Seoul Journal of Business
Volume 4, Number 1 (June 1998)

The Association of Firm Risk Measures and Accounting Information in the Korean Capital Market*

Changwoo Lee
College of Business Administration
Seoul National University

Kapsoon Kim
Doctoral Candidate in Accounting
Seoul National University

Abstract

The purpose of this study is to investigate and document an empirical relation between the risk of a firm and firm-specific information such as financial leverage and other variables in the Korean capital market.

The results indicate that in the Korean capital market, the working capital position and firm size are positively associated with various risk measures. For the financial leverage variable, we observe inconsistent results with respect to different risk measures; financial leverage and total risk are positively associated, while financial leverage and systematic risk are negatively associated. It is interesting, therefore, that the Korean market exhibits somewhat different features from those found in U.S. empirical results and in the theory of finance.

1. Introduction

In accounting and finance literature, many studies explain stock price volatility changes through changes in the level of

---

* This study has been partially supported by a research fund provided by the Institute of Management Research at Seoul National University. The authors are thankful to the three anonymous referees for their constructive comments.

stock prices.[1] Black (1975) argues that the direction of price movement can be used in estimating volatility. A stock that drops sharply in price is likely to show a higher volatility in the future than a stock that rises sharply in price. This negative association between the volatility of security returns and the level of stock prices is empirically tested and supported by Schmalensee and Trippi (1978), MacBeth and Merville (1980), Beckers (1980), and Christie (1982). Black (1976) has found a strong relationship between stock returns and volatility changes; he argues that a drop in the value of a firm will cause a negative return on its stock and will usually increase the leverage of the stock.[2] The increase in financial leverage also increases stock return volatility.[3] Geske (1979) argues that it is financial leverage which alters the total risk or volatility of stockholder's equity as the market continuously revalues a firm's prospective cash flows. Through the compound option pricing model, Geske shows that changes in equity value change a firm's leverage, and the stock return variance is monotonically increasing with leverage. As the stock price falls (rises), the firm's financial leverage ratio rises (falls), and this increased (decreased) risk is reflected by a rise (fall) in the variance of the stock return.

This relationship between the volatility and the financial leverage of a firm is also empirically supported. Beckers (1980) has found that an increase in leverage does significantly affect the risk to stockholders. Christie's findings (1982) are also consistent with this result. He has found that one source of variation in the volatility of equity return is changes in financial

1) Information arrival is shown to be another reason for the volatility change. Studies such as Beaver (1968), Morse (1981), Ohlson (1979), Press (1967), and Damodaran (1984) can be viewed in this category.

2) This can be seen in the following example. Suppose that a firm has 6 million dollars of stock and 4 million dollars of bonds outstanding, with a total market value of 10 million dollars. If the value of the firm drops to 5 million dollars, the value of the bonds might drop to 3 million and the value of the stock would be 2 million. In this case, the debt-equity ratio rises from 2/3 to 3/2. Note that the elasticity of the value of equity with respect to the value of the firm is greater than or equal to one, whereas the elasticity of the bond is usually less than one.

3) The volatility of the stock returns can also change even if the firm has no debt, because the firm is likely to have operating leverage. When income falls, expenses do not fall as much. The value of the firm falls and becomes more volatile, because small changes in income now mean large percentage changes in the difference between income and expenses.

leverage of the firm; he has also found that financial leverage induces a negative relationship between the volatility and the level of stock price. Boness, Chen, and Jatusipitak (1974) have found that changes in capital structure increase the riskiness of the return on equity, but only on the portion of unsystematic risk. It is noteworthy that their tests reject the hypothesis that systematic risk varies directly with leverage changes.

Some studies have examined the relationship between firm risk and accounting variables in the Korean capital market, such as Cho (1989), Park (1993), Kim and Cho (1996), and Lee (1996). However, most of these studies have focused on estimating firm risk using a firm's financial characteristics.

The purpose of this study is to investigate and document the empirical relationship between the risk of a firm, represented by equity return volatility and systematic risk, and firm-specific information, including financial leverage and other variables, in the Korean capital market. Although it is true that there is no economic reason to expect different empirical results for the Korean market, it is still interesting to see if theory and U.S. experiences hold for other markets.

The results indicate that in the Korean capital market, working capital position and firm size, representing firm business risk, have a positive impact on a firm's total risk, as well as on the systematic risk. It is noted here that these results are not consistent with theoretical predictions and previous U.S. empirical results. Moreover, for the financial leverage variable, we observe inconsistent results with respect to different risk measures that are employed in the regression analyses. When the total volatility of equity returns is used, we observe a positive association between firm risk and financial leverage. But, we found that the financial leverage has a negative impact on the systematic risk of the firm. According to theory, we should observe a positive association between firm risk and financial leverage. It is interesting, therefore, that while this theoretical expectation holds empirically in the U.S. market, the Korean market shows somewhat conflicting results.

This study is organized as follows: Section 2 develops research issues that are examined in this study; Section 3 describes the research design and the data used in the tests; Section 4 reports the empirical results; and Section 5 concludes the study.

2. Research Issues

Consider the following theoretical relationship, which is well known in both accounting and finance literature:

$$\sigma_S = N(d_1)\ \sigma_v\ (1 + DR) \text{ for } \textit{risky debt},$$

and as a special case,

$$\sigma_S = \sigma_v\ (1 + DR) \text{ for } \textit{riskless debt},$$

where

σ_S = volatility of the rate of return on equity,
σ_v = operating risk of a firm,
DR = the market financial leverage measured as M(D)/S, where M(D) is the market value of debt and S is the market value of equity,
$N(d_1)$ = the cumulative normal probability of the unit normal variate,

where d_1 is defined as follows:

$$d_1 = \frac{\ln(V / D) + r_F T}{\sigma\sqrt{T}} + \frac{1}{2}\sigma\sqrt{T}$$

where

V = market value of a firm's assets,
r_F = the risk-free rate,
T = time to maturity, and
D = face value of debt.

As Geske (1979) points out, the implication from the above equations is that the financial leverage of a firm alters the volatility of the return on equity as the market continuously revalues the firm's prospective cash flows. Changes in equity value change the firm's financial leverage, and the volatility of the return on equity is monotonically increasing with leverage. As the equity value falls (rises), the firm's financial leverage ratio rises (falls), and this increased (decreased) risk is reflected by a rise (fall) in the volatility of the return on equity. Note that this relationship holds as well between the systematic risk and the financial leverage of a firm.

The research issues examined in the empirical investigations to follow are based on the theoretical relationship described above. In order to derive an estimated version of the above theory, interpretations of the variables $N(d_1)$ and σ_v are needed.

From the option pricing framework, the economic meaning of $N(d_1)$ is the probability of a call option finishing "in the money" at maturity.[4] If a common stock can be viewed as an option on the assets of a firm, it is reasonable to assume that $N(d_1)$ is close to 1, as long as the probability of default is low. The variable σ_v represents the operating risk of a firm.

Previous empirical studies assume that the business risks of firms are homogeneous within the same industry but differ across industries.[5] However, another variable that may be important in explaining cross-sectional differences in business risk is firm size. Castanias (1983) has pointed out that an increase in firm size may lead to less business risk per dollar of assets invested, or per dollar of expected earnings, due to diversification; his empirical investigation confirms this argument, indicating a consistent result. Dun & Bradstreet provides data on the percentage of firm failures classified by size and industry, which also indicate that both variables contain important information on the likelihood of financial distress.

Therefore, based on the discussions above, our research issues concern whether, in the Korean capital market, we observe: i) a negative association between firm risk measures and firm working capital positions, as theory and U.S. experiences indicate; ii) a negative association between firm risk measures and firm size that are evident in U.S. empirical results; and iii) a positive association between firm risk measures and the financial leverage of firms as theory and empirical results in the U.S. capital market indicate. These issues are particularly interesting since although a theory may hold empirically in one market, it may not in another. Thus, we think it is important to document Korean empirical results and compare them with foreign experiences to help understand any

4) See Cox and Rubinstein (1985).

5) For example, Modigliani and Miller (1966), Hamada (1972), Lev (1974), Ferri and Jones (1979), and Castanias (1983).

possible differences across capital markets.

3. Research Design

3.1 Test Model

Based on theory and empirical results observed in the U.S. capital market, we have the following relationship. For firm i at time t,

$$\sigma_{Sit} = b_{0t} + \sum_{k=1}^{K} \delta_{kt} D_{kit} + b_{1t} LOGWC_{it} + b_{2t} LOGAST_{it} + b_{3t} DE_{it} + \varepsilon_{it}$$

where σ_{Sit} denotes the total risk of firm i's equity (S) at time t; k denotes a specific industry group k; D denotes industry grouping; LOGWC denotes the working capital position of a firm;[6] LOGAST denotes the log-transformation of asset size;[7] and DE denotes the financial leverage of a firm.[8] Note that the above relationship still holds even if we replace the total risk of a firm σ_{Sit} by the systematic risk of a firm.

The independent variables *D*, *LOGWC*, and *LOGAST* are included in the model as proxies for the operating risk of a firm to control for the left-hand side (asset side) of the balance sheet, while the financial leverage variable *DE* controls for the right-hand side of the balance sheet. According to theory and U.S. empirical evidence, we should observe negative coefficients on the *LOGWC* and *LOGAST* variables, and the coefficient on the *DE* variable should be positive.

3.2 Data

The stock price data, accounting data, and systematic risk

---

6) LOGWC is measured as the log-transformation of current assets minus current liabilities at the 1000 won level.
7) LOGAST is measured as the log-transformation of total assets at the 1000 won level.
8) DE is measured as total liabilities (at book value) divided by the number of common stocks outstanding multiplied by the closing price of the previous period.

measures used in this study are retrieved from KIS-SMAT. First, the volatility of the return on equity of firm i during year t is computed as follows:

$$\sigma_{Sit} = \sqrt{\sum_{w=1}^{W} (R^2{}_{iw})},$$

where w denotes week and W represents the number of weeks in year t.[9] The weekly return measure R_w is obtained using the following relationship:

$$R_w = \frac{P_w - P_{w-1}}{P_{w-1}}.$$

where P_w is the closing price at week w. The weekly returns available from KIS-SMAT are based on Wednesday closing prices regardless of the number of trading days in-between. As a substitute for total risk, we also use the systematic risk of firms.[10] The working capital position of firms are computed as the difference between current assets and current liabilities of firms. The size of a firm is measured as a log-transformation of total asset, and the financial leverage variable is computed as the long-term liability divided by the market value of equity at the end of the previous year.

The sample firms are obtained from 727 firms listed at the Korea Stock Exchange as of December 31, 1995. This satisfies the following selection criteria:

i) stock price and accounting data are available from 1981 to 1994;

ii) firms are not classified as bank and insurance companies;

9) This volatility measure is based on the assumptions that weekly returns are independent and that the mean returns are zero. It is likely that these assumptions may not hold and cause some measurement error. In this sense, the coefficient estimates may be biased to this extent.

10) They use a market model to estimate a systematic risk measure. Sim and Song (1989) argue that the optimal estimation period for the systematic risk is 4 years. However, their purpose is to come up with stable systematic risk measures and use these measures for future investments. Since the purpose of the current study is different, we decide to use the systematic risk measures based on KIS-SMAT.

and
iii) the fiscal year ends on December 31.

The first criterion is employed because of the data requirement in calculating security returns and accounting variables.[11] The

Table 1. Number of Sample Firms by Industry

Industry	Number of Firms
Mining & Quarrying	2
Food & Beverages	32 (IND1)
Textiles	24 (IND2)
Apparel and Fur Articles	6
Leather, Luggage, Handbags, Saddlery and Harness & Footwear	2
Wood & Wood Products	2
Pulp, Paper & Paper Products	9
Chemicals & Chemical Products	39 (IND3)
Rubber and Plastic Products	8
Other Non-Metallic Mineral Products	13 (IND4)
Basic Metals	14 (IND5)
Fabricated Metal Products	6
Machinery and Equipment	7
Radio, Television and Communication Equipment and Apparatus	11 (IND6)
Electric Machinery and Apparatus	3
Motor Vehicles, Trailers and Semi-Trailers	6
Other Transport Equipment	1
Medical, Precision and Optical Instruments, Watches and Clocks	1
Furniture, Manufacturing N.E.C.	2
Electricity, Gas & Steam Supply	1
Construction	28 (IND7)
Sale & Repair of Motor Vehicles	1
Wholesales Trade & Commission Trade	14 (IND8)
Retail Trade	1
Land Transport, Transport via Pipelines	5
Water Transport	2
Total	240

Footnote: (IND*) represents the dummy variable grouping needed in the empirical study, which will be explained later.

second and third criteria are imposed because banking and insurance companies and non-December-31st firms operate under different business environments. The number of sample firms varies from 121 in 1981 to 175 in 1989, but when pooled, the total size of the sample is 2,148 firms. Table 1 reports the number of firms in each industry group. Note that although the majority of firms represent food & beverages, textiles, chemical & chemical products, and construction industries, other industries are also well represented.

4. Empirical Results

4.1 Descriptive Statistics

Descriptive statistics are reported in Table 2. The number of sample firms reported here is based on pooled data. The mean volatility of equity returns for the sample firms is 0.4100 with a standard deviation of 0.1640. The mean systematic risk is 0.7019 with a standard deviation of 0.4795. The mean debt-equity ratio for sample firms is 11.5849 with a standard

Table 2. Descriptive Statistics

Variables	N	Mean	Std Dev
σ	2148	0.4100	0.1641
β	2148	0.7019	0.4795
LOGWC	2148	16.0434	1.5032
LOGAST	2148	18.2475	1.2454
DE	2148	11.5849	89.2776

N = number of sample firms
Std Dev = standard deviation
σ = total volatility of equity returns
β = systematic risk of a firm
LOGWC = log-transformation of a firm's working capital position
LOGAST = log-transformation of a firm's total asset
DE = financial leverage of a firm

11) Due to this requirement, the empirical results are subject to survivorship bias.

deviation of 89.2776. Table 3 reports the correlations among the variables used in the empirical test models.

We observe a positive correlation between total risk and working capital position (0.1078 at a significance level less than 1%) and between total risk and firm size (0.1144 at a significance level less than 1%). This positive correlation is also observed when the systematic risk measure is used: 0.1558 between systematic risk and working capital position, and 0.1653 between systematic risk and firm size (both at a significance level less than 1%). Note that these results are *inconsistent* with both theoretical predictions and the empirical experiences of the U.S. market. However, these results are *consistent* with previous studies on the Korean capital market.[12] In addition, we observe a positive and significant correlation between the total risk measure and financial leverage (0.0446 at a significance level less than 5%), which is consistent with theoretical expectations. However, we observe a negative and significant correlation between systematic risk and financial

Table 3. Correlation Results-Risk Measures and Accounting Information

Variables	σ	β	LOGWC	LOGAST	DE
σ	1.0000				
	(0.0)				
β	0.2898	1.0000			
	(0.0001)	(0.0)			
LOGWC	0.1078	0.1558	1.0000		
	(0.0001)	(0.0001)	(0.0)		
LOGAST	0.1144	0.1653	0.6613	1.0000	
	(0.0001)	(0.0001)	(0.0001)	(0.0)	
DE	0.0446	-0.0691	0.0134	-0.0139	1.0000
	(0.0386)	(0.0013)	(0.5325)	(0.5191)	(0.0)

σ = the total volatility of equity returns
β = the systematic risk of a firm
WC = the working capital position of a firm
LOGAST = the log-transformation of a firm's total asset
DE = the financial leverage of a firm
(.) represent the p-values for the cross-sectional coefficient estimates

12) For example, Cho (1989), Park (1993), and Lee (1996).

leverage (-0.0691 at a significance level less than 1%), and this result is *inconsistent* with theoretical predictions. Also note that the correlation coefficient between firm size and firm working capital position is 0.6613.[13] However, this somewhat high correlation does not cause a multicollinearity problem when conducting regression analyses.[14]

4.2 Cross-Sectional Regression Analyses

Table 4 reports the results from regression analyses using the empirical test model explained in Section 3. The ordinary least squares regressions are run year-by-year starting from 1981. In Panel A, where the total risk measure is used as a dependent variable, adjusted-R^2 varies from -0.0061 in 1991 to 0.0748 in 1985, with the sample sizes varying from 121 in 1981 to 174 in 1989. Panel B reports the regression results using systematic risk as a dependent variable, with adjusted-R^2 ranging from 0.0062 in 1990 to 0.2377 in 1984. When total risk is used as the dependent variable, we observe 7 positive coefficients on the working capital variable, 7 positive coefficients on the firm size variable, and 9 negative coefficients on the financial leverage variable (out of a total of 14 cases), which is *contrary* to traditional theoretical expectations. We observe a similar phenomenon in Panel B where the systematic risk measure is used as a dependent variable: out of 14 cases, only 3 cases in terms of the working capital position and firm size, and only 4 cases in terms of financial leverage are consistent with theoretical expectations. Also, note that statistical significances vary year-by-year, raising a robustness issue regarding the cross-sectional analyses. Therefore, we can not come up with any definite conclusions from these cross-sectional analyses.

---

13) Note that this result is different from the one reported by Kim and Cho (1996), where they found a significant negative relationship between firm size and liquidity with liquidity measured as liquid assets divided by total assets. Kim and Cho (1996) also found that a firm's leverage, measured as total debt divided by total assets, is negatively correlated with liquidity, which is different from the results reported here.

14) We checked the Variance Inflation Factors (VIF) for the variables LOGWC, LOGAST, and DE. The VIFs are 1.7791, 1.7791, and 1.0011, respectively. As these VIFs are less than 10, we conclude that there would be no multicollinearity problems in the empirical studies.

Table 4. Regression Results by Year

Panel A: Volatility of Equity Return

Model: $\sigma_{it} = \beta_{0t} + b_{1t}\mathbf{LOGWC}_{it} + b_{2t}\mathbf{LOGAST}_{it} + b_{3t}\mathbf{DE}_{it} + \varepsilon_{it}$

Year	INTERCEP	LOGWC	LOGAST	DE	Adj R-sq	F Value (Prob>F)	N
1981	-0.3913	-0.0003	0.0489	-0.0001	0.0458	2.918	121
	(-1.312)	(-0.025)	(2.287)**	(-0.049)		(0.0371)	
1982	0.2991	-0.0214	0.0261	-0.0068	0.0213	2.065	148
	(1.248)	(-1.504)	(1.512)	(-2.307)**		(0.1075)	
1983	0.0063	-0.0034	0.0199	-0.0009	0.0212	2.045	146
	(0.051)	(-0.481)	(2.196)**	(-0.581)		(0.1102)	
1984	-0.1044	0.028	0.0043	-0.0000	0.0498	3.461	142
	(-0.548)	(2.344)**	(0.332)	(-0.042)	(0.0182)		
1985	-0.5084	0.0081	0.0386	0.0001	0.0748	5.016	150
	(-2.33)**	(0.641)	(2.444)**	(0.511)		(0.0024)	
1986	0.2477	-0.009	0.0159	0.0001	-0.0032	0.84	151
	(1.456)	(-0.997)	(1.318)	(0.852)		(0.4738)	
1987	0.4598	0.0119	-0.0088	0.003	0.1487	9.679	150
	(2.658)***	(1.256)	(-0.751)	(4.961)***		(0.0001)	
1988	0.0344	0.0238	-0.0017	-0.0001	0.0502	4.012	172
	(0.235)	(2.92)***	(-0.185)	(-0.401)		(0.0087)	
1989	0.5146	0.0005	-0.0121	-0.0000	0.0387	3.321	174
	(7.215)***	(0.157)	(-2.697)***	(-0.327)		(0.0212)	
1990	0.7875	-0.0014	-0.0118	-0.0000	0.0541	3.957	156
	(10.997)***	(-0.451)	(-2.804)***	(-0.254)		(0.0095)	
1991	0.3426	-0.0069	0.0041	-0.0000	-0.0061	0.715	143
	(4.023)***	(-1.405)	(0.705)	(-0.197)		(0.5447)	
1992	0.9613	0.0011	-0.0243	0.002	0.0218	2.023	139
	(5.257)***	(0.124)	(-2.1)**	(0.998)		(0.1136)	
1993	0.8476	-0.0114	-0.0133	0.0001	0.0646	4.063	134
	(6.097)***	(-1.725)*	(-1.534)	(0.085)		(0.0085)	
1994	0.6831	0.0017	-0.0114	-0.0013	0.0019	1.086	138
	(4.542)***	(0.196)	(-1.177)	(-0.79)		(0.3575)	

Panel B: Systematic Risk (β)

Model: $\beta_{it} = b_{0t} + b_{1t}\mathbf{LOGWC}_{it} + b_{2t}\mathbf{LOGAST}_{it} + b_{3t}\mathbf{DE}_{it} + \varepsilon_{it}$

Year	INTERCEP	LOGWC	LOGAST	DE	Adj R-sq	F Value (Prob>F)	N
1981	-1.3335	-0.0245	0.1376	0.0025	0.0414	2.742	122
	(-1.569)	(-0.571)	(2.271)**	(0.278)		(0.0463)	
1982	-0.8039	-0.0505	0.15	-0.0249	0.0524	3.675	146
	(-1.062)	(-1.121)	(2.745)***	(-2.657)***		(0.0138)	
1983	-3.5059	0.0391	0.2105	-0.0125	0.1335	8.5	147
	(-4.172)***	(0.81)	(3.433)***	(-1.125)		(0.0001)	
1984	-4.2933	0.1528	0.1571	-0.0007	0.2377	15.655	142
	(-5.512)***	(3.125)***	(2.955)***	(-0.816)		(0.0001)	
1985	-1.2505	0.0573	0.0396	0.0000	0.0743	4.989	150
	(-2.624)***	(2.057)**	(1.148)	(0.143)		(0.0025)	
1986	-1.1419	0.0223	0.08	-0.0000	0.0599	4.23	153
	(-2.21)**	(0.806)	(2.17)**	(-0.128)		(0.0067)	
1987	-0.7937	0.0763	0.0175	0.0002	0.0992	6.577	153
	(-1.81)*	(3.051)***	(0.581)	(0.53)		(0.0003)	
1988	0.1024	0.0861	-0.0444	-0.0002	0.0363	3.148	172
	(0.2)	(3.024)***	(-1.317)	(-0.25)	(0.0265)		
1989	0.0861	0.052	-0.0093	-0.0009	0.0293	2.75	175
	(0.222)	(2.539)**	(-0.377)	(-0.655)		(0.0444)	
1990	0.4895	0.0415	-0.0199	-0.0000	0.0062	1.324	157
	(1.065)	(1.978)**	(-0.737)	(-0.049)		(0.2687)	
1991	-0.3214	0.0463	0.0141	0.0001	0.0166	1.823	147
	(-0.601)	(1.486)	(0.38)	(0.116)		(0.1457)	
1992	-1.0148	0.0072	0.0852	-0.0031	0.0442	3.125	139
	(-1.804)*	(0.257)	(2.395)**	(-0.5)		(0.028)	
1993	-0.4761	0.0221	0.0542	-0.0178	0.045	3.122	136
	(-0.9)	(0.885)	(1.656)	(-2.258)**	(0.0282)		
1994	-0.4094	-0.0343	0.0822	-0.015	0.0668	4.271	138
	(-0.899)	(-1.304)	(2.786)***	(-2.883)***		(0.0065)	

LOGWC = log-transformation of a firm's working capital
LOGAST = log-transformation of a firm's total asset
DE = financial leverage of a firm
t-statistics in parentheses
*, **, *** statistically significant at the 10%, 5%, and 1% confidence level, respectively

4.3 Pooling Cases

In Section 4.2, we observe inconsistencies in the year-by-year regression analyses and cannot come up with any specific conclusions. Since there is no reason not to expect constant parameters over time, we consider here pooling the cross-sectional and time-series data in order to obtain more efficient parameter estimates. We combine all cross-sectional and time-series data and perform ordinary least squares regressions on the entire data set. Table 5 reports the results of pooling analyses; we use the firms working capital position (LOGWC), firms size (LOGAST), and financial leverage (DE) as independent variables and the two different risk measures as separate dependent variables. The adjusted-R^2 is 0.0156 when total risk is employed and 0.0345 when systematic risk is employed as the dependent variable.

Note that we observe positive coefficients on both LOGWC and LOGAST that are statistically significant regardless of the risk measures used. However, for the financial leverage variable, we observe different results: when the total risk measure is used as a dependent variable, the coefficient estimate on the financial

Table 5. Regression Results-Pooling Case 1

Model: σ_{it} **or** $\beta_{it} = b_0 + b_1 \mathrm{LOGWC}_{it} + b_2 \mathrm{LOGAST}_{it} + b_3 \mathrm{DE}_{it} + \varepsilon_{it}$

Depen Val	INTERCEP	LOGWC	LOGAST	DE	Adj-R sq	F Value (Prob>F)	N
σ	0.1233	0.006	0.0103	0.0000	0.0156	12.332	2,148
	(2.38)**	(1.94)*	(2.746)***	(2.099)**		(0.0001)	
β	-0.4886	0.0272	0.0415	-0.0003	0.0345	26.608	2,148
	(-3.259)***	(3.019)***	(3.814)***	(-3.243)***		(0.0001)	

LOGWC = log-transformation of a firm's working capital
LOGAST = log-transformation of a firm's total asset
DE = financial leverage of a firm
t-statistics in parentheses
*, **, *** statistically significant at the 10%, 5%, and 1% confidence level, respectively

leverage is positive and statistically significant at a less-than-5% level; when the systematic risk measure is used, the coefficient estimate is -0.0003, statistically significant at a less-than-1% level.

Table 6 reports two types of pooling regressions: Panel A shows the results when the year dummy variables are included as independent variables and Panel B shows the results when the industry dummy variables are instead included. Note that in both panels, we observe an increased level of explanatory power for the models compared to the results reported in Table 5. For the model including the year dummy variables, adjusted-R^2 are 0.2607 and 0.1145 when total risk and systematic risk are respectively used as the dependent variable; for the model including the industry dummy variables, the adjusted-R^2 are 0.0510 and 0.2241 when total risk and systematic risk are used as the dependent variable, respectively.

The coefficients on the independent variables suggest that the results reported from Table 5 do not change much. The financial leverage variable, DE, has a positive coefficient (0.0993) for the total risk measure with a significance level less than 1%. However, DE has a negative coefficient (-0.3712) that is statistically significant at a less-than-1% level when the systematic risk measure is used. Similar situations are observed for Panel B where the industry dummy variables are used instead of the year dummy variables.

For the cases of business risk variables LOGWC and LOGAST, we observe that when the year dummy variables are used, the coefficient on LOGWC is not statistically significant for total risk, although the sign is positive. We observe a positive coefficient for LOGAST on both risk measures with statistical significance for Panel A, but observe inconsistent results for Panel B.

Therefore, based on the results reported in Tables 5 and 6, we conclude that in the Korean capital market, financial leverage is positively associated with total risk, but negatively associated with the systematic risk of a firm. This is *inconsistent* with theoretical expectations. As for the business risk measures, we conclude, with some reservations, that, in the Korean capital market, there are positive associations between risk measures and firm working capital position and between risk measures and firm size; these results are *inconsistent* with theoretical

Table 6. Regression Results-Pooling Case 2

Panel A Model: σ_{it} **or** $\beta_{it} = b_0 + b_1 LOGWC_{it} + b_2 LOGASS_{it} + b_3 DE_{it} + b_4 YD81_{it} + b_5 YD82_{it} + b_6 YD83_{it} + b_7 YD84_{it} + b_8 YD85_{it} + b_9 YD86_{it} + b_{10} YD87_{it} + b_{11} YD88_{it} + b_{12} YD89_{it} + b_{13} YD90_{it} + b_{14} YD91_{it} + b_{15} YD92_{it} + b_{16} YD93_{it} + \varepsilon_{it}$

	When Year Dummies are used	
	σ	β
INTERCEP	0.3030	-1.2481
	(5.555)***	(-7.158)***
LOGWC	0.0030	0.0388
	(1.083)	(4.387)***
LOGAST	0.0068	0.0581
	(2.041)**	(5.425)***
DE	0.0993	-0.3712
	(2.897)***	(-3.389)***
YD81	-0.02372	0.3690
	(-1.287)	(6.263)***
YD82	-0.0866	0.4844
	(-5.004)***	(8.758)***
YD83	-0.1610	0.3588
	(-9.372)***	(6.534)***
YD84	-0.0648	0.4948
	(-3.793)***	(9.056)***
YD85	-0.1503	-0.0357
	(-8.972)***	(-0.667)
YD86	-0.0606	0.2587
	(-3.662)***	(4.893)***
YD87	0.0517	0.3247
	(3.14)***	(6.166)***
YD88	-0.0931	0.2232
	(-5.797)***	(4.349)***
YD89	-0.1817	0.2883
	(-11.438)***	(5:677)***
YD90	0.0613	0.3140
	(3.775)***	(6.054)***
YD91	-0.1788	0.2176
	(-10.857)***	(4.133)***
YD92	0.0476	0.1892
	(2.854)***	(3.549)***
YD93	-0.0702	0.3268
	(-4.221)***	(6.149)***
Adj-R sq	0.2607	0.1145
F Value	48.306	18.358
(Prob>F)	(0.0001)	(0.0001)
N	2,148	2,148

Panel B Model: σ_{it} **or** $\beta_{it} = b_0 + b_1\mathbf{LOGWC}_{it} + b_2\mathbf{LOGASS}_{it} + b_3\mathbf{DE}_{it} + b_4\mathbf{IND1}_{it} + b_5\mathbf{IND2}_{it} + b_6\mathbf{IND3}_{it} + b_7\mathbf{IND4}_{it} + b_8\mathbf{IND5}_{it} + b_9\mathbf{IND6}_{it} + b_{10}\mathbf{IND7}_{it} + \varepsilon_{it}$

	When Year Dummies are used	
	σ	β
INTERCEP	0.2678	0.8910
	(3.924)***	(4.866)***
LOGWC	0.0032	0.0109
	(0.861)	(1.079)
LOGAST	0.0054	-0.0070
	(1.16)	(-0.554)
DE	0.5003	-1.4319
	(3.011)***	(-3.213)***
IND1	-0.0411	-0.4112
	(-1.867)*	(-6.959)***
IND2	-0.0394	-0.4664
	(-2.161)**	(-9.531)***
IND3	-0.0424	-0.4031
	(-2.578)***	(-9.131)***
IND4	-0.0478	-0.1949
	(-2.319)**	(-3.525)***
IND5	0.0096	-0.2722
	(0.472)	(-4.984)***
IND6	-0.0177	-0.0720
	(-0.826)	(-1.253)
IND7	0.0306	0.1449
	(1.748)*	(3.087)***
Adj-R^2	0.0510	0.2241
F Value	9.407	46.163
	(0.0001)	(0.0001)
N	1,565	1,565

LOGWC = log-transformation of a firm's working capital
LOGAST = log-transformation of a firm's total asset
DE = financial leverage of a firm
YD = year dummy variables
IND = industry dummy variables:
IND1-food & beverages
IND2-textiles
IND3-chemicals & chemical products
IND4-other non-metallic mineral products
IND5-basic metals
IND6-radio, television and communication equipment and apparatus
IND7-construction
t-statistics in parentheses
*, **, *** statistically significant at the 10%, 5%, and 1% confidence level, respectively

expectations and the empirical results of the U.S. market.

4.4 Absolute Price Added

It is possible that some relevant variable is omitted from the empirical models above and this omission would yield inconsistent parameter estimates. If this is the case, the slope estimates would be biased, and these biases would not disappear even if the sample size is increased. In order to check for possible omission of a relevant variable in the model, we look for varying results when absolute price, LOGPR, is included in the empirical model as an independent variable.[15] Table 7 reports the correlations between LOGPR and other variables included in the empirical models. Note that LOGPR is

Table 7. Correlation Results-Absolute Price Added Risk Measures and Accounting Information

Variable	σ	β	LOGWC	LOGASS	DE	LOGPR
σ	1.0000					
	(0.0)					
β	0.2898	1.0000				
	(0.0001)	(0.0)				
LOGWC		0.1078	0.1558	1.0000		
	(0.0001)	(0.0001)	(0.0)			
LOGAST	0.1144	0.1653	0.6613	1.0000		
	(0.0001)	(0.0001)	(0.0001)	(0.0)		
DE	0.0446	-0.0691	0.0134	-0.0139	1.0000	
	(0.0386)	(0.0013)	(0.5325)	(0.5191)	(0.0)	
LOGPR	-0.0656	-0.0076	0.2636	0.2515	-0.2238	1.0000
	(0.0023)	(0.7232)	(0.0001)	(0.0001)	(0.0001)	(0.0)

σ = total volatility of equity returns
β = systematic risk of a firm
LOGWC = log-transformation of a firm's working capital
LOGAST = log-transformation of a firm's total asset
DE = financial leverage of a firm
LOGPR = log-transformation of the absolute price
The numbers in parentheses represent the p-values for the cross-sectional coefficient estimates.

15) LOGPR is the log-transformation of absolute price.

significantly correlated with the risk measures and with all the independent variables, excluding a minor exception.[16] Thus, the absolute price variable seems to be a good proxy for any possible omitted variable.

Table 8 reports the regression results when absolute price is included in the model as an independent variable. Absolute price has a negative impact on both risk measures and this result is *consistent* with theoretical expectations and U.S. empirical evidence.[17] The table shows that we obtain basically the same

Table 8. Regression Results-Absolute Price Added

Model: σ_{it} **or** $\beta_{it} = b_0 + b_1\mathbf{LOGWC}_{it} + b_2\mathbf{LOGAST}_{it} + b_3\mathbf{DE}_{it} + b_4\mathbf{LOGPR}_{it} + \varepsilon_{it}$

	σ	β
INTERCEP	0.2599	-0.1664
	(4.348)***	(-0.961)
LOGWC	0.0081	0.0321
	(2.583)***	(3.53)***
LOGAST	0.0120	0.0457
	(3.208)***	(4.183)***
DE	0.0400	-0.4703
	(0.991)	(-4.024)***
LOGPR	-0.0216	-0.0510
	(-4.525)***	(-3.687)***
Adj-R sq	0.0244	0.0402
F Value	14.452	23.471
(Prob>F)	(0.0001)	(0.0001)
N	2,148	2,148

LOGWC = log-transformation of a firm's working capital
LOGAST = log-transformation of a firm's total asset
DE = financial leverage of a firm
LOGPR = log transformation of the absolute price
t-statistics in parentheses
*, **, *** statistically significant at the 10%, 5%, and 1% confidence level, respectively

16) Although statistically not significant, the correlation between LOGPR and the systematic risk measure is negative and this is consistent with theoretical expectations.

17) See, Christie (1982).

results as obtained earlier. Although not reported here, inclusion of year and industry dummy variables does not alter the results and we arrive at the same conclusions discussed above.

5. Conclusions

In this study, we have examined whether we observe empirical results that are consistent with theory and some previous U.S. experiences. We have investigated the impact of some firm-specific accounting information on firm risk measures. It is found that in the Korean capital market, both firm working capital position and firm size have a positive impact on risk measures represented by total volatility of equity returns and systematic risk of firms. It is noted here that these results are not consistent with theoretical expectations and previous U.S. empirical results. For the financial leverage variable, we observe inconsistent results with respect to the risk measures employed in the regression analysis. When total volatility of equity returns is used as the dependent variable, we observe a positive association between firm risk and financial leverage; contrary to this, we found that financial leverage has a negative impact on the systematic risk of firms.

According to theory, we should observe a positive association between firm risk and financial leverage. It is interesting, therefore, that while this theoretical expectation holds empirically in U.S. market, we observe somewhat conflicting results in the Korean market. Although it is beyond the scope of this study, further research should be conducted to better understand why this phenomenon occurs.

References

Beaver, W. H., 1968, The Information Content of Annual Earnings Announcements, *Journal of Accounting Research*, Selected Studies VI (Supplement), 67-92.

Beckers, S., 1980, The Constant Elasticity of Variance Model and its Implications for Option Pricing, *Journal of Finance* 40 (June), 661-673.

Black, F., and M. Scholes, 1973, The Pricing of Options and Corporate

Liabilities, *Journal of Political Economy* 81, 637-654.

Black, F., 1975, Fact and Fantasy in the Use of Options, *Financial Analysts Journal* (July/August), 36-72.

Black, F., 1976, Studies of Stock Price Volatility Changes, *Proceedings of the Meetings of the American Statistical Association, Business and Economics Statistics Section*, 177-181 (Chicago).

Boness, A. J., A. H. Chen, and S. Jatusipitak, 1974, Investiga-tions of Nonstationarity in Prices, *Joruna1 of Business* 47, 518-537.

Castanias, R., 1983, Bankruptcy Risk and Optimal Capital Structure, *Journal of Finance* 38 (December), 1617-1635.

Cho, J., 1989, A Study on Forecasting Stock Returns, *The Journal of Korean Securities Association* 11.

Christie, Andrew A., 1982, The Stochastic Behavior of Common Stock Variances: Value, Leverage and Interest Rate Effects, *Journal of Financial Economics* 10, 407-432.

Cox, J. C., and M. Rubinstein, 1985, *Options Markets* (Prentice-Hall, Englewood Cliffs, New Jersey).

Damodaran, Aswath, 1985, Economic Events, Information Collection and The Return Generating Process, Ph. D. Dissertation, University of California at Los Angeles.

Ferri, M., and W. Jones, 1979, Determinants of Financial Structure: A New Methodological Approach, *Journal of Finance* 34 (June), 631-644.

Geske, R., 1979, The Valuation of Compound Options, *Journal of Financial Economics*, 41-52.

Hamada, R. S., 1969, Portfolio Analysis, Market Equilibrium, and Corporation Finance, *Journal of Finance* (March), 13-31.

Kim, C., and D. Cho, 1996, Determinants of Corporate Investment in Liquid Assets in Korea, *The Korean Journal of Finance* 12 (October).

Lee, K., 1996, The Relationship between Firm's Beta and its Financial Characteristics, *STOCK* No.340 (December), Korea Stock Exchange.

Lev, B., 1974, On the Association between Operating Leverage and Risk, *Journal of Financial and Quantitative Analysis* (September), 627-641.

MacBeth, J. D., and L. J. Merville, 1980, An Empirical Examination of the Black-Scholes Call Option Pricing Model, *Journal of Finance* 35 (May), 285-301.

Merton, R. C., 1973, Theory of Rational Option Pricing, *Bell Journal of Economics and Management Science* 4 (Spring), 141-183.

Merton, R. C., 1974, On the Pricing of Corporate Debt: The Risk Structure of Interest Rates, *Journal of Finance*, 449-470.

Morse, Dale, 1981, Price and Trading Volume Reaction Sur-rounding Earnings Announcements: A Closer Examination, *Journal of Accounting Research* 19, 374-383.

Modigliani, F., and M. H. Miller, 1963, Taxers, and the Cost of Capital: A Correction, *American Economic Review* (June), 433-443.

Ohlson, J. A., 1979, On Financial Disclosure and The Behavior of Security Prices, *Journal of Accounting and Economics* 1, 211-232.

Park, S., 1993, An Empirical Study on the Forecasting Ability of Systematic Risk Prediction Model in Korea Stock Market, *The Journal of Korean Securities Association* 15.

Schmalensee, R., and R. R. Trippi, 1978, Common stock Volatility Expectations Implied by Option Premia, *Journal of Finance* 33 (March), 129-147.

Sim, B. and Y. Song, 1989, Empirical tests of the nonstationarity and the optimal period of beta risk, *The Journal of Korean Securities Association* 11.