
Beta 5Y	1.346
D/E	1.996
Market Cap	1.758
Int. R.	1.939
Liquidity C. Ratio	2.137
Net income	1.374
Local Ben. Index	1.055
Quarter	1.023
Year	1.939

Sustainable Development Goals (SDG) Statement

Through the research conducted for this master's thesis, I seek to contribute to one or more of the 17 SDG(s) set forth by the United Nations (https://www.undp.org/sustainable-development-goals). Specifically:

SDG Code(s): 8

The research of this master thesis will contribute achieving goal number 8 regarding decent work and in particular economic growth as it will increase the transparency between investors and financial institution. Specifically, RAPMs, considering the real risk assumed respectively for a determined level of performance, enhance the information available to shareholders and investors while carrying the decision-making process. In this context, the study favours a better allocation of financial resources that will contribute to the economic growth and to the development of the financial markets. In addition, the conflict of interest and the information asymmetry between directors and shareholder, within the context of financial institution, will be significantly reduced: shareholders will have the possibility to incorporate in their investment strategy more detailed information about the risk of the bank to make the soundest investment decision, while the management can be stimulated towards a long-term orientation and sustainable growth, favouring the creation of shareholders' value. Because of larger transparency, the results of the study will strengthen the capacity of domestic financial institutions to encourage and expand financing from local investors.