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The Volatility Effect of Option Listing: Some Canadian Evidence

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This paper examines the effect of the Canadian option listings on the volatility of the underlying stocks. Towards this end, this paper adjusts for contemporaneous change in market volatility and regression tendency of beta, and employs distribution-free Moses test of a change in variance. On average, Canadian option listings reduced the variance as well as the beta of the optioned stocks during the early years of trading (1970's). Surrounding the market crash of October 1987, option listings tended to increase the beta, but not the variance. A comparison of simultaneous listing of call and put options to listing of call options only reveals that put options reduce the beta as well as the variance of the underlying stock.

I. INTRODUCTION

The prevailing theories of option pricing and asset pricing generally assume that options do not affect the underlying shares. On the practical side, however, the potential destabilizing effect of option trading has always been of utmost concern to the regulators. Since the stock market crash of October 1987, such concerns have heightened and are now widely shared by investors and the public in general.

Harris (1989) notes that theoretical modelling of the effect of option listing leads to conflicting conclusions, depending upon what assumptions are made. The empirical evidence on the effect of option listing on stock volatility is also mixed.[1] Thus, a study of the Canadian market may provide new and independent evidence on this issue. While the Canadian option market is much smaller than its U.S. counterpart, it has grown in terms of the number of optioned stocks, volume and dollar-value of trading since the first listings in September 1975 on the Montreal Stock Exchange (ME). Trading commenced on the Toronto Stock Exchange (TSE) and the Vancouver Stock Exchange (VE) shortly after.

Potential volatility effects are especially important to the Canadian institutional investors—the major participants in the Canadian option market (Mandron

1988a,b). The Canadian regulatory authorities, such as the Federal Department of Insurance, closely monitor the option market transactions of the institutional investors. The Canadian financial institutions also face regulations regarding the type of stocks they can hold in their portfolio. Any destabilizing effect of options on the stocks may lead to further regulatory restraints on options trading. The legal environment is, however, already considered by many Canadian financial institutions to be too restrictive for the development of a deeper option market in Canada.[2]

Notwithstanding the graveness of the matter, empirical evidence about the effect of option listing on stock volatility in the Canadian market is scarce. To our knowledge, the only such study is that of Chamberlain, Cheung and Kwan (CCK) (1991). However, they did not find any significant evidence of volatility effect for an average optioned stock.

In this paper we deal with a more comprehensive sample than CCK. The breadth of the sample allowed us to apply stronger screening criteria to minimize the impact of potential thin trading problems and possible outliers and still retain a reasonable sample of listing events. In addition to examining the whole sample, we also compare simultaneous listings of call and put options to listings of call option only. Since put options are often considered redundant derivatives, it would be interesting to see if the redundancy argument holds in the context of volatility effects. There has been no reported evidence about this matter.

Since our sample of listings spans a period of nearly fifteen years, we carry out the analysis for three non-overlapping sub-periods to see if the volatility effects of option listing has changed over time.

Lastly, most studies, including CCK, examine the average effect on optioned stocks. It is of course possible that many optioned stocks are affected individually and yet the average effect is zero. Accordingly, we examine the statistical significance of volatility change for individual optioned stocks in addition to that for the average optioned stock.

The plan for the rest of this paper is as follows. First, we describe the data and the methodology. second, the results are discussed. Finally, summary and concluding remarks will follow.

II. DATA AND METHODOLOGY

Options trading on the Canadian exchanges (Toronto, Montreal and Vancouver) is currently coordinated by Trans-Canada Options Inc. (TCO), the common clearing corporation jointly owned by the exchanges. TCO provided information about option listings on a total of 155 underlying stock series from the inception of trading on the exchanges in September 1975 through June 30, 1990.[3] However, not all of these were independent because of name changes, mergers and restructures. In such cases, we retained the earliest listing only. Also, the daily return data for some series were not available on the TSE/Western database. We further omitted all events beyond March 31, 1989, since the available daily return data series were not long enough even for the smallest of our sampling intervals. This process resulted in a sample of 119 first ever option listing events. There were 78 events of simultaneous listing of call and put and 41 events of call listing alone. Following Skinner (1989), Conrad (1989) and CCK, we use four different sampling intervals (100, 200, 250 and 500 trading days on either side of listing date) to estimate stock return volatility. Since the longer interval estimates can be viewed as averages of shorter interval estimates, they permit us to compare long-term effects to immediate effects of option listing on stock volatility. As a majority of the optioned stocks are large and well-known, thin trading problems are expected to be minimal. Nevertheless, as a precautionary measure, we eliminated all events with less than 80, 170, 225, and 450 daily returns for the 100, 200, 250, and 500 trading day sampling intervals respectively. To minimize the influence of outliers, we further excluded all events where the after-to-before variance ratio or the market-adjusted variance ratio (to be discussed shortly) was greater than 10 or less than 0.10.

The remaining sample contains 57 to 80 first listing events depending upon the sampling interval (100, 200, 250 or 500 trading days) and the market index. Sixty-three of the largest sample of eighty stocks were on the TSE 300 index as of June 1991. Sixty of the eighty stocks had the first calls and puts listed simultaneously.[4] Twenty-five of the eighty first listings were on the ME, fourteen on the VE, and forty-one on the TSE. Sixty were listed during the 1980's and nine of them after the stock market crash of October 1987.

For each optioned stock, two alternative measures of volatility are estimated: the daily return variance and the market model beta. The beta estimate is generated using the TSE/Western value-weighted (VW) index of all TSE stocks as the market index.

In addition to estimating betas, we also use market index to adjust the variance of optioned stocks. This adjustment is desirable since the volatility of optioned stocks may change as a result of contemporaneous change in market volatility prompted by events other than option listings. The adjusted variance results may, however, differ depending upon whether a value-weighted or an equally-weighted market index is used.

If the optioned stocks are relatively large and thus weigh heavily in the market index, as they do in TSE 300 for example, the use of a value-weighted index may bias the findings in the direction of no change in adjusted variance. On the other hand, the well-known anomalous behavior of small stocks may unduly influence the results if an equally-weighted market index is used to adjust the variance of the optioned stocks which are in general relatively large. This problem is potentially more acute in Canada due to the preponderance of small stocks in the Canadian market. Moreover, since theoretical arguments favor the use of a value-weighted index in estimating beta, it would be preferable for the sake of consistency, to use a value-weighted index to adjust the stock variance as well.

Weighing the merits and demerits of using a value-weighted vs. equally-weighted market index to adjust stock variance, we decided to use the VW (TSE/Western value-weighted index of all TSE stocks) since it seems to offer a reasonable compromise. It is broader than the TSE 300 value-weighted index; the influence of the large stocks is thus attenuated. At the same time, unlike its equally-weighted counterpart, the VW is not overly influenced by the large majority of small stocks in the Canadian market.

For each stock, we estimate two variances for a given sampling interval, one for the period before the event date and the other for the period after the event date. An after-to-before variance ratio is then calculated. This ratio is referred to as the variance ratio. If option listing increases (reduces) volatility, this ratio would be greater (less) than 1.0.

We also form a market-adjusted variance ratio (or simply the adjusted variance ratio) using the contemporaneous variance estimates of the market index (VW) returns. The stock variance before (and after) the event date is deflated by the market variance during the same period. If option listing increases (reduces) the volatility net of the market-wide changes (i.e., relative to an average non-optioned stock), this ratio would be greater (less) than 1.0 like the variance ratio.

If stock returns are normally distributed, F-test can be undertaken to determine if the unadjusted or the adjusted variance ratio for a given optioned stock is significantly different from 1.0. Skinner (1989), however, showed that the F-distribution is not an appropriate empirical model for the variance ratios. Therefore, we perform Moses test (Daniel 1978, pp. 97–101) of a change in variance. Like most non-parametric tests, it neither assumes nor requires normality. A distinct feature of this test is that it does not depend on assumptions of known or equal location parameters (mean, median) of the populations concerned. This feature is desirable since previous research (Conrad 1989, Kim and Young 1991) indicates a possible change in mean return following option listing.

The before-listing (b_i) and after-listing betas ($d_i = b_i + c_i$), and their difference or change in beta (c_i) are estimated from the following regression equation:

$$R_i(t) = a_i + b_i R_m(t) + c_i(R_m(t)\, D(t)) + e_i(t) \tag{1}$$

where $t = -T_1, .., -1, 0, 1, .., T_2$, with 0 as the listing date, T_1 and T_2 are the last available trading days before and after the listing date within a given sampling interval; $R_i(t)$ and $R_m(t)$ are the natural logarithms of one plus the rate of return on the stock and the market respectively; $D(t)$ is a dummy variable which assumes a value of 1 for $t = 1, 2, .., T_2$ and 0 otherwise; and $e_i(t)$ is an i.i.d. error term.

If option listing increases (reduces) non-diversifiable risk, c would be positive (negative). A t-test can determine if the change in beta is statistically significant at two-sided 5 percent level.

Any beta effect of option listing may, however, be confounded as a result of the regression tendency of beta towards 1.0 (Blume 1971; Levy 1971). If the pre-listing beta estimate of a stock is below (above) 1.0 because of sampling error, the post-listing beta estimate would likely be higher (lower) than the pre-listing estimate. In their study of CBOE listings, Klemkosky and Maness (1980, p.15) noted a minor regression tendency. Table 2 of Whiteside, Dukes and Dunne (1983) indicates that the change in beta for 53 of the 71 securities is consistent with a regression tendency. The same can be said about Table III of Trennepohl and Dukes (1979), where beta change for 29 of the 32 stocks is consistent with a regression tendency. In all three sampling intervals of Skinner (1989, Table 2), the average pre-listing beta is above 1.0, and beta decreases following option listing. A similar observation also applies to CCK (Table 2). None of the above authors, however, recognize this tendency.

To guard against this regression tendency effect, we adapt Blume's technique to estimate beta change adjusted for regression tendency. For each stock, a non-event period is formed going back the length of the sampling interval (100, 200, 250, 500) from the earliest pre-listing return date. A non-event beta (h_i) is derived from the market model estimated over the non-event period:

$$R_i(t) = g_i + h_i R_m(t) + u_i(t) \tag{2}$$

For each sampling interval, the following cross-sectional beta tendency regression equation is then estimated using the pre-listing beta (b_i) as the regressand and the non-event beta (hi) as the regressor:

$$b_i = p + q\, h_i + v_i \tag{3}$$

Assuming that the regression tendency relationship is constant from period to period, once Equation 3 is estimated, it can be used to forecast beta for the post-listing period. The pre-listing beta (b_i) now takes over the role of the predictor variable (regressor) and the post-listing beta (d_i) occupies the position of the predicted variable (regressand). A conditional (upon pre-listing beta) prediction (P_i) of post-listing beta can thus be generated from:

$$P_i = p + q\, b_i \tag{4}$$

The use of Equation 4 to predict beta assumes that the mean pre-listing beta equals the mean predicted beta. This may not, however, be a valid assumption. Generally speaking, using regression tendency equations to predict betas produces an upward drift in the average sample beta. Accordingly, the post-listing beta forecast (f_i) is formed by making an adjustment to P_i for the drift in the mean beta:[5]

$$f_i = P_i + \mathrm{Mean}(b_i) - \mathrm{Mean}(P_i) \tag{5}$$

This produces a Mean(f_i) that equals Mean(b_i). A comparison of f_i's (beta forecasts) and d_i's (post-listing betas) would thus yield average beta change results similar to a comparison of b_i's (pre-listing betas) and d_i's (post-listing betas); the difference would, however, be felt in the individual beta change results if a regression tendency is present in the sample.

Finally, we estimate the change in beta adjusted for regression tendency (cr_i) in the following manner:

$$cr_i = f_i - d_i \tag{6}$$

To see if the post-listing beta (d_i) significantly differs from the beta forecast, we use the familiar 95 percent confidence interval for the prediction of individual value:

$$f_i \pm t_{n-2,0.025}\left(\left[1+\frac{1}{n}+\frac{(b_i-\bar{h})^2}{\left(\sum_{i=1}^{n} h_i^2 - n\bar{h}^2\right)}\right] s_v^2\right)^{1/2} \tag{7}$$

where n is the number of stocks, $\bar{h}$ is the mean non-event beta and s_v^2 is the variance of residuals from Equation 3.

So far we have discussed the tests for individual stocks. In order to determine the statistical significance of the effect on an average optioned stock, we perform Wilcoxon signed-rank test (two-sided 5 percent level) on the sample of variance ratios, adjusted variance ratios, and beta changes. Under the null hypothesis of no volatility effect, we expect that the variance (or adjusted variance) ratios and beta changes to average 1.0 and 0.0 respectively.

Like any other average, the effect on the average optioned stock could be misleading. It is possible that option listing affects different types of optioned stocks in different manners. The test results for the average optioned stock should therefore be judged by the individual Moses and confidence interval tests we have suggested above.

III. EMPIRICAL RESULTS

A. First Ever Option Listing

A.1. *Variance Change*

In Table 1 we present the results for the whole sample of listings without any grouping. Panel A shows that the average variance ratio is greater than 1.0 for all four sampling intervals. Except in the 100 day interval, the proportion of stocks experiencing an increase in variance ranges from 59 percent and above.

The Wilcoxon test confirms that, except in the immediate period (100 days), an average optioned stock experiences a significant increase in variance following options listing. The average increase ranges from 14 percent (100 days) to 49 percent

Table 1. **VARIANCE RATIOS AND BETAS FOR FIRMS WITH OPTIONED STOCKS AROUND THE DATE OF FIRST EVER OPTION LISTING; SEPTEMBER 1975 TO MARCH 1989.**

Estimation interval (in days on either side of the option listing date)	**+/–100**	**+/–200**	**+/–250**	**+/–500**
(A) Variance ratios: estimated variance for period after options listing divided by estimated variance before				
Number of firms	80	71	68	57
Mean	1.143	1.315	1.490	1.493
Median	0.983	1.161	1.201	1.361
Number(%) of firms with:				
variance increase	39(49)	42(59)	44(65)	38(67)
variance decrease	41(51)	29(41)	24(35)	19(33)
Wilcoxon signed–rank test of change in variance:				
p-value	0.292	0.027	0.002	0.000
Number(%) of firms with a sigificant change in variance at 5 percent level in Moses test:				
increase	8(10)	17(24)	16(24)	21(37)
decrease	8(10)	10(14)	10(15)	8(14)
(B) Adjusted variance ratios: estimated market-adjusted variance for period after options listing divided by estimated market–adjusted variance before (Adjusted by value-weighted market index)				
Number of firms	80	75	69	57
Mean	1.094	1.072	0.975	0.764
Median	0.968	0.827	0.823	0.595
Number(%) of firms with adjusted variance:				
increase	38(48)	26(35)	22(32)	14(25)
decrease	42(52)	49(65)	47(68)	43(75)
Wilcoxon signed–rank test of change in adjusted variance:				
p–value	0.962	0.264	0.041	0.000
Number(%) of firms with a sigificant change in adjusted variance at 5 percent level in Moses test:				
increase	4(5)	8(11)	4(6)	5(9)
decrease	10(13)	19(25)	21(30)	25(44)
(C) Change in beta: estimated beta for period after options listing minus estimated beta before				
Number of firms	80	75	69	57
Number (%) of firms with a significant (in t test at 5% level) pre-listing beta:	63(79)	67(89)	59(86)	56(98)
Mean beta:				
Pre-listing	1.064	1.075	0.987	1.016
Post-listing	1.095	1.092	1.051	1.055
Change in beta:				
Mean	0.031	0.017	0.065	0.040
Median	0.034	0.036	0.065	0.070
Number(%) of firms with beta:				
increase	42(58)	40(53)	42(61)	31(54)
decrease	38(48)	35(47)	27(39)	26(46)
Wilcoxon signed–rank test of change in beta:				
p–value	0.628	0.730	0.196	0.289
Number(%) of firms with a significant (in t test at 5 percent level) beta:				
increase	4(5)	10(13)	11(16)	14(25)
decrease	3(4)	9(12)	10(15)	7(12)

(250 days and 500 days). The medians range from 2 percent decline (100 days) to 36 percent increase (500 days).

In the Moses test for individual stocks, the proportion of stocks experiencing a significant change in variance ranges from a low of 20 percent (100 days) to a high of 51 percent (500 days). With the exception of 100 day interval, more stocks experience a significant increase rather than decrease in variance.

Panel B results show that, once adjusted for contemporaneous change in market variance, the average optioned stock actually experiences a decrease in variance following option listing. Although the adjusted variance ratio averages are split above and below 1.0, all the medians are below 1.0, and a majority of the optioned stocks show a decrease in adjusted variance. However, the Wilcoxon test results indicate that the null hypothesis of zero average change in variance can be rejected at the conventional 5 percent significance level in the two longer intervals (250 and 500 day) only.

In the Moses test for individual stocks, 18 (100 day interval) to 53 (500 day interval) percent of stocks exhibit a significant change in adjusted variance. In all four intervals, a larger number of stocks experience a significant decrease rather than increase in adjusted variance. The longer interval results, in particular the 500 day results, should, however, be interpreted with caution. During such an extended period of time, many stock-specific factors other than option listing may have a bearing on the risk of the underlying stock.

A.2. *Beta Change*

As shown by Panel C of Table 1, most (79 percent or more) of our sample stocks have a pre-listing beta significantly different from 0.0. The average change in beta following options listing ranges from 0.017 (200 days) to 0.065 (250 days), and the median varies between 0.034 (100 days) and 0.070 (500 days). A beta increase occurs for a low of 53 percent (200 days) to a high of 61 percent (250 days) of stocks. In the individual *t*-test at 5 percent level, the proportion of stocks with a significant beta change varies from 9 percent (100 days) to 37 percent (500 days). Only in the 500 day interval, the proportion of significant increases (25 percent) is substantially higher than that of significant decreases (12 percent).[6] Lastly, the Wilcoxon test shows no significant change in beta for an average optioned stock in any of the sampling intervals.

These beta results may, however, be confounded because of the regression tendency of estimated betas towards 1.0 in successive periods. To examine this possibility, panels A and B of Table 2 show the beta change results separately for the two groups—stocks with a pre-listing beta below 1.0 and those with a pre-listing beta above 1.0. As reported in Panel C of Table 1, the sample average pre-listing betas are, however, slightly different from 1.0.

Table 2. **REGRESSION TENDENCY OF BETA AND CHANGE IN BETA ADJUSTED FOR REGRESSION TENDENCY FOR FIRMS WITH OPTIONED STOCKS AROUND THE DATE OF FIRST EVER OPTION LISTING; SEPTEMBER 1975 TO MARCH 1989**

Estimation interval (in days on either side of the option listing date)	**+/–100**	**+/–200**	**+/–250**	**+/–500**
(A) Change in beta for firms with pre–listing beta less than one				
Number of firms	39	38	39	34
Mean beta:				
Pre-listing	0.536	0.596	0.579	0.675
Post-listing	0.792	0.828	0.840	0.866
Change in beta:				
Mean	0.256	0.232	0.260	0.191
Median	0.171	0.125	0.121	0.180
Number(%) of firms with beta:				
increase	27(69)	27(71)	29(74)	23(68)
decrease	12(31)	11(29)	10(26)	11(32)
Wilcoxon signed–rank test of change in beta:				
p–value	0.001	0.002	0.000	0.001
Number(%) of firms with a significant (in t test at 5 percent level) beta:				
increase	4(10)	8(21)	9(23)	12(35)
decrease	1(3)	2(5)	2(5)	2(6)
(B) Change in beta for firms with pre–listing beta greater than one				
Number of firms	41	37	30	23
Mean beta:				
Pre-listing	1.566	1.567	1.516	1.519
Post-listing	1.383	1.363	1.327	1.336
Change in beta:				
Mean	–0.183	–0.204	–0.189	–0.183
Median	–0.133	–0.165	–0.185	–0.151
Number(%) of firms with beta:				
increase	15(37)	13(35)	13(43)	8(35)
decrease	26(63)	24(65)	17(57)	15(65)
Wilcoxon signed–rank test of change in beta:				
p–value	0.008	0.018	0.053	0.021
Number(%) of firms with a significant (in t test at 5 percent level) beta:				
increase	0(0)	2(5)	2(7)	2(9)
decrease	2(5)	7(19)	8(27)	5(22)
(C) Blume's regression equation of measuring beta tendency: Pre-listing beta $(b_i) = p + q$ Non-event beta $(h_i) + v_i$ .... (3)				
Number of firms	80	75	69	57
p	0.230	0.573	0.348	0.522
t-test p-value	0.022	0.000	0.004	0.000
q	0.854	0.469	0.711	0.547
t-test p-value	0.000	0.000	0.000	0.000
R-square	0.536	0.270	0.369	0.529
Standard error of regression	0.413	0.545	0.477	0.374

(continued)

Table 2. **(continued)**

Estimation interval (in days on either side of the option listing date)	**+/−100**	**+/−200**	**+/−250**	**+/−500**
(D) Change in beta adjusted for regression tendency: post–listing beta minus beta forecast				
Number of firms	80	75	69	57
Mean	0.032	0.018	0.064	0.043
Median	0.030	−0.013	0.015	0.075
Number(%) of firms with a change in beta adjusted for regression tendency:				
increase	45(56)	36(48)	36(52)	31(54)
decrease	35(44)	39(52)	33(48)	26(46)
Wilcoxon signed–rank test of change in beta adjusted for regression tendency:				
p–value	0.505	0.921	0.338	0.258
Number(%) of firms with a significant (in 95% confidence interval test) change in beta adjusted for regression tendency:				
increase	0(0)	3(4)	2(3)	0(0)
decrease	1(1)	2(3)	0(0)	0(0)

Consistent with the regression tendency, for stocks with pre-listing beta below (above) 1.0, the average beta is higher (lower) following option listing. The number of increases and decreases, the number of significant increases and decreases, and the Wilcoxon test results also support the existence of a regression tendency. These results suggest that if we combine the two groups, we are likely to find (as we in fact did in panel C of Table 1) evidence in favor of an increase in beta for an average optioned stock. In general, more than 50 percent of firms had pre-listing beta less than 1.0. The average increase in beta for these firms was greater in magnitude than the average decrease in beta for stocks that had pre-listing beta above 1.0.

To measure the regression tendency, Panel C of Table 2 reports Equation 3 results of regression of pre-listing beta on non-event beta. The slope coefficient indicating beta tendency is always positive and highly significant.[7]

The above evidence regarding regression tendency of our sample stocks suggests that we compare the post-listing beta (d_i) with the beta forecast from regression tendency (f_i). Panel D of Table 2 contains these beta change results. As expected, the results for an average optioned stock remain essentially the same as in the case of no adjustment for regression tendency. Using a 95 percent confidence interval, we also test, for each stock, whether there is a significant difference between post-listing beta and beta forecast based upon regression tendency. Unlike Panel C of Table 1, there is virtually no evidence of a significant change in beta irrespective of the sampling interval used. One reason for the statistical insignificance of individual beta changes is that while a regression tendency is present in our sample betas, it cannot be measured with precision as indicated by the relatively large standard error of beta tendency regression (Panel C, Table 1). This led to too wide confidence intervals. For example, out of the 80 option listings in the 100 day case, not a single confidence interval ranges from a positive lower bound to an upper bound below 2.0; 14 intervals range from a negative value to above 2.0, 32 intervals range from a negative value to a value below 2.0, and 34 intervals range from a positive value to above 2.0. In contrast, of the 80 post-listing betas, only 3 are negative and only 5 are above 2.0.

B. Stability of Volatility Effect

The above results do not differentiate the simultaneous listing of call and put options from the listing of call option only. They also span a period of nearly fifteen years during which time the options market has grown, some regulatory changes have taken place,[8] and the equity market has experienced wide swings, including the market crash of October 1987. It would thus be appropriate to study stability of the volatility effect of option listing.

Accordingly, we have divided the sample of listings into four groups: simultaneous listing of call and put, September 1975 to December 1979 (period 1); simultaneous listing of call and put, January 1980 to September 1985 (period 2); simultaneous listing of call and put, October 1985 to March 1989 (period 3); and listing of call only, September 1975 to December 1979 (period 1). The call only type of listings did not take place during the '80s.

B.1. *Stability of Variance Effect*

Panels A and C in Table 3 indicate that the average optioned stock experienced a variance increase following option listing during the periods 1 and 3. Between these two periods, the period 1 increase tends to be stronger both in terms of the proportion of firms experiencing an increase in variance, and the significance level of the Wilcoxon test.[9] In both periods, many stocks were individually affected according to the Moses test and more firms had a significant increase rather than decrease except in the 100 days in period 3.

In contrast, as shown by panel B of Table 3, the period 2 listings were followed by a decrease in variance for the average optioned stock although not statistically significant in the Wilcoxon test. Most firms experienced a decrease rather than an increase in variance. According to the Moses test, many firms were significantly affected despite the absence of significant effect on the average optioned stock. The majority of these were cases of a significant decrease in variance.

The adjusted variance ratio results in Table 4 show altogether a different picture. Panel A provides strong evidence (except in the 100 day interval) of a decline in adjusted variance in period 1 for the average stock as well as at the individual level. The evidence in Panel C, other than the average adjusted variance figures, also point towards a decline in variance in period 3, albeit weaker compared to period 1. In contrast, panel B evidence is in favor of a variance increase in period 2, although not statistically significant.

Table 3. **VARIANCE RATIOS FOR FIRMS WITH OPTIONED STOCKS AROUND THE DATE OF FIRST EVER OPTION LISTING (CALL AND PUT SIMULTANEOUSLY)**

Estimation interval (in days on either side of the option listing date)	**+/–100**	**+/–200**	**+/–250**	**+/–500**
(A) Period 1: September 1975 to December 1979				
Number of firms	10	10	10	9
Mean	1.339	1.425	1.538	1.617
Median	1.234	1.376	1.600	1.522
Number(%) of firms with variance:				
increase	6(60)	8(80)	9(90)	7(78)
decrease	4(40)	2(20)	1(10)	2(22)
Wilcoxon signed-rank test of change in variance:				
p-value	0.193	0.037	0.014	0.020
Number(%) of firms with a sigificant change in variance at 5 percent level in Moses test:				
increase	2(20)	3(30)	4(40)	6(67)
decrease	0(0)	1(10)	1(10)	1(11)
(B) Period 2: January 1980 to September 1985				
Number of firms	20	22	23	21
Mean	0.967	0.920	0.924	0.879
Median	0.837	0.920	0.995	0.892
Number(%) of firms with variance:				
increase	9(45)	10(45)	11(48)	8(38)
decrease	11(55)	12(55)	12(52)	13(62)
Wilcoxon signed-rank test of change in variance				
p-value	0.312	0.318	0.459	0.143
Number(%) of firms with a sigificant change in variance at 5 percent level in Moses test:				
increase	1(5)	1(5)	2(9)	4(19)
decrease	3(15)	3(14)	7(30)	6(29)
(C) Period 3: October 1985 to March 1989				
Number of firms	30	28	27	19
Mean	1.085	1.376	1.731	1.847
Median	0.938	1.078	1.207	1.646
Number(%) of firms with variance:				
increase	12(40)	15(54)	17(63)	17(89)
decrease	18(60)	13(46)	10(37)	2(11)
Wilcoxon signed-rank test of change in variance:				
p-value	0.881	0.234	0.021	0.000
Number(%) of firms with a sigificant change in variance at 5 percent level in Moses test:				
increase	3(10)	7(25)	7(26)	6(32)
decrease	3(10)	5(18)	2(7)	1(5)

Table 4. **ADJUSTED VARIANCE RATIOS FOR FIRMS WITH OPTIONED STOCKS AROUND THE DATE OF FIRST EVER OPTION LISTING (CALL AND PUT SIMULTANEOUSLY)**
(Adjusted by value-weighted market index)

Estimation interval (in days on either side of the option listing date)	**+/–100**	**+/–200**	**+/–250**	**+/–500**
(A) Period 1: September 1975 to December 1979				
Number of firms	10	10	10	9
Mean	0.899	0.551	0.545	0.442
Median	0.726	0.519	0.508	0.416
Number(%) of firms with an adjusted variance:				
increase	4(40)	0(0)	0(0)	0(0)
decrease	6(60)	10(100)	10(100)	9(100)
Wilcoxon signed–rank test of change in adjusted variance:				
p–value	0.557	0.002	0.002	0.004
Number(%) of firms with a sigificant change in adjusted variance at 5 percent level in Moses test:				
increase	0(0)	0(0)	0(0)	0(0)
decrease	1(10)	6(60)	7(70)	9(100)
(B) Period 2: January 1980 to September 1985				
Number of firms	23	23	23	21
Mean	1.237	1.114	1.177	1.224
Median	1.075	0.850	0.918	1.104
Number(%) of firms with an adjusted variance:				
increase	14(61)	9(39)	11(48)	12(57)
decrease	9(39)	14(61)	12(52)	9(43)
Wilcoxon signed-rank test of change in adjusted variance:				
p-value	0.187	0.441	0.407	0.200
Number(%) of firms with a sigificant change in adjusted variance at 5 percent level in Moses test:				
increase	2(9)	3(13)	2(9)	4(19)
decrease	0(0)	2(9)	4(17)	3(14)
(C) Period 3: October 1985 to March 1989				
Number of firms	36	31	28	19
Mean	1.136	1.333	1.028	0.520
Median	1.004	0.986	0.825	0.428
Number(%) of firms with an adjusted variance:				
increase	18(50)	15(48)	9(32)	2(11)
decrease	18(50)	16(52)	19(68)	17(89)
Wilcoxon signed-rank test of change in adjusted variance:				
p-value	0.735	0.646	0.225	0.000
Number(%) of firms with a sigificant change in adjusted variance at 5 percent level in Moses test:				
increase	2(6)	5(16)	2(7)	1(5)
decrease	7(19)	6(19)	7(25)	8(42)

Table 5. **CHANGE IN BETA ADJUSTED FOR REGRESSION TENDENCY (POST-LISTING BETA MINUS FORECAST BETA) FOR FIRMS WITH OPTIONED STOCKS AROUND THE DATE OF FIRST EVER OPTION LISTING (CALL AND PUT SIMULTANEOUSLY)**

Estimation interval (in days on either side of the option listing date):	**+/–100**	**+/–200**	**+/–250**	**+/–500**
(A) Period 1: September 1975 to December 1979				
Number of firms	10	10	10	9
Mean	–0.240	–0.270	–0.276	–0.175
Median	–0.215	–0.237	–0.205	–0.197
Number(%) of firms with a change in beta adjusted for regression tendency:				
increase	1(10)	1(10)	1(10)	3(33)
decrease	9(90)	9(90)	9(90)	6(67)
Wilcoxon signed–rank test of change in beta adjusted for regression tendency:				
p–value	0.020	0.020	0.027	0.203
Number(%) of firms with a significant (in 95 percent confidence intervel test) change in beta adjusted for regression tendency:				
increase	0(0)	0(0)	0(0)	0(0)
decrease	0(0)	1(10)	0(0)	0(0)
(B) Period 2: January 1980 to September 1985				
Number of firms	23	23	23	21
Mean	0.034	–0.043	–0.016	–0.017
Median	0.011	–0.045	–0.056	–0.000
Number(%) of firms with a change in beta adjusted for regression tendency:				
increase	12(52)	11(48)	10(43)	10(48)
decrease	11(48)	12(52)	13(57)	11(52)
Wilcoxon signed–rank test of change in beta adjusted for regression tendency:				
p–value	0.860	0.616	0.769	0.987
Number(%) of firms with a significant (in 95 percent confidence intervel test) change in beta adjusted for regression tendency:				
increase	0(0)	0(0)	0(0)	0(0)
decrease	0(0)	1(4)	0(0)	0(0)
(C) Period 3: October 1985 to March 1989				
Number of firms	36	31	28	19
Mean	0.144	0.163	0.250	0.240
Median	0.144	0.134	0.217	0.272
Number(%) of firms with a change in beta adjusted for regression tendency:				
increase	27(75)	20(65)	21(75)	15(79)
decrease	9(25)	11(35)	7(25)	4(21)
Wilcoxon signed–rank test of change in beta adjusted for regression tendency:				
p–value	0.006	0.048	0.001	0.001
Number(%) of firms with a significant (in 95 percent confidence intervel test) change in beta adjusted for regression tendency:				
increase	0(0)	2(6)	2(7)	0(0)
decrease	0(0)	0(0)	0(0)	0(0)

B.2. *Stability of Beta Effect*

The (adjusted for regression tendency) beta results for the three periods are reported in Table 5. Across all four sampling intervals, a decline in beta is indicated in periods 1 and 2 while an increase seems to have taken place in period 3. The magnitude of average decrease in period 1 (more than 0.19) and average increase in period 3 (more than 0.14) appears to be material. The proportion of beta increase ranges from a low of 65 percent (200 days) to a high of 79 percent (500 days) in period 3. In contrast, this range is from 10 percent (100, 200 and 250 days) to 33 percent (500 days) in period 1, and from 43 percent (250 days) to 52 percent (100 days) in period 2.

In the Wilcoxon test, the period 2 decline in beta for an average optioned stock is not significant. The average decrease in beta is significant for 100, 200 and 250 days in period 1, while in period 3 the average increase is significant for all intervals.

We conclude that option listing had on average a beta reduction effect in the early years of trading. To a lesser extent, a similar effect prevailed for listings in the early 1980's. Surrounding the market crash of October 1987 however, options seem to have increased the non-diversifiable risk of an average underlying stock. Most of the individual beta changes are, however, not statistically significant as shown by the confidence interval test results. As mentioned earlier, one possible reason for the statistical insignificance of individual beta changes is the lack of precision (large standard error of regression, Panel C, Table 2) in the estimation of regression tendency of beta, which in turn leads to a wide confidence interval for beta forecast.

C. Volatility Effect of Put Listing

Let us now compare the simultaneous listings of call and put options (panel A of Tables 3, 4, 5) and the listing of call option only (Table 6) during the common period of September 1975 to December 1979. The effects look quite similar when we consider the unadjusted variance ratios in panel A of Tables 3 and 6. Looking at the adjusted variance ratios in panel A of Table 4 and panel B of Table 6, the call only average and median figures are higher except in the 100 day case. The Wilcoxon test *p*-values, the pattern of increase versus decrease, and the Moses test results for individual significance also support a volatility reducing effect of put listing.

Comparing panel A of Table 5 and panel C of Table 6, we find that the magnitude of beta change for an average optioned stock is greater when call and put are listed simultaneously rather than listing of call alone. Irrespective of the estimation interval, relatively more stocks experience a beta reduction rather than inflation (adjusted for regression tendency) following a simultaneous listing of call and put as opposed to listing of call alone. The Wilcoxon test results also support a beta stabilizing effect of

Table 6. **VARIANCE RATIOS AND BETAS FOR FIRMS WITH OPTIONED STOCKS AROUND THE DATE OF FIRST EVER OPTION LISTING (CALL ONLY); SEPTEMBER 1975 TO DECEMBER 1979.**

Estimation interval (in days on either side of the option listing date)	**+/–100**	**+/–200**	**+/–250**	**+/–500**
(A) Variance ratios: estimated variance for period after options listing divided by estimated variance before				
Number of firms	20	11	8	8
Mean	1.310	1.850	2.247	2.125
Median	1.208	1.689	2.251	2.215
Number(%) of firms with a variance:				
increase	12(60)	9(82)	7(88)	6(75)
decrease	8(40)	2(18)	1(12)	2(25)
Wilcoxon signed–rank test of change in variance:				
p–value	0.048	0.032	0.023	0.039
Number(%) of firms with a sigificant change in variance at 5 percent level in Moses test:				
increase	2(10)	6(55)	3(38)	5(63)
decrease	2(10)	1(9)	0(0)	0(0)
(B) Adjusted variance ratios: estimated market–adjusted variance for period after options listing divided by estimated market–adjusted variance before				
Number of firms	11	11	8	8
Mean	0.838	0.838	0.747	0.499
Median	0.589	0.732	0.746	0.457
Number(%) of firms with an adjusted variance:				
increase	2(18)	2(18)	2(25)	0(0)
decrease	9(82)	9(82)	6(75)	8(100)
Wilcoxon signed–rank test of change in adjusted variance:				
p–value	0.067	0.032	0.078	0.008
Number(%) of firms with a sigificant change in adjusted variance at 5 percent level in Moses test:				
increase	0(0)	0(0)	0(0)	0(0)
decrease	2(18)	5(45)	3(38)	5(63)
(C) Change in beta adjusted for regression tendency of beta: estimated beta for period after options listing minus forecast beta				
Number of firms	11	11	8	8
Mean	–0.093	–0.005	0.072	–0.044
Median	–0.060	–0.066	–0.042	–0.023
Number(%) of firms with a change in beta adjusted for regression tendency:				
increase	5(45)	4(36)	4(50)	4(50)
decrease	6(55)	7(64)	4(50)	4(50)
Wilcoxon signed–rank test of change in beta adjusted for regression tendency:				
p–value	0.520	0.765	0.844	0.547
Number(%) of firms with a significant (in 95 percent confidence intervel test) change in beta adjusted for regression tendency:				
increase	0(0)	1(9)	0(0)	0(0)
decrease	1(9)	0(0)	0(0)	0(0)

put listing. Thus, put options can hardly be considered as redundant when either the total risk or the non-diversifiable risk of optioned stock is an important consideration.

IV. SUMMARY AND CONCLUSIONS

In this paper we have examined the effects of the Canadian option listings (September 1975 to March 1989) on the volatility of the underlying stocks over the sampling intervals of 100, 200, 250 and 500 trading days on either side of the listing date. To improve the reliability of empirical results, we have employed two new sets of tests. Because of the inadequacy of the F distribution in describing the variance ratios (Skinner 1989), we have used a distribution-free non-parametric test (Moses test) of change in variance. Further, previous studies of the beta effect of option listing have ignored the regression tendency of betas estimated over successive periods. In this paper, we adapt Blume's (1971) technique of forecasting beta to adjust for the regression tendency of beta.

Option listings during the early years (1970's) of trading had a stabilizing effect on the underlying stocks in a total risk as well as a non-diversifiable risk sense. More recently (October 1985 and later), surrounding the market crash of October 1987, option listings appear to have increased the non-diversifiable risk of the underlying stocks.

Previously Chamberlain et al. (1991) found no significant impact on either the variance or the beta of the Canadian optioned stocks between November 1979 and January 1987. This is to be expected from our results since they used a sampling interval of four months (about 84 trading days) and 21 of their 37 listings were between January 1980 and September 1985. During this period, our 100-day evidence indicates no statistically significant listing effect on either the variance or the beta of the underlying stock. Using an interval of 45 days, Whiteside, Dukes and Dunne (1983) also did not find any significant change in the average beta for the U.S. listings. They, however, noted that 90 percent of the option listings led to lower beta in 1981 compared to 50 percent in 1973, the first year of CBOE listings.

Our beta results during the 1970's and in more recent time (1985–1989) are different from the U.S. evidence of Trennepohl and Dukes (1979), Klemkosky and Maness (1980), Conrad (1989) and Skinner (1989); none of the studies found any significant effect on the beta of the average optioned stock. Conrad and Skinner, however, report a statistically significant decline in variance. Given the evidence of a changing (total and systematic) volatility effect in our study and to a limited extent in Whiteside et al. (1983), it would be interesting to see if Skinner's (1989) findings would have been different had he examined option listings over separate time periods.

A comparison of the simultaneous listing of put and call options and the listing of call option only during the 1970's indicate that put options, far from being redundant, tend to reduce the total as well as the non-diversifiable risk. This finding contradicts the U.S. findings of Conrad (1989, p. 497) and Kim and Young (1991, p. 146) who claim that the introduction of put options does not affect the pricing behavior of the optioned stocks.

We also find that, even when there was no significant average effect, many optioned stocks were affected individually, especially in a total risk sense. This finding may partially explain the perception of the investment professionals and the concern of the regulators about the destabilizing effect of options. The individual results should be interpreted with caution though. It is difficult to control for other stock-specific events that may have contributed to the volatility changes especially over the longer sampling intervals.

Overall, we find Canadian option listings to have a beneficial risk-reducing effect on the underlying stocks except in the destabilizing environment surrounding the 1987 market crash. Hence, there is no strong rationale to further regulate the options trading of the Canadian institutional investors who are the major participants in the market.

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NOTES

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1. Nathan Associates (1974) and CBOE (1975,1976) found the option listings to stabilize stock prices. Klemkosky and Maness (1980) found no pronounced tendency for either the total risk or the systematic risk. Trennepohl and Dukes (1979), Whiteside, Dukes and Dunne (1983), Conrad (1989) and Skinner (1989) also found no significant effect on the systematic risk. The last two studies found the variance to decline on average. However, Harris (1989) reported a modest but significant increase in standard deviation of the S&P 500 stocks since index futures and options started trading.

2. See, Mandron (1988b, p.16) and the citations therein. Up until the end of 1980, option transactions other than issuing covered calls on the part of the institutional investors were considered improper by various regulators. Since then the buying of protective puts have become acceptable to the regulators. But naked put sales and buying calls are still governed by the "prudent man rule".

3. Except for the ones listed in September 1975, the exact date of listing was available. Hatch (1983, p. 402) mentions that option trading began around mid-September 1975. Accordingly, we used September 15, 1975 as the event date for these initial listings.

4. These figures represent cases where the equally-weighted market index was used to adjust the variance of the stock and estimate its beta. The figures vary somewhat when the value-weighted index is used instead.

5. We thank an anonymous referee for this suggestion.

6. Once again, we caution the reader about the 500-day individual stock results. An individual stock's risk may be affected by stock-specific events other than option listing over such an extended period of time.

7. While we do not report the results here, we found the regression tendency to be weaker using the equally-weighted index of all TSE stocks as the market index. Thus there seems to be a greater potential for confounded beta change (not adjusted for regression tendency) results with the use a value-weighted market index. Klemkosky and Maness (1980, Table 2) found some regression tendency of beta around early CBOE listings. Of the three cases they mention, CRSP Value-Weighted Index was used in two. In other studies with a potential regression tendency problem (Trennepohl and Dukes (1979), Whiteside, Dukes and Dunne (1983), Skinner (1991), CCK), betas were estimated using a value-weighted market index.

8. As mentioned by Mandron (1988b, p.16), up until the end of 1980 many institutional investors felt safe only with writing covered calls. Since then the purchase of protective puts also became acceptable to the regulators.

9. This is also supported by the medians of the variance ratios in the two periods.

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