Options and Investment Strategies

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INTRODUCTION

The general framework suggested by Hakanson (1978), Cox (1976), and Ross (1976) indicates that the appearance of an option market has the effect of increasing the general efficiency of financial markets by increasing the number of investment opportunities available to investors. One interesting aspect of the options market is the insurance component discussed by Leland (1980), Bookstaber and Clark (1983) and Tremolieres and Morard (1984). Aside from the characteristics inherent to options, option management in a portfolio context has been examined by many authors. Sears and Trennepohl (1982) have studied the risk to investors of portfolios composed exclusively of options. They conclude that option portfolios are more volatile than security portfolios but that a portfolio containing 20 securities allows for the elimination of 95% of the diversifiable risk. Booth, Tehranian, and Trennepohl (1985) have studied a variety of options strategies, including the buying of calls, the combined purchase of calls and risk-free assets, the buying of shares, and a fully-hedged strategy of writing calls on shares. Merton, Scholes, and Gladstein (1978, 1983) have examined fully-hedged writing option strategies. They find that different hedged strategies are qualitatively identical. Their results also show that any decrease in risk is obtained at the cost of a similar reduction in returns.

Generally, these studies seem to indicate that an investor cannot gain a particular advantage by including options in his portfolio. However, this finding should be analyzed in light of the information contained in studies which indicate that 85% of written call options are used for hedging purposes. There is, of course, a difference between the interest in options as an investment instrument and their degree of popularity. Without analyzing the origin of this difference, one can make some remarks on methodological considerations such as the level of calculated returns, the various ways of constituting portfolios, and the level of hedging.

Generally, returns are computed semi-annually. This could be of no consequence even though the retention period seems long when not considering rigid strategies where the buyer of an option cannot exercise that option before its maturity. As for the constitution of portfolios, it is assumed that the investments in each asset are equally weighted. Markowitz's (1959) solution is not optimal unless the number of securities is very large. Otherwise, as indicated by Sears and Trennepohl (1982), it is a "naïve investment policy." Finally, as far as the coverage of securities by writing

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options is concerned, various studies have suggested a simple approach that covers calls. Such strategies are always very questionable. This article attempts to avoid these methodological weaknesses.

In the general informational sense, the definition of an option strategy used here is based on the writings of Chiras and Manaster (1978), Manaster and Rendleman (1982), and Bhattacharya (1987). In equilibrium, the price of an option and its underlyng stock should reflect common information. The speed at which stock and option prices adjust to new information depends on the degree of friction in each market and the inherent risk/return characteristics of the two securities. Option characteristics that are likely to appeal to "informed traders" include obtaining leverage positions in stock indirectly through options, smaller dollar outlays, and an upper bound at the top (in the case of long-position options). In these circumstances: *option market friction is lower, due to smaller dollar transaction costs, than* those required for equivalent stock positions, margin conditions are less stringent, and the uptick rule for shortenant is suspended. Based on the advantages offered by option positions, one can conclude that the operation of the two markets can generate some excess return when the portfolio is long on stock and short on call options. This article attempts to develop an original point of view on this subject.

This article takes a more realistic stand than previous studies, by introducing a new investment strategy which combines diversification and hedging, i.e., allowing a New York Stock Exchange investor not only to write calls on the Chicago Board of Options Exhange but offering him an original formula of calculating his or her optional hedging rates (optimal mix of stocks and options). This article eliminates several constraining hypotheses made by previous studies. Returns are calculated on daily basis, portfolios are composed of securities which do not have equal weight, and transactions are not free from costs. Several additional precautions were taken to solidify the findings. The analysis is conducted both *ex-ante* and *ex-post* and the test is carried out under both mean/variance and stochastic dominance criteria. The section which follows presents a new formulation of the question of hedged investments, both in terms of mean variance and stochastic dominance. Section III is devoted to an explanation of the sample and the methodology. Section IV contains the empirical research and presents the new efficient set which includes options and which is derived by using the stochastic dominance methodology. Concluding remarks appear in the final section.

II. INVESTMENT MODEL

Markowitz's (1959) diversification principle led to a number of different formulations of the investment model. The linear model developed by Garman (1977) and the model proposed by Danthine and Anderson (1981) are among the more recent. These models are oriented more towards an optimal hedged strategy than towards a global hedging strategy which combines diversification and hedging. However, the results published in Morard and Trémolières (1987) and Trémolières and Morard (1984) indicate that a global approach to hedged investments would be of interest.

The generalization of the mean/variance approach to hedging strategy can be explained in the following way. Consider a set of n financial assets simultaneously sold on two different markets: the spot market, where securities are transferred with certainty to the buyer; and the conditional market, where securities might never be transferred to the buyer. In this last case, the right to fail to execute the contract is immediately paid to the writer as a premium.

Suppose that all the investments have the same maturity. If the conditional buyer does not execute the contract, the securities are sold by the writer on the spot market. Let call:

x_i = the \$1 portion of capital invested in the i security,
n = the number of assets considered on the spot market $i = 1\ldots,n$
μ_i = the portion of x_i covered by a conditional writer; if $\mu_i = 0$, the security is not subject to any conditional contract writing; if $\mu_i = 1$, the security is sold conditionally, and if $0 < \mu_i < 1$, for k_i securities bought, $\mu_i k_i$ are sold conditionally.
r_{if} = the return on the spot market for asset i;
r_{ic} = the hedged return for asset i on the conditional market, for an investor who buys at t on the spot market and, at the same time, sells a call option or is asked to deliver the stock at $(t + \epsilon)$, or for a seller on the spot market at $e(t)$ (maturity date).
$\bar{r}_{if}, \sigma_{if}, \bar{r}_{ic}, \sigma_{ic}$ the mean and standard deviation (respectively) of returns on the spot and the conditional markets.

The portfolio return could be expressed as:

$$r(x, \mu) = \sum_{i=1}^{n} r_i(\mu_i)x_i \tag{1}$$

with

$$r_i(\mu_i) = r_{if}(1 - \mu_i) + r_{ic}\mu_i$$

As established by Trèmoliéres and Morard (1984) make the following changes:

$$h_i = x_i(1 - \mu_i),\ u_i = x_i\mu_i \tag{2}$$

$\sigma_{if,jc}$ the covariance between unhedged share i and a fully-hedged stock (all other alternatives being possible.)

We can then write:

$$\begin{cases} \min\limits_{(h,u)} \dfrac{1}{2}\left[\sum\limits_{i=1}^{n} \sigma_{if}^2 h_i^2 + \sum\limits_{i=1}^{n} \sigma_{ic}^2 u_i^2 + 2\sum\limits_{i<j} \sigma_{if,jf} h_i h_j + 2\sum\limits_{i<j} \sigma_{ic,jc} u_i u_j \right. \\ \qquad \left. + 2\sum\limits_{i<j} \sigma_{if,jc} h_i u_j + 2\sum\limits_{i=1}^{n} \sigma_{if,ic} h_i u_i \right] \\ \sum\limits_{i=1}^{n} (\bar{r}_{if} h_i + \bar{r}_{ic} u_i) = r \\ \sum\limits_{i=1}^{n} (h_i + u_i) = 1 \\ 0 \leq h_i \leq 1 \qquad i = 1,\ldots n \\ 0 \leq u_i \leq 1 \qquad i = 1,\ldots n. \end{cases} \tag{3}$$

A formulation close to that of the traditional mean/variance model is obtained but it includes twice as many variables. Also, the model defined in (3) is a generalization of the Markowitz model, provided it is obtainable by simply setting μ_i to 0.

The crucial point is to know whether an investor will gain an advantage by combining hedging and diversification, as suggested in (3). A common belief is that doubling the number of assets in a portfolio automatically leads to risk reduction. This belief needs to be clarified. On the one hand, diversification of over 20 securities will converge asymptotically with an irreducible minimal risk; on the other hand, it is very important to know the characteristics of the new securities included in the portfolio. For these reasons, it is not evident a priori that the model defined in (3) will lead to the creation of a "supra efficient set" which will dominate the efficient set characterized by simple diversification. It is therefore important to understand that the results obtained here are not obvious, and must be tested. Two procedures are used to test this model. The first is the classical mean/variance analysis; the second is the stochastic dominance analysis.

First, the model in (3) can be classified as a mean/variance model with a special purpose. It allows an optimal solution for combined strategies and uses a distribution of two first moments only. However, if the underlying distributions are incompletely described by their mean and variance, an inconsistency might result (Ali, 1975). To avoid this, the stochastic dominance criteria is used concurrently. This provides a more efficient test no matter what form the distribution might take. Furthermore, even if the distributions are normal, the two analyses give the same results. The use of the stochastic dominance analysis is mainly intended to increase the validity of the findings.

Different algorithms have been used to test stochastic dominance: those in Porter, Ward, and Fergusson (1973); Levy and Kroll (1978); Bawa, Lindenberg, and Rafski (1979); Bawa, Bodurtha, Rao and Suri (1985), among others. This study is limited to discrete procedures using discontinuous distributions and assuming that the weight of the vector of the optimal portfolio is known. Although the algorithm defined in Bawa, Lindenberg, and Rafsky (1979) seems more suitable for large scale tests, the procedure described in Porter, Ward and Fergusson (1973) is used because this approach is sufficiently appropriate, precise, and easy to use for any reduced initial set of securities. This approach assumes that the two portfolios return vectors f and g are known through a total of N observations and k observations per vector, then:

$$N = 2k$$

For a given realization j, it is known that

$$f(r_j) = 1/k$$

The cumulative distribution $F(r_n)$ is obtained by the addition of the probabilities, no matter what the value of r_j, $j \leq n$. For dominance to occur, one must have:

--> at the 1st level, $F(r_n) \leq G(r_n)$ for all $n \leq N$
with a strict inequality for at least one $n \leq N$ where:

$$F_1(r_n) = \sum_{j=1}^{n} f(r_j), \qquad n = 2, 3, \ldots N \tag{4}$$

--> at the 2nd level, $F_1(r_n) \leq G_1(r_n)$ for all $n \leq N$, with
a strict inequality for at least one $n \leq N$, where:

$$F_2(r_n) = \sum_{j=2}^{n} F(r_{j-1})(r_j - r_{j-1}) \qquad n = 2, 3, \ldots N \tag{5}$$

--> at 3rd level, $F_2(r_n) < G_2(r_n)$ for all $n \leq N$, with a strict inequality for at least one $n \leq N$ and $F_2(r_n) \leq G_2(r_n)$, where:

$$F_3(r_n) = \frac{1}{2}\sum_{j=2}^{n}[F_1(r_j) + F_1(r_{j-1})](r_j - r_{j-1}) \qquad n = 2, 3, \ldots N \tag{6}$$

III. SAMPLING AND METHODOLOGY

To show the advantage of combined strategies, both *ex-ante* and *ex-post* analyses are used and a sample of 22 securities subject to simultaneous transactions at the New York Stock Exchange and at the Chicago Board of Options Exchange are created. Daily stock prices are taken from the Center of Research on Stock Prices file of the University of Chicago, and option prices from The Wall Street Journal. All the data are adjusted to include dividends and .6% transaction costs as suggested by Rubinstein and Cox (1985). The options selected are either at parity or out of the money, because those in the money are exercised. Options for ther terms of January, April, July, and October are chosen, because returns are calculated for specific time intervals: the period beginning January 1981 and ending October 1985 for the *ex-ante* analysis; and beginning January 1986 and ending December 1986 for the *ex-post* analysis. These periods cover different economic environments of increases and decreases in profitability. It is assumed that the maximum detention period does not exceed 15 days (i.e., from the first day of the month to the option maturity date). The short interval choice can be justified in at least three ways. First, if longer initial intervals of retention are chosen one would have the choice of options for other terms, December, March, June, and September. Second, since the markets are dynamic, one can assume that buyers have rapid reactions; or, at least, that they can liquidate securities before their term (allowed by American options). However, the interval can be shorter if securities are exercised by the buyer (or the contract is executed by him). Third, transactions on options are less steady for detention periods exceeding 15 days and this would lend to discontinuous data. The returns of unhedged and hedged positions are calculated for the same time intervals using the formulas below. Call:

p_{t+1}, p_t	;	security price at time $t + 1$ and t,
w_t	;	option premium at time t,
p_e	;	exercise price at time t, and
d	;	eventual dividend.

Unhedged Position Return

$$r_{t+1} = [p_{t+1} - p_t + d]/p_t \tag{7}$$

Hedged Position Return

Hedged returns can be expressed in two different ways, depending upon whether the realized price is greater or lesser than the exercise price plus the premium. Note that the classical formulation "the realized price is greater or lesser than the exercise price" does not modify short returns but overestimates the hedged returns.

This situation can be formulated in the following two ways:

$$\text{if } p_{t+1} > p_e + w: \qquad r_{t+1} = [p_e - p_t + w]/p_t, \text{ or} \tag{8}$$

$$\text{if } p_{t+1} \leq p_e + w: \qquad r_{t+1} = [p_{t+1} - p_t + w + d]/p_t, \tag{9}$$

(9) automatically includes dividend for the writer of the option, if he has kept his security until maturity.

For every security 20 returns are obtained. Table I gives the mean and variance of returns taking into account transaction costs for each security, both at the level of the spot market and the conditional market. It can be noted that the hedged position does not systematically lead to a lower level of return for a lower level of risk, as suggested by Tinic and West (1979) (p. 142). As a matter of fact, one can see that in most cases levels of risk are significantly reduced in the case of hedged strategies. This situation can be explained theoretically by analyzing the problem in terms of distributions. If the existence of an "a priori" return distribution for a given security is assumed, the acquisition of a premium by the writer of a call option induces a translation and the exercise of this option up to the exercise price causes a truncation (Bookstaber, 1983). The initial distribution is reduced, thus reducing the risk as well in most cases.

Table II shows the normality, skewness, and kurtosis characteristics of return distributions. As far as normality is concerned, its presence is rejected by the

Table I

EX-ANTE ANALYSIS, AND VARIANCE OF UNHEDGED AND HEDGED POSITIONS

	Unhedged Returns		Hedged Returns		Unhedged	Hedged
Securities	Mean	Variance	Mean	Variance	σ^2/r	σ^2/r
Atl. Rich	.99799	.38163	1.1823	.23888	.3823	.2020
Avon	1.60990	.27760	.9965	.27298	.1725	.2739
B. America	.02871	.33880	−2.0187	.37539	11.8000	−1.8500
B. Steel	−2.26110	.39390	−3.0483	.79010	−.1742	−.0950
Burlington	2.34200	.42953	.7828	.27388	.1834	.3498
City Corps.	.06653	.18397	−.4099	.16891	2.7652	−.4120
Delta	.87320	.40458	.9778	.46561	.4633	.4761
E. Kodak	.32210	.19134	−.3145	.12996	.5940	−.4132
Exxon	1.24370	.12872	.6261	.14040	.1035	.2242
Fed. Exp.	.73149	.45673	.1360	.41100	.6243	3.0220
Fluor	2.52094	.81342	.2498	.40950	.3226	1.6393
Halliburton	1.36375	.39289	1.0776	.47612	.2880	.4417
Homestack	2.95200	1.03890	2.5123	.94600	.3521	.3762
IBM	1.58939	.12118	.7220	.07318	.0761	.1101
I. Mineral	−.98536	.25165	−.8404	.20562	−.2550	−.2440
I. Paper	.00494	.27020	−.4008	.25440	30.0000	−.6230
Kerr.	1.20380	.88639	.5703	.88870	.7380	1.5430
Merk.	.96843	.12520	.3865	.13930	.1292	.3600
MMM	.55127	.21020	−.2407	.14914	.3810	−.5830
Mosanto	.63735	.25210	.1130	.23008	.3950	2.0350
Pennzoil	.24279	.72590	−.2618	.40590	2.9900	−1.5500
Polaroid	.09148	.24170	.5430	.26750	2.6440	.4926

Table II
EX-ANTE ANALYSIS SKEWNESS, KURTOSIS AND D'AGOSTINO TEST OF RETURN DISTRIBUTIONS

	Unhedged			Hedged		
	Skewness	Kurtosis	D. Test	Skewness	Kurtosis	D. Test
Atl. Rich	−.6824	2.505	.0931	−.4651	2.891	.0629
Avon	−.0598	3.776	−.0327	.0632	2.692	−.098
B. America	.5420	5.354	−.0152	−.7116	3.9416	−.0146
B. Steel	−1.7795	5.63	−.1399	−.4301	2.640	−.1314
Burlington	.7677	3.16	−.0192	.69	3.293	−.059
City Corps.	.3351	1.98	.0947	.3927	2.394	.0163
Delta	.42035	3.504	−.0235	.542	3.28	−.0325
E. Kodack	−.0227	3.328	−.0306	−.2631	2.06	.0119
Exxon	1.7967	5.22	.144	2.302	8.997	−.053
Fed. Exp.	−1.7046	7.01	−.0196	−2.048	7.969	−.053
Fluor	.868	4.89	.0571	−.7314	2.901	.028
Halliburton	−.955	3.671	.0581	−.5844	3.62	.0152
Humestack	.0397	2.066	−.0234	.2516	2.28	−.0341
IBM	.2028	2.27	.16	.2485	2.94	.0937
I. Mineral	.2871	2.34	−.0038	.32	2.36	.0244
I. Paper	−.4671	2.34	−.0221	−.248	2.136	−.0592
Kerr.	.7360	4.121	−.0057	1.108	5.257	−.0273
Merk.	.936	3.656	.0619	.662	2.98	−.0471
MMM	−.4788	2.948	.0315	−.6114	3.794	−.0153
Mosanto	.248	3.41	.0189	.397	3.566	−.0507
Pennzoil	.7073	5.06	.0227	−.2392	3.33	.0226
Polaroid	.5981	2.527	.0267	.3637	2.36	−.0496

D'Agostino (1986) test which indicates that normality is admitted at the .005 level if the test value is between 0,256 and 0,286. As for the skewness and kurtosis characteristics of the return distribution, the skewness coefficient should be equal to zero and the kurtosis coefficient should be equal to 3 (Naciri, 1986). It can be concluded then that the return distributions, for hedged and unhedged portfolios, are far from being normal. Concerning the weak synchronization of the Chicago Board of Option Exchange and the New York Stock Exchange, it is worth mentioning that closed prices are different for options and stocks as pointed out by Bookstaber (1981). The synchronization phenomenon is particularly important when the option is evaluated using the Black and Scholes model, and less determinant otherwise; for instance when the market model is used for the same purpose, as is the case in this study. The possible bias which might be introduced by the lack of synchronization seems, therefore, less important in this study.

IV. EMPIRICAL RESULTS

The findings can be divided into 2 groups (*ex-ante* results, and *ex-post* results). Contrary to prior studies, concern here is with reconstructing the efficient investment set, point by point, thus solving the problem presented in (3). For return levels ranging from 0.25% to 2.75%, returns under and over the interval of 0.25%–2.75%

are omitted because they are not part of the efficient set. Different quadratic optimization algorithms may be used to solve this problem: the reduced gradient suggested by Wolfe (1983) and defined in Bazaraa and Shetty (1979) or the complementary algorithm proposed by Lemke (1970), to name only two. Wolfe's procedure is used.

In Table III and Figure 1, the results of portfolio optimization are presented. These results seem to indicate that it is impossible to create a risk-free portfolio and that the efficient set of the hedged portfolio is the one which dominates Markowitz's efficient set at every level of the return under 2.25% and that over a 2.25% return, Markowitz's efficient set and the hedged portfolio efficient set are equivalent. It seems that the higher the desired return, the riskier the hedged portfolio is because the investor has to include in his hedged portfolio more options which are more risky.

This situation is confirmed by the stochastic dominance which compares the entire return distribution for each methodology, hedged and unhedged portfolio, and which leads to the conclusion that the returns from the hedged portfolio exceed those of the unhedged portfolios for all 20 observations. Note, however, that the mean/variance criteria always give the same ranking as stochastic dominance.

Table IV shows the results obtained, using hedged and unhedged equally weighted portfolios.

The results presented in Table IV confirm the common belief that hedged strategies allow investors to decrease their risk, but lead to decreased returns. Also, the equally weighted portfolio does not belong to the efficient set any more than the equally weighted hedged portfolio belongs to the supra efficient set. This, perhaps, is why previous studies using equally weighted portfolios have failed to demonstrate the dominance of hedged strategies over unhedged strategies, and to show the advantage of hedged strategies for the investor. At this point, the optimal hedge ratio is calculated.

Table III

***EX-ANTE* ANALYSIS: RISK AND RETURN OF UNHEDGED AND HEDGED STRATEGIES AND STOCHASTIC DOMINANCE TEST**

Portfolio Number	Portfolio Return	Unhedged Strategy Risk (1)	Hedged Strategy Risk (2)	Stochastic Dominance Test (2) > (1)
1	.25%	.2142941	.088410	1st order
2	.50%	.2023502	.088130	1st order
3	.75%	.2203100	.103573	1st order
4	1.00%	.2089113	.140559	1st order
5	1.25%	.3184350	.227435	1st order
6	1.50%	.4441050	.402172	1st order
7	1.75%	.7288830	.682792	3rd order
8	2.00%	1.2488000	1.225870	1st order
9	2.25%	2.1225100	2.115700	no dominance
10	2.50%	3.4980000	3.501520	no dominance
11	2.75%	5.9960000	6.001200	no dominance

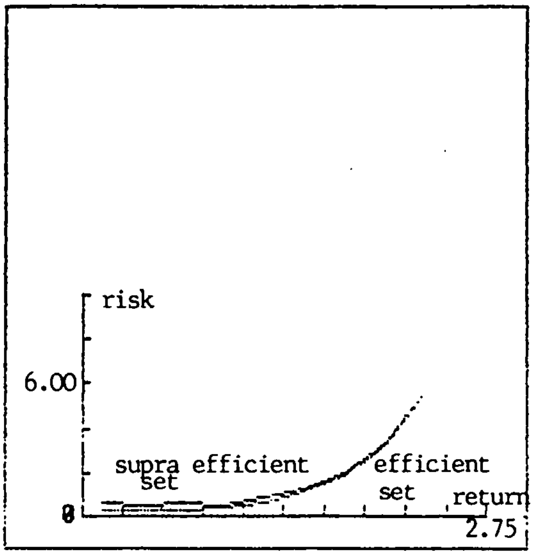

Figure 1
Efficient Sets.

To calculate the hedge ratio, eq. (3) and set μ_i are used as follows:

$$\mu_i = \frac{u_i}{u_i + h_i}$$

The optimal hedging for the security i is then obtained. Table V indicates that the concept of a global hedging portfolio suggested by Howard and D'Antonio (1984) does not apply here. The reason for this is that true portfolios are used for more than one security. Furthermore, the optimal hedge ratio is dynamic and varies with each portfolio. Also, full hedging of a portfolio, i.e., 100%, is a special case in this analysis. For high levels of returns, i.e., for 1.75% and over, the optimal hedge approaches zero. The reason is that, at these levels, more options are required for hedging purposes and these options are more risky.

An *ex-post* analysis is conducted to improve the robustness of the findings. Table VI presents the results of the portfolio optimization suggested in this article. The optimal hedged ratios calculated in the previous section are applied to the New York Stock Exchange and the Chicago Board of Options Exchange regarding stocks and options respectively for the period beginning January 1986 and ending December 1986. It seems that in 1986 a New York Stock Exchange investor using the Chicago Board of Options Exchange at the same time would have been better off

Table IV
RISK AND RETURN OF EQUALLY WEIGHTED PORTFOLIOS, UNHEDGED AND FULLY HEDGED STRATEGIES

	Return (r)	**Risk** (σ^2)	σ^2/r
Equally weighted portfolio unhedged strategy	.77708	.6301	.81
Equally weighted portfolio hedged strategy	.4638	.4729	1.0796

Table V
OPTIMAL HEDGE RATIO

Portfolio	Return	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	.25	.61	.54	.98	0	.89	.48	.81	.88	.46	0	0	.92	0	.93	.43	.86	0	.92	.82	.05	.26	.9
2	.5	.67	0	.79	.03	.65	.49	.78	.66	.31	.83	.83	.87	.19	0	.34	.81	0	1	.72	.03	.36	.94
3	.75	.71	.45	1	0	.52	.51	.87	.53	.25	0	.85	.88	.04	.89	.30	.82	0	1	.63	.01	.47	.96
4	1	.75	.20	0	0	.26	.43	.83	.76	.15	1	.23	.86	.08	.8	0	.74	0	.3	.39	.01	.28	.98
5	1.25	.84	.08	0	0	.02	0	.91	0	.06	1	0	.82	.12	.24	0	0	0	.08	.15	0	0	.99
6	1.50	.9	.02	0	0	0	0	.88	0	.03	0	0	.77	.06	.05	0	0	0	.02	0	.01	0	.99
7	1.75	1	0	0	0	0	0	.95	0	.01	0	0	.62	.02	0	0	0	0	0	0	0	0	1
8	2	0	0	0	0	0	0	.95	0	.02	0	0	.53	0	0	0	0	0	0	0	0	0	1
9	2.25	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	2.50	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	2.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table VI
EX-POST ANALYSIS, RISKS AND RETURNS OF UNHEDGED AND HEDGE STRATEGIES AND STOCHASTIC DOMINANCE TEST

Portfolio Number	Unhedged Portfolio (1)		Hedged Portfolio (2)		Stochastic Dominance Test (2) > (1)
	r	σ^2	r	σ^2	
1	−1.1718	3.239	−2.513	3.364	no dominance
2	−1.454	3.1692	−2.039	2.8976	1st order
3	−1.065	2.7197	−1.511	2.5686	1st order
4	−1.356	1.8266	−.9292	2.1876	1st order
5	−.414	1.8378	−.8627	1.9602	1st order
6	−.7398	1.8136	−.968	1.804	no dominance
7	−1.35857	2.241	−1.4164	2.1643	no dominance
8	−1.4741	2.3506	−1.2706	2.2963	1st order
9	−.5463	2.1679	.532	2.1815	1st order
10	−2.3163	4.068	.6332	2.346	no dominance
11	−3.511	4.1745	1.767	3.7117	1st order

than an investor using the New York Stock Exchange only. This is concluded from the returns and risks on hedged and unhedged portfolios and confirmed by the stochastic dominance test.

The *ex-ante* and *ex-post* analyses seem to confirm the superiority of the investment strategy suggested in this article over the classical mean/variance strategy and over other known hedged strategies.

V. CONCLUDING REMARKS

This article suggests an investment model oriented towards global hedging that combines diversification and hedging. The superiority of such global hedging over Markowitz's strategy is suggested and an original approach to calculating the optimal hedge ratio is proposed. In this regard, two different analyses are used: *ex-ante* and *ex-post* analysis, along with two different tests: mean/variance and stochastic dominance.

The main empirical findings are as follows: (1) The analysis indicates that an investor can earn excess returns in covered call writing instead of holding a Markowithz's portfolio and (2) it is possible to calculate the optimal hedge ratio. This ratio, although different for each portfolio, never equals full hedging; i.e., equals one as suggested by previous studies.

Several considerations appear relevant from this analysis: (1) The capacity of the suggested model to capture the effect of hedging adds usefulness to classical diversification strategies followed by hedging and might prove to be useful in financial decision making. It seems clear that it is advantageous for a New York Stock Exchange investor to be able to write options on the Chicago Board of Options Exchange. If he is not allowed to do so, he is kept from operating with optimal means; (2) the findings concerning excess returns of hedged strategy over classical diversification might be viewed as conservative. The same transaction costs are used for both stocks and options; however, in practice, costs for options are lower; (3) the solidity of the findings are improved by using *ex-ante* and *ex-post* analyses in mean/variance and a stochastic dominance environments and by paying special attention to other methodological considerations such as the use of daily returns and taking into account dividends and transaction costs; and (4) although, as suggested by Bookstaber (1981), synchronization is not important in the case of studies like this, the findings should be interpreted in light of the non-synchronization which characterizes daily transactions on the Chicago Board of Option Exchange and the New York Stock Exchange. It seems that the non-synchronization phenomena alone cannot explain the findings.

A general equilibrium hedging model which includes the writing of calls and all other term contracts needs to be researched and developed.

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