Equity Risk Premium and Investors Preferences Towards Reward-to-Risk from Europe, USA, and Asia

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The equity risk premium is key for the cost of capital and a crucial tool to guide investment decisions. In the literature, an ex-post approach is widely used to estimate equity risk premium investor's future claims. In this paper, Merton's framework (1980) is applied to the Eurozone, USA, and Asia, using historical data for the period between 2002 and 2015. The expected equity risk premium will be calculated in the context of the financial crisis that started in 2008 and will be testing the reward-to-risk ratio non-negativity constraint. For all three economic areas, empirical analyses suggest investors' aggregate risk preferences that are stable for measurable periods. The authors subscribe to a direct connection between the time under analysis and the accuracy of equity risk premium estimates. At best, it is expected that equity risk premium for the Eurozone, USA, and Asia stand at 5.04%, 4.91%, and 7.75%, respectively. (JEL: G10; G30)

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I. Introduction

Since 1980, significant changes in the financial markets have been registered, which, along with technological developments, have given rise to global markets with increased liquidity capacity for financial securities, especially derivative financial instruments.

Globalization is a trending topic that has sponsored changes in the diversification and appreciation of investment securities. Recently, there has been witnessing an increase in investor concern with the search for assets that are capable of maximizing profit for each unit of risk undertaken. The concept of premium risk refers to the excess return of an asset with an inherent risk as compared to an asset that doesn't involve any risk.

Dimson, Marsh and Staunton (2003) introduced two fundamental aspects that explain the importance of the risk premium: the reward for the incurred risk and the need for managers to be aware of the reward rate that shareholders should demand projects that involve different sorts of risks. Estimating the level of risk may be extremely complex (Campbell, 2008; Fernandez, 2016), because it is not a variable that can be directly observed and it must, instead, be assessed at each moment.

For several decades, the issue of premium risk has been given considerable attention by academics and experts working in the field and has been increasing in importance as a study object since the Capital Asset Pricing Model (CAPM) of Treynor (1961, 1962), Sharp (1963), Lintner (1965a and 1965b) and Mossin (1966) first appeared, in which the concept of equity risk premium (ERP) is introduced. Researchers, analysts, and investors estimate the ERP value about different models, which has sponsored heated debate in the literature. Even though the calculation of the ERP value is largely made about the CAPM, other models have contributed for more complex calculations of the ERP, namely those of Arbitrage Pricing Theory (APT) by Ross (1976), the three-factor model by Fama and French (1995) and Option-pricing based models (Hsia,1981 and 1991; McNulty, Schulze and Lubatkin, 2002). Nonetheless, Mehra(2003) shows that neither one of these contributions is exempt from criticism, both concerning the model itself or the premises around which it is built, and there is a wide debate around ERP stability over time.

Concerning the definition of the period set for analysis, Pastor and Stambaugh (2001) have demonstrated the importance of analyzing historical periods that are relatively long, to introduce an aspect of accuracy and flexibility to these analyses. In the same line of thinking is Damodaran (2012), who doesn't even consider the possibility of calculating ERP based on the above-mentioned models of profitability for developing economies, since historical data for these economies is not very reliable.

According to Brigham and Daves (2007), the methodologies used for ERP calculations could potentially be subdivided into two groupings, namely those that are based on historical data, those that focus on ex-post approaches, and those based on prospective data - the so-called ex-ante approach. In the ex-post approach, calculations of the historical ERP are based on the assumption that, on average, investors estimate future results according to the results achieved in the past, which leads to the creation of a single reference rate for all investors. In this type of analysis, is advisable that yearly time series is used as a reference, as they are more stable and less prone to volatility. However, authors such as Jorion and Goetzmann (1999), Pastor and Stambaugh (2001), and Damodaran (2012) point towards the risk of observations in which standard-error becomes of little importance. This leads us to consider another option: monthly time series which, even though more unstable, are more likely to produce a representative sample. Limitations detected in the practical use of the ex-post approach, have given room to the expression of other alternative approaches, namely those based on the implicit ERP, based on the modified formula of Gordon's model (1962). The latter is focused on the current market structures and assumes that market prices are correctly fixed and can be applied to any market that is more or less efficient. The inability to achieve consensus regarding the use of Gordon's model (1962) is combined with some difficulties with the ex-ante approach to ERP, which produces divergent results.

The aim of this study is not only to estimate and compare ERP but also to use Merton's framework (1980) to analyze investors' risk preferences in the Eurozone, USA, and Asia, in an ex-post approach. At the same time, it is our goal to contribute to the validation of this framework in terms of its applicability, consistency, and behavior when analyzing markets and different junctures. This study is relevant to demonstrate the developments made by Merton (1980) and the possibility of contributing to explain the expectations of investors in terms of risks and return, based on future market developments. The reference historical period, 2002/2015, will allow for an analysis of the effect of the financial crisis that started in 2008 on ERP figures. To our knowledge, Neves and Pimentel (2004) were the only authors that applied and tested Merton's framework (1980) to calculate the ERP. This was done based on the historical excess-return in the Portuguese capital market between 1993 and 2001. Now, over a decade later, it is intended to build on that knowledge and bring more into this matter.

Besides the introduction chapter, this article also includes 3 more chapters: chapter II introduces the goals and methodology of the study, chapter III lists the results and limitations of the study, and chapter IV presents the main findings and suggestions for future research.

II. Methodology

Merton (1980) carried out an ex-post exploratory analysis to estimate the value of ERP for emerging economies, where such calculation is of interest, use short periods.

The author's framework is based on three models that estimate ERP and are mutually excluding, bearing in mind different sorts of investor behavior regarding risk. Model 1 suggests that aggregate risk preferences are more or less stable over relatively long periods. Model 2, on the other hand, suggests that the slope in the line of capital markets or risk price remains relatively stable for periods that are considerably long. Model 3 indicates that ERP remains stable over relatively long periods, even though the level of risk may vary. While models 1 and 2 allow for some variation in the ERP as the risk grows, model 3, on the other hand, suggests that it remains stable, as in the naive approach. However, the 3 models reveal two major concerns: The lack of stability in market variance and the non-negativity of excess-return.

Merton (1980) suggested the following specifications estimate ERP:

$$\alpha - r = Yg\left(\sigma^2\right) \tag{1}$$

where:

α, expected return of the market;

r, risk-free interest rate;

Y, reward-to-risk ratio, with interpretation subject to the specification of the function g;

g, the function of σ^2, with $g(0) = 0$ and $dg / d\sigma^2 > 0$; and

σ^2, market return variance.

After N observations within the T period, in which Y_j is constant, estimates of the reward-to-risk ratio (RRR), $\hat{Y}_j$, with j = 1, 2, 3, are obtained as follows in these equations:

$$\text{Model 1: } \hat{Y}_1 = \left[\sum_1^N X_t\right] \Big/ \left[\sum_1^N \sigma_t^2\right] + 0.5 \tag{2}$$

$$\text{Model 2: } \hat{Y}_2 = \left\{\sum_1^N [X_t/\sigma_t] + 0.5\sum_1^N \sigma_t\right\} \Big/ N \tag{3}$$

$$\text{Model 3: } \hat{Y}_3 = \left\{\sum_1^N \left[X_t/\sigma_t^2\right] + 0.5N\right\} \Big/ \sum_1^T \left[1/\sigma_t^2\right] \tag{4}$$

with:

$\hat{Y}_1$, aggregate risk preferences;

$\hat{Y}_2$, risk price;

$\hat{Y}_3$, equity risk premium;

σ_t^2, market return variance, for the t period;

σ_t, market return standard deviation, for the t period;

$X_t \equiv \ln\left[R_{M,t}/R_t\right]$, excess return;

$R_{M,t} \equiv M_{t+h}/M_t$, the return of the market portfolio between t and $t+h$, considering a lognormal distribution to $R_{M,t}$; and

$R_t \equiv \exp\left[\int_t^{t+h} r_t ds\right]$, return of the risk-free asset between t and $t+h$.

In a scenario where variance in the ERP value is stable, there is a convergence of all models towards model 3. Should this not be the case, it is expected that different calculations among the three models should arise, which confirms what many studies have stated before on the impossibility of ERP variance to be stable for relatively long periods (Black, 1976; Schwert, 1989). Given that σ_t^2 (variance) and α_t (expected market return) are non-observable variables, it is up to us to estimate what their value could be. Merton's (1980) general model admits that variance and risk-free interest rates can be considered as constant for limited time spans h.

To estimate the RRR, it is important to check the relevance of the non-negativity constraint, through estimations $\bar{Y}_j$ for the same time spans T in which $\hat{Y}_j$ is estimated. The way to estimate the $Y_j, \bar{Y}_j = E\left[Y_j \middle| \hat{Y}_j, \Omega_j^2; b\right], j$, j = 1, 2, 3, is:

$$\bar{Y}_j = \hat{Y}_j + e^{-\frac{1}{2}\eta j^2} \left\{1 - \exp\left[-b\Omega_j^2\left(\bar{y}_j - \hat{Y}_j\right)\right]\right\} / \left\{\sqrt{2\pi}\Omega_j\left[\Phi\left(p_j\right) - \varphi\left(\eta_j\right)\right]\right\} \tag{5}$$

where:

$0 \leq Y_j \leq b$;

Φ, cumulative distribution function;

$\lambda_j \equiv \hat{Y}_j, j = 1,2,3$;

$\Omega_j^2 \equiv \sum_1^N [\sigma_t]^{4-2j}$;

$p_j \equiv \Omega_j\left(b - \lambda_j\right)$;

$\eta_j \equiv -\lambda_j\Omega_j = -\hat{Y}_j\Omega_j$;

$\bar{y}_j \equiv b/2$; e

$\bar{Y}_j$, RRR estimate based on the distribution function, locked in the interval [0, b].

In the absence of more information, the reasonable option should be to define the top limit of the normal cumulative distribution function towards an infinite ceiling, i.e., $b = \infty$, which concerns the investor's risk aversion. In that case, $\bar{Y}_j$ could be represented by the following equation:

$$\bar{Y}_j = \hat{Y}_j + \exp\left[-\eta_j^2/2\right] / \left\{\sqrt{2\pi}\,\Omega_j\left[1 - \Phi\left(\eta_j\right)\right]\right\} \tag{6}$$

After defining the RRR value for each model, the ERP is estimated as follows:

Model 1 - Constant aggregate risk preferences

$$\alpha_t - r_t = Y_1\sigma_t^2 \tag{7}$$

Model 2 - Constant risk pricing

$$\alpha_t - r_t = Y_2\sigma_t \tag{8}$$

Model 3 - Constant ERP Constant ERP

$$\alpha_t - r_t = Y_3 \tag{9}$$

The variance used to estimate RRR is given by the sum of the square roots of immediate daily logarithmic returns (α_k), as this allows us to obtain more accurate figures. This variance is expressed in monthly intervals *t*, sustained by *M* daily observation of return rates (*k*).

$$\hat{\sigma}_t^2 = \sum_{k=1}^{M} \left(\alpha_k - \bar{\alpha}\right)^2 \tag{10}$$

However, and since considering daily observations, adjustments are made when weekends and holidays are concerned, dividing immediate daily returns by the square root of the number of days that go in between transactions. Additionally, some adjustments are necessary regarding the non-transaction effects, since the precise period in between consecutive transactions is unknown. Merton (1980) suggests the method indicated below, considering that the non-transaction effect disappears after three days.

$$X_k = \mu\Delta + \sigma\sqrt{\Delta\varepsilon_k}, \qquad k = 1, 2, ..., n \tag{11}$$

$$\hat{X}_k = \mu\Delta + \sigma\sqrt{\Delta}\left[\delta_0\varepsilon_k + \delta_1\varepsilon_{k-1} + \delta_2\varepsilon_{k-2} + \delta_3\varepsilon_{k-3}\right] \tag{12}$$

where:

$0 \leq \delta_j \leq 1, j = 0, 1, 2, 3$ *e* $\delta_0 = 1 - \delta_1 - \delta_2 - \delta_3$;

X_k , effective daily change to the Index value; and

$\hat{X}_k$, the daily change observed in the value of the Index.

The adjustment procedure consists of the division of the monthly estimates of variance by the sum of the square roots of δ_j, $E\left(\sigma_t^2\right) = \left[\sum_{j=0}^{3} \delta_j^2\right] \times \sigma_t^2$. Note that the parameters δ_j were estimated through non-linear procedures in the equation:

$$\hat{X}_k = A + B\hat{X}_{k-1} + B^2\hat{X}_{k-2} + B^3\hat{X}_{k-3} \tag{13}$$

From equations (12) and (13), there are:

$$B = \left[\delta_1 + \delta_1\delta_2 + \delta_2\delta_3\right] \big/ \left[1 + \delta_1^2 + \delta_2^2 + \delta_3^2\right] \tag{14}$$

$$B^2 = \left[\delta_2 + \delta_1\delta_3\right] \big/ \left[1 + \delta_1^2 + \delta_2^2 + \delta_3^2\right] \tag{15}$$

$$B^3 = \delta_3 \big/ \left[1 + \delta_1^2 + \delta_2^2 + \delta_3^2\right] \tag{16}$$

The adjustment to the non-transaction effects is unfeasible for the American market since the result is $B < 0$. If B is negative, the only possible solution for δ_j is also negative and thus, it is deprived of economic or financial rationality. For the European market, the effect of the correction was merely marginal. Therefore, it is acceptable to assume that the difference between adjusted variance and variance without any adjustment is of little importance.

III. Empirical results

Merton (1980) framework was applied to the Eurozone, with historical data for the period comprehended between 2002 and 2015. The Nasdaq Eurozone Total Return Index was used as a proxy to the stock market of the Eurozone. The risk-free interest rate is represented by the sovereign bonds of the main issuers in the Eurozone, namely France, Germany, Italy, the Netherlands, and Spain, for a 10-year maturity. For the US market, the S&P 500 Total Return Index was selected, which covers around 80% of this market and in which the risk-free interest rate is represented by US sovereign bonds for a 10-year maturity. Last but not least, the Asian market was represented by the Dow Jones Singapore Total Stock Market Total Return Index, and the proxy to the risk-free interest rate is provided by the average of sovereign bond yields of Singapore for a 10-year maturity.

It is worth highlighting that, if no criterion leads us to choose a specific period in which the ratio between reward and risk is assumed to be constant, the models will be estimated according to different values for the following time T: Total of 14 years; Two-time intervals of 7 years each; One of 6 years and another of 8 years; One-time interval of 2 years and the remainder in 4-year intervals; Every 2 years;

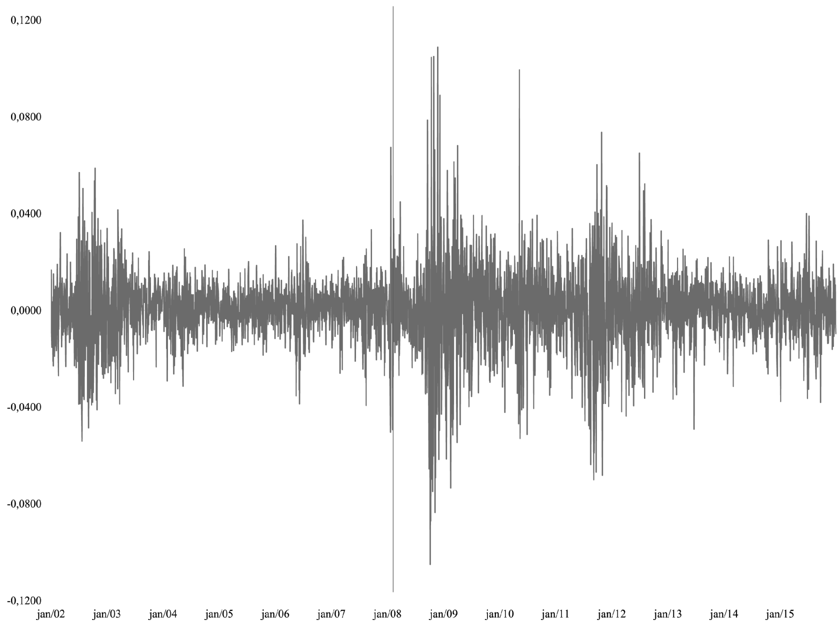

FIGURE 1.— Nasdaq Eurozone Daily Returns between 2002 and 2015

Annual periods. The selection of these periods T was due to the Financial crisis experienced in the US and Europe since 2008, which is considered to be the worst financial crisis recorded since the Great Depression of 1929.

A. Euro Zone

Figure 1 shows the behavior of daily returns of the Nasdaq Eurozone Total Return, where it can be seen that the period showing greater volatility is the one comprehended between 2008 and 2015.

Table A1 leads us to conclude that the estimated reward ratios are always higher when the non-negativity constraint is considered ($b = \infty$).

Besides, it is normal that $\overline{Y}_2$ and $\overline{Y}_3$ converge to $\hat{Y}_2 \, e \, \hat{Y}_3$, respectively, with the need for smaller intervals in which the ratio is considered constant and faster than in Model 1, leading to some differences in the order of magnitude between the two estimates, which are of little importance. Merton (1980) had already demonstrated that $\overline{Y}_j$

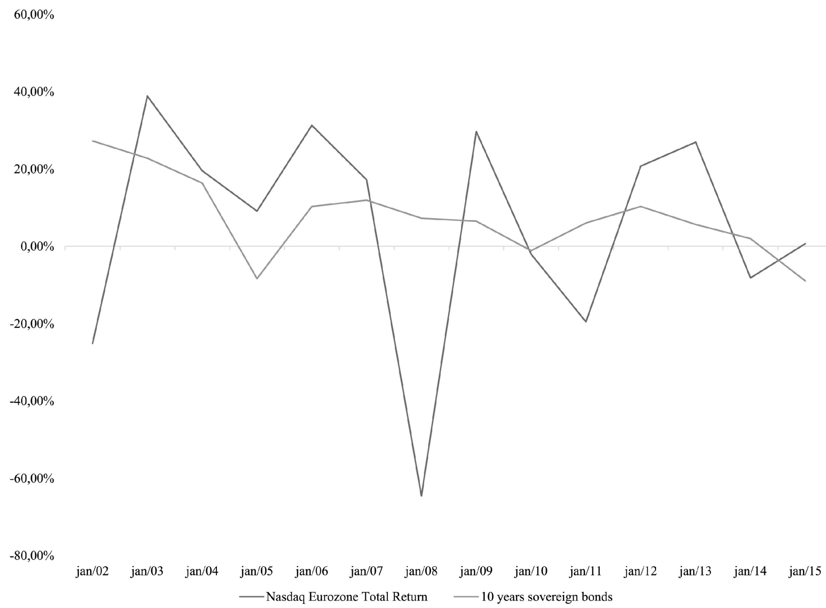

FIGURE 2.— Nasdaq Eurozone annual return rates between 2002 and 2015

converges to $\hat{Y}_j$ as the number of observations, N, increases.

By analyzing table A2, it is concluded that the RRRs that are stable for 2 years and the remainder in periods of 4 years show average differences between the estimates that are not constrained by the non-negativity principle and the ones that are, which range from 16.50% (Model 3) and 47.31% (Model 1). Thus, they rely on the excess-return of the respective period. This means that the smaller the interval in which Y_j is considered stationary, the less negligible the differences between $\hat{Y}_j$ and $\bar{Y}_j$ will be the differences found between the estimate subject to the non-negativity constraint and the estimate that is constraint-free are not significant for the periods in which the values of excess-return are positive. For the periods 2002/2003 and 2008/2011, the percentage differences between the two RRR estimates are substantial for each of the three models, since the excess-return was negative for these years. By shortening the periods, the likelihood of obtaining negative risk-premium becomes higher, and thus, the values that result from the incorporation of the non-negativity constraint are more in line with financial theory. However, the introduction of the

TABLE 1. Estimates of Nasdaq Eurozone ERP from 2002 to 2015

ERP Model 1: $\alpha_t - r_t = \overline{Y}_1\sigma_t^2$	5.0415%
ERP Model 2: $\alpha_t - r_t = \overline{Y}_2\sigma_t$	12.6544%
ERP Model 3: $\alpha_t - r_t = \overline{Y}_3$	16.7843%
Yields on sovereign bonds (r_t)	7.7124%
Nasdaq Eurozone return (α_t)	5.3316%
Naïve ERP	–2.3807%

non-negativity constraint is not only important in cases in which $\hat{Y}_j$ the excess-return is negative, as verified in the period 2008/2011. In these years, the difference between the two estimates using model 3 is of 44.41%, but $\hat{Y}_3$ is positive.

Looking at table A3 it becomes evident that there are two moments in time in which there is a considerable difference between the RRR with a non-negativity constraint and the RRR that is not subject to such constraint, especially for the periods 2002-2003 and 2008-2009.

Figure 2 confirms what had been concluded in table A3. Two distinct periods are critical for the European market, with the biggest slippage recorded for the years 2008 and 2009. On the assumption that RRR is stable throughout an annual period, 2002 and 2008 show for the biggest difference between the estimate subject to the non-negativity constraint and the constraint-free estimate.

As seen from table A4, the estimates with a non-negativity constraint are more stable. When RRR stability is assumed for annual periods, the results without the non-negativity constraint are on average 89% more unstable than the rest, a trend that is expected to be reversed in the ERP.

The information so far analyzed shows that it is reasonable to focus more on the RRR estimates for the longest *T*, 14 years. This calculation is the result of an analysis of the standard deviation and the mean squared error between the foreseen value and the estimated value for the excess-return, which shows that such estimates are of inferior value than those resulting from smaller periods.

Using the estimates for $\overline{Y}_j$, with a stable ratio throughout the 14 years, the expected ERPs were determined, as well as the immediate return of the equity and yields index, through naïve techniques.

Table 1 shows that the average of expected ERPs varies considerably according to the model used in descending order, model 1 has an estimated 5.04% a year, followed by model 2 with 12.65% and, coming last, model 3, with an average 16.78% a year. On the other hand, the historical ERP value is –2.38%. The analysis of the data in

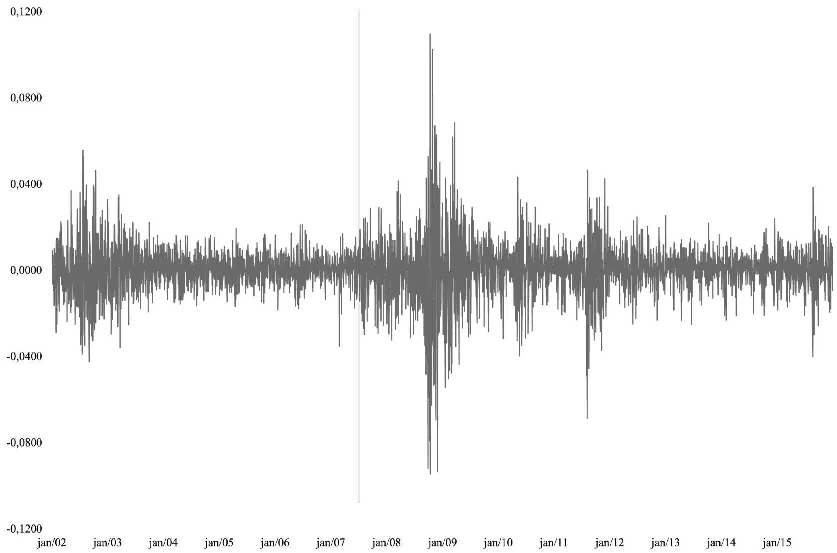

FIGURE 3.— Daily return of S&P 500, between 2002 and 2015

table 1, combined with the assumption that, in the future, investors will maintain their aggregated preferences in face of the risk, it is expected that model 1 should produce the best ERP estimate.

The analytical expressions of RRR, and according to what has been empirically confirmed, models 1 and 2 are more vulnerable to oscillations variance over time. Nevertheless, since model 3 considers variance as stable, if significant changes to variance over time are verified, this model becomes more sensitive to the historical period than the other models.

B. USA

In the case of the US, Merton's framework (1980) was applied for the periods between 2002 and 2015. Figure 3 illustrates volatility among daily returns of the S&P 500 Total Return and confirms that the period between 2008 and 2015 has the most accentuated volatility rate.

The RRR analysis was carried out for the 14 years, as well as for two intervals of 7 years each, as seen in table A5. It is concluded that RRR estimates are higher when the non-negativity constraint is considered. The biggest difference between estimates with and without the non-negativity constraint is registered in model 1, while the other

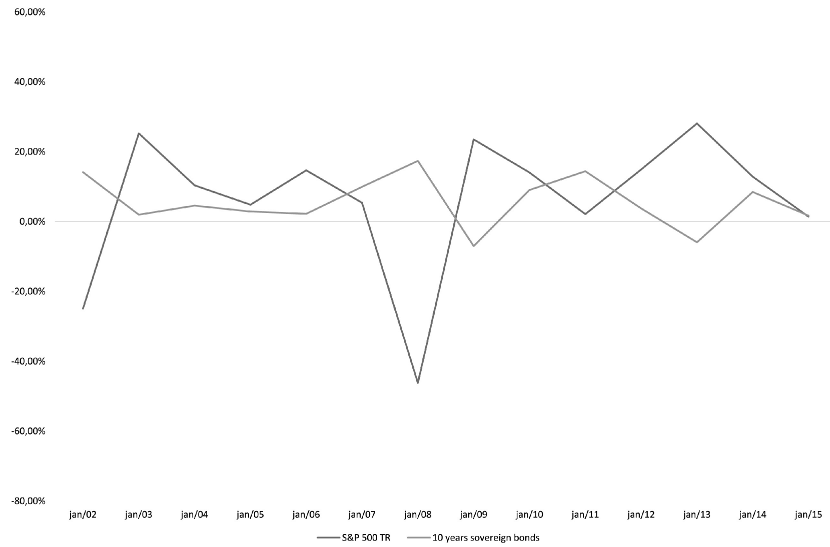

FIGURE 4.— S&P 500 annual return rates between 2002 and 2015

models show for biggest convergence between both kinds of estimates.

In table A6 average differences between the estimates with and without the non-negativity constraint range from 3.53% (Model 3) and 35.30% (Model 1).

In this case, the non-negativity constraint is also relevant for periods with negative RRR. Combining table A7 and figure 4, considerable differences between both estimates are observed, especially for the periods 2002-2003 and 2008-2009, which result from the negative excess-return values and the high volatility of the market.

In the US market, RRR ratios without non-negativity constraints are, on average, 52% more volatile than the ratios with such constraint whenever it is considered stability for annual periods, as portrayed in table A8.

According to the data in table 2 and based on estimates of $\overline{Y}_j$ over 14 years, the expected ERP ranges between 4.91% and 19.16%. Given the considerable dispersion of the estimates of the 3 models and the historical ERP of 0.62%, a prudent analysis points towards a tendency for investors to introduce constant aggregate risk preferences. Just like in the Eurozone, for which it is expected that the aggregate risk preferences of investors are maintained in the future, it is also expected that Model 1 produces the best ERP estimate, at 4.91%.

TABLE 2. ERP estimates 2002 to 2015, S&P 500

ERP Model 1: $\alpha_t - r_t = \overline{Y}_1\sigma_t^2$	4.9145%
ERP Model 2: $\alpha_t - r_t = \overline{Y}_2\sigma_t$	16.2453%
ERP Model 3: $\alpha_t - r_t = \overline{Y}_3$	19.1615%
Yields on sovereign bonds (r_t)	5.5127%
S&P 500 return (α_t)	6.1348%
Naïve ERP	0.6221%

C. Asia

The analysis of the Asian market was based on results from 2007 to 2015. The time intervals were subdivided according to previous analyses since similar behavior was identified with regards to the daily returns in previous periods. Figure 5 shows volatility between daily returns of Dow Jones Singapore Total Return. It is confirmed that even though a period of great volatility begins in 2008, such a period is very limited in scope and time since 2010 marks the return of this market to the lowest volatility level when compared with the US and the Eurozone.

In table A9 it can be seen that the estimates concerning the period between 2007 and 2008 have the biggest value discrepancies because this is a period that comprehends negative excess-return and dabbles in high volatility levels.

In table A10, average differences between estimates with and without non-negativity constraints for 1 year and the remainder in periods of 4 years, stand at 4.33% (Model 3) and 48.86% (Model 1). This means that the shorter the period, the bigger its dependence on excess-return and, consequently, the differences between the estimates are no longer negligible. The differences between both estimates are generally smaller in the cases where RRRs are positive, as is the case with the period between 2012 and 2015, which has a maximum difference of 25.54% (Model 1). Once again, it is the period comprehended between 2008 and 2011 that registers a negative RRR for Model 1, with a difference between estimates of 148.54%. This difference only becomes insignificant in Model 3, where values of 2.65% are registered.

Table A11 and figure 6 are evidence of the above since three critical moments are registered, namely 2008/2009, 2010/2011, and 2014/2015.

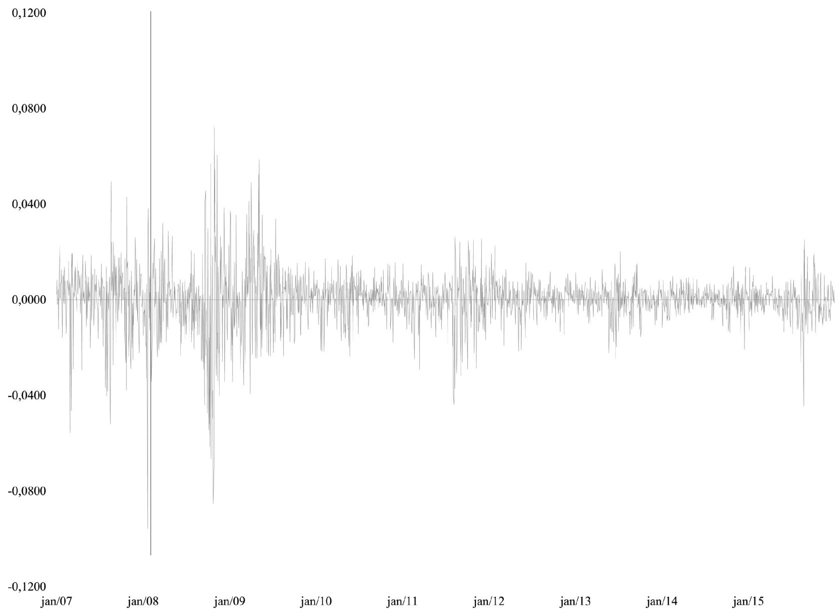

FIGURE 5.— DJ Singapore's daily return, between 2007 and 2015

In table A12, for annual intervals, greater stability is observed for estimates with the non-negativity constraint. The RRRs without the non-negativity constraint is, on average, 67% more unstable.

Empirical results show that estimating the ERP based on longer periods, in this case for 9 years, is the most reasonable approach. In table 3, Model 1 registers the smallest expected ERP value –7.75%, while its historical value is 0,81%.

Considering investors that intend to maintain their aggregate risk preferences, Model 1 has the best ERP estimate, at 7.75%. Nevertheless, of all three markets under analysis, the Asian market is the one that shows a greater convergence in the ERP estimates for the 3 models, confirming the convergence behavior for model 3 when market variance tends to be constant. Hence, as in the other markets, the prudent analysis points towards a preference for constant risk by investors.

IV. Conclusion

In the presence of risk-averse investors in a context of uncertainty, the

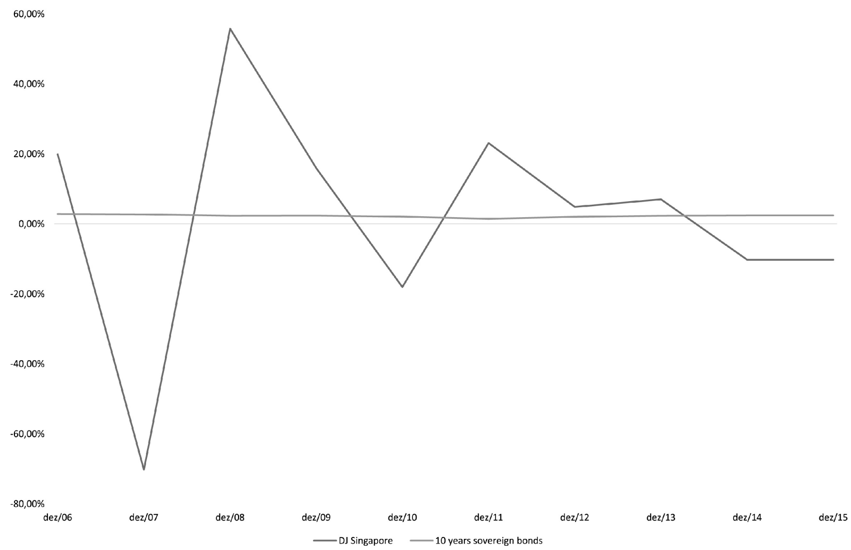

FIGURE 6.— Annual Return DJ Singapore, 2007 - 2015

ERP takes on a key role in determining the return that is required for investment options and opportunities (Fama and French, 2002).

This article encompasses an ex-post analysis of the ERP for three great economic regions - the Eurozone, the USA, and Asia - based on Merton's learning (1980).

Contrary to what Neves and Pimentel (2004) state in their study, Model 3 has empirically produced the highest ERP estimates, which are very far from the respective naïve estimates. Such discrepancy can be explained by the unique features of the sample periods, which are influenced by the economic crisis that began in 2008, combined with the inclusion of a correction for the lack of stability in market variance and the non-negativity constraint of excess-return.

The dimension of the sample in which RRR is treated as constant introduces a direct correlation between the quality and stability of results.

For any of the three markets under analysis, and crossing the results with the excess-return, the most modest evidence points towards the assumption of aggregate risk preferences that are stable over time, despite the subjectivity that such option entails. To be precise, the best forecast of ERP values relies on the behavior of investors towards risk in the future. The ERP registered in the past is very distant from the best estimates that can be expected based on historical data, regardless of the

TABLE 3. ERP estimates 2007 - 2015, DJ Singapore

ERP Model 1: $\alpha_t - r_t = \overline{Y}_1\sigma_t^2$	7.7489%
ERP Model 2: $\alpha_t - r_t = \overline{Y}_2\sigma_t$	8.6287%
ERP Model 3: $\alpha_t - r_t = \overline{Y}_3$	11.1934%
Yields on sovereign bonds (r_t)	2.2861%
DJ Singapore return (α_t)	3.1003%
Naïve ERP	0.8143%

model used. Thus it is assumed that there was some adjustment to the recession periods included in the sample. Thus, in the Eurozone, it is likely that the best long-term premium estimate must be around 5.04%, while in the past it was around –2.38%. If a negative estimate were admitted, it would be saying that investors are willing to pay to take on the risk, a situation that is entirely contrary to financial rationality. This serves the purpose of highlighting the importance of introducing the non-negativity constraint in RRR estimates. According to Reuters, the ERP in the Eurozone for 2016 ranged from 6.00% to 8.00%.

In the American market, the results point towards an ERP of 4.91%, a value which is closer to the one presented by Fernandez, Pizarro and Acín (2016), 5.30%. A lower ERP in the Eurozone, as compared to the one registered in the US market, is compliant with the forecasts of investment agencies in 2016.

The Asian market has an ERP of 7.75%, the closest figure to the estimates of Fernandez, Pizarro and Acín (2016), of 5.90%, and Damodaran (2016), of 5.33%. Thus, the impact that the historical period under-appreciation had on the results verified is unquestionable, since the sample is considerably affected by the period that immediately followed the beginning of the crisis in 2008. For the Eurozone, USA, and Asia, the estimates obtained with Model 1 are the most reasonable, as the remaining models introduce very high values.

The present study is not without some limitations. No sophisticated approach was used when estimating the time (T) in which the RRR is considered to be relatively constant. Since this study does not focus on determining variance, this has been estimated with simple calculations. The scale of variance in the American market may suffer due to the impossibility of making the necessary adjustments to the non-transaction effect. Lastly, the use of the DJ Singapore Total Stock Market Total Return Index as a proxy for the Asian market is a debatable methodological option.

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Appendix

TABLE A1. RRR estimates, considering that Y_j is stationary throughout the 14 years and in intervals of 7 years: from 2002 to 2015, Nasdaq Eurozone

		14 years	7 years		
		2002/2015	2002/2008	2009/2015	Mean
Model 1:					
	$\hat{Y}_1$	0.0402	–1.3353	1.2121	–0.0616
	$\bar{Y}_1$	0.9519	0.9939	1.8286	1.4112
	Dif. %	–95.78%	–234.36%	–33.71%	–104.37%
Model 2:					
	$\hat{Y}_2$	0.1697	0.1830	0.2130	0.1980
	$\bar{Y}_2$	0.1725	0.1942	0.2196	0.2069
	Dif. %	–1.61%	–5.76%	–3.03%	–4.31%
Model 3:					
	$\hat{Y}_3$	0.0130	0.0132	0.0123	0.0128
	$\bar{Y}_3$	0.0130	0.0133	0.0124	0.0128
	Dif. %	0.00%	–0.08%	–1.38%	–0.71%

TABLE A2. RRR estimates, considering that Y_j is stationary for intervals of 2 and 4 years: 2002 to 205, Nasdaq Eurozone

		2002/2003	2004/2007	2008/2011	2012/2015	Mean
Model 1:						
	$\hat{Y}_1$	–2.983	6.263	–1.358	2.812	1.7789
	$\bar{Y}_1$	1.6497	6.5570	0.8703	3.5632	3.3758
	Dif. %	–280.84%	–4.48%	–256.00%	–21.08%	–47.31%
Model 2:						
	$\hat{Y}_2$	–0.0706	0.4194	–0.0145	0.2244	0.1697
	$\bar{Y}_2$	0.1397	0.4202	0.1100	0.2427	0.2408
	Dif. %	–150.50%	–0.20%	–113.18%	–7.53%	–29.52%
Model 3:						
	$\hat{Y}_3$	0.0034	0.0185	0.0056	0.0119	0.0108
	$\bar{Y}_3$	0.0086	0.0185	0.0101	0.0123	0.0129
	Dif. %	–60.37%	–0.01%	–44.41%	–3.22%	–16.50%

TABLE A3. RRR estimates, considering that Y_j is stationary for intervals of 2 years: 2002 to 2015, Nasdaq Eurozone

	2002/2003	2004/2005	2006/2007	2008/2009	2010/2011	2012/2013	2014/2015	Mean
Model 1:								
$\hat{Y}_1$	−2.983	7.3229	5.6369	−1.5692	−1.0637	4.2608	0.3918	1.7137
$\overline{Y}_1$	1.6497	8.4572	6.5067	1.1883	1.5997	4.9771	3.6979	4.0110
Dif.%	−280.84%	−13.41%	−13.37%	−232.05%	−166.49%	−14.39%	−89.40%	−57.27%
Model 2:								
$\hat{Y}_2$	−0.0706	0.3537	0.4850	−0.0448	0.0158	0.3584	0.0905	0.1697
$\overline{Y}_2$	0.1397	0.3727	0.4899	0.1476	0.1688	0.3765	0.2005	0.2708
Dif. %	−150.50%	−5.08%	−1.00%	−130.38%	−90.62%	−4.82%	−54.85%	−37.33%
Model 3:								
$\hat{Y}_3$	0.0034	0.0137	0.0245	0.0032	0.0079	0.0211	0.0057	0.0114
$\overline{Y}_3$	0.0086	0.0140	0.0245	0.0122	0.0141	0.0214	0.0090	0.0148
Dif. %	−60.37%	−2.11%	−0.05%	−73.53%	−44.19%	−1.78%	−36.11%	−23.38%

TABLE A4. RRR estimates considering that Y_j is stationary for annual intervals: 2012 to 2015, Nasdaq Eurozone

		Mean	Std. Dev.	Max.	Min.
Model 1:					
	$\hat{Y}_1$	2.5435	6.0733	15.7876	–6.6674
	$\bar{Y}_1$	5.9308	4.1761	16.7291	1.0757
	Dif. %	–57.11%	45.43%	–5.84%	19.80%
Model 2:					
	$\hat{Y}_2$	0.1697	0.3762	0.7099	–0.5916
	$\bar{Y}_2$	0.3570	0.1795	0.7155	0.1061
	Dif. %	–52.46%	109.59%	28.57%	69.08%
Model 3:					
	$\hat{Y}_3$	0.0104	0.0173	0.0309	–0.0289
	$\bar{Y}_3$	0.0185	0.0082	0.0343	0.0064
	Dif. %	–43.73%	111.68%	33.98%	72.83%

TABLE A5. RRR estimates, considering that Y_j is stationary throughout the 14 years and at 7-year intervals: 2002 to 2015, S&P 500

		14 years	7 years		
		2002/2015	2002/2008	2009/2015	Mean
Model 1:					
	$\hat{Y}_1$	0.6898	–1.8486	4.3611	1.2562
	$\bar{Y}_1$	1.4663	1.0224	4.5205	2.7714
	Dif. %	–52.96%	–280.81%	–3.53%	–54.67%
Model 2:					
	$\hat{Y}_2$	0.2870	0.1298	0.5400	0.3349
	$\bar{Y}_2$	0.2871	0.1541	0.5400	0.3470
	Dif. %	–0.01%	–15.77%	0.00%	–3.50%
Model 3:					
	$\hat{Y}_3$	0.0147	0.0091	0.0197	0.0144
	$\bar{Y}_3$	0.0147	0.0092	0.0197	0.0145
	Dif. %	0.00%	–0.48%	0.00%	–0.15%

TABLE A6. RRR estimates, considering that *Y* is stationary for intervals of 2 and 4 years: 2002 to 2015, S&P 500 TR

		2002/2003	2004/2007	2008/2011	2012/2015	Mean
Model 1:						
	$\hat{Y}_1$	–1.514	3.460	–0.988	9.133	3.0993
	$\bar{Y}_1$	2.3621	5.0687	1.2249	9.2905	4.7901
	Dif. %	–164.09%	–31.74%	–180.68%	–1.70%	–35.30%
Model 2:						
	$\hat{Y}_2$	0.0092	0.2844	0.1984	0.5173	0.2870
	$\bar{Y}_2$	0.1663	0.2929	0.2228	0.5174	0.3189
	Dif. %	–94.44%	–2.89%	–10.98%	–0.02%	–9.99%
Model 3:						
	$\hat{Y}_3$	0.0058	0.0109	0.0204	0.0182	0.0149
	$\bar{Y}_3$	0.0096	0.0109	0.0204	0.0182	0.0155
	Dif. %	–39.16%	–0.28%	–0.07%	0.00%	–3.53%

TABLE A7. RRR estimates, considering that Y_j is stationary for 2-year intervals: 2002 to 2015, S&P 500

	2002/2003	2004/2005	2006/2007	2008/2009	2010/2011	2012/2013	2014/2015	Mean
Model 1:								
$\hat{Y}_1$	–1.514	4.3546	2.9087	–1.1828	–0.4758	18.6645	1.7683	3.5034
$\overline{Y}_1$	2.3621	7.5292	5.6529	1.4329	2.7573	18.6981	5.1580	6.2272
Dif.%	–164.09%	–42.16%	–48.55%	–182.54%	–117.25%	–0.18%	–65.72%	–43.74%
Model 2:								
$\hat{Y}_2$	0.0092	0.2000	0.3689	0.1215	0.2753	0.7813	0.2532	0.2870
$\overline{Y}_2$	0.1663	0.2602	0.3854	0.2157	0.3113	0.7813	0.2955	0.3451
Dif. %	–94.44%	–23.15%	–4.28%	–43.68%	–11.57%	–0.01%	–14.30%	–16.82%
Model 3:								
$\hat{Y}_3$	0.0058	0.0067	0.0153	0.0188	0.0211	0.0260	0.0113	0.0150
$\overline{Y}_3$	0.0096	0.0078	0.0154	0.0200	0.0211	0.0260	0.0115	0.0159
Dif. %	–39.16%	–14.49%	–0.33%	–6.10%	–0.31%	0.00%	–1.93%	–5.77%

TABLE A8. RRR estimates, considering that Y_j is stationary for annual intervals: 2002 to 2015, S&P 500

		Mean	Std. Dev.	Max.	Min.
Model 1:					
	$\hat{Y}_1$	5.2650	9.7364	32.3660	–6.4270
	$\bar{Y}_1$	9.2033	7.8956	32.3804	1.1679
	Dif. %	–42.79%	23.31%	–9.74%	6.79%
Model 2:					
	$\hat{Y}_2$	0.2870	0.4316	1.1803	–0.5537
	$\bar{Y}_2$	0.4369	0.2710	1.1803	0.1105
	Dif. %	–34.30%	59.30%	12.50%	35.90%
Model 3:					
	$\hat{Y}_3$	0.0123	0.0190	0.0386	–0.0314
	$\bar{Y}_3$	0.0180	0.0110	0.0386	0.0058
	Dif. %	–31.66%	73.04%	20.69%	46.86%

TABLE A9. RRR estimates, considering that Y_j is stationary for 9 years and in intervals of 2 and 7 years: 2007 to 2015, DJ Singapore

		9 years	2 and 7 years		
		2007/2015	2007/2008	2009/2015	Mean
Model 1:					
	$\hat{Y}_1$	0.6566	–1.1946	5.0876	3.6915
	$\bar{Y}_1$	1.4394	1.0333	5.2733	4.3311
	Dif. %	–54.39%	–215.61%	–3.52%	–14.77%
Model 2:					
	$\hat{Y}_2$	0.1300	–0.1088	0.2910	0.2022
	$\bar{Y}_2$	0.1469	0.1291	0.2922	0.2560
	Dif. %	–11.52%	–184.29%	–0.43%	–21.03%
Model 3:					
	$\hat{Y}_3$	0.0089	0.0004	0.0091	0.0072
	$\bar{Y}_3$	0.0089	0.0093	0.0091	0.0092
	Dif. %	–0.06%	–96.05%	–0.06%	–21.74%

TABLE A10. RRR estimates, considering that Y_j is stationary for intervals of 1 and 4 years: 2007 to 2015, DJ Singapore

		2007	2008/2011	2012/2015	Mean
Model 1:					
	$\hat{Y}_1$	1.293	–0.722	4.637	1.8836
	$\bar{Y}_1$	2.2842	1.4886	6.2280	3.6834
	Dif. %	–43.40%	–148.54%	–25.54%	–48.86%
Model 2:					
	$\hat{Y}_2$	0.3050	0.1227	0.2559	0.2022
	$\bar{Y}_2$	0.3821	0.1727	0.2683	0.2385
	Dif. %	–20.18%	–28.95%	–4.63%	–15.23%
Model 3:					
	$\hat{Y}_3$	0.0223	0.0112	0.0073	0.0107
	$\bar{Y}_3$	0.0251	0.0115	0.0074	0.0112
	Dif. %	–11.05%	–2.65%	–1.24%	–4.33%

TABLE A11. RRR estimates, considering that Y_j is stationary for intervals of 1 and 2 years: 2007 to 2015, DJ Singapore

	2007	2008/2009	2010/2011	2012/2013	2014/2015	Mean
Model 1:						
$\hat{Y}_1$	1.2928	–0.6565	–0.9719	12.8739	–3.5279	1.8587
$\bar{Y}_1$	2.2842	1.7213	3.4413	13.4469	4.5465	5.3996
Dif. %	–43.40%	–138.14%	–128.24%	–4.26%	–177.60%	–65.58%
Model 2:						
$\hat{Y}_2$	0.3050	0.0537	0.1917	0.4984	0.0134	0.2022
$\bar{Y}_2$	0.3821	0.1840	0.2551	0.5025	0.1678	0.2890
Dif. %	–20.18%	–70.80%	–24.87%	–0.83%	–92.00%	–30.05%
Model 3:						
$\hat{Y}_3$	0.0223	0.0066	0.0133	0.0139	0.0020	0.0104
$\bar{Y}_3$	0.0251	0.0110	0.0137	0.0139	0.0043	0.0123
Dif. %	–11.05%	–39.91%	–2.86%	–0.20%	–52.12%	–15.19%

TABLE A12. RRR estimates, considering that Y_j is stationary for annual intervals: 2007 to 2015, DJ Singapore

		Mean	Std. Dev.	Max.	Min.
Model 1:					
	$\hat{Y}_1$	2.8959	10.3795	24.9638	–8.8672
	$\bar{Y}_1$	8.1446	7.7111	25.2353	1.1060
	Dif. %	–64.44%	34.60%	–14.92%	9.84%
Model 2:					
	$\hat{Y}_2$	0.1780	0.4372	0.8062	–0.5226
	$\bar{Y}_2$	0.3778	0.2337	0.8086	0.1143
	Dif. %	–52.90%	87.08%	17.09%	52.09%
Model 3:					
	$\hat{Y}_3$	0.0065	0.0156	0.0269	–0.0217
	$\bar{Y}_3$	0.0134	0.0087	0.0269	0.0047
	Dif. %	–51.56%	80.14%	14.29%	47.22%

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