

Article

# Accounting Beta as an Indicator of Risk Measurement: The Case of the Casablanca Stock Exchange

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**Abstract:** The problem of determining the cost of equity is crucial to the development of organizations. It is an essential means of calculating value creation. The financial literature has proposed several models for estimating the cost of equity, such as the capital asset pricing model (CAPM). However, this model is only used for listed companies, and cannot be used for unlisted companies. To remedy this situation, alternative measures of the cost of equity have emerged, such as accounting beta. The main objective of this research was to explore the relationship between market beta and accounting beta calculated using ROA, ROE and net income to demonstrate the ability of accounting beta to measure risk for unlisted companies. To carry out this study, we exploited data from a sample of 49 companies listed on the Casablanca Stock Exchange during the period of 2015–2019. We used panel data econometrics to empirically test the research hypotheses. The results show that the accounting beta calculated using ROA and ROE significantly represents the market beta and is a satisfactory solution to calculate the cost of equity of unlisted firms. The results of the study contribute to the existing literature on the cost of capital by reinforcing the role of accounting beta as a solution for determining the cost of equity and therefore the creation of value for the organization.

**Keywords:** accounting beta; cost of equity; unlisted companies; ROA; ROE



**Citation:** Faiteh, Anouar, and Mohammed Rachid Aasri. 2022. Accounting Beta as an Indicator of Risk Measurement: The Case of the Casablanca Stock Exchange. *Risks* 10: 149. <https://doi.org/10.3390/risks10080149>

Academic Editor: Krzysztof Jajuga

Received: 14 June 2022

Accepted: 16 July 2022

Published: 26 July 2022

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## 1. Introduction

The risks faced by an organization inevitably depend on the environment in which it operates. Investing in projects without paying attention to the risk they generate can lead to failures and loss of capital. Indeed, the notion of risk is crucial in the sphere of finance; it is a determining element in each investment, and its identification and measurement are debated among a range of researchers and practitioners. The importance of the risk factor in the process of choosing an investment has allowed it to be directly associated with the return. A high-risk company increases its remuneration to attract investors, and in return, the firm would have satisfied its need in terms of funding. Therefore, according to Roque and Caicedo Carrero (2021) and Phuoc et al. (2018), the overall risk of an asset can be decomposed into systematic and specific risks; the latter can be crystallized by an efficient investment, hence the implication of portfolio diversification, while systematic risk cannot be managed with a diversification of the portfolio of securities, and therefore, investors will have an interest in being remunerated for this risk-taking. Systematic risk is considered as an important element in the calculation of the cost of equity, as noted by Altaf (2016), because it determines the cost generated by the use of the company's equity in order to highlight the real value creation of the organization.

At this stage, several financial models allow the risk–return relationship to be assessed, facilitating greater efficiency in the financial decision-making process. According to Intrinsicano et al. (2017), among the most used models is the Capital Asset Pricing Model (CAPM), which analyzes the relationship between risk and expected return on equity and represents the cost of equity.

One of the most important components of the CAPM that influences expected returns is the beta, which represents the sensitivity coefficient that explains the relationship between the fluctuations in a given stock and the market; it is calculated by linear regression between stock and market returns. The CAPM calculation estimates future profitability based on historical data and is considered a key component for the cost of capital and as a discount rate for business valuation (Rutkowska-Ziarko 2022). Since the CAPM uses information from financial markets, it is difficult to use it for unlisted companies.

For this reason, several approaches have been proposed following the example of analogical, qualitative and analytical approaches (Britzelmaier 2019). The analogy approach relies on a sample of publicly traded companies used as a benchmark to extract information and use them as a target to calculate the beta. It should be noted that using the market beta for unlisted companies could bias the results by giving a value that does not reflect the real risk, which could lead to overvaluation or undervaluation. This approach is based on the assumption that unlisted companies generate the same characteristics as listed companies. The difficulty of this method is finding a company that has the same characteristics as the target company. Moreover, in emerging countries such as Morocco, where the number of listed companies is minimal compared to the total number of companies in the country, it is almost impossible to find a listed organization that has the same specificities of the target company. Indeed, for public sector companies and small and medium-sized enterprises that are not listed on the stock exchange, it is essential to find an alternative model to calculate the beta and therefore determine the cost of capital (Roztocki and Needy 1999).

In this respect, the accounting beta model presents itself as a powerful alternative to the CAPM. It provides considered visibility for the calculation of risk and, consequently, of the cost of capital. It is calculated by the linear regression between the accounting measure of the company and the average of the same accounting measure related to all companies of the market. The accounting beta seems to be suitable for unlisted companies (Teixeira et al. 2020).

To this end, several studies have demonstrated that accounting beta presents a relevant measure for calculating risk for unlisted companies (Almisher and Kish 2000; Sarmiento-Sabogal and Sadeghi 2015; Intrisano et al. 2017; Rutkowska-Ziarko and Pyke 2017; Teixeira et al. 2020; Sarmiento et al. 2021; Roque and Caicedo Carrero 2021; Rutkowska-Ziarko 2022). However, other researchers interested in the same issue have concluded that accounting beta does not present a valuable measure of risk for firms (Vos 1992; St-Pierre and Bahri 2006).

The main objective of this study is to verify whether the accounting beta represents the systematic risk measured by the market beta. Given this objective, the following hypotheses were formulated:

**Hypothesis 1 (H<sub>1</sub>):** *The accounting beta calculated based on ROA is positively related with market beta.*

**Hypothesis 2 (H<sub>2</sub>):** *The accounting beta calculated based on ROE is positively related with market beta.*

**Hypothesis 3 (H<sub>3</sub>):** *The accounting beta calculated based on net income is positively related with market beta.*

## 2. Literature Review

The notion of risk in the sphere of finance is considered as an anchor point—its determination directly impacts profitability and investment choice. In this context, the corporate finance literature has provided us with several risk measurement models, such as the Arbitrage Pricing Theory, the Fama–French three-factor model and others. The most widely used in the expert community remains the CAPM (Intrisano et al. 2017), which is based on the assumption that, in equilibrium, the cost of equity equals the return on a

risk-free investment plus a risk premium, where the risk premium is equal to the market risk premium multiplied by the individual risk of the firm, called beta (Britzelmaier 2019).

It is calculated using the fundamental equilibrium relation of Sharpe (1964):

$$K_{cp} = R_f + \beta (R_m - R_f)$$

where:

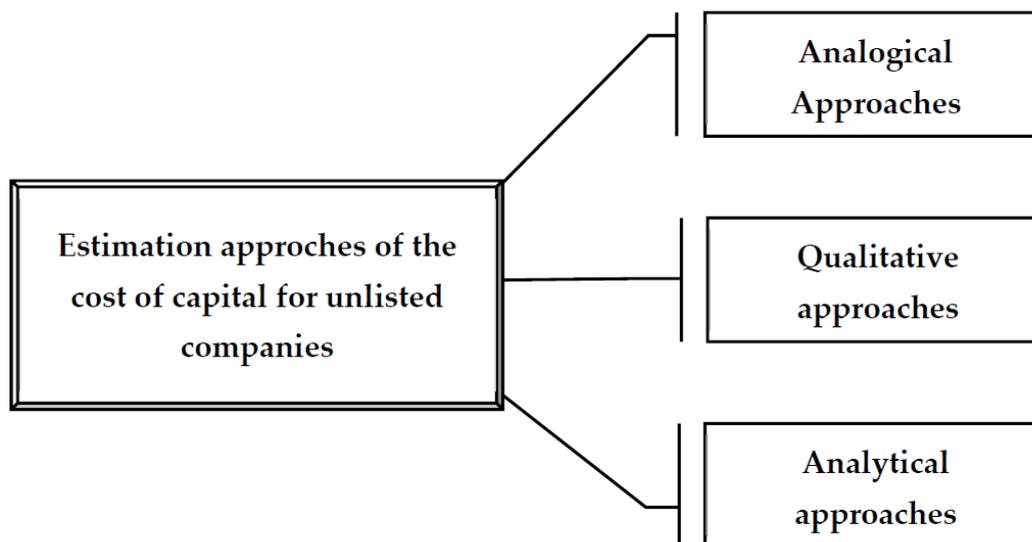
$R_f$  = risk-free rate, usually 10-year government bonds or AAA-rated bonds;

$R_m$  = market return; and

$\beta$  = sensitivity coefficient of the stock in relation to the market. It is calculated by:

$$\beta_i = \frac{COV(R_{it}, R_{mt})}{VAR(R_{mt})}$$

The objectives of the estimation of the CAPM are multiple, which allows us to measure the return required to invest in an organization, but also serves as a means to estimate the cost of capital of organizations in order to measure the value creation (Faiteh and Aasri 2022). Nevertheless, the CAPM model can only be applied to publicly traded companies, hence the need to find alternatives to calculate the risk and, subsequently, the cost of capital for unlisted organizations. In this context, the use of alternative models for estimating the cost of equity for non-publicly traded organizations is crucial. In this regard, Britzelmaier (2019) identified three alternative approaches to market beta, namely, analogical, qualitative and analytical approaches (Figure 1).



**Figure 1.** Estimating approaches of the cost of capital for unlisted companies.

Indeed, for Britzelmaier et al. (2013), the use of the analogical approaches allows the  $\beta$ -factor of an unlisted company to be derived from the  $\beta$ -factors of comparable listed companies. The basic requirement for the application of  $\beta$ -factors on unlisted companies is the existence of listed companies with identical characteristics in terms of size of environment and activity. Indeed, the analogical approaches can be distinguished by three methods: pure play, peer group and industry beta (Steinle et al. 2007). Nevertheless, the approach faces several limitations. First is the difficulty of finding a target firm or group of firms to exploit their market data to use as a basis for measuring  $\beta$ , and the second is the difficulty of finding a firm that has the same criteria and operates in the same field of activity.

The qualitative approaches exploited as a solution for calculating  $\beta$  are based on a subjective assessment of a company's systematic risk; these include rating models such as the Boston Consulting Group model. The shortcoming of this method is that the majority

of rating agencies cannot provide an estimate for all unlisted companies, especially in emerging countries.

For the analytical approaches, the technique used is the accounting beta, which can be apprehended as the best solution for estimating the beta, and subsequently the cost of equity capital for unlisted companies (Palliam 2005; Rutkowska-Ziarko 2022). This approach attempts to link accounting data to determine the cost of capital. The concept is based on the assumption that accounting data are influenced by information and events, which would also be the basis of market prices. As an example, a company that loses its main client will have negative consequences on its result; this information will be the basis for a probable decline in the share price on the financial market.

Indeed, the calculation of accounting beta is represented by the ratio of the covariance between the accounting return of the company under analysis and the market return, divided by the variance of the market return (Rutkowska-Ziarko 2022). This method of calculation is based on the assumption that there is a significant correlation between the accounting data of companies and the market portfolio returns, so since this correlation exists, the accounting beta tends toward the true market beta (Roque and Caicedo Carrero 2021).

According to Hill and Stone (1980), each beta coefficient calculated on the basis of index price can be referred to as market beta. By analogy, beta coefficients determined on the basis of accounting data are called accounting betas. Nekrasov and Shroff (2009) proposed the use of accounting betas when it is difficult to collect market risk data. Among others, Stubelj and Laporšek (2021) have exploited accounting betas in order to compare the level of systematic risk across different sectors.

Several researchers have expanded the term “accounting beta” by positioning it as a regression coefficient suitable for any accounting-oriented variable (Beaver et al. 1970; Amorim et al. 2012; Latif and Shah 2021). Indeed, Rutkowska-Ziarko (2022) provided an adapted explanation of accounting beta, characterizing it as a sensitivity measure describing a change in the accounting profitability of a given company induced by a change in the accounting profitability of the industry.

Thus, the accounting beta can be calculated by different profitability indicators, such as ROA (return on assets), ROE (return on equity), ROI (return on investment), net income and others. It is written as follows (Rutkowska-Ziarko 2022), (Rutkowska-Ziarko and Markowski 2022):

$$\text{Accounting Beta} = \frac{\text{COV}(R_E, R_{IMm})}{\text{VAR}(R_{IMm})}$$

where:

$R_E$ : accounting return of the company; and

$R_{IMm}$ : accounting return of the market.

The first authors to focus on accounting beta were Ball and Brown (1969), who stated that accounting income has an explanatory power of about 40% of the changes in market beta. Among others, Almisher and Kish (2000) conducted research to test the relationship between performance and the use of accounting beta on a sample of 701 U.S. companies between 1990 and 1995. The researchers empirically demonstrated the direct and significant relationship of accounting beta and the performance of companies.

Similarly, Sarmiento-Sabogal and Sadeghi (2015) conducted a study on a group of U.S. listed companies to test the performance of accounting beta as a powerful measure of risk and a substitute for classical market-based measures. The results showed that accounting beta overestimates market beta by 20–50% when using ROA, so applying some corrective measures, such as using ROE, can reduce this difference to a range of 22–25%. Nevertheless, the results also suggested that accounting beta may be biased when used to assess the risk of small firms given their specificities and characteristics.

Intriso et al. (2017) conducted a survey of 303 Italian firms over a period from 2006 to 2015; their objective was to draw attention to accounting beta as a model that can be used for unlisted companies to measure the cost of equity. The authors demonstrated that

accounting beta based on ROE represents an acceptable and better indicator for calculating risk and, therefore, the cost of equity capital.

In 2017, Rutkowska-Ziarko and Pyke tried to address the issue of whether beta based on accounting indicators is correlated with the market beta. The authors exploited data from 27 construction companies listed on the Warsaw Stock Exchange from 2012 to 2017. The results were robust, and the researchers demonstrated the existence of the significant similarities between market betas and accounting betas. Moreover, they stated that accounting betas using return on assets (ROA) and return on sales (ROS) are positively correlated with market betas.

The aim of the research of [Teixeira et al. \(2020\)](#) determined whether accounting indicators could predict the risk of Brazilian credit unions. The results indicated a positive and significant relationship between the risk of cooperatives and accounting performance.

[Sarmiento et al. \(2021\)](#) affirmed that the accounting beta explains the variability of stock returns with some limitations, conducting a study composed of 61,618 observations related to companies listed on NYSE and NASDAQ between 1970 and 2016.

The reliability of the use of accounting beta as an indicator for measuring the systematic risk of a company is not without limits. In particular, the use of accounting beta implies the availability of accounting information for unlisted companies to use it as a reference in its calculation ([Rutkowska-Ziarko and Pyke 2017](#)). Moreover, it requires the availability of historical data.

[Vos \(1992\)](#) tested the possibility of using accounting betas as a measure of risk on a sample of 209 small companies in New Zealand. The researcher concluded that the use of accounting beta for the purpose of establishing an equilibrium relationship between risk and return is not sufficient.

[St-Pierre and Bahri \(2006\)](#) sought to test whether accounting beta is considered a recognized measure of risk for publicly traded companies, and therefore the possibility of being used for unlisted companies. The researchers used a sample of 128 small and medium-sized companies in Canada. The results have shown that accounting beta does not appear to be a comprehensive measure of risk for unlisted companies and for SMEs in particular. Similarly, in a study by [Cohen et al. \(2009\)](#), the researchers used accounting beta directly as a proxy for market beta. The results indicated that the market beta may generate overly optimistic results for estimating stock prices.

[Hakan and İbrahim \(2012\)](#) argued that there is not a significantly positive association between accounting measures and market beta. They found that this association is strong only in developed markets, with the exception of the Turkish market.

From the above, we can note that the studies dealing with the relationship between the accounting beta and the market beta has not converged to a synthesis, since some researchers have affirmed a positive relationship, while others have not.

From these findings, the main objective of this study is to verify whether the accounting beta best represents the systematic risk measured by the market beta in the Casablanca Stock Exchange.

Indeed, the demonstration of the use of accounting beta as an effective measure of risk and, consequently, of the cost of capital will give an alternative to experts and researchers who want to calculate the value creation for unlisted companies in emerging countries, such as Morocco, which is characterized by a low number of listed companies and the dominance of SMEs in the economic sphere.

However, our study differs from other studies in the field. First, the econometric choice of our study reinforces the position of accounting beta, as most studies have used correlation without resorting to more relevant econometric methods. Second, our study provides an important foundation for researchers who want to exploit accounting beta in the case of emerging countries, as most studies have focused on developed countries. Third, this is the first study in Morocco that investigates the relationship between accounting beta and market beta to draw conclusions on the robustness of exploiting accounting beta as an indicator to measure the risk of unlisted firms.

### 3. Data and Methodology

This study is focused on listed companies on the Casablanca Stock Exchange in the period from 2015 to 2019, which includes 76 listed companies as of June 2022.

We excluded six companies belonging to the banking and insurance industry. More, we excluded 21 companies with missing data (newly introduced companies and those delisted from the Casablanca Stock Exchange).

In total, 49 companies comprise our sample data.

The period chosen for the study voluntarily excludes the years of the COVID-19 pandemic in Morocco (2020–present), which may perturb the financial market.

The data consist of the closing prices of the month of December to calculate the market beta. As for the ROA and ROE profitability ratios, they are calculated annually to estimate them over an 8-year period before our period, to calculate the accounting beta (Table 1). The data were collected from the site of the Casablanca Stock Exchange.

**Table 1.** Definitions of variables.

Variables	Method of Calculation	Description
Beta Market	$\frac{COV (R_{it}, R_{mt})}{VAR (R_{mt})}$	$R_{it}$ represents the return on the stock. $R_{mt}$ represents the market return.
Beta ROE	$\frac{COV (ROE, RIMm)}{VAR (RIMm)}$	$ROE$ represents the firm's return on equity. $RIMm$ represents the return on the total pool. $Rim = \frac{\sum_{i=1}^n ROE}{n}$
Beta ROA	$\frac{COV (ROA, RIMm)}{VAR (RIMm)}$	$ROA$ represents the firm's return on assets. $RIMm$ represents the return on assets of the total pool. $Rim = \frac{\sum_{i=1}^n ROA}{n}$
Beta Net Income	$\frac{COV (NI, RIMm)}{VAR (RIMm)}$	$NI$ represents the net income of the firm. $RIMm$ represents the net income of the total pool. $Rim = \frac{\sum_{i=1}^n NI}{n}$

For this research, panel data econometrics is used to empirically test the research hypotheses. The calculations are performed with STATA 15 software.

The following equation is developed to test the research hypotheses:

$$Beta\ Market\ (i,t) = \alpha + \beta_1\ Beta\ ROA\ (i,t) + \beta_2\ Beta\ ROE\ (i,t) + \beta_3\ Beta\ NI\ (i,t) + \varepsilon(i,t) \quad (1)$$

## 4. Result and Discussion

### 4.1. Descriptive Statistics

Table 2 presents the results of the descriptive statistics for the full range of variables used in this research.

**Table 2.** Descriptive statistics.

Variables	Obs	Mean	Std. Dev.	Min	Max
Beta Market	245	0.4485	1.302632	−2.346392	2.811751
Beta ROE	245	0.5738783	0.8256249	−1.870892	2.598368
Beta Net Income	245	0.7294162	1.175039	−2.806337	2.846289
Beta ROA	245	0.3438026	1.223904	−2.672103	2.669721

Source: STATA 15 output.

From Table 2, we can see that the number of observations is identical for all the independent variables (245 observations). This situation is due to the initial choice of data, as we eliminated a priori the companies that do not have complete information for the calculation of variables. Among other things, all the variables are more volatile with respect to the standard deviation (std. dev), except for the variable Beta ROE, which has a lower take out (std. dev). In addition, the range (max–min) of all the variables in our study is low, which demonstrates the absence of outliers in the observations.

#### 4.2. Correlation of Variables

The purpose of using statistical correlation is to calculate the degree of the relationship between two phenomena (Bourbonnais 2021, p. 6). It gives us an idea of the intensity and direction of the relationship between two quantitative variables. The following table (Table 3) represents the correlations between the dependent variable beta market and the independent variables beta ROE, beta ROA and beta net income.

**Table 3.** Correlation study.

	Beta Market	Beta ROE	Beta Net Income	Beta ROA
Beta Market	1.0000			
Beta ROE	0.2528	1.0000		
Beta Net Income	0.2003	0.8560	1.0000	
Beta ROA	0.7427	0.1668	0.1207	1.0000

Source: STATA 15 output.

Through the correlation results, we noticed the existence of a strong positive correlation between the accounting beta based on ROA and the market beta ( $r_{B_M, B_{ROA}} = 0.7427$ ). On the other hand, there is a positive but weak relationship between the accounting beta based on ROE and that of net income with the market beta; this is demonstrated by coefficients of 0.2528 and 0.2003, respectively.

#### 4.3. Multicollinearity Test

Based on the results of the multicollinearity test (Table 4), we notice that the tolerance values are between 0.263 and 0.970, with VIF values between 1.03 and 3.80. The set of tolerance values is greater than 0.1 and the VIF values are less than 10. To this end, the tolerance values and VIF values of the variables are in line with the recommended range of Hair et al. (2018). In this regard, we concluded the absence of the risk of multicollinearity between the variables.

**Table 4.** Multicollinearity test.

	VIF	Tolerance Value
<b>Beta ROE</b>	3.80	0.263179
<b>Beta Net Income</b>	3.75	0.266766
<b>Beta ROA</b>	1.03	0.970351
<b>Mean VIF</b>		2.86

Source: STATA 15 output.

#### 4.4. Specification Test

To be able to use panel data econometrics, it is essential to check the “homogeneous or heterogeneous” specification of the data-generating process (Hurlin 2004). Among others, there are several tests to distinguish the model to be chosen. Among these tests, we used the Fisher test and the Hsiao test (Bourbonnais 2021, p. 375). We used the Fisher test because of its rapidity and robustness, and this test will allow us to decide whether to estimate our model on panel data or not.

The results of the Fisher test are as follows:

$$F(48,193) = 2.09$$

$$\text{Prob} > F = 0.0002$$

Referring to the result of the Fisher test ( $p < 5\%$ ), we accept the individual effects model, so it is appropriate to estimate our model by panel data (Turki-Abdelhedi et al. 2014). However, the individual effects are of two orders, fixed effects and random effects, which forces us to use the Hausman test to distinguish the most appropriate model for our analysis.

#### 4.5. Hausman Test

Before estimating the regression results, it is crucial to decide on the criterion for using the fixed effects or random effects model (Bourbonnais 2021, p. 384). To decide on the choice of model, we used the Hausman test. The result of the test is as follows:

$$\text{Chi}^2(1) = 23.15$$

$$\text{Prob} > \text{chi}^2 = 0.0000$$

Based on the Hausman test, we found that the probability associated with the test is 0.0000, which is less than the 5% value, indicating that the preferred model is fixed effects (Shah 2020).

#### 4.6. Regression Result

Table 5 expresses the relationship between market beta and beta calculated using ROE, ROA and net income. Three assumptions were evaluated in this research. The regression of the research model yields an R-squared value that is equal to 0.5548, which means that 55.48% of the variation in the market beta variable is explained by the explanatory variables (beta ROE, beta ROA, beta net income), while 44.52% is due to error. For the overall significance of the model, the F-value is 72.84 and its probability is 0.0000, which is less than 5%, which means that the model is globally significant.

The interpretation of the regression results shows a positive and statistically significant relationship at the 1% threshold between market beta and accounting beta measured by ROE (beta ROE coef. = 0.4974502,  $p = 0.001$ ). Moreover, the results related to the variable beta ROA reveal a positive and significant coefficient at the 1% threshold (beta ROA coef. = 0.6396429,  $p = 0.000$ ). These results confirm the hypotheses  $H_1$  and  $H_2$ , which stipulate that the use of the accounting beta based on ROE and ROA, respectively, as a measure of systematic risk is positively related with the market beta in the case of listed Moroccan firms.

**Table 5.** Regression analysis.

Beta Market	Coef.	Std. Err.	t	P >  t	95% Conf.	Interval
Beta ROE	0.4974502 ***	0.1472762	3.38	0.001	0.2069726	0.7879277
Beta Net Income	−1.695572	0.1089882	−1.56	0.121	−0.3845182	0.0454037
Beta ROA	0.6396429 ***	0.050505	12.66	0.000	0.5400303	0.7392555
Constant	0.0667911	0.0638401	1.05	0.297	−0.0591228	0.1927049
R <sup>2</sup>	0.5548					
F (3193)	72.84					
Prob > F	0.0000					

Source: STATA 15 output. \*\*\* Significant at the 1% level.

These results are in line with the [Sarmiento et al. \(2021\)](#) study, which showed that accounting beta measured by ROE can substitute for market beta in order to calculate the risk of unlisted firms. Similarly, the findings of this study corroborated those of [Intrigano et al. \(2017\)](#), who found that ROE-based accounting beta presents a powerful solution to determine risk. Among others, these results are consistent with those of [Roque and Caicedo Carrero \(2021\)](#), who justified the hypothesis that accounting beta presents itself as an alternative to systematic risk measurement. Moreover, this result confirms the results of the studies of [Rutkowska-Ziarko and Pyke \(2017\)](#) and [Rutkowska-Ziarko \(2022\)](#) that predict the existence of significant similarities between market and accounting betas. On the other hand, the results of our study contradicted the conclusions of [St-Pierre and Bahri \(2006\)](#), who argued that accounting beta cannot substitute for market beta. Therefore, the basic assumption of accounting beta can be confirmed such that accounting data are influenced by information and incidents, which would also underlie market prices.

Furthermore, we found that the coefficient of the independent variable accounting beta measured by net income is negative and statistically insignificant with market beta (net income beta coef. = −1.695572,  $p = 0.121$ ). This result allowed us to reject our  $H_3$  hypothesis, which states that the use of accounting beta based on net income as a measure of systematic risk is positively related to market beta. However, our results are in line with previous studies that have shown that accounting beta measured by net income is not significantly associated with market beta ([Sarmiento-Sabogal and Sadeghi 2015](#)).

#### 4.7. Testing the Validity of the Model

To strengthen our results, it is necessary to proceed to the validation of the chosen model. To this end, we performed three tests: test of normality of the residuals, test of autocorrelation of the residuals and test of heteroscedasticity of the residuals.

##### 4.7.1. Test of Normality of Residuals

To test the normality of the residuals generated after the estimation of our fixed-effects model, we opted to use the skewness and kurtosis test. The latter allows us to decide whether or not the residuals of a linear regression follow a normal distribution ([Bourbonnais 2021](#), p. 263). The result of the test for our model is presented in Table 6.

**Table 6.** Result of the skewness and kurtosis test.

	Obs	Chi-2	Prob
Residue	245	5.97	0.0506

Source: STATA 15 output.

Following the result of the test, the associated probability is higher than 5%, which leads us to conclude that the residuals of our study are distributed according to a normal distribution.

#### 4.7.2. Autocorrelation Test of Residuals

The autocorrelation of the residuals expresses the correlation between the error terms with respect to their time-lagged values (Bourbonnais 2021, p. 266). With this in mind, we used the Wooldridge test to test the autocorrelation of the residuals in our model (Table 7).

**Table 7.** Result of the Wooldridge test.

	F (148)	Prob > F
<b>Residue</b>	0.143	0.7067

Source: STATA 15 output.

With respect to the error autocorrelation test, the probability associated with the Fisher statistic for this test is greater than 5%. In this context, we concluded that there is no autocorrelation of the residuals.

#### 4.7.3. Testing the Heteroscedasticity of Residuals

To improve our study, the heteroscedasticity test was performed (Table 8). The test explains whether the variance of the residuals is constant or not; in the case where the variance of the residuals is not constant, then the ordinary least squares method becomes ineffective. To perform the heteroscedasticity test, we used the Wald test (Bourbonnais 2021, p. 155).

**Table 8.** Result of the Wald test.

	Chi-2	Prob
<b>Residue</b>	255.85	0.0000

Source: STATA 15 output.

Based on the result of the heteroscedasticity test, the corresponding probability of the test is less than 5%. Therefore, the residuals of the model are heteroscedastic. To correct this situation, we used the “robust” command on the STATA software.

For this purpose, the new model is as follows (Table 9):

**Table 9.** Regression analysis corrected for heteroscedasticity.

Beta Market	Coef.	Robust Std. Err.	t	P >  t	95% Conf.	Interval
<b>Beta ROE</b>	0.2921178 **	0.1269072	2.30	0.021	0.0433843	0.5408513
<b>Beta Net Income</b>	−0.045159	0.0899463	−0.50	0.616	−0.2214505	0.1311326
<b>Beta ROA</b>	0.72874 ***	0.0535891	13.60	0.000	0.6237073	0.8337726
<b>Constant</b>	0.0632569	0.0818937	0.77	0.440	−0.0972518	0.2237656
<b>R<sup>2</sup></b>	0.5677					

Source: STATA 15 output. \*\*\* Significant at the 1% level, \*\* significant at the 5% level.

Table 9 shows the regression analysis of the search model adjusted for heteroscedasticity. The regression results in an R-squared of 0.5677, meaning that 56.77% of the variation in the market beta variable is explained by the accounting beta explanatory variables, while 43.23% is due to error.

The interpretation of the results of the second regression corrected for heteroscedasticity shows a positive and statistically significant relationship at the 5% threshold between market beta and accounting beta measured by ROE (beta ROE coef. = 0.2921178,  $p = 0.021$ ). Furthermore, the results related to the variable beta ROA reveal a positive and significant relationship at the 1% threshold (beta ROA coef. = 0.72874,  $p = 0.000$ ). On the other hand, we find that the coefficient related to the independent variable accounting beta measured by

net income is negative and statistically insignificant with the market beta (beta net income coef. =  $-0.045159$ ,  $p = 0.616$ ). These results are in accordance with the first estimate.

The research results show that accounting beta has a positive and significant relationship with market beta. To this end, unlisted firms can use accounting beta as a risk measure to determine the cost of equity capital and, subsequently, value creation. Indeed, the accounting beta provides the shareholders of unlisted companies with a picture of the optimal use of capital. A high accounting beta implies a high cost of equity, which negatively impacts value creation within the organization.

## 5. Conclusions

The problem of determining the risk factor is crucial in the process of choosing an investment. To this end, the global risk of an asset can be divided into two categories, a systematic risk and a specific risk; the latter can be managed by an efficient investment, hence the implication of portfolio diversification. On the other hand, the systematic risk cannot be controlled by diversification, which obliges issuers to remunerate investors for their risk appetite.

As a result, risk measurement methods have become of paramount importance in the sphere of finance, and its determination and calculation with a satisfactory degree of accuracy is still the intention of researchers and experts. Our review of the literature has allowed us to note the existence of several models that can substitute the CAPM in order to measure the risk for unlisted organizations, such as the analogical model that is based on a sample of listed companies as a reference to calculate the beta. The difficulty of this method is finding a company that has the same characteristics as the target company; moreover, in emerging countries such as Morocco, the number of listed companies is minimal compared to the total number of companies in the country. In addition, another model can be used to measure the risk of unlisted companies, the qualitative approach, which is based on the rating given by the rating agencies in order to quantify the risk and then calculate the cost of capital and the value of the firm. The weakness of this method is that the majority of rating agencies cannot give an estimate for all unlisted companies, especially in emerging countries where said agencies are not present. In this respect, accounting beta is seen as a powerful solution for measuring the risk of unlisted companies. It is based on the assumption that accounting data are influenced and impacted by information and events, which would also drive market price fluctuations. The accounting beta gives a considered view for the calculation of risk and, consequently, of the cost of capital; it is calculated by the linear regression between the accounting measure of the company and the average of the same accounting measure related to all companies in the market. Therefore, the results of the literature review allowed us to find that the accounting beta is one of the best performing alternative models for estimating beta. Its strength lies in the fact that it does not use market information as a starting point—it attempts to reconstruct the market beta from an organization-specific accounting measure.

The main objective of this study verified whether there is a positive relationship between the systematic risk measured by the market beta and that calculated using the accounting beta of Moroccan companies listed on the Casablanca Stock Exchange. Our aim was to provide an alternative quality measure of systematic risk for unlisted firms such as SMEs and public sector firms.

To carry out this study, data from 49 companies listed on the Casablanca Stock Exchange between 2015 and 2019 were used. We employed panel data regression to empirically test the research hypotheses.

The analysis shows a positive and statistically significant relationship between market beta and accounting beta, as measured by ROE and ROA. These results confirm hypotheses  $H_1$  and  $H_2$ , which state that the use of accounting beta based on ROE and ROA, respectively, as a measure of systematic risk is more representative of market beta in the case of Moroccan firms. On the other hand, the accounting beta measured by the net income is negative and statistically insignificant with the market beta. This result allows us to reject our hypothesis

H<sub>3</sub>, which states that the use of accounting beta based on net income as a measure of systematic risk is positively and significantly related to market beta.

However, there are several limitations to using accounting beta to measure organizational risk. The first is the availability and frequency of accounting information, as not all unlisted companies have a legal obligation to publish their data regularly to the general public, which hinders the use of this method. The second is the quality of the accounting data published by unlisted companies, as a significant proportion of unlisted companies do not have a public accountant to attest to the quality and reliability of the information provided, especially in the case of SMEs. Third, the results of this study focus on a single market—a comparative study with other financial markets in emerging countries should be developed to decide on the use of accounting beta as an alternative to measure the risk of unlisted companies.

**Author Contributions:** Conceptualization, A.F. and M.R.A.; methodology, A.F.; software, A.F.; validation, M.R.A.; formal analysis, A.F. and M.R.A.; investigation, A.F.; resources, A.F.; data curation, A.F.; writing—original draft preparation, A.F.; writing—review and editing, M.R.A.; visualization, A.F.; supervision M.R.A.; project administration, M.R.A.; funding acquisition, A.F. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research received no external funding.

**Data Availability Statement:** All data used in the study were obtained from the Casablanca Stock Exchange.

**Conflicts of Interest:** The authors declare no conflict of interest.

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