MERGERS AND ACQUISITIONS BANK STRATEGY AGAINST SYSTEMATIC RISK BEFORE THE COVID-19 PANDEMIC

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Abstract

This study examines the relationship between the reduction of systematic risk and mergers and acquisitions (M&As) only in the Greek banking system. We have to mention that Adam et al. (2012) analyzed and estimated the time-varying betas of the banking sectors in eight advanced markets but they did not find strong evidence of declining systematic risk before the recent financial and sovereign crises, in contrast to our own work which deals with the systematic risk of banks in emerging economies. This research aims to investigate if the Greek systemic banks reduced the systematic risk after the main wave of M&As that started and completed soon after the international financial crisis of 2009, but before the new financial crisis that the COVID-19 pandemic brought in Greece. The purpose of this monograph was to examine the impact of systematic risk (Beta b) from those M&As. Our findings were extracted from multiple linear regressions using the capital asset pricing model (CAPM) and showed that the reduction of systematic risk succeeded after M&As that took place in the Greek banking industry after the international financial crises but before the COVID-19 pandemic. For this reason, maybe in some other economies mainly in Europe, the banks would follow the same strategy of M&As to reduce their systematic risk.

Keywords: Banks, Mergers and Acquisitions, Information and Market Efficiency, Financial Crises

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1. INTRODUCTION

The banks are a basic tool of the economy and their development indicates the development of the economy itself and therefore of the whole country. Global financial crises usually primarily affect a country's banking sector and lead to mergers and acquisitions (M&As) to strengthen domestic banks, so that they would be able to face potential financial distress, which may lead to insolvency, bankruptcy, or an aggressive takeover by abroad.

M&As have always played an important role in the global business economy because they facilitated the rationalization of the assets of the merged companies for the purpose of potentially increased synergistic profits with lower risk at the same time, so that the markets could better reward the shareholders of these merged companies (Tanna & Yousef, 2019). In the case of guaranteed loans, if the borrowers go bankrupt, the banks do not take into account the resulting loss as well as the external effect that occurs on the economy in general in a systemic crisis. For risk management, transfer pricing and strategic capital allocation, banks should analyze losses at both the company and group level (Acharya et al., 2016). In order for investors to maintain efficient and diversified portfolios, the correlation between acquired investment securities should be considered mainly with models of asset pricing, capital allocation, risk management and option pricing and hedging, so as to reduce systematic risk (Skintzi & Refenes, 2005). The M&A risk management model is used to identify and manage the risks arising from the M&A processes so as to maximize the probability of success in M&As by managing and reducing the risks associated with the M&A activities. The approach of the M&A risk management model is divided into two steps: 1) risk identification and 2) risk quantization (Chui, 2011). This study is focused on domestic banks' M&As in the Greek banking industry and tries to answer the research question that concerns whether M&As of the Greek systemic banks helped the acquiring banks to decrease their systematic risk soon after the global financial crisis before the COVID-19 pandemic. The year 2013 was a landmark year for the Greek banking system as the four Greek systemic banks were created after acquisitions of smaller Greek ones, as well as branches of foreign banks that became operational in Greece. The four Greek systemic banks still are Piraeus Bank, Eurobank, Alpha Bank, and National Bank of Greece. The empirical part of the article mainly deals with the estimation of the capital asset pricing model (CAPM) for the four aforementioned systemic banks. The share prices of the four Greek systemic banks listed on the emerging Athens Stock Exchange (ATH) market are also analysed. In this paper, we advanced an empirical application of the CAPM model, focusing on the behaviour of Greek systemic banks 1) shortly after the invasion of the financial crisis in Greece, during the great wave of M&As, 2) during the year of completion of the main volume of their M&As, 3) during the attempt to integrate the target banks by the acquiring banks and 4) in the time period after the completion of the absorption of the target banks by the acquiring banks, which ended before the start of the COVID-19 pandemic. From our findings, we notice that M&As in the Greek banking sector took place probably according to the needs of Greek systemic banks to reduce their systematic risk, so as to be stronger against any future financial shocks and not to gain expansions. Our study concerns only an analysis of banks that operate in emerging markets and our main measurements can be summarized in four time periods as follows: 1) Beta during M&As in the Greek banking system three years after the global financial crisis (2010–2012), 2) Beta of the M&As in the Greek banking system in 2013 when most of them completed, 3) Beta after the completion of the important M&As in the Greek banking system (2014–2016), and 4) Beta after the absorption of all target banks three years before the onset of the COVID-19 pandemic (2017–2019).

The main contribution of this study is that we, to the best of our knowledge, provided results about reducing the systematic risks of the acquirers' Greek systemic banks after the global financial crises but before the COVID-19 pandemic with these comprehensive and empirical findings. We found out that the systematic risks gradually decreased according to a wide range of market Beta estimations, after M&As in the Greek banking industry.

The rest of the paper is structured as follows. Section 2 presents the relevant literature review, new estimators for Beta coefficient and the findings of other similar studies. Section 3 describes the methodology of the study. Section 4 analyses the results. Section 5 comments on the findings. Section 6 concluded the paper.

2. LITERATURE REVIEW

Systematic risk of the banks has been studied by many researchers in the financial literature. The issue of systematic risk becomes interesting after banks' M&As take place but we have to mention that there are not many studies of the recent past dealing with this specific topic.

Modern portfolio theory shows that investors are rewarded for the systematic risk of an investment and not for the total risk of an investment because total risk includes the firm-specific risk that can be eliminated in a well-diversified portfolio (Gardner et al., 2010).

In general, banks are subjected to a wide array of risks, but we can categorize them into three major categories: 1) financial risks, 2) operational risks, and 3) environmental risks, as illustrated in Table 1 below.

Table 1. Banking risks categories

Financial risks		***Operational risks***	***Environmental risks***
a) Traditional financial risks related to loss results	b) Treasury risks based on arbitrage & have profit results	Related to a bank's overall business processes & strategy	Associated with a bank's business environment
Balance sheet	Liquidity	Internal fraud	Country & political risks
Earnings and income statement structure	Market	External fraud	Macroeconomic policy
Capital adequacy	Interest rate	Employment practices & workplace safety	Financial infrastructure
Credit	Currency	Clients, products & business services	Legal infrastructure
Solvency		Damage to physical assets	Banking crisis & contagion
		Business disruption & system failures (technology risks)	All types of exogenous risks
		Execution, delivery & process management	

Source: van Greuning and Bratanovic (2020).

The systemic risk of banks due to acquisition is mainly estimated with marginal expected shortfall (MES). The MES measure was first proposed by Acharya et al. (2016). MES is calculated as the average return of a bank during the x% worst days for the market. Huang et al. (2012a, 2012b) extend the use of this model and measure the marginal contribution of each financial institution so that the premium paid to cover individual losses in a financial crisis includes the risk premium. Malz (2013) measures the systemic risk of financial institutions using probability-based measures of interdependence. Huy et al. (2021), in their research, provide evidence that the market risk tends to increase higher in the post-low inflation period, hence more risk management plans are needed to avoid systematic risk. Ferguson (2002) concludes that the potential effects of financial consolidation on the risk of individual financial institutions are mixed and that the net result is impossible to generalize. Caporale (2012) suggests that the risk was mispriced because the systematic risk was underestimated, as the banks took the highest leverage and risk at this time, while the expected risk was low. Bhattacharyya and Purnanandam (2011) conclude that financial markets were able to identify banks engaged in risky operations before the meltdown. Di Biase and D'Apolito (2012) found that the effects of intangible assets and loan loss provisions on banks' systematic risk, create conditions for systematic bank's opportunistic accounting behavior. Tanna and Yousef (2019) investigated the impact of global M&As on acquirer risk. Their overall findings show that acquirers' systematic risk and thus their cost of capital usually increase after a merger, but only in cases where pre-acquisition risk is relatively low relative to market risk. The systematic risk of acquirers is reduced when pre-acquisition risk is relatively high relative to market risk. Therefore, buyers with higher risk than the market could benefit from risk reduction through domestic M&As, while low-risk buyers would increase their risk accordingly. Van Oordt and Zhou (2016) find out that systematic risk under extremely adverse market conditions may have asset pricing implications. Song et al. (2011) found that the systematic risk is not fully reflected in the Beta. Singh and Bhatia (2014) found that the risk of banking shares is quite evenly distributed between systematic risk and unsystematic risk. It is also reflected in the values of their coefficients of determination which range from 0.4 to 0.6. Mandel (2015) revealed that the nature of market risk is global, i.e., these risks affect the entire investment market. He also mentioned that market risk is influenced by factors like economic conditions, political events, mass psychological factors, etc. and these factors cannot be predicted accurately. Mardini (2013) found that bank systematic risk is significantly and negatively correlated with a bank's profitability, liquidity levels, and loan loss ratio. Rutkowska-Ziarko et al. (2022) using the CAPM model investigated the typical and mostly negative relationships between systematic risk measures and average returns for London Stock Exchange (LSE) listed firms/banks. They observed that the relationship between conventional Beta coefficients and realized returns is completely different in bull and bear markets and is significantly affected by the sign of LSE stock market returns. They even found that under some conditions, the value of the risk premium was positive and significant during periods of positive stock market returns, while the systematic risk premium was significantly less than zero during periods of negative stock market returns.

3. RESEARCH METHODOLOGY

Focusing on systematic or otherwise market risk, portfolio theory CAPM suggests that this element of total risk (= systematic risk + unsystematic risk) cannot be reduced by creating a portfolio of diversified stocks that are uncorrelated. Therefore, the main issue is whether M&As affect bidders' systematic risk, as reflected in the cost of capital (Beta) or the value of the bank. When the number of M&As increases, it is noticed that there is an increase in the finance and accounting complexity processes. For this reason, there appears an increase in the demand for information regarding target banks' financial soundness and solvency condition. Greece has four domestic systemic banks. These four systemic Greek banks are the following: Piraeus Bank, National Bank, Alpha Bank, and Eurobank. During the first three years of the financial crisis (2010–2012), a domestic wave of M&As took place in the Greek banking system and it was completed mainly by the end of 2013. The post-period of this wave of M&As time period was 2014–2016. Finally, the full integration of the acquired banks by the acquiring banks into the Greek banking system took place during the three years 2017–2019, which found the remaining Greek banks financially stronger and they successfully faced the new financial crisis caused by the pandemic. To test for changes in systematic risk (Beta) after M&As in the Greek banking system we introduce CAPM as a formal statistical model of security returns as other researchers did in the past. Systematic risk is measured by Beta (b). We define Beta (b) as a measure of sensitivity or correlation of a security or an investment portfolio to movements in the overall market. Wang (2021) in his study found that time-varying market risk (Beta) is an important indicator for diversification and confirmed that a conditional Beta-return relationship exists in the banking industry. Time-varying betas in banking are qualified as an indicator for dynamic diversification strategy-making. Systematic risk is the underlying risk that affects the entire market. The Beta coefficient relates general-market systematic risk to stock-specific unsystematic risk by comparing the rate of change between general-market and stock-specific returns. On the contrary, the unsystematic risk is a stock-specific risk that can be reduced by diversifying the invested portfolio.

The calculation for Beta is as follows (Kenton, 2024; Fama & French, 2004):

$$Beta(b) = \frac{Covariane(R_e, R_m)}{Variance(R_m)} \quad (1)$$

where, R_e is the return on an individual stock and R_m is the return on the overall market.

In conclusion about Beta, we can say that the Beta of stocks or bank portfolios measures the volatility of the securities compared to the overall volatility of market returns. It is used as an indicator of the systematic risk of a stock or portfolio compared to market risk. When Beta (b) is used as a proxy to measure the systematic risk of the stock or portfolio it takes the following values: 1) $b = 0$ the stocks or portfolios' returns are uncorrelated with the returns of the general stock exchange market index, 2) $b < 0$ the stocks or portfolios' returns are inversely correlated with the general stock exchange market index returns, 3) $0 < b < 1$ the stocks or portfolios' returns are positively correlated with the general stock exchange market index returns, however with less volatility, 4) $b = 1$ the stocks or portfolios' returns have a perfect correlation with the general stock exchange market index returns and 5) $b > 1$ the stocks or portfolios returns have a positive correlation and larger price volatilities from the returns of the general stock exchange market index. The market model is a widely used method for estimating the expected returns of a stock or a portfolio. It is also used to calculate abnormal returns which mainly occur during a major event that affected the stock market. The model is based on a simple linear regression framework and captures the relationship between the returns of a stock or portfolio and the returns of a stock exchange market index. The market model can be represented by the following equation (Dimson, 1979; Jaffe & Westerfield, 1985; Scholes & Williams, 1977):

$$R_{i,t} = a_{i,t} + b * Rm_{i,t} + e_{i,t} \quad (2)$$

where, $R_{i,t}$ is the return of a stock or portfolio i at time t, $a_{i,t}$ is the intercept term, representing the average stock return not explained by market movements, b is the coefficient beta which captures the straight line slope term and represents the sensitivity of the stock or portfolio return to the market return, $Rm_{i,t}$ is the market return at time t, $e_{i,t}$ is the disturbance term or the error of the stock or portfolio return, which represents special factors of a firm or bank that are not captured by market performance.

Other methods that estimate Beta rely on certain assumptions on the return moments (Skintzi & Refenes, 2005), which impose the assumption that the return correlation is identical for all stocks in the cross-section. This Beta coefficient estimator is:

$$b_{j,t}^{SR} = \frac{\omega_{j,t} * \sigma_{j,t} + \sum_{i \neq j} \omega_{j,t} * \rho_{j,t} * \sigma_{j,t} * \sigma_{i,t}}{\sigma_{M,t}^{2}} \quad (3)$$

Prokopczuk and Simen (2014) to implement an adjustment for the volatility risk premium measured the risk-premium-adjusted Beta (*RP ADJ*) by using the historical correlation $\rho_{j,t}$ and risk-p:

$$b_{j,t}^{RP-ADJ} = \rho_{j,t} * \frac{RMFIV_{j,t}}{RMFIV_{M,t}} \quad (4)$$

Optimal forecast combinations using Bayesian model averaging were presented in Eq. (3) according to Stock and Watson (2006):

$$b_{j,t}^{BMA} = \sum_{K=1}^{K} \omega_k * b_{j,t}^{(k)} \quad (5)$$

The above simple regression equation represents the CAPM market model (Kolari & Pynnönen, 2023):

$$E(R_i) = R_f + \beta * (R_m - R_f) \quad (6)$$

where, $E(R_i)$ is the expected return on investment, R_f *is* the risk-free rate, b *is* the beta of the investment, and $(R_m–R_f)$ is the market risk premium.

The CAPM is an important model that measures the relationship between the systematic risk of investments in stocks or portfolios and the expected return of those investments given the risk of those investments and their cost of capital (Kenton, 2023).

In the statistical part, the CAPM model assumes that all investment returns during their measurement period are normally distributed. This means that investors cannot lose more than they have invested, so their E(R) cannot fall below -100%, as this is inconsistent with a normal distribution that associates a positive probability with any return. This fact is supported by significant empirical research that shows for many investments that the normal distribution is not a good approximation of the return distribution (Munk, 2015).

One of the most important implications of CAPM is that the researchers can use the contribution of a bank asset to the variance of the market portfolio (the asset's Beta) as a measure of the bank asset's systematic risk. In recent years, it has also become used for financial stability purposes to estimate the cost of equity or even to measure the level of financial stress (Barnes & Lopez, 2006).

According to the CAPM model, a low Beta (b) means a low expected return on investments and thus a high valuation of those investments. However, it could be possible that the relationship between Beta (b) and expected return is weaker in the stock market than it appears in the CAPM model. The value of a market-based buyout target is determined by a higher discount rate, so it is higher than the value calculated in the CAPM model. If the acquirer uses the CAPM model to determine the price paid to acquire the acquisition target, it may pay more than the valuation based on the market itself. If the market believes that the publicly traded buyer overpaid to acquire the target, then the buyer's share price may decline (Hombert, 2020).

The ratio of Beta (b) values based on CAPM model is the market risk premium adjustment. So, the risk premium is a necessary element that investors require in order to place themselves in risky investments. If Beta (b) equals one, then investors expect a risk-reward equal to the market premium. If Beta (b) of the investment is greater than one, then investors require a greater risk premium compared to the market risk premium and thus greater than market returns. Since the model for CAPM is calculated over a specific period of time, it means that the Beta (b) value can vary over time for the same investments. When calculated for a combined portfolio, the investor calculates the weighted average of Beta (b) that the portfolio has. If the weighted Beta (b) value of the portfolio is negative, then there is a negative risk premium, which creates an expected return below the market return. Thus, securities containing a negative Beta value tend to perform better during periods when small or large financial crises occur, such as the global financial crisis of 2009 as well as the financial crisis during the COVID-19 pandemic (Berk et al., 2022).

Unsystematic risk is the specific risk of a particular bank/insurance company or business. Systematic risk is the risk that an entire market faces as a whole and cannot be cured by diversifying portfolios in that market. The only solution was the diversification of investments in multiple different mainly efficient markets which of course also face systematic risk but to a lesser extent. However, even this does not completely eliminate systematic risk, it just reduces it to some extent (Thakur, 2021).

Systematic risk comprises market risk, interest rate risk, purchasing power risk and, in some countries, exchange rate risk. The risk of the exchange rate does not exist in the market of the Eurozone countries. One reason market risk is created is the herd mentality that mainly small investors possess. This is reflected as the tendency of investors to follow the upward or downward trend of market returns. Therefore, market risk is the tendency of security price yields to move together. Sudden changes in market prices are the most important source of risk for securities and, by extension, for investors. Interest rate risk arises from changes in market interest rates. In the stock market, this primarily affects fixed income securities because bond prices are inversely related to the market interest rate. In fact, interest rate risks include two opposing components: the risk of the price of securities and the risk of reinvestment of those securities. Both of these risks work in opposite directions. Price risk relates to changes in the price of a security due to changes in interest rates. Reinvestment risk relates to the reinvestment of interest and dividend income from the invested securities (CFI Team, n.d.).

Systemic risk describes an event that can cause a major collapse in a particular sector of the economy, such as banking and insurance. Systematic risk is the pervasive, widespread, and persistent market risk that reflects a variety of troubling and potentially destructive factors for a stock market and by extension for an economy. Systemic risk is often a complete, exogenous shock to the financial system. Such an example is the bankruptcy of a large bank that brought about the expansion of the financial crisis at the global level in 2009 with the collapse of many markets. So, it could be said that systematic risk is the overall, daily, ongoing market risk that can be caused by a combination of factors such as the economy, interest rates, geopolitical issues, corporate health, wars and other factors (Nguyen, 2024).

Although systematic risk is unpredictable and very difficult to completely avoid, investors can partially avoid it by ensuring that their portfolios include various asset classes such as mutual funds, government bonds, fixed income deposits, cash and real estate, each of which will react differently to a risky event affecting the overall market, but also by investing in indifferent markets from the domestic market. Also, another way of safeguarding investments from systematic risk is the risk hedging methodology with financial derivatives (Chen, 2023).

If we define the return of the general stock market index by (Rm) and (b) the systematic risk, then the rise in bank stock returns will be equal to:

$$Rs_i = b * R_m \tag{7}$$

where, the Rs_i is the bank stock returns.

All our data were extracted from the published annual financial reports of Greek banks, the ATH Market, the Greek Capital Market Commission, and investing.com. For our calculations, we used EViews software.

4. RESULTS

This section shows our empirical analysis for 2010–2019. The results are interpreted as to whether the M&As, reduce or not the systematic risk of Greek systemic banks because of the global financial crisis. The empirical analysis targeted at first the investigation of the Beta coefficients of Greek systemic banks during the big wave of M&A in 2010–2012. Then we calculated the systematic risk of each bank's stock, through their stock's Beta in 2013 which was the year of the ending of the main wave of mergers of acquisitions in the Greek banking sector. Afterwards, our research aimed at the full absorption of all target banks from bidder banks. In Table 2 below, we present the cumulative performance of the General Market Index (GMI) of the ATH Market (2010–2020) and we can see the high volatility of the index. In Table 3 below, we present our calculations for the average annual returns (AAR) of the ATH during 2009–2019 that we used in our analysis.

Table 2. The General Market Index for the Athens Stock Exchange Market from 2010–2020

Years	*2020*	*2019*	*2018*	*2017*	*2016*	*2015*	*2014*	*2013*	*2012*	*2011*
2019	-11.75%									
2018	31.91%	49.47%								
2017	0.83%	14.25%	-23.56%							
2016	25.69%	42.42%	-4.71%	24.66%						
2015	28.14%	45.19%	-2.86%	27.09%	1.95%					
2014	-2.08%	10.95%	-25.77%	-2.88%	-22.09%	-23.58%				
2013	-30.42%	-21.16%	-47.25%	-30.99%	-44.64%	-45.70%	-28.94%			
2012	-10.89%	0.97%	-32.45%	-11.62%	-29.11%	-30.46%	-9.00%	28.06%		
2011	18.90%	34.72%	-9.86%	17.92%	-5.41%	-7.21%	21.42%	70.88%	33.43%	
2010	-42.78%	-35.17%	-56.62%	-43.25%	-54.48%	-55.35%	-45.57%	-17.77%	-35.79%	-51.88%

Source: Annual report for 2020 of the Greek Capital Market Commission.

Table 3. The Athens Stock Exchange average annual returns (%) 2009–2019

Years	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*
AAR (%)	-42.78	-51.88	33.43	28.06	-28.94	-23.58	1.95	24.66	-23.56	49.47

Source: Author's calculations.

For the extraction of our results as well as conclusions regarding the relationship and measurement of systematic or investment risk with the use of accounting parameters, a specific methodology will be followed using statistical methods such as linear regression (OLS regression), using the market model. The assumptions in our analysis were:

H_0: The slope b is equal to zero $b = 0$: This means that the Beta coefficient (systematic risk) was not reduced at all by M&As.

H1: The slope b is statistically significantly different from the zero $b \neq 0$. This means that the Beta coefficient (systematic risk) was reduced by M&As.

The statistical significance levels were: 1) Prob > 10% there is no statistical significance, 2) 10% > Prob > 5% there is a little statistical significance (*). 3) 5% > Prob > 1% there is a high statistic significance (**), and finally 4) Prob < 1% there is a strong statistic significance (***). In order to find the Beta of the annual returns of the four

Greek systemic banks, we took into account their daily returns in the period 2010–2019 and calculated the average annual return of these shares. We followed the same procedure with the returns of the general share index of the ATH.

In Tables 4–7 below, we present the results from the regression statistics analysis using CAPM on the four Greek systemic banks during 2010–2019. As we can see R^2 has values higher than 50%. SE values are very low and below 0.50 and p-value prices are lower than 0.1. Finally, probability (Prob) shows that the results are statistically significant in levels of significance of 1%, 5%, and 10%. Therefore, we are able to suppose that those regression results explain very well our analysis. The results presented in Tables 4–7 below concerning the linear regressions show that the systematic risk of the four Greek systemic banks' stocks has almost the same behavior except for Piraeus Bank in 2015. Variations regarding the magnitude of systematic risk appear mainly in the period 2010–2012 during the great wave of M&As. These differences disappear with the passage of years and the complete integration and absorption of the target banks by the bidder systemic Greek banks is accomplished. In the case of our models, the coefficient of determination of the linear regression shows the part of the volatility of the stock returns of systemic Greek banks that depends on the volatility of the market returns. A satisfactory value for R^2 is close to 1 or 100% and far from 0. The regression line fits the real data not excellently but relatively well. So, from Tables 4–7 below we observe that the R^2 for Piraeus Bank had a minimum price of 0.505 in 2013 and a maximum price of 0.611 in 2019. This shows us that the total variation is explained from a minimum of 50.5% to a maximum of 61.1% by market movements (systematic risk), while the remaining from a maximum of 49.5% to a minimum of 38.9% is explained by other factors. The R^2 for Eurobank had a minimum price of 0.512 in 2013 and a maximum price of 0.646 in 2019. This shows us that the total variation is explained from a minimum of 51.2% to a maximum of 64.6% by market movements (systematic risk), while the remaining from a maximum of 48.8% to a minimum of 35.4% is explained by other factors. The R^2 for National Bank had a minimum price of 0.521 in 2013 and a maximum price of 0.678 in 2019. This shows us that the total variation is explained from a minimum of 52.1% to a maximum of 67.8% by market movements (systematic risk), while the remaining from a maximum of 47.9% to a minimum of 32.2% is explained by other factors. The R^2 for Alpha Bank had a minimum price of 0.519 in 2013 and a maximum price of 0.695 in 2019. This shows us that the total variation is explained from a minimum of 51.9% to a maximum of 69.5% by market movements (systematic risk), while the remaining from a maximum of 48.1% to a minimum of 30.5% is explained by other factors. As we can see the four systemic Greek banks had minimum R^2 in year 2013 and maximum in year 2019. We can observe that the R^2 values explain the ability and the predictability of the model is sufficient but did not have high values during 2010–2019 for all Greek systemic banks. What follows from the relatively low values of R^2 is that there are other important factors influencing our findings.

Table 4. Results of regression statistics analysis for Piraeus Bank

Years/Metrics	***2010***	***2011***	***2012***	***2013***	***2014***	***2015***	***2016***	***2017***	***2018***	***2019***
R^2	0.523	0.525	0.550	0.505	0.514	0.518	0.577	0.573	0.562	0.611
R^2 adjusted	0.521	0.524	0.548	0.503	0.512	0.516	0.576	0.572	0.560	0.609
SE	0.125	0.121	0.236	0.119	0.062	0.140	0.165	0.398	0.297	0.267
T-statistic	25.09	26.97	22.03	26.42	26.13	29.56	26.05	25.34	23.67	24.77
P-value	0.042	0.038	0.029	0.012	0.031	0.022	0.015	0.032	0.025	0.016
Prob	0.09*	0.08*	0.06*	0.03**	0.05*	0.07*	0.06*	0.08*	0.07*	0.04**
F-statistic	5.293	6.812	6.855	5.484	6.056	5.068	5.416	5.639	5.802	6.091
Beta (b)	1.953	1.628	2.238	1.634	1.419	2.387	0.979	0.748	0.0631	0.526

*Note: Levels of significance: * > 10%, ** 1 > 5% > 10%, *** > 1%.*
Source: Author's calculation from Athens Stock Market's data and investing.com.

Table 5. Results of regression statistics analysis for Eurobank

Years/Metrics	***2010***	***2011***	***2012***	***2013***	***2014***	***2015***	***2016***	***2017***	***2018***	***2019***
R^2	0.519	0.524	0.528	0.512	0.542	0.539	0.575	0.634	0.558	0.646
R^2 adjusted	0.514	0.523	0.527	0.510	0.542	0.537	0.573	0.632	0.555	0.644
SE	0.077	0.187	0.210	0.110	0.200	0.220	0.060	0.047	0.056	0.049
T-statistic	28.93	21.81	28.03	24.69	27.81	21.24	28.69	27.27	27.90	27.95
P-value	0.012	0.019	0.013	0.015	0.021	0.032	0.041	0.022	0.031	0.020
Prob	0.07*	0.06*	0.09*	0.04**	0.09*	0.07*	0.08*	0.07*	0.06*	0.03**
F-statistic	6.649	6.156	5.194	5.342	6.672	5.667	6.089	5.262	5.525	5.814
Beta (b)	2.134	1.968	2.866	1.542	1.321	0.926	0.839	0.693	0.532	0.383

*Note: Levels of significance: * > 10%, ** 1 > 5% > 10%, *** > 1%.*
Source: Author's calculation from Athens Stock Market's data and investing.com.

Table 6. Results of regression statistics analysis for National Bank

Years/Metrics	***2010***	***2011***	***2012***	***2013***	***2014***	***2015***	***2016***	***2017***	***2018***	***2019***
R^2	0.590	0.557	0.526	0.521	0.541	0.580	0.535	0.539	0.567	0.678
R^2 adjusted	0.588	0.555	0.524	0.519	0.539	0.578	0.529	0.537	0.562	0.675
SE	0.051	0.232	0.160	0.140	0.150	0.260	0.136	0.132	0.232	0.146
T-statistic	25.23	23.94	22.03	24.29	22.57	25.32	29.25	26.49	25.51	24.15
P-value	0.013	0.036	0.022	0.028	0.039	0.027	0.043	0.047	0.014	0.035
Prob	0.09*	0.07*	0.05*	0.02**	0.05*	0.09*	0.07*	0.08*	0.06**	0.04**
F-statistic	6.874	6.757	5.754	5.338	5.608	5.322	5.065	5.919	5.701	6.237
Beta (b)	1.401	1.306	1.763	1.464	0.950	0.806	0.728	0.557	0.489	0.276

*Note: Levels of significance: * > 10%, ** 1 > 5% > 10%, *** > 1%.*
Source: Author's calculation from Athens Stock Market's data and investing.com.

Table 7. Results of regression statistics analysis for Alpha Bank

Years/Metrics	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*
R^2	0.568	0.548	0.555	0.519	0.574	0.592	0.557	0.563	0.582	0.695
R^2 adjusted	0.561	0.543	0.551	0.517	0.572	0.591	0.551	0.563	0.581	0.691
SE	0.069	0.065	0.036	0.056	0.018	0.021	0.073	0.088	0.157	0.092
T-statistic	28.88	26.38	26.22	27.58	26.91	25.52	27.47	26.26	27.70	24.15
P-value	0.025	0.031	0.039	0.018	0.016	0.015	0.017	0.011	0.014	0.012
Prob	0.06*	0.08*	0.07*	0.02**	0.08*	0.05*	0.09*	0.06*	0.07*	0.03**
F-statistic	6.967	6.456	5.526	5.607	6.128	6.488	6.301	6.198	5.216	5.213
Beta (b)	1.182	1.062	1.603	1.048	0.701	0.642	0.518	0.406	0.304	0.203

*Note: Levels of significance: * > 10%, ** 1 > 5% > 10%, *** > 1%.*
Source: Author's calculation from Athens Stock Market's data and investing.com.

Our findings are statistically significant at the level of significance * > 10% in the time period 2010–2012, at the level of significance ** 1% > 5% > 10% in 2013, at the level of significance * > 10% in 2014–2018, and at the level of significance ** 1% > 5% > 10% in 2019 and are the same for all four Greek systemic banks. We have to mention that no significance level is observed at *** > 1%. The results of f-statistics are over 2.5 (f > 2.5) for the four Greek systemic banks during all the examined time periods 2010–2019, thus we are led to the conclusion that we must reject the null hypothesis (H_0). The stock exchange (SE) for the four Greek systemic banks has minimum values during all the examined time periods 2010–2019. So, we can say that compared to our other findings there is relevant but not high-reliability precision in the measures taken and scores obtained in this test.

In Table 8, we divide the considered time period 2010–2019 into individual time periods for better Beta analysis. Thus, the first-time sub-period 2010–2012 refers to the wave of M&As of Greek banks with the advent of the global financial crisis in order to obtain a strong banking system, a fact that is reinforced by the directives of the memorandum as imposed by the financial institutions of the European Union and the International Monetary Fund both. The second sub-period concerns the year 2013, which is a milestone for the Greek banking system since the four systemic Greek banks were created in it. The third time sub-period 2014–2016 concerns the integration of the target banks by the bidder banks. We have noticed that Alpha Bank completed its acquisitions in 2014 with the acquisition of the entire branch network of Citibank in Greece. The Piraeus Bank made another acquisition in 2015 by taking over the entire branch network of Panhellenic Bank. The National Bank and the Eurobank completed their main acquisitions in 2013. The fourth time period 2017–2019 concerns the complete absorption of the target banks by the bidder banks before the onset of the COVID-19 pandemic and the significant consequences that this pandemic brought to the Greek economy. Finally, with our findings, we proved the hypothesis *H1*.

Table 8. Beta (b) of the four Greek systemic banks in the 4th examined time period

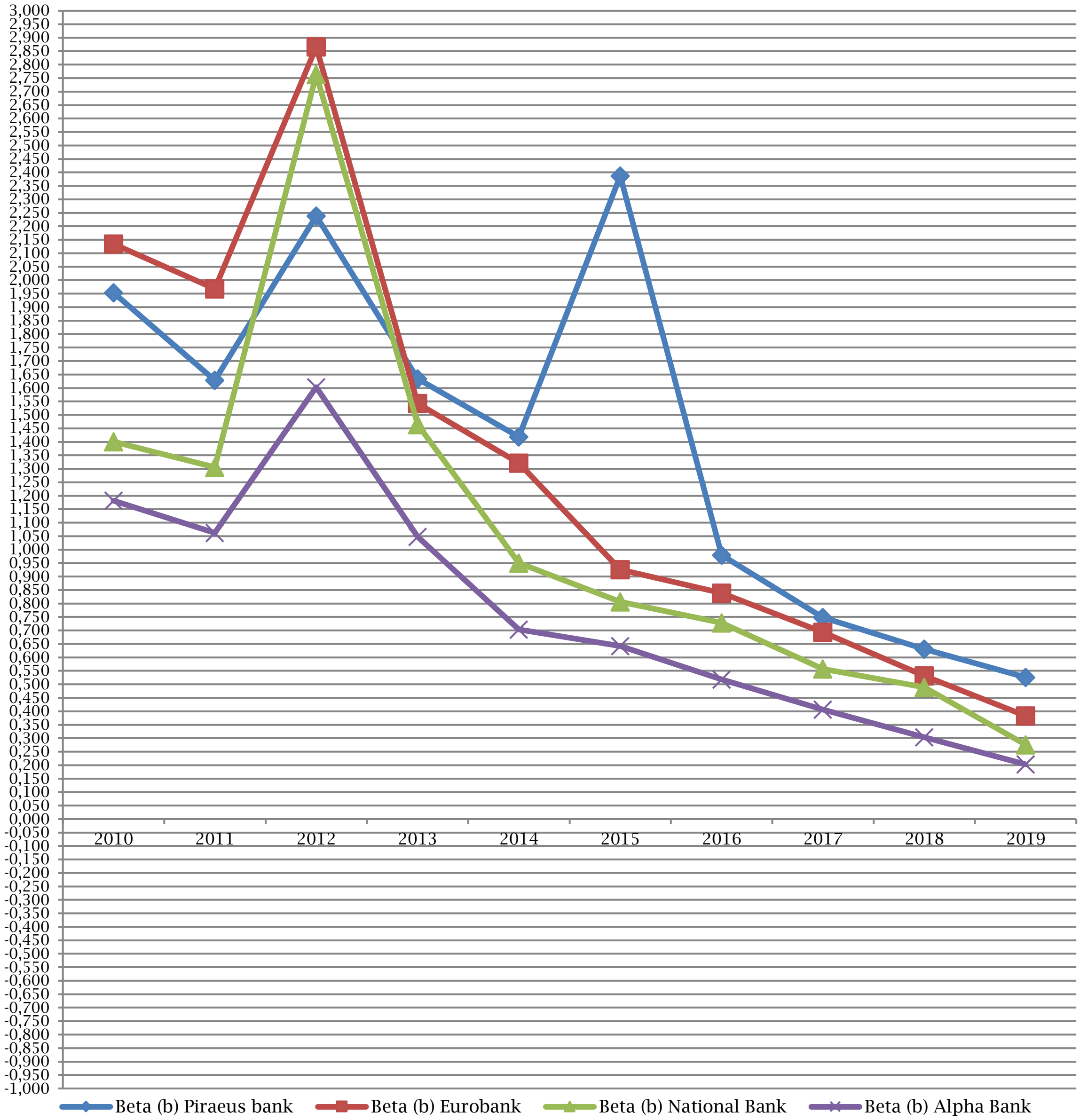
Beta during M&A in the Greek banking system three years after the global financial crisis				
Years	*Beta (b) Piraeus*	*Beta (b) Eurobank*	*Beta (b) National Bank*	*Beta (b) Alpha Bank*
2010	1.953	2.134	1.401	1.182
2011	1.628	1.968	1.306	1.062
2012	2.238	2.866	2.763	1.603
The beta of the M&A in the Greek banking system in 2013 was most of them completed				
2013	1.634	1.542	1.464	1.048
Beta after the completion of the important M&A in the Greek banking system				
2014	1.419	1.321	0.950	0.703
2015	2.387	0.926	0.806	0.642
2016	0.979	0.839	0.728	0.518
Beta after the absorption of all target banks 3 years before the onset of the COVID-19 pandemic				
2017	0.748	0.693	0.557	0.406
2018	0.631	0.532	0.489	0.304
2019	0.526	0.383	0.276	0.203

Source: Tables 4–7.

Our findings for Beta (b) are shown in above Table 8 and the four sub-periods are explained. In the first sub-period 2010–2012 we can observe in our findings that the values of Beta coefficients (b) for all examined Greek systemic banks were over the unit (b > 1) for each year. This means that their stocks were risky having systematic risk as an aggressive attitude towards the general index of the ATH. In this time period the highest stock risk belongs to Eurobank stocks and the lowest belongs to Alpha Bank stocks. The second sub-period includes only 2013 and we displayed from our findings that values of Beta coefficients (b) for all examined Greek systemic banks were also over the unit (b > 1). This means again that their stocks were risky having systematic risk as an aggressive attitude towards the general index of the ATH. In the third sub-period 2014–2016, in which an attempt was made to assimilate the target banks by the acquiring banks, while all acquisitions have not yet been fully completed, it is observed that we had different results for the examined banks. More specifically it is displayed that: 1) the values of Beta coefficients (b) for Piraeus Bank were over the unit (b > 1) in 2014 and 2015, so its stocks were risky and its returns have transformed into aggressive against the yields of the general index of the ATH, but in 2016 they decreased under the unit but over zero (0 < b < 1), so its stocks were not risky and their returns have transformed into defensive against the yields of the general index of the ATH, 2) the values of Beta coefficients (b) for Eurobank were over the unit (b > 1) only in 2014, so its stocks were risky and its returns have transformed into aggressive against the yields of the general index of the ATH and they decreased under the unit but below zero (0 < b < 1) in 2015 and 2016, so its stocks were not risky and its returns have transformed into defensive against the yields of the general index of the ATH, 3) the values of Beta coefficients (b) for both National Bank and Alpha Bank were under the unit but below zero (0 < b < 1) for each year of this sub period so their stocks were not risky and their returns have transformed into defensive against the yields of the general index of the ATH. In the fourth sub-period 2017–2019, during which time period the absorption of the acquired banks by the acquiring banks has been completed, we had the same results for all examined Greek systemic banks. Thus, Table 8 above displayed that the values of Beta coefficients (b) were under the unit but over zero (0 < b < 1) so their stocks were not risky and their returns transformed into defensive against the yields of the general index of the ATH.

In the above Figure 1, we present the course volatility of the systematic risk (Beta) that concerns the four Greek systemic banks in the financial period 2010–2019. As we have said this time period was divided into four sub-periods.

Figure 1. The course of Beta (b) of four Greek systemic banks 2010–2019



Source: Table 8.

So, from Figure 1 above we present the first examined time period as 2010–2012, soon after the global financial crisis that invaded the Greek economy and in which time the most important M&A took place in the Greek banking system. In this period of time, we observe that the Beta for the examined banks is greater than unity (b > 1) and presents high volatility in combination with a significant downsizing of its course. This shows that there is a systematic risk level and stocks are bullish on the general index of the ATH. However, in any rise in the returns of the general index of the ATH, the returns of the Greek systemic banks would have greater gains than the rise in the returns of the general index of the ATH. It is favorable that in any fall of the general index of the ATH, the returns of the Greek systemic banks would also be with a greater loss than the fall in the returns of the general index of the ATH. We also observe that the course of the Beta coefficient for all Greek systemic banks started in 2010 with an upward course and in 2012 it reached the highest point from which its downward course began with the lowest point occurring in the year 2019 after a smooth downsize course without volatility that started in 2016 for all Greek systemic banks. It is displayed that the values of the Beta (b) coefficient had the highest course volatility of all the other Greek systemic banks but the highest value Beta (b) coefficient was observed in year 2012 and it concerns Eurobank.

Table 9 below displays the results of the E(R) of the stocks for the four Greek systemic banks during 2010–2019.

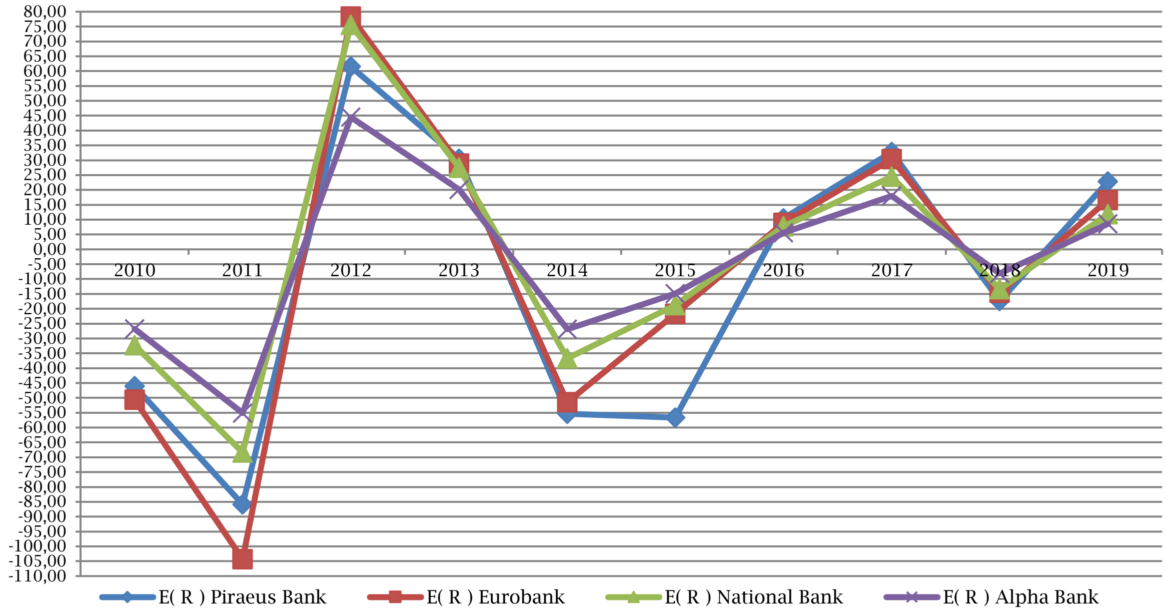
Table 9. CAPM E(R) results of Greek systemic banks 2010–2019

CAPM E(R)/ Years	*CAPM E(R) Piraeus Bank*	*CAPM E(R) Eurobank*	*CAPM E(R) National Bank*	*CAPM E(R) Alpha Bank*
2010	-46.04	-50.57	-32.24	-26.77
2011	-85.87	-104.35	-68.37	-55.10
2012	61.51	78.35	75.59	44.48
2013	30.47	28.84	27.47	20.12
2014	-55.34	-51.44	-36.67	-26.84
2015	-56.60	-21.65	-18.78	-14.86
2016	10.44	8.95	7.78	5.55
2017	32.75	30.37	24.48	17.95
2018	-17.38	-14.59	-13.37	-8.15
2019	22.78	16.52	11.84	8.65

Source: Author's calculations from investing.com.

In Figure 2, we present the E(R) course of the stocks for the four Greek systemic banks during 2010–2019. We notice the high volatility of the course. We can also observe that the highest E(R) were in 2012 due to the high systematic risk and the lowest E(R) were in 2011 due to the lowest market return.

Figure 2. E(R) course of Greek systemic banks 2010–2019



Source: Table 9.

Finally, in Table 10 below we present the results of risk premium (R_m–R_f) of the ATH Market during 2010–2019. We observed that the highest positive price was recorded in 2019 and the lowest and also negative price was recorded in 2011. We also noticed that there is a high volatility between negative and positive values.

Table 10. Risk premium results from 2010–2019

Years	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*
Risk premium (Rm-Rf)	-25.00	-54.35	26.81	17.66	-39.81	-23.92	10.60	43.29	-28.21	43.77

Source: Author's calculations from investing.com.

5. DISCUSSION

The four Greek systemic banks in 2016 showed signs of gradual profitability, as an increase in operating income was observed with a simultaneous increase in their operating costs. The outbreak of the COVID-19 pandemic and the consequent contraction of economic activity due to the curfews and changes in economic activities inevitably led to a major recession and affected the entire Greek banking industry. The calculation of the average annual stock returns of the examined four Greek systemic banks was carried out using the daily stock returns of these banks and calculated with the CAPM E(R) formula from 2009 to 2019. We use the same methodology to calculate the AAR of the general index of the ATH in the same time period. The results from this monograph are similar to other studies, even though there are not many, which examine the banks' risk during the recent financial crisis. So, we accept that our hypothesis *H1* is true. As we have shown the Beta coefficient (b) is defined by the ratio of the variation of a security's returns with market returns to the variation of market returns. But this means that the Beta coefficient (b) can be estimated through a simple linear regression. Therefore, we were able to separately estimate the Beta coefficient (b) of all bank stocks of the examined Greek systemic banks, by regressing on the time series of the returns of each bank stock.

$$E(R) = R_f + b * (R_m - R_f) \tag{8}$$

The examined four Greek systemic banks are very closely linked to the index of the ATH. Therefore, the coefficient (b) should take values relatively close to unity, which would indicate that an increase or decrease in market returns creates a corresponding increase or decrease in bank stock returns or vice versa. For estimating the returns of examined Greek systemic banks' stocks we used the following equation which is similar to the equation.

$$Return(R) = [(Value_1 - Value_0)/Value_0] * 100 \tag{9}$$

The decline in bank stock returns is best seen when the dependent variable versus a stock market index is used as the independent variable. The regression slope coefficient Beta (b) is the measure of systematic risk for bank stocks. Systematic risk shows the positive or negative direction in which bank shares move in relation to the general stock market index and at the same time measures the intensity of this direction. A higher Beta (b) coefficient means that banks' stock returns move in the same direction and more positively than the GMI during periods of economic growth, while the opposite occurs during periods of financial crises and other adverse factors for an economy. These stocks are considered aggressive. A lower Beta (b) coefficient indicates that banks' stock returns move less incrementally than the returns of the GMI during periods of economic growth, while the opposite occurs during periods of financial crises and adverse events. These stocks are considered defensive banking shares. Our findings that concern the Beta coefficient drove us to reject the null hypotheses and that the positive onset was fulfilled. As for the systematic risk of their stocks, it seems that the riskier stock period was in 2012 and the less risky stocks were found in 2019. So, we are able to say that M&A were an important factor that helped the Greek banks to reduce their systematic risk after the international financial crisis but before the COVID-19 pandemic. Finally, we have to mention that our findings are similar to Tanna and Yousef's (2019) results.

6. CONCLUSION

From our findings, we conclude that the strategy of M&As in the Greek banking sector brought significant positive financial results for the remaining acquiring Greek banks, which managed to maintain their financial strength at high levels, despite the strong economic effects of the global financial crisis on the Greek economy. The results of our analysis showed that the systematic risk of the Greek systemic banks has started to decrease mainly from 2015. Our findings in the regression analysis are statistically significant and R^2 which explains the results have values over 50%, so we excluded hypothesis H_0. This means that the Beta coefficient was not affected at all by M&As, and we accepted hypothesis *H1*. This means that the Beta coefficient was affected by M&As. So, we are able to say that the systematic risk of the four Greek systemic banks decreased in short-term (2014) and long-term periods (2015–2016) after the completion of M&As. This reduction in systematic risk continued during the next three-year period 2017–2019. Our findings show some benefit for the strengthening against the systematic risk of Greek systemic banks which derived from the wave of M&As that actually took place in 2010–2012 and a large part of them were completed in 2013. In general, and according to our findings, we are able to assume that there were other risk factors that affected the systematic risk of Greek systemic banks besides M&As. Therefore, it is important to note that this analysis only concerns the Greek banking system. In no way do these results correspond to the banking systems of other countries where M&As were also carried out in order to strengthen their banks against the same global financial crisis. Moreover, our findings can only be employed by comparing banks that are included in an emerging market index. Furthermore, we suggest that the study could be repeated at least three years after the end of the COVID-19 pandemic in order to establish the influence of the financial crisis of the COVID-19 pandemic on the systematic risk of the Greek systemic banks. Finally, it would be interesting to use our method to explore the banks' systematic risk that belong to advanced market indexes in the same time period after their M&As.

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