Evaluation of Investment Strategies with Options

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Abstract

The financial literature has revealed that option strategies originate asymmetric return distributions, providing new investment opportunities, especially in the control and reduction of risk. In this way, it seems important to evaluate the performance of investment strategies that result from the combination of stock and option positions. On the other hand, given the inadequacy of the measures based upon mean and variance, we highlight the work of Leland (1999), which suggests a modification of the traditional risk measure (beta) of CAPM to incorporate other moments of the return distributions.

In this context, we applied this methodology on six dynamic hedging strategies with options on the Index FTSE 100 (covered calls at-, in- and out-of-the-money and protective puts at-, in- and out-of-the-money), in the sense of evaluating its performance. The results indicate that the new risk measure is more statistical significant than the traditional beta of CAPM, for that the information supplied by the measure of the performance (modified alpha) seems to be more reliable. On the other hand, the values of modified alphas reveal that these dynamic strategies result in excess returns close to zero (as theoretically expected), denouncing that the market price of these options appears to be in equilibrium (the options seem to be correctly priced).

1. Introduction

The development of financial markets has been reflected in an increment of uncertainty, given the major complexity of relations between economic agents. Trying to respond to stockholders' increasing needs, especially the need for risk protection, several innovating instruments are emerging, more and more sophisticated, from which we enhance the options.

As an organized market (regulated), the options are very recent. In spite of been transacted for many years in the so-called over-the-counter market, just in 1973, with the opening of Chicago Board Options Exchange (CBOE), the first option standardize contracts appeared. However, in the following years, other markets were created, the option transaction volume intensified and the number of underlying assets enlarged, which denotes the increasing interest of these financial instruments.

Generically speaking, the possibility of combining simultaneously positions in the spot market and in the option market originates new investment opportunities, namely at the level of risk control. In this sense, options' role has been debated broadly in the financial literature, above all the effects produced in the relationship return-risk. Effectively, many studies have evidenced the peculiar characteristics of the option investment strategies, especially emphasizing the asymmetry presence in the generated return distributions. However, if it seems to exist some consensus about the peculiar characteristics of the referred strategies, can we say the same in relation to its evaluation? Which methodologies are offered to evaluate option investment strategies? Which are the most appropriated? In what way the asymmetry fits in the investors' preferences and interferes in the evaluation of the strategies?

The growing importance assumed by options in the financial markets, its peculiar context and the need of evaluating option investment strategies performance seems to justify a deeper investigation of this thematic. Thus, the main purpose of this study is the evaluation of option investment strategies, applying, in such a context, the methodology suggested by Leland (1999), which will be subject to a critical appreciation. For that purpose, two option investment strategies - the covered call and the protective put - will be simulated, since these are two very popular strategies for the underlying asset risk management, represented, in our study, by the FTSE-100.

2. Related Literature

The introduction of options has provided new challenges, increasing, in this way, markets' efficiency. This idea is pointed out in several studies, specifically, Ross (1976), Arditti and John (1980) and Breeden and Litzenberger (1978), among others, evidencing the important contribute of these instruments for the expansion contingencies covered by the market. On the other hand, some empirical studies demonstrate that options' introduction has positive reflexes in volatility and the underlying price, contributing to market's stability [Nabar and Park (1988), Conrad (1989), Gemmill (1989), Detemple and Selden (1991), Haddad and Voorheis (1991), Figlewski and Webb (1993)].

The investment opportunities offered are related, above all, with the peculiar return distributions and the consequent return-risk combinations. Effectively, by combining call options or put options with the underlying asset, the investor can build several investment strategies, generating new return distributions. Bookstaber and Clarke (1983) consider that the stock portfolio alone has restricted flexibility, as the investor is not able to manipulate the return distribution, approaching it, for example, of a left truncated distribution, in which the probability of great losses is eliminated. Only by going beyond the confines of the stock portfolio, the investment objectives can be realized. Options provide the means for manipulating portfolio return distributions, expanding portfolio management opportunities.

Consequently, the evaluation of investment strategies with options implies the analysis of the respective return distributions. In this sense, Merton, Scholes and Gladstein (1978 e 1982) present two studies with the purpose of discussing the implications of the adoption of strategies that combine options and stocks, in particular the covered call option and the protective put option. The authors conclude that both allow a reduction of risk exposure, accompanied of a decrease in expected return, elements reflected in the asymmetric distributions. This idea is corroborated by other studies that reveal, once again, the presence of asymmetry in the distributions and an accentuated reduction of risk [e.g.: Bookstaber and Clarke (1981), Abken (1987), Books (1989), Nederlof (1993) and Beighley (1994)].

In this way, investment choices cannot be explained only through the first two moments of return distribution (mean and variance), being the third moment (asymmetry) an important element in the investment decision. The investors' preferences have been described by the quadratic function, based in the idea that the investors care only about mean and variance, despising every superior moment. However, as Tsiang (1972) refers «...a quadratic function is not only limited in its range of applicability as a utility function, but that even within its range of applicability it involves the highly implausible implication of increasing absolute risk-aversion...». Indeed, many studies have been presenting enough empiric evidence on the investors' preferences for the asymmetry [e.g.: Jean (1971), Feldstein (1969), Arditti (1971), Levy (1974), Sears and Wei (1985)]. Kraus and Litzenberger (1976), by trying to systematize the relationship asymmetry – assets' prices, extend CAPM (Capital Asset Pricing Model) of Sharpe (1964) and Lintner (1965), to the third moment. Accordingly with the authors' empirical results, investors have risk aversion and preference for positive asymmetry, being even disposed to pay a significant price for the "safety" provided by that asymmetry in the stock return distribution.

Thus, given option investment strategies' singular return distributions, where asymmetry stands out, contemplated in investors' preferences, some methodologies based on the traditional mean-variance approach seem to be inappropriated to evaluate these strategies. Effectively, the asymmetric distributions require evaluation approaches that integrate other moments of the distribution beyond mean and variance [Ritchken (1985), Bookstaber (1984), Booth, Tehranian and Trennepohl (1985), Gastineau (1993)].

In this sense, several alternative approaches have been developed, such as semivariance or stochastic dominance. Even so, these seem to present serious limitations. The mean-semivariance approach offers a doubtful picture, as pointed out by Lewis (1990), since it just analyses the risk associated to losses. On the other hand, in the stochastic dominance approach, doubts also subsist in the scope of its applicability and consequently in the scope of its usefulness [Porter and Gaumnitz (1972), Meyer (1977) and Fischmar and Peters (1991)].

Recognizing the value of the use of options in the investment management and the inadequacy of methods based in mean - variance for evaluating option investment strategies, Leland (1999) suggests a new methodology, more appropriated for asymmetric return distributions that will be exposed in the third section.

Leland (1999) modifies the traditional risk measure, beta, so that it captures all the elements of risk, here unknown. In the sequence of this adjustment, the performance of any investment strategy can be more correctly evaluated. Thus, «...using the correct beta is critical for correct performance measurement of investment strategies that use options, market timing or other dynamic strategies» (1999, p. 33).

3. Data and Methodology

In order to carry out this study, we have chosen a sample of the FTSE-100 index options, traded in LIFFE (London International Financial Futures and Options Exchange), and the respective Index spot prices. The selection of daily observations implied the election of a two-year period, beginning in the 20th November 1997 until 19th November 1999, corresponding to 488 daily observations, which seems to be quite a reasonable set of data.

Given the purpose of evaluating option investment strategies, through the application of the methodology developed by Leland (1999), the following step consists of calculating daily returns of two option investment strategies on the FTSE 100 Index – covered call option and protective put option. As it is referred by the literature, these are two strategies often used by investors for covering risk. Both strategies are bullish, that is, the investor hopes the underlying asset's price will rise for, this way, benefiting from the realized investment, given the long position in the Index. Both strategies were conceived through the constitution of long positions in the underlying asset and positions in options (call and put), so that the covered portfolio has a neutral delta[1].

The dynamic hedging strategies are, generally, conceived by holding a position on the options market followed by the acquisition of delta values of the underlying asset. In our study, we assume a long position in the FTSE 100 Index, for that hedging is done through variations in option positions. Thus, we have to calculate the inverse of delta (the neutral ratio), which establishes the number of options that are needed to hedge the underlying asset (e.g.: Ritchken, 1987, Dubofsky, 1992, Watsham, 1992 and Kolb, 1993).

The construction of those strategies considers that a long position in FTSE 100 is covered by a short position of $1/N(d_1)$ value in a call option and by a long position of $1/\{N(d_1)-1\}$ value in a put option. The options involved in this process have a three months maturity and they will be in or out-of-the-money if X/S ratio is closest to 0.9 (1.1) and 1.1 (0.9) for the call (put) option, respectively. In each period, the exercise price is adjusted so that the condition just mentioned is respected. The positions are opened and closed daily, allowing the calculation of daily logarithmic returns. The implicit volatility of the *at-the-money* option is used as a proxy for the remaining relationships exercise price/underlying asset price and we will make use of U.K. Treasury Bills' rate of return[2] as an estimate of the risk free rate. The effects of transaction costs are not considered, as well as taxes or any margin cost. The option contracts are infinitely divisible and it is possible to make continuous transactions.

In what concerns the performance methodology used in this study, Leland (1999) based

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[1] The option's delta measures the sensibility of the price of the option to variations in the price of the underlying asset. The delta of a call option is always positive, that is to say, a variation in the price of the underlying asset implies a variation, in the same direction, in the price of the call option. On the other hand, the value of a put option decreases if the price of the asset-based increases, implying, therefore, a negative delta. Naturally, the delta stays neutral during a short period of time, given the influences of the sudden variations in the price of the Index and of time factor. This way, the implementation of these strategies leads to a periodic adjustment, being, in this case, a daily adjustment (dynamic hedging).

[2] Information supplied by LIFFE

his work on the equilibrium equation presented by Rubinstein (1976) to evaluate assets with any return distribution, along an interval of time.

$$P_0 = \frac{E\{(1+R_p)P_0\} - \lambda\rho\{(1+R_p)P_0, -(1+R_M)^{-b}\}\sigma_{\{(1+R_p)P_0\}}}{1+R_f} \tag{5}$$

where, P_0 is the price of an asset; R_p, R_M are the portfolio *p* and market portfolio *M* returns, respectively, along an interval of time; $\rho\{x, y\}$ is the correlation coefficient between x and y; E(.) is the expected value; σ is the standard deviation; and $\lambda = \sigma_{(1+R_M)^{-b}} \big/ E\{(1+R_M)^{-b}\}$. Starting from equation (5), we get the following formula:

$$E(R_p) = R_f + B_p\{E(R_M) - R_f\} \tag{6}$$

being B_p the modified beta, resulting from:

$$B_p = \frac{cov_{R_p, -(1+R_M)^{-b}}}{cov_{R_M, -(1+R_M)^{-b}}} \tag{7}$$

Rubinstein (1976) verifies that *b* can be defined as:

$$b = \frac{\ln\{E(1+R_M)\} - \ln(1+R_f)}{\sigma^2_{\ln(1+R_M)}} \tag{8}$$

being, therefore, related with the market excess return when market returns follow a lognormal distribution. If we compare the traditional beta (β_p) equation with the equation of B_p, we verify that the risk measures are related to each other. It is interesting to observe that the necessary information for computing B_p is basically the same we use to compute β_p.

As a consequence of the adjustments operated in the risk measure, a new performance measure, that Leland designates of modified alpha (A_p), substituting the well known α_p:

$$A_p = E(R_p / G) - B_p\{E(R_M) - R_f\} - R_f \tag{9}$$

Naturally, A_p is different from α_p, since B_p is also different from β_p. In agreement with Leland's results, the use of the new risk measure reflects in new performance values, being these equal to zero. That is to say, «...if the correct measure of risk is used, the result is correct: Managers who buy or sell fairly priced assets add no value!» (1999, p. 32).

4. Empirical Results

In section 2, where we presented the most relevant literature on the subject, we mentioned the valuable contribution of option investment strategies in the reduction of risk. For that reason, we believe it is pertinent, at once, the analysis of the present strategies' characteristics, of the point of view of risk-return combination. The evaluation of the effects of these strategies on the referred combination implies an analysis of the return distributions and, above all, a comparison of the new generated situation with the initial position - long in the FTSE 100.

In the covered call option strategy, the investor has a long position in the FTSE 100 in simultaneous with a short position in a call option. This strategy involves the reception of the option's premium and this revenue motivates the investors to choose this strategy. Therefore, the investor abdicates of the possibility of large gains in favour of the premium received in the moment of the celebration of the contract.

Table 1

Summary of the most relevant statistics

Covered Call Option *vs* FTSE 100

	FTSE	COVERED CALL OPTION		
		AT	IN	OUT
Mean	0.0543%	0.0169%	0.0122%	0.0319%
Standard Deviation	0.7228%	0.3493%	0.4685%	0.3334%
Mode	-0.0970%	-0.0328%	0.0961%	-0.0019%
Maximum	2.1491%	3.9143%	6.0421%	1.8600%
Minimum	-2.3382%	-4.4838%	-6.6089%	-2.2776%
Skewness	-0.1395	-1.5556	-1.4652	-0.9482
Kurtosis	3.1173	89.9220	139.7488	13.0958
Observations	488	488	488	488

In table 1, we present some statistics of the daily returns distribution of the covered call option investment strategy at-the-money, in-the-money and out-of-the-money, built in this study. The observation of the results allows us to verify that the covered call option introduction, at-the-money, in-the-money and out-of-the-money, reflects in a decrease of the expected return, as well as the risk. Effectively, the construction of the covered call option has the purpose of covering risk, for that its reduction would be expected. In fact, this is a conservative investment, since it always presents a smaller risk relatively to the stockholder position (long position in the asset). If we confront the deviation-standard values, we conclude that it suffers a significant decrease, above all with the out-of-the-money covered call option. Of the three types of options, the in-the-money option is the one that presents the largest associated risk, 0.4685%. Parallel to this effect, we observe a decrease in the expected return in comparison with the Index-only position. This decrease is more pronounced in the in-the-money strategy. Generally, the out-of-the-money covered call options offer larger potential gains, but the protection offered is smaller relatively to the in-the-money option strategy. On the other hand, to accomplish the maximum gain potential, an out-of-the-money option always demands that the underlying asset price goes up, while in the in-the-money option a slight decrease in the price can still allow the obtaining of the maximum gain.

In the combination of the position in the stock market and in the option market, both sides of the distribution are affected. Naturally, the change will depend on the value of the premium received and of the revenue obtained by the detention of that premium until the expiration date. The left side tail approaches the centre, as well as the right tail. However, the right side of the distribution appears truncated, being compressed to the mean value of the strategy distribution. Simultaneous to this truncated effect, the pick of the distribution moves to the right. The maximum return is limited to the difference between the FTSE 100 acquisition value and the exercise value of the option added the received premium.

The more evident characteristic of the covered call option is the degree of the third moment of the distribution - asymmetry. Concerning the three strategies, the negative value of the asymmetry is accentuated, confirming the idea that the covered call option presents right-truncated return distributions, offering limited gains and limitless potential losses[3]. Therefore, the daily return distribution of the covered call option is characterized by a negative asymmetry and an accentuated kurtosis, namely the in-the-money covered call option.

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[3] The application adjustment quality evaluation tests (Program *BestFit Version 1.12a*) allow us to reinforce the presence of asymmetry. The Qui-Square (Q-S) test positions the three call option in the triangular distribution while the Kolmogorov-Smirnov (K-S) and the Anderson-Darling (A-D) tests consider the lognormal distribution more adjusted to the *at-* and *in-the-money* option and the logistic distribution more adapted to the *out-of-the-money* option.

The purpose of the construction of the protective put investment strategy is, just as the covered call option, risk covering. In this strategy, the investor buys a put option on the underlying asset, protected himself against a decrease in the asset's price. This way, the losses are limited, while the gains are potentially limitless. Naturally, this situation implies the payment of a price in the moment of the contract celebration.

Relatively to the protective put investment strategy built in the present investigation, we dispose, in Table 2, some important statistics for the referred strategy's return distribution characterisation.

Table 2

Summary of the most relevant statistics

Protective Put Option *vs* FTSE 100

	FTSE	PROTECTIVE PUT OPTION		
		AT	IN	OUT
Mean	0.0543%	0.0179%	0.0152%	0.0149%
Standard Deviation	0.7228%	0.5054%	0.3209%	0.5374%
Mode	-0.0970%	-0.0552%	0.0379%	-0.0269%
Maximum	2.1491%	7.6932%	4.7241%	7.8692%
Minimum	-2.3382%	-2.6380%	-1.0614%	-1.4203%
Symmetry	-0.1395	7.4082	7.2448	6.7957
Kurtosis	3.1173	115.0656	99.7665	95.8196
Observations	488	488	488	488

Just as it happened with the covered call option, the protective put option reduces risk and expected return. If we examine the standard deviation values on Table 2, we verify that they decrease when we introduce the put option to cover the risk associated with the FTSE 100. This effect is, however, more pronounced in the in-the-money option[4]. On the other hand, the expected return also presents lower values in comparison with FTSE 100, especially in the out-of-the-money option. Effectively, the protective put option investment strategy results in distributions whose tails are compressed to the centre. The left side is, however, more affected, as it is truncated, limiting, in this way, the potential losses. Since this strategy implies the payment of a premium, all the distribution moves to the left in result of that cost.

The selection of the option type determines the value of the potential profit that the investor abdicates and the amount of the limited risk. The out-of-the-money option doesn't

[4] The *in-the-money* protective put option has more probability to be exercised. The decision belongs to the asset-based (Index FTSE 100) stockholder and, as such, he will only exercise in case the situation is advantageous. In this way, the distribution is truncated and has smaller variability.

provide so much protection as the at- and in-the-money options, because the effect of the protective put option only works out when the price reduce. This way, buying protective put option deep out-of-the-money avoids disastrous losses, but it doesn't seem so efficient (in the relationship cost-benefit) in the case of a limited reduction of the underlying asset's price. On the other hand, the in-the-money put option is considered very conservative, since the potential gain is restricted in a certain way because the underlying price would have to arise above the exercise price so that the gains would be accomplished. The maximum loss is larger in out-of-the-money put options and smaller in in-the-money options, since the rácio X/S determines the magnitude of the referred maximum loss. As the in-the-money put option presents the lowest volatility, we easily conclude that the returns associated with this option are less sensitive to the movements of the underlying asset's price.

Relatively to the third moment of the distribution, we verify that it assumes a positive value in any of the three put options. In the protective put option, the asymmetry is, without a doubt, more evident, since its values are superior (in absolute terms) to the ones of the covered call option. This positive value confirms not only the shift of the distribution to the left, but also its pick[5].

Concerning the estimates presented, it is necessary some prudence in the evaluation of these strategies, or more specifically, in the risk evaluation. The traditional evaluation, based on the analysis mean-variance, is not adequate, as we have seen, to this type of strategies, since the risk reduction is asymmetric (as well as the distributions). With effect, «traditional methodologies have priced financial assets based simply on the first two-moments of the distributions (mean and variance or standard deviation), assuming, implicitly, the normality of their returns» (Machado-Santos and Fernandes, 2000, p. 19), becoming, therefore, questionable the adaptation of the referred methodologies to options particular context. As so, option investment strategies invalidate two presupposed conditions of the traditional approach: the normality of return distributions and the presence of quadratic utility functions.

The analysis of the strategies' distribution in this investigation work led to the identification of asymmetry. On the other hand, we cannot assume that investors despise these superior moments, regarding only mean and variance, as quadratic utility function considers.

Being the strategies evaluation an important subject to the investor and representing the main objective of this study, it is essential the development of new approaches that

[5] The application of adjustment quality evaluation tests reinforces the presence of asymmetry. All the three tests employed (Q-S, K-S and A-D) are unanimous in classifying the return distributions generated by the protective put options as asymmetric, given the preference for the lognormal and loglogistic distributions.

contemplate not only the mean and variance, but also asymmetry, which, seems to pick the investors' preferences.

The following Table shows the coefficients (α_p e β_p) obtained through time series regression of the six strategies, $R_{p,t} - R_{f,t} = \alpha_p + \beta_p (R_{M,t} - R_{f,t}) + e_{p,t}$, simulated for the period of 20th November 1997 to 19th November 1999.

Table 3

Traditional Alpha and Beta

		Alpha	t-stat	p value	Beta	t-stat	p value
Covered Call Option	**AT**	-0.0011%	-0.069	0.945	0.034	1.545	0.123
	IN	-0.0044%	-0.208	0.835	-0.001	-0.029	0.977
	OUT	0.0100%	0.694	0.488	0.137	6.843	0.000
Protective Put Option	**AT**	0.0037%	0.163	0.871	-0.068	-2.157	0.031
	IN	0.0000%	0.000	1.000	0.039	1.963	0.050
	OUT	-0.0036%	-0.147	0.883	0.046	1.373	0.171

The critical value t, at 5% confidence level and considering 487 degrees of freedom, is approximately 1.9648.

The results reveal that at- and in-the-money covered call option strategies presents negative performance. In what concerns investment strategies with put options, the out-of-the-money strategy is located below the Security Market Line (SML). The remaining strategies have a superior performance compared with the portfolio market, represented by the FTSE 100 Index. The performance values don’t correspond to those evidenced by the literature[6], namely the negative performance of two covered call option strategies and the positive performance of two protective put option investment strategies. However, the significant tests carried out show that alpha values are not statistical significant, for that the analysis of these estimates should be done with some careful, given we cannot reject the null hypothesis ($\alpha_p = 0$). As Leland (1999, p. 30) refers the traditional measures, based on the mean-variance approach, are suspicious, revealing doubtful information in the assets’ context with non-normal return distributions, as it happens with option strategies. If we only consider mean and variance, the out-of-the-money covered call negative asymmetric returns seem to show a superior performance. Even so, «... in CAPM approach, superior performance doesn't mean

[6] The financial literature has evidence that put option strategies translate positive alphas, while call option strategies present negative alphas [:erton, Scholes and Gladstein (1978 e 1982), Bookstaber e Clarke (1984 e 1985), among others].

that the investor adds value through the identification of undervalued assets or through the detention of additional information» (1999, p. 29) because the average investor is not willing to sacrifice asymmetry just improve returns in terms of mean and variance.

This way, we applied Leland's methodology, calculating modified beta (B_p) and alpha (A_p), for the six built investment strategies, through equations (7) and (9), respectively.

Table 4

Modified Alpha and Beta

		A_p	t-stat	p value	B_p	t-stat	p value
Covered Call Option	**AT**	-0.0011%	-0.227	0.820	0.034	2.511	0.012
	IN	-0.0043%	-0.966	0.334	-0.004	-2.249	0.025
	OUT	0.0099%	1.519	0.129	0.140	7.759	0.000
Protective Put Option	**AT**	0.0042%	0.618	0.537	-0.081	-4.241	0.000
	IN	0.0001%	0.014	0.989	-0.041	-2.780	0.006
	OUT	-0.0032%	-0.366	0.714	0.037	3.034	0.003

The critical value t, at 5% confidence level and considering 487 degrees of freedom, is approximately 1.9648.

By the observation of the values in Table 4, we verify that the use of modified risk measure, the B_p, reflects in a A_p approximately equal to zero, that is to say, the covered call and protective options' investors don't add value besides the risk free rate (the excess return is null). The significant tests executed allows us to conclude, once again, that the estimates are not statistical significant, at a level of significance of 5%, driving to the rejection of the null hypothesis ($A_p = 0$).

Since the new risk measure incorporates superior moments of return distributions, the obtained estimates seem more reliable. According to Leland (1999, p. 32), the new beta is more adapted in the sense that depends on return distribution and investors' preferences. The investment strategies with options on the Index FTSE 100 result in returns approximately equal to equilibrium values, which seems to show that current market prices approach the "fair value". If A_p value were significantly different from zero, we could conclude that investors possess additional information, reflecting in superior/inferior performance.

The empirical results are not surprising in the sense that we were expecting that dynamic strategies present a return similar to the risk free rate, for that the excess returns will be null, as well as performance (the modified alpha is zero).

Of the six studied strategies, the out-of-the-money covered call option presents the higher performance value, being, therefore, the strategy that stands more out in terms of performance. In effect, the out-of-the-money covered call option offers larger probabilities of obtaining gains, before the option is in condition to be exercised, although the degree of risk protection is relatively smaller to the in-the-money option. McMillan (1993, p. 37) considers that the detained position in the referred option «...tends to reflect more the result of the underlying price movements and less the benefits of writing the call option», because the premium amount received is relatively low. If the FTSE 100 Index value (underlying asset) increased, for example to the out-of-the-money option exercise value, obtained gains would be certainly superior to those of the in-the-money option, since the investor would achieve the difference between the exercise and the asset price values and the premium value. This point reflects necessarily in the return distribution, whose pick is positioned more to the right. In what concerns the put options, we verify that the best performance is attributed to the at-the-money put option, once it is the protective strategy that supplies the best combination return-risk. Effectively, the in-the-money protective put strategy seems to be more expensive, which can justify its inferior performance relatively to the at-the-money put strategy.

The correction of the risk measure results in slight variations in the Jensen performance measure, above all in the protective put options. When the new beta is applied, the positive performance of the at- and in-the-money investment strategies is more evident, since the protection effect is intensified for situations of decrease in FTSE 100 value, reflecting in a better cost/benefit relationship.

With the application of Leland's methodology, the new beta (B_p) seems to differ from the traditional beta (β_p), verifying the largest difference in the in-the-money put option strategy. The in-the-money protective put option present a positive beta when the risk is measured by β_p. The modification of the risk measure implies changes, being the new beta of the referred option negative. Of referring that the largest variations in the risk measure happen in those strategies with the largest asymmetry values. Therefore, when we include the effect of this moment in the risk measure, it is natural to find differences among β_p and B_p. However, it is important to enhance that B_p contemplates the effects of every moment of return distribution, including those above the asymmetry, not evidenced in this investigation.

It becomes of extreme importance to point out that the reliability of the new betas is clearly confirmed by the significant test performed, which clearly rejects the null hypothesis, which does not happen with β_p values. The average performance value of the two hedging strategies allows us to confirm the results evidenced in the financial literature, which refers that the covered call option performance tends to be superior to protective put options, resulting from the fact that these last ones imply the payment of a premium for acquiring protection. In fact, in our study, the covered call options evidence a superior performance, with an average of approximately 0.0015%, in contrast with the protective put value of 0.0004%.

5. Conclusions

With the present investigation study, we intend to deepen the evaluation performance thematic in the context of investment strategies with options. Thus, in the first point, we analysed the importance of options in the financial market, enhancing its contribution for markets improvement, through the creation of new opportunities and risk reduction. We verified also that these opportunities are linked to the peculiar return distributions of strategies that combine stocks and options and, therefore, its effect in return-risk combination. Facing this fact, the following step was a deeper investigation of option investment strategies, giving special attention to two popular hedging strategies - the covered call option and the protective put option. The results revealed that the referred strategies provide different return-risk combinations, adapting them to each investor's preferences. The covered call option evidences a negative asymmetry, truncating, this way, the desirable side of the distribution (right side), meaning the limitation of potential gains and the possibility to incur in theoretically limitless losses. On the other hand, the protective put option generates a positive asymmetric distribution, implying losses limitation and providing the possibility of potentially limitless gains.

Given the existent lacks in the main evaluation methodologies, Leland (1999) suggests a new methodology, conceived for all the return distributions, even the asymmetric distributions. The simple modification of the traditional risk measure, (β_p), is, according to the author, a sufficient condition for the correct performance evaluation of, for example, investment strategies with options. The new beta (B_p) presupposes the use of the same type of information of the traditional beta, in spite of the modification result in a more substantial risk measure, in the sense that it captures additional risk elements. In this his way, and since we ignore any empirical application of the referred methodology to any given real market data, we tried to accomplish a double purpose: to evaluate investment strategies with options, applying Leland´s methodology and, simultaneously, to test its validity through the critical appreciation of the proportionate results.

Consequently, the methodology analysed in more detail in section 3 was empirically tested in a sample of six dynamic hedging strategies - the covered call options at-, in - and out-of-the-money and the protective put options at-, in - and out-of-the-money. Even so, before the application of the methodology, we proceeded to a deep analysis of the distributions' characteristics. The observation of the values of some important descriptive statistics allows us to confirm the asymmetry presence, as well as of an accentuated kurtosis. Besides, as it would be expected, we verified a decrease in risk, as well as in return for all strategies.

The obtained results evidence that B_p is more statistical significant than β_p, which reflects in a new alpha (A_p), whose values translate more correctly the strategies performance. However, in spite of α_p and A_p values not being statistical significant (we cannot reject the null hypothesis), it seems those measures reveal that option investment strategies on the FTSE 100 Index results approximately in returns equal to the equilibrium values, indicating that current market prices correspond to the "fair value". The results are not surprising, since it was expected that dynamic hedging strategies present a return approximately equal to the risk free rate.

Of the six appraised strategies, the out-of-the-money covered call option stands out of the remaining strategies, presenting the most positive performance measure. Although this strategy offers the smallest risk protection comparatively to at- and in-the-money covered call options, it also presents the largest potential gains, reflected in a superior return-risk relationship.

On the other hand, we observed that the largest differences between β_p and B_p are verified in the two strategies with the largest asymmetry values, for that, when we include the effect of this moment in the risk measure, the empiric evidence suggests that the used methodology detects (and evaluates) other moments of the distributions.

The financial literature has been referring that covered call option investment strategies tends to present superior performance in relation to protective put option investment strategies. In this study, the average performance values of the two hedging strategies allow, effectively, to confirm the mentioned results.

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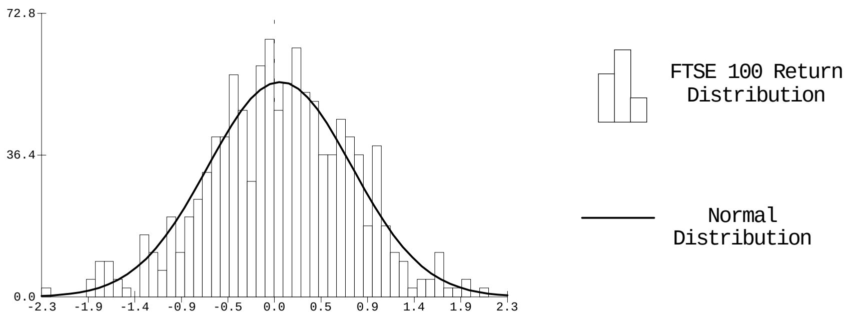
Appendix 1

Adjustment Quality Evaluation (FTSE 100)
Qui-Square (C-S), Kolmogorov-Smirnov (K-S)
Anderson-Darling (A-D) Tests

	Normal	Logistic	Triang	Expon	Pareto	Chisq	LogLogis	Beta	ExtrValue	Lognorm	Lognorm2	Student's
C-S Test	62.322	63.418	103.761	792.372	1828.372	7006.075	9.26E+04	6.90E+10	1.85E+12	3.81E+23	3.81E+23	1.00E+34
C-S Rank	1	2	3	4	5	6	7	8	9	10	11	12
K-S Test	0.021	0.038	0.130	0.370	0.505	0.834	0.098	0.056	0.088	0.091	0.091	0.491
K-S Rank	1	2	8	9	11	12	7	3	4	5	6	10
A-D Test	0.325	0.817	14.805	108.807	188.754	559.854	8.654	3.708	10.691	8.573	8.573	185.370
A-D Rank	1	2	8	9	11	12	6	3	7	4	5	10

Notes:
1. At a 5% level of significance, the Qui-Square critical value is approximately 66.34 (considering 50 classes).
2. At a 5% level of significance, the K-S critical value is approximately 0.0616. This value is computed, for n > 35, through $1.36/\sqrt{n}$ (Kanji, 1995).
3. At a 5% level of significance, the Anderson-Darling critical value is approximately 2.492.

Normal Distribution *vs* FTSE 100 Return Distribution



Appendix 2

Adjustment Quality Evaluation (Covered Call Option)
Qui-Square (C-S), Kolmogorov-Smirnov (K-S) and
Anderson-Darling (A-D) Tests

		Triang	Expon	Pareto	Chisq	Logis	Normal	Student's	Lognorm2	Lognorm	LogLogis	ExtrValue	Beta
Covered Call Option (*at-the-money)*	**C-S Test**	4250.002	1.30E+04	3.29E+04	5.98E+04	2.58E+07	5.51E+32	1.00E+34	1.00E+34	1.00E+34	1.00E+34	1.00E+34	1.00E+34
	C-S Rank	1	2	3	4	5	6	7	8	9	10	11	12
	K-S Test	0.417373	0.565991	0.782831	0.812301	0.239751	0.251693	0.493841	0.218974	0.218974	0.260046	0.313837	0.260891
	K-S Rank	8	10	11	12	3	4	9	1	2	5	7	6
	A-D Test	149.6478	204.8839	427.4479	465.1179	53.61963	60.47004	187.6121	43.64586	43.64586	56.26687	65.31974	60.47229
	A-D Rank	8	10	11	12	3	5	9	1	2	4	7	6

		Triang	Expon	Pareto	Chisq	Logis	Student's	Normal	Lognorm2	Lognorm	LogLogis	ExtrValue	Beta
Covered Call Option (*in-the-money)*	**C-S Test**	7451.123	2.23E+04	7.38E+04	8.33E+04	2.24E+08	1.00E+34	1.00E+34	1.00E+34	1.00E+34	1.00E+34	1.00E+34	1.00E+34
	C-S Rank	1	2	3	4	5	6	7	8	9	10	11	12
	K-S Test	0.434324	0.578856	0.844728	0.776408	0.326824	0.491289	0.332336	0.310931	0.310931	0.344678	0.400468	0.340982
	K-S Rank	8	10	12	11	3	9	4	1	2	6	7	5
	A-D Test	164.8448	212.212	561.5369	396.1546	101.5968	187.6933	106.9758	88.33827	88.33827	103.7633	114.4236	106.9939
	A-D Rank	8	10	12	11	3	9	5	1	2	4	7	6

		Triang	Logis	Expon	Pareto	Chisq	Normal	LogLogis	Student's	Lognorm2	Lognorm	ExtrValue	Beta
Covered Call Option (*out-of-the-money)*	**C-S Test**	1521.722	1613.136	5342.938	9724.365	3.54E+04	2.32E+08	6.57E+16	1.00E+34	1.00E+34	1.00E+34	1.00E+34	1.00E+34
	C-S Rank	1	2	3	4	5	6	7	8	9	10	11	12
	K-S Test	0.345791	0.175824	0.496518	0.594955	0.851837	0.187349	0.212866	0.493507	0.216293	0.216293	0.250021	0.205029
	K-S Rank	8	1	10	11	12	2	4	9	5	6	7	3
	A-D Test	97.64877	21.38015	175.6676	236.9267	589.471	27.13413	26.49689	187.3154	34.10541	34.10541	45.34738	28.6714
	A-D Rank	8	1	9	11	12	3	2	10	5	6	7	4

Notes:
1. At a 5% level of significance, the Qui-Square critical value is approximately 66.34 (considering 50 classes).
2. At a 5% level of significance, the K-S critical value is approximately 0.0616. This value is computed, for n > 35, through $1.36/\sqrt{n}$ (Kanji, 1995).
3. At a 5% level of significance, the Anderson-Darling critical value is approximately 2.492.

Appendix 3

Adjustment Quality Evaluation (Protective Put Option)
Qui-Square (C-S), Kolmogorov-Smirnov (K-S) and
Anderson-Darling (A-D) Tests

		Triang	**Expon**	**Pareto**	**Chisq**	**LogLogis**	**Logistic**	**Beta**	**Student's**	**Normal**	**Lognorm2**	**Lognorm**	**ExtrValue**
Protective Put Option (*at-the-money*)	**C-S Test**	3145.93786	4431.91241	8511.32012	2.76E+04	3.68E+08	2.08E+09	3.19E+23	1.00E+34	1.00E+34	1.00E+34	1.00E+34	1.00E+34
	C-S Rank	1	2	3	4	5	6	7	8	9	10	11	12
	K-S Test	0.582476	0.504488	0.638496	0.838532	0.212883	0.194723	0.203372	0.491581	0.204739	0.160044	0.160044	0.233037
	K-S Rank	10	9	11	12	6	3	4	8	5	1	2	7
	A-D Test	249.880649	177.118742	266.871238	561.574189	42.038601	37.834199	43.997927	187.109461	44.821098	27.205591	27.205591	44.330067
	A-D Rank	10	8	11	12	4	3	5	9	7	1	2	6

		LogLogis	**Expon**	**Triang**	**Pareto**	**Chisq**	**Logistic**	**ExtrValue**	**Beta**	**Lognorm2**	**Lognorm**	**Student's**	**Normal**
Protective Put Option (*in-the-money*)	**C-S Test**	1166.56698	2596.9948	2808.85435	3797.35624	2.69E+04	9.65E+08	2.67E+10	1.45E+12	1.49E+33	1.49E+33	1.00E+34	1.00E+34
	C-S Rank	1	2	3	4	5	6	7	8	9	10	11	12
	K-S Test	0.255699	0.470023	0.655426	0.501451	0.87756	0.253122	0.231391	0.221171	0.201716	0.201716	0.495766	0.259381
	K-S Rank	6	8	11	10	12	5	4	3	1	2	9	7
	A-D Test	55.051862	154.954402	365.917706	173.074021	750.209	45.481094	47.057626	49.228903	32.798202	32.798202	187.619766	51.859
	A-D Rank	7	8	11	9	12	3	4	5	1	2	10	6

		LogLogis	**Expon**	**Triang**	**Pareto**	**Chisq**	**ExtrValue**	**Logistic**	**Beta**	**Lognorm2**	**Lognorm**	**Student's**	**Normal**
Protective Put Option (*out-of-the-money*)	**C-S Test**	531.932259	1653.85301	2258.95815	2661.51084	1.59E+04	9.14E+05	9.19E+08	2.83E+10	1.55E+13	1.55E+13	1.00E+34	1.00E+34
	C-S Rank	1	2	3	4	5	6	7	8	9	10	11	12
	K-S Test	0.205407	0.416482	0.650992	0.467506	0.859816	0.182491	0.177881	0.175124	0.147865	0.147865	0.494334	0.185328
	K-S Rank	7	8	11	9	12	5	4	3	1	2	10	6
	A-D Test	31.011736	127.514135	399.233997	155.464025	678.510584	26.725359	25.880758	29.218848	19.264872	19.264872	186.836899	31.794889
	A-D Rank	6	8	11	9	12	4	3	5	1	2	10	7

Notes:

1. At a 5% level of significance, the Qui-Square critical value is approximately 66.34 (considering 50 classes).
2. At a 5% level of significance, the K-S critical value is approximately 0.0616. This value is computed, for n > 35, through $1.36/\sqrt{n}$ (Kanji, 1995).
3. At a 5% level of significance, the Anderson-Darling critical value is approximately 2.492.