THE USE OF FINANCIAL RATIOS AS MEASURES OF RISK IN THE DETERMINATION OF THE BID-ASK SPREAD

Huldah A. Ryan[*]

Abstract

The effect of financial reports on stock market behavior is a central issue of research in accounting and finance. A number of studies investigate how financial information becomes impounded in security prices and affects investment decisions. Prior studies on the determinants of the bid-ask spread investigate the effect of market risk measures, and provide evidence that the bid-ask spread is a positive function of risk. Other studies report on an association between market risk measures and accounting risk measures. The present study extends this line of research by examining the effect of risk, proxied by accounting risk measures, on the bid-ask spread. The results of ordinary least squares (OLS) regressions provide evidence of a statistically significant association between certain accounting ratios and the bid-ask spread, and indicate that accounting risk measures account for more variability in the bid-ask spread than market risk measures. Most notably, the results indicate that a model which includes both accounting risk measures and market risk measures is a better fitted model that one which includes either accounting risk measures or market risk measures alone.

INTRODUCTION

During the past two decades a large body of financial research has focused on the complexities of the stock market and specifically on the process by which prices are determined. Previous theoretical research proposes that the dealer's bid-ask spread (which is the compensation to dealers for providing immediacy to market traders), is comprised of three components: inventory order costs, inventory carrying costs, and adverse selection costs (Demsetz, 1968; Tinic and West, 1972; Stoll, 1978; Copeland and Galai, 1983). Stoll (1989) reports that 43 percent of the bid-ask spread reflects the dealer's adverse selection costs - the costs of trading with investors who possess "superior" information about the value of security.

The finance literature shows that security dealers can diversify their unsystematic risk by maintaining a portfolio of stocks (Sharpe, 1965; Fama, 1976), and empirical studies which relate risk to the bid-ask spread utilize market-based measures of systematic and unsystematic risk in the analyses (Benston and Hagerman, 1974; Barnea and Logue, 1975). Other studies report on an association between accounting ratios and market risk measures, and propose that certain accounting ratios can be used as proxies in predicting future security betas (Beaver et al. 1970; Elgers and Murray, 1982).

This study investigates the effect of financial ratios as measures of risk on the bid-ask spread. It proposes that financial statement analysis yields valuable information that can aid in investor decision-making, and uses as a theoretical basis, a simple valuation model expressed as follows:

$$V = \frac{E(FCF)}{(1+r)}$$

where:

---
[*]City University of New York

V = market value of the firm
E(FCF) = expected future cash flows
r = discount rate

Most event studies on the information content of accounting numbers base the analyses on earnings announcements as a proxy for the numerator of the model, expected future cash flows. Trading occurs when there are differences in expectations among investors relative to expected future cash flows and expected discount rates. In this study, the focus is on the denominator of the model, and the proposal is that accounting ratios improve market efficiency by providing additional information, on the value of the firm, that is not reflected in market risk measures. These ratios include dividend payout, asset size, asset growth, liquidity, leverage, earnings variability, and earnings covariability.

Fortin et al. (1989) report on the curious behavior of the spread around the end of the year which may be partly due to the release of firm-specific financial information. Lev (1986) proposes that the more "equitable" and "broadly informative" the firm's financial information disclosure is, the lower is the information asymmetry between informed and uninformed traders. Thus, the quality of information can determine the level of information asymmetry in the market.

The present study investigates the determinants of the spread by analyzing a model using both accounting risk measures and market risk measures to determine if it is superior to a model using either accounting or market risk measures alone. The empirical results give new insights on how to evaluate risk in relation to the bid-ask spread, and indicate that financial data do convey new information to market traders about a firm's risk, which is reflected in changes in the spread.

The remainder of this study is organized as follows: Section I describes the research methodology, the sample design, and the various statistical tests used in the study. Section II reports on the key empirical findings, while the summary and conclusions are presented in Section III.

RESEARCH METHODOLOGY

The proportional bid-ask spread, which is represented by:

$$\frac{(\,ask\;price - bid\;price\,)}{(\,ask\;price + bid\,price\,) \times .5}$$

is determined for each security over the three-year sample period, and then used as the dependent variable in several ordinary least squares (OLS) regressions to determine the factors affecting the bid-ask spread.

The Explanatory Variables

Previous theoretical and empirical studies report that the determinants of the bid-ask spread include the price of the security, its trading volume, the number of dealers, and the number of shareholders trading in the stock (e.g., Demsetz, 1968; Benston and Hagerman, 1975; Stoll 1976, 1978; and Glosten and Milgrom, 1985). Tinic and West (1972) show that spreads are negatively related to trading volume, while Glosten and Milgrom (1985) propose that the average spread tends to decline for large volumes of trade. These variables are examined in this study, and consistent with the results of previous studies, negative signs on their coefficients are expected in the results.

Roll (1984) presents a formulation of the bid-ask spread and empirically tests his model to determine the effect of firm size on the spread. His findings reveal an inverse relation between size and the bid-ask spread. The present study uses market value as a proxy for size, and examines its effect on the spread.

Studies on the determinants of the bid-ask spread use the Capital Asset Pricing Model as the basis for selecting the risk variables analyzed (Bagehot, 1971; Ho and Stoll, 1983; Copeland and Galai, 1983). The studies which report on the relationship between accounting ratios and market risk measures identify the accounting risk variables examined in this study, as surrogates for the total variability of return on a firm's securities (Beaver et al.,

1970). The second analysis extends the basic model to include these accounting risk measures, since previous research show that they are related to market risk measures for which there is a theoretical base.

The overall expected results are for a positive relation between risk and the bid-ask spread as proposed by Copeland and Galai (1983) and Glosten and Milgrom (1985). However, certain accounting ratios (dividend payout, asset size, and asset growth), despite being risk measures, are negatively related to the bid-ask spread. In terms of dividend payout (the ratio of the sum of cash dividends paid to common stockholders to the sum of income available for common stockholders), previous empirical studies report a positive correlation between stock prices and cash dividends (Aharony and Swary, 1980). Eades (1982) finds a clearly significant and negative relation between dividends and risk, consistent with that reported by Beaver et al. (1970), and Rozeff (1982) reports that an increase in dividend payout is associated with a decline in risk. Thus, as the dividend payouts increase, prices increase because this can be interpreted as "good news" by investors, with the expectation for the firm to generate higher future cash flows. As the firm's risk is reduced, the bid-ask spread decreases. The empirical findings are expected to be consistent with these predictions.

In terms of the asset variables (*asset size - the natural log of total assets, and asset growth - the ratio of the natural log of total assets in time period t, to the natural log of total assets in time period t-1*), prior research findings show that larger firms are usually more diversified in terms of lines of business and less susceptible to failure than smaller firms (Ohlson, 1980). Even though firms with larger asset sizes and higher asset growth rates are riskier than firms with smaller asset sizes and lower growth rates, these variables provide signals to investors and creditors about higher future cash flows. If investors value cash flows, they will trade more frequently in the stocks of firms with increasing asset growth rates and asset sizes, and the bid-ask spreads will decline. Since the number of shareholders is included in the model to control for the frequency of trading in a stock, the effect of asset growth and asset size on bid-ask spreads can be determined.

The other accounting risk variables (*leverage - the ratio of total senior securities to total assets, liquidity - the ratio of current assets to current liabilities, earnings variability - the standard deviation of the earnings-price ratio, and earnings covariability - the accounting beta computed by regressing the earnings-price ratio of each firm over an eight-year period on a proxy for the market earnings-price ratio*) are chosen because previous research show them to be good surrogates for risk. It is conceivable that investors use these ratios in predicting the future risk potential of a security, and positive signs on the coefficients for these variables are predicted in this study.

The third analysis examines the effect of market risk on the bid-ask spread. The use of both price variability and market beta is intended to represent the total risk of a security as proxied by market variables. Positive coefficients for these variables are expected in the results, consistent with the theoretical and empirical results of past research.

Based on the foregoing description of the explanatory variables, the model to be analyzed is presented as follows:

$$BA = \beta_0 + \beta_1 PS + \beta_2 NS + \beta_3 ND + \beta_4 VOL + \beta_5 MV + \beta_6 DP + \beta_7 G$$

$$\beta_8 AS + \beta_9 DE + \beta_{10} L + \beta_{11} EV + \beta_{12} AC + \beta_{13} MR + \beta_{14} PV + e$$

where:

BA	= proportional bid-ask spread	*AS*	= asset size
PS	= closing price per share	*L*	= liquidity
NS	= number of shareholders	*EV*	= earnings variability
ND	= number of dealers	*AC*	= accounting beta
VOL	= trading volume	*MR*	= market beta
MV	= market value	*PV*	= price variability
DP	= dividend payout	β_0	= intercept term
G	= asset growth	$\beta_1, \beta_2, ..., \beta_{14}$	= regression coefficients
DE	= leverage	*e*	= error term, assumed to be serially independent, normally distributed, and independent of the regressors

The Hypotheses

The first analysis tests the hypothesis which predicts a negative association between price, number of shareholders, number of dealers, trading volume, and market value on the bid-ask spread.

H1: $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5 < 0$

The second analysis examines the association between the spread and the accounting risk measures, and the hypotheses are stated as follows:

H2.1: $\beta_6, \beta_7, \beta_8 < 0$

H2.2: $\beta_9, \beta_{10}, \beta_{11}, \beta_{12} > 0$

The relationship between the market risk measures and the bid-ask spread is investigated in the third analysis with the following hypothesis being tested:

H3: $\beta_{13}, \beta_{14} > 0$

The model predicts that the coefficients on price, number of shareholders, number of dealers, trading volume, market value, and certain accounting variables (dividend payout, asset size, and asset growth) will be negative, while the coefficients on the other accounting risk variables (leverage, liquidity, earnings variability, and earnings covariability), and the market risk variables, (beta and price variability) will be positive.

The Data

Data for a three-year period, January 1, 1982 through December 31, 1984, were collected on a random sample of 60 Over-the-Counter (OTC) firms. Other data requirements for selection include the following:

(1) Each firm had financial statement data available in Moody's Manuals for the period 1982 through 1984;

(2) Daily ask and bid prices, as well as volume data for each firm were available on Compuserve Tapes for the period to be studied;

(3) Data on the number of shareholders and the number of dealers were available for each firm in Moody's Manuals and the National Stock Summary, respectively.

Summary statistics on the bid-ask spread were computed for each security. Several OLS regressions were then estimated using the bid-ask spread as the dependent variable, and price per share, trading volume, number of dealers, number of shareholders, market value, accounting risk measures, and market risk measures as predictor variables. The variables in the model were measured either at the end of the year (number of shareholders, number of dealers, market value of the firm, accounting risk measures, and market risk measures), or over the entire year (average of daily bid-ask spreads, prices, and volume).

CROSS-SECTIONAL REGRESSION RESULTS

The first analysis examines the effect of price, trading volume, number of shareholder, number of dealers, and market value on the bid-ask spread. The correlation analysis indicates a high correlation between price and market value (0.935), and the regression results do not show any significant difference in the effect using price or market value. Accordingly, the results in Table 1 excludes the effect of market value. The regression coefficients for the variables are all of the predicted signs with price and volume having statistically, significant effects on the proportional spread. The F-ratio indicates that the variables as a whole, significantly determine the size of the bid-ask spread.

TABLE 1
Regression Results For Hypothesis 1 Testing The Effect Of Price,
No. Of Shareholders, No. Of Dealers, And Trading Volume On The Bid-Ask Spread

Variable	Expected Sign	Coefficient	T-Value	Alpha Level
Intercept		0.1622	6.686***	.0001
Price	-	-0.0004	-1.563	.1038
No. Of Shareholders	-	<-0.0001	-0.012	.9907
No. Of Dealers	-	-0.0033	-0.339	.7357
Volume	-	-0.0147	-4.937***	.0001

N　　　　　　= 180
Adjusted R-Square = 0.3346
F-Statistic　　= 8.291***

***Significant at the 0.01 level with one-tailed test.

The results of the regression including accounting risk variables in the basic model above are presented in Table 2. The coefficients for dividend payout, asset size, and asset growth are negative as predicted, and in the case of asset size and asset growth, the results indicate a statistically, significant effect on the bid-ask spread. In terms of liquidity, leverage, and earnings variability, the signs are all positive, indicating that the bid-ask spread widens with increases in risk, as proxied by these variables, consistent with the theory of risk that has been developed. The negative sign on the coefficient for accounting beta may be due to the fact that several variables are proxying for risk in the model.

TABLE 2
Regression Results For Hypothesis 2 Testing The Effect
Of Accounting Risk Measures On The Bid-Ask Spread

Independent Variable	Expected Sign	Coefficient	T-Value	Alpha Level
Intercept		0.3398	5.162***	.0001
Price	-	-0.0003	-1.224	.2270
No. Of Stockholders	-	<-0.0001	-0.072	.9431
No. Of Dealers	-	-0.0009	-0.120	.9051
Volume	-	-0.0084	-2.857***	.0064
Dividend Payout	-	-0.0196	-0.765	.4479
Asset Growth	-	-0.0681	-2.294**	.0263
Asset Size	-	-0.0293	-3.361***	.0016
Leverage	+	0.0243	1.163	.2508
Liquidity	+	0.0026	0.966	.3389
Earnings Variability	+	<0.0001	1.089	.2818
Accounting Beta	+	-0.0010	-0.423	.6743

N　　　　　　= 180
Adjusted R-Square = 0.6046
F-Statistic　　= 9.064

*Significant at the 0.10 level with one-tailed test
**Significant at the 0.05 level with one-tailed test
***Significant at the 0.01 level with one-tailed test

The F-statistic for the regression is statistically significant at the one percent level. The effect of the accounting risk measures on the spread is evidenced by the increase in the adjusted R-square (from 0.3346 to 0.6046) with the addition of these ratios to the first model. A partial F-ratio test to determine the incremental explanatory power of adding these variables to the basic model indicates a significant partial F-statistic at the one percent level. Thus, the addition of accounting risk variables enhances the basic model, and provides justification for including financial ratios as measures of risk in explaining variability in the bid-ask spread.

One objective of this study is to determine whether accounting risk variables explain more variation in the bid-ask spread than market risk measures. The results of the regression analyzing the effect of market risk measures are presented in Table 3, and they provide further evidence on the effect of risk on the bid-ask spread. A partial F-ratio test indicates that the increase in the proportion of variance accounted for by market risk variables is statistically significant at the one percent level. Accordingly, as the market risk increases, the bid-ask spread widens, indicating that dealers charge more for assuming higher risk.

TABLE 3
Regression Results For Hypothesis 3 Testing The Effect
Of Market Risk Measures On The Bid-Ask Spread

Variable	Expected Sign	Coefficient	T-Value	Alpha Level
Intercept		0.1688	7.700***	.0001
Price	-	-0.0028	-2.123**	.0386
No. Of Stockholders	-	<-0.0001	-0.275	.7842
No. Of Dealers	-	-0.0054	-0.602	.5495
Volume	-	-0.0137	-5.033***	.0001
Market Beta	+	0.1131	1.752*	.0857
Price Variability	+	0.0043	1.478	.1453

N   = 180
Adjusted R-Square = 0.4612
F-Statistic   = 9.273

*Significant at the 0.10 level with one-tailed test
**Significant at the 0.05 level with one-tailed test
***Significant at the 0.01 level with one-tailed test

The adjusted R-square in Table 3 using market risk variables (0.5169) is lower than the results shown in Table 2 using accounting ratios as risk measures (0.6046). This suggests that accounting risk variables account for larger variations in the bid-ask spread than market risk variables.

The regression results presented in Table 4 (adjusted R-square = 0.6327) indicate that the full model outperforms all of the other models estimated in this study. These results confirm the hypotheses of a positive relation between accounting risk measures, proxied by liquidity, leverage, and earnings variability, and the bid-ask spread. The findings on market beta also indicate a positive, but marginally significant association (at the 10 percent level) with the spread. However, the signs on the coefficients for the number of dealers and market value are positive instead of negative as predicted. Note must be taken of the inclusion of price, price variability, and market value in the regression model, and also, of the finding of a high correlation between the price variables and market value.

SUMMARY AND CONCLUSION

This study investigates the effects of several variables on the bid-ask spread by use of separate cross-sectional regression models. The empirical findings of the models support prior research that there is an inverse relation between the bid-ask spread and price, volume, the number of stockholders, and the number of dealers, and a positive association between the spread and risk as proxied by several accounting and market risk variables (liquidity, leverage, earnings variability, market beta, and price variability). The results also indicate a statistically significant association between certain accounting ratios (asset size and asset growth) and the bid-ask spread.

TABLE 4
Regression Results On The Effect Of A Reduced
Accounting Risk Variable Set On The Bid-Ask Spread

Variable	Expected Sign	Coefficient	T-value	Alpha Level
Intercept		0.1723	8.247***	.0001
Price	-	-0.0020	-2.960***	.0047
No. Of Stockholders	-	<-0.0001	-0.779	.4397
No. Of Dealers	-	<-0.0001	-0.009	.9932
Volume	-	-0.0096	-3.196***	.0001
Dividend Payout	-	-0.0555	-2.327**	.0240
Asset Growth	-	-0.0852	-2.798***	.0073
Earnings Variability	+	<0.0001	0.445	.6582

N   = 180
Adjusted R-Square = 0.5035
F-Statistic   = 9.404

***Significant at the 0.01 level with one-tailed test
**Significant at the 0.05 level with one-tailed test

Prior studies which examine the effect of risk on the bid-ask spread utilize market measures as proxies for risk in the analyses. The results of this study indicate that accounting risk measures, as proxies for risk, explain a significantly higher proportion of the variance in the bid-ask spread than market risk measures. Further, the explanatory power of a combined model with both accounting risk measures and market risk measures is higher than that of a model using either accounting or market risk measures alone, and higher than any of the models tested in previous studies.

This study attempts to build on prior research on the usefulness of accounting information. The findings indicate that the use of financial ratios as risk measures enhances the predictive power of a model explaining variability in the bid-ask spread, and illustrate that a model with both accounting and market risk measures is better fitted than one using either accounting or market risk measures alone. The evidence presented in this study suggests that financial statement data provide information that reduces information asymmetry in the market, and indicates that investors should fully utilize this information set in assessing the potential riskiness of a security, and accordingly, in their investment decision-making.

The theoretical literature on the bid-ask spread focuses on market risk, but not on accounting risk. The findings of this study highlight a need for the development of a theory that incorporates accounting ratios as they affect the underlying risk characteristics of a security. Another possible avenue for future research is an examination of the spread around the report release date. A comparison of the results obtained from analyzing the effect of these variables around a window period surrounding a December 31 report date, with the results of their effect around a window period surrounding a non-December 31 report date would be a natural extension of this study.

TABLE 5
Regression Results On The Determinants Of
The Bid-Ask Spread The Full Model

Variable	Expected Sign	Coefficient	T-Value	Alpha Level
Intercept		0.3379	5.142***	.0001
Price	-	-0.0031	-2.161**	.0362
No. Of Stockholders	-	<-0.0001	-0.168	.8673
No. Of Dealers	-	0.0001	0.017	.9863
Volume	-	-0.0093	-3.210***	.0025
Market Value	-	<0.0001	1.618	.1128
Dividend Payout	-	-0.0056	-0.210	.8347
Asset Growth	-	-0.0636	-2.206**	.0327
Asset Size	-	-0.0274	-3.134***	.0031
Leverage	+	0.0163	0.797	.4295
Liquidity	+	0.0036	1.334	.1889
Earnings Variability	+	<0.0001	0.672	.5053
Accounting Beta	+	-0.0001	-0.041	.9672
Market Beta	+	0.2103	1.358	.1815
Price Variability	+	-0.0015	-0.356	.7235

N   = 180
Adjusted R-Square = 0.6327
F-Statistic   = 8.138

*Significant at the 0.10 level with one-tailed test
**Significant at the 0.05 level with one-tailed test
***Significant at the 0.01 level with one-tailed test

REFERENCES

[1]   Aharony, J. and I. Swary, "Quarterly Dividends and Earnings Announcements and Stockholders' Returns: An Empirical Analysis," *Journal of Finance*, March 1980, pp. 1-12.

[2]   Amihud, Y. and H. Mendelson, "Dealership Market: Market- Making With Inventory," *Journal of Financial Economics*, March 1980, pp. 31-53.

[3]   Bagehot, W., "The Only Game in Town" *Financial Analyst Journal*, March/April 1971, pp. 12-14.

[4]   Barnea A. and Logue, D., "The Effect of Risk on the Market Maker's Spread," *Financial Analyst Journal*, November 1975, pp. 45-49.

[5]   Beaver, W., P. Kettler, and M. Scholes, "The Association Between Market Determined and Accounting Determined Risk Measures," *The Accounting Review*, October 1970, pp. 654-682.

[6]   Benston, G. and R. Hagerman, "Determinants of Bid-Asked Spreads in the OTC Market," *Journal of Financial Economics*, December 1974, pp. 353-364.

[7]   Copeland, T. and D. Galai, "Information Effects of the Bid-Ask Spread," *Journal of Finance*, December 1983, pp. 1457-1469.

[8]   Demsetz, H., "The Cost of Transacting," *Quarterly Journal of Economics*, February 1968, pp. 33-53.

[9] Eades, K., "Empirical Evidence on Dividends as a Signal of Firm Value," *Journal of Financial and Quantitative Analysis*, November 1982, pp. 471-500.

[10] Elgers P. and D. Murray, "The Impact of the Choice of Market Index on the Empirical Evaluation of Accounting Risk Measures," *The Accounting Review*, April 1982, pp. 358-375.

[11] Fama, E., "The Behavior of Stock Market Prices," *Journal of Business*, January 1965, pp. 34-105.

[12] Fortin, R., R. Grube, and O. Joy, "Seasonality in NASDAQ Dealer Spreads," *Journal of Financial and Quantitative Analysis*, September 1989, pp. 395-407.

[13] Foster, G., "Intra-Industry Information Transfers Associated with Earnings Releases," *Journal of Accounting and Economics*, March 1981, pp. 201-232.

[14] Garman, M., "Market Microstructure," *Quarterly Journal of Financial Economics*, June 1976, pp. 257-276.

[15] Glosten, L. and P. Milgrom, "Bid, Ask and Transaction Prices in a Specialist Market with Heterogeneously Informed Traders," *Journal of Financial Economics*, March 1985, pp. 71-100.

[16] Ho, T. and H. Stoll, "On Dealer Markets Under Competition," *Journal of Finance*, May 1980, pp. 259-267.

[17] Lev, B., "Toward a Theory of Equitable and Efficient Accounting Policy," *The Accounting Review*, January 1988, pp. 1-22.

[18] Morse, D. and N. Ushman "The Effect of Information Announcements on the Market Microstructure," *The Accounting Review*, April 1983, pp. 247-258.

[19] Ohlson, J., "Financial Ratios and the Probablistic Prediction of Bankruptcy," *Journal of Accounting Research*, Spring 1980, pp. 109-131.

[20] Ou, J. and S. Penman, "Financial Statement Analysis and the Prediction of Stock Returns," *Journal of Accounting and Economics*, November, 1989, pp. 295-329.

[21] Roll, R., "A Simple Implicit Measure of the Effective Bid-Ask Spread in an Efficient Market," *The Journal of Finance*, March 1984, pp. 1127-1139.

[22] Rozeff, M., "Growth, Beta and Agency Costs as Determinants of Dividend Payout Ratios," *Journal of Financial Research*, Fall 1982, pp. 249-259.

[23] Stoll, H., "The Supply of Dealer Services in Securities Markets," *Journal of Finance*, September 1978, pp. 1133-1151.

[24] Tinic, S. "Inferring the Components of the Bid-Ask Spread: Theory and Empirical Tests," *Journal of Finance*, March 1989, pp. 115-134.

[25] Tinic, S. and R. West, "Competition and the Pricing of Dealer Service in the Over-the-Counter Market," *Journal of Financial and Quantitative Analysis*, June 1972, pp. 1707-1728.

[26] Woodridge, J., "Dividend Changes and Security Prices," *Journal of Finance*, December 1983.