SIZE, LEVERAGE, AND DIVIDEND RECORD AS DETERMINANTS OF EQUITY RISK

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The last decade has witnessed significant advancements in capital theory and its application to corporate finance, investment policy, and portfolio analysis. More recently a growing body of empirical work has undertaken the task of systematically testing the positive implications of the theory. The study of risk has occupied a central position in this endeavor as it provides the link between the various branches of finance theory. The purpose of this paper is to investigate the empirical determinants of equity risk through the analysis of the firm's underlying characteristics, specifically, the firm's size, its financial leverage, and its dividend record.

Section I summarizes the literature, Section II provides the theoretical framework, Section III describes the empirical model and the data, Section IV presents the statistical results, Section V analyzes the effect of excluded variables, and Section VI provides a summary and conclusions.

I. Empirical Literature on Risk

The following survey is not exhaustive; it intends to trace the direction of research on the subject and provide background for the interpretation of our results.[1]

The empirical investigation of the determinants of risk can be usefully classified into two broad categories according to their macro or micro orientation. In the former category, numerous studies[2] have analyzed the relationship between risk premium on the stock market as a whole, the level of Standard and Poor's stock index, and required rate of return on equity, on the one hand, and macro aggregates such as, the money supply, the federal deficit, long-term short-term interest rate spread, and expected inflation, on the other hand. Lately, Robichek and Cohn [18] tested the influence of real economic growth and inflation on the systematic risk (beta) of individual firms. They found that these macro variables shed no light on the determinants of the systematic risk, and that only for a small number of firms can variations in beta be explained by real growth and inflation.

In the micro cateogory earlier work, of which Fisher and Hall [10] is representative, has focused on individual firms' risk-rate of return relationship through an empirical analysis of the mean and the higher moments of the rate of return distribution. The study of individual firms' risk as related to their underlying characteristics begins with the seminal work of Beaver, Kettler, and Scholes [3] which examined the relationship of certain accounting ratios (payout, liquidity, earning variability, etc.) to the firm's systematic risk (beta), and found a strong and significant association between them.

Using a similar set of explanatory variables on cross-section monthly regressions, Breen & Lerner [7] presented additional evidence in support of this relationship. They found that although the variables' signs, on the whole, conformed to traditional literature, many of the reported coefficients were not significantly different from zero; those which were significant displayed such wide variations from sample to sample that they could not have been drawn from the same underlying population. In particular, the sign, magnitude, and statistical significance of the leverage variable were most unstable, a result which the authors view as a reflection of the leverage-risk theoretical controversy. In contrast, however, Hamada [14] found that, conditional on the validity of Modigliani and Miller's model, leverage accounts for a substantial portion (21% to 24%) of the systematic risk.

Along the similar lines, Rosenberg & McKibben [19] have analyzed the joint influence of the firm's accounting data and its historical stock returns on the systematic and specific risk of its common stocks. They have used an intuitively suggested set of thirty-two explanatory variables with mixed results: of the thirteen variables for which empirical results were given, four had the expected sign, three had the opposite sign, and four had a strong effect when "no strong effect" was expected. Most recently, Melicher [15] and Melicher and Rush [16] have reported results similar to those obtained in previous studies by using data on 71 electric utility firms, and selecting explanatory variables on the basis of factor analysis rather than intuition.

The present paper differs from previous studies in several respects:

(1) We have focused on a relatively small number of economic variables, selected on a priori theoretical grounds, rather than on a large number of accounting and financial variables (partly colinear) based on intuition.

(2) Contrary to previous studies, which have confined themselves to onemeasure of risk[3] (beta) whose stability has been somewhat challenged, we have examined three alternative risk measures, and analyzed their consistency and interrelationship.

(3) With the exception of Hamada [14], all previous studies used an accounting measure of leverage, based on book value, whereas a more appropriate measure would seem to be one based on market value. For any given level of business risk, the firm's equity ("financial") risk would depend on the probability distribution of expected earnings in relation to interest payments on debt; since the firm's expected earning power is capitalized in its assets prices, equity risk would depend on the ratio of the firm's debt to the market value of its total capital. Hence a relevant measure of leverage in a risk context is not an accounting measure based on book value, but an economic measure based on the market value of equity.[4] We have used the latter.

Our approach was guided by the earlier work of Fisher [9] who has demonstrated that firm's size and leverage are important risk-determinants of corporate bonds. In this paper we have analyzed the effect of these two variables, in conjunction with the firm's dividend record, on the risk of common stock. Obviously, our study deals only with three out of a larger population of explanatory variables which jointly constitute the determinants of corporate risk. The possible effect of other variables, such as earnings variability, does not fall within the scope of this paper.[5]

II. Some Theoretical Considerations

The empirical study of equity risk is hampered by the methodological difficulty encountered in the valuation of residual, rather than contractual, claims to the firm's uncertain stream of future income. Unlike the risk of corporate bonds, for which an explicit measure does in principle exist (say, risk premium), the risk of corporate stocks remains elusive in theory and difficult to measure in practice. Indeed, the empirical literature in finance often makes little distinction between variables which are measures of risk and those which constitute determinants of risk.

Ideally, one would have liked to possess one set of variables which are theoretically presumed to influence "risk", and another set of variables which are direct measures of "risk", while attempting to explain empirically the latter by the former. Unfortunately, this is not entirely possible at the present state of the arts. Consequently, an empirical study of the determinants of equity risk poses some difficult alternatives regarding the surrogate variable "risk". This is merely to say that in selecting the dependent variables we have been aware of the difficulty, and have attempted to choose the most direct surrogates for risk we could find, while avoiding variables which clearly seem to represent determinants of risk.

We have further attempted to reduce ambiguity by selecting the regressants to be external to the firm (at least in the short-run), and the regressors to be internal to it. The measures of risk chosen as dependent variables are external in that the firm does not directly exercise control over their magnitudes, which in turn are largely market-determined. In contrast, the variables selected as explanatory are internal in the sense that they are intertwined with the firm's financial policies and are largely within its decision space.

Following is a discussion of the three variables which we used as determinants of risk:

1. The leverage of the firm is an important determinant of its equity risk since senior securities have priority over common stock in the distribution of the firm's income as well as in the distribution of its assets in case of bankruptcy. The larger the debt in the firm's capital structure, the higher is the risk of default, and the lower is the valuation of its equity.[6]

2. The size of the firm is another determinant of risk, where large firms are presumed to be less risky. Several theoretical arguments, not entirely independent of one another, can be advanced in support of this assertion:

   (a) Marketability: this argument, developed by Fisher [9], suggests that large firms' securities represent marketable assets which can be more readily turned into cash, thereby being less risky.

   (b) Probability of Bankruptcy: since large firms do not appear overnight, but rather grow over a period of time into their existing size, and since failing firms tend to disappear in their early years of operation, it follows that the firm's size constitutes a measure of its past performance, and may be indicative of its future performance and, hence, its risk.

(c) Diversification: unless returns on individual assets are perfectly correlated, large firms would attain a low variance of overall returns when compared with smaller firms. In the context of portfolio theory, a lower variance of returns would not necessarily mean lower risk, unless the covariance with market returns is also lower. Large firms would be less risky, however, if firms can diversify their operations more efficiently than the individual investor can diversify his own stock portfolio.

(d) Economies of Scale: insofar as scale economies (technical or managerial) enable firms to incur lower unit costs and consequently earn an above-normal economic rent, the latter can serve as a buffer against losses, thereby reducing the probability of bankruptcy and, hence, risk.

3. The firm's dividend record may serve not only as a criterion of its effectiveness in successfully pursuing its own target dividend policy, but may also be indicative of its underlying earning stability in the face of business fluctuations.

In order to test the assertion that risk is a function of the firm's age and size we looked at the record of business failures by these categories. The results are consistent with the hypothesis.[7] We also used aggregate income and sales of firms in different size classes during the depression of 1930; we computed the earnings/sales and earnings/assets ratios for different size classes, expecting large firms to perform better during the depression. The results are consistent with the hypothesis that large firms perform better than small ones during a major depression.[8]

III. The Empirical Model, the Variables, and the Data

Our empirical test is concerned with the relationship between the firm's risk and its leverage, size, and dividend record. We have estimated the parameters of the following model:

(1) $$R_{ij} = f(X_{1j}, X_{2j}, X_{3j})$$

where:

R_{ij} - represents three alternative risk measures for the j firm. (i=1, ...,3).

X_{1j} - is a measure of the j firm's leverage.

X_{2j} - is a measure of the j firm's size.

X_{3j} - is a measure of the j firm's dividend record.

For our basic sample we have used the 1000 largest U.S. industrial corporations in 1970 from the Fortune Directory [11], with the following definitions of variables and sources of data:

R_1: Earnings Dividend Ranking (EDRISK): This measure was based on Standard & Poor's Stock Guide of August 1971 [21] which provides a letter ranking for common stock (A^+, A,...,C). In order to form a risk variable we have translated the letter ranking into a numerical scale ranging from 1 to 7. This measure reflects the assessment of risk by investment agencies and other practitioners operating in the stock market.[9]

R_2: Beta Risk Measure (BETA): This measure, which is the regression coefficient of an individual stock returns on the market's returns, has been widely used in modern literature of finance and represents the assessment of risk by academics. The source for the calculations of Beta was the price relative tape of the University of Chicago Center for Research in Security Prices (CRSP). The calculations were based on 60 monthly observations from June 1962 to June 1968.

R_3: Stock Turnover Ratio (TOR): This risk measure is defined as the ratio of the number of shares traded during a given period of time to the average number of shares outstanding, and reflects the extent of trading activity in the stock. That trading activity can be used as a measure of risk has long been recognized by financial analysts, e.g., Grossvenor [13] and, more recently, by Babson and Babson [1], Friend, et. al. [12], and Rosenberg and McKibben [19]. The theoretical justification for this measure is based on stock trading as an indicator of a speculative activity which originates in the dispersion of investors' expectations with respect to the distribution of future stock returns; the higher the trading intensity of a given stock the higher its risk.[10]

The Turnover Ratio (TOR) was calculated as the ratio of the annual trading volume of each stock to the number of shares outstanding. The former was based on the 1971 Dow Jones Investor's Handbook [8], and the latter on the 1970 Fortune Directory [11].

X_1: The firm's financial leverage (LEV) was measured by the ratio:

$$\frac{\text{total assets - common stock equity}}{\text{market value of common stock}}$$

A similar measure of leverage has been suggested by Fisher [9]; its main advantage lies in the division debt and other senior liabilities by the market value, rather than book value, of the firm's net worth. In our sample leverage was computed from the Fortune Directory [11] and stock market prices as of December 31, 1970.

X_2: The firm's size (SIZE) was measured by the logarithm of its 1970 annual sales, rather than its equity market value, largely because the former represents a more direct measure of size, while the latter is correlated with leverage and is not independent of risk.[11] The annual sales figures were based on the Fortune Directory [11], and the firms' sizes range from $55 million sales for the smallest, to $18.7 billion for the largest.

X_3: The firm's dividend record (DIV) was based on Standard & Poor's Stock Guide of December 1971 [21], which reports the year since which uninterrupted annual cash dividends have been paid on junior issues. The variable used was the logarithm of the number of years of uninterrupted dividends.

Inserting the above empirical measures for the variables in equation (1) we obtain:

$$(2) \qquad \left.\begin{matrix} \text{EDRISK} \\ \text{BETA} \\ \text{TOR} \end{matrix}\right\} = f(\text{LEV, SIZE, DIV})$$

IV. The Empirical Results

For our empirical test we have assumed the following linear specification of equation (2):

$$(3) \qquad \left.\begin{matrix} \text{LOG (EDRISK)} \\ \text{BETA} \\ \text{LOG (TOR)} \end{matrix}\right\} = \alpha_0 + \alpha_1\text{LEV} + \alpha_2\text{LOG(SIZE)} + \alpha_3\text{LOG(DIV)} + U$$

We have estimated the parameters of equation (3) by Ordinary Least Square regressions, the results of which are reported below in Table 1 for the three alternative risk measures EDRISK, BETA and TOR. The regressions' coefficients and their t-values have been reported step-wise to enable a better assessment of each variable's explanatory power. The prefix "L" denotes a variable which entered the regression in logarithmic form.

TABLE 1

REGRESSION COEFFICIENTS OF LEVERAGE, SIZE, AND DIVIDEND RECORD,

ON EDRISK, BETA, AND TOR

(t - values in parantheses)

	L E D R I S K			B E T A			L T O R		
Constant	.9010	2.085	2.515	.9025	1.347	1.825	2.537	3.454	3.887
	(23.17)	(17.77)	(18.08)	(32.76)	(14.32)	(17.16)	(40.75)	(16.14)	(14.84)
LEV (X_1)	.2621	.2670	.2134	.1161	.1179	.05811	.2415	.2454	.1912
	(6.676)	(7.999)	(6.360)	(4.172)	(4.407)	(2.265)	(3.842)	(4.030)	(3.025)
LSIZE (X_2)		-.1916	-.1646		-.07184	-.04173		-.1483	-.1210
		(10.52)	(9.054)		(4.920)	(3.002)		(4.465)	(3.535)
LDIV (X_3)			-.1623			-.1808			-.1637
			(5.230)			(7.622)			(2.802)
F	44.57	86.14	71.86	17.41	21.515	36.58	14.76	17.84	14.79
D.F.	287	287	287	287	287	287	287	287	287
R^2	.135	.377	.431	.054	.131	.279	.049	.111	.135

The empirical results in Table 1 are all in the direction expected theoretically, with highly significant coefficients: the firm's risk, as captured by all three alternative risk measures, is positively related to its leverage and negatively related to its size and dividend record. Noteworthy is the remarkable stability of the coefficients throughout the successive steps of the regressions. It is equally noteworthy that the three alternative risk measures, although based on entirely different sets of data can be explained by the same underlying factors. This may be taken as an indirect affirmation that our three risk measures are indeed monitors of the same phenomenon.

Since information on Beta was relatively scarce in our data, the inclusion of the Beta regressions has considerably reduced the number of observations down to 287. As the shrinkage of sample size could have possibly occurred in a non-random manner (e.g., the systematic exclusion of smaller firms), we found it advisable, as an additional check, to estimate the model's parameters for the larger sample as well, exclusive of Beta. The results, based on 536 degrees of freedom, are reported in Table 2 for EDRISK and TOR. It is evident that the effect on the estimated parameters of almost doubling the sample size was quite negligible. The signs of the regression coefficients were unchanged throughout, their magnitudes were substantially the same as before, and their statistical significance has increased.

V. Other Determinants of Risk

It is entirely possible that the three explanatory variables which we have used did not exhaust the set of risk-determinants, and that other determining factors have not been captured by either one of our regressors. If this is the case, the deleted factors would be common to the three alternative risk measures used, if the latter do indeed measure substantially the same phenomenon, namely risk. Since the regressions' residuals are the por-

TABLE 2

REGRESSION COEFFICIENTS OF LEVERAGE, SIZE AND DIVIDEND RECORD,

ON EDRISK AND TOR

(t - values in parentheses)

	L E D R I S K			L T O R		
Constant	1.030 (39.61)	2.135 (27.80)	2.473 (28.84)	2.614 (60.97)	3.209 (21.59)	3.666 (21.51)
LEV	.1905 (7.671)	.2092 (10.02)	.1834 (9.096)	.1818 (4.440)	.1919 (4.748)	.1570 (3.918)
LSIZE		-.1944 (15.01)	-.1659 (12.87)		-.1046 (4.174)	-.06607 (2.580)
LDIV			-.1458 (7.539)			-.1972 (5.130)
F	58.85	154.42	132.65	19.71	18.87	21.95
D.F.	536	536	536	536	536	536
R^2	.099	.366	.428	.036	.066	.110

tions of the dependent variables unexplained by the three regressors, one could detect these common, omitted factors by testing the respective residuals for a positive correlation.

We have calculated the regressions' residuals for EDRISK, BETA and TOR, labelled them U_1, U_2, U_3 respectively and reported their correlations in the correlation matrix of Table 3. The results show that while the EDRISK residuals (U_1) correlate poorly with either BETA's residuals (U_2) or TOR's residuals (U_3), the last two are significantly correlated: $r(U_2, U_3) = .266$.

In order to determine the incremental explanatory contribution of these excluded factors, we have included them as additional regressors in their respective, non-corresponding, equations:

$$\text{LEDRISK} = f(\text{LEV, LSIZE, LDIV}, U_2, U_3)$$
$$\text{BETA} = f(\text{LEV}, \ldots\ldots\ldots\ldots, U_1, U_3)$$
$$\text{LTOR} = f(\text{LEV}, \ldots\ldots\ldots\ldots, U_1, U_2)$$

The results are given in Table 4 for EDRISK, BETA and TOR, respectively.[12] These results show that the unexplained portions of BETA and TOR have little incremental explanatory power for EDRISK, and that the unexplained portions of EDRISK, in turn, add little explanation to BETA and TOR. In contrast, the residuals of BETA and TOR have significant explanatory power when introduced as incremental variables in each other's equations. This indicates a "missing-factor" which affects risk as measured by either BETA or TOR, but not when measured by EDRISK.

The foregoing represents an interesting result which could be attributed to an important difference between EDRISK on the one hand, and BETA and TOR on the other hand. While EDRISK is a discretionary, man-made measure based entirely on firm-generated information (earnings and dividends), both BETA and TOR are more "objective" measures based on market-generated data,

TABLE 3

CORRELATION MATRIX

	LEDRISK (R_1)	BETA (R_2)	LTOR (R_3)	LEV (X_1)	LSIZE (X_2)	LDIV (X_3)	U_1	U_2
BETA (R_2)	.348							
LTOR (R_3)	.312	.390						
LEV (X_1)	.367	.239	.221					
LSIZE (X_2)	-.486	-.268	-.246	.014				
LDIV (X_3)	-.455	-.496	-.274	-.291	.268			
U_1	.753	.049	.095	0.0	0.0	0.0		
U_2	.043	.849	.247	0.0	0.0	0.0	.058	
U_3	.077	.266	.930	0.0	0.0	0.0	.102	.266

TABLE 4

REGRESSION COEFFICIENTS OF LEVERAGE, SIZE, DIVIDEND

RECORD AND RESIDUALS ON EDRISK, BETA AND TOR

(t - values in parentheses)

	LEDRISK	BETA	LTOR	LEDRISK	LTOR
Constant	2.515 (18.12)	1.825 (17.75)	3.887 (15.40)	2.473 (28.86)	3.666 (21.53)
LEV	.2314 (6.374)	.05811 (2.343)	.1912 (3.140)	.1834 (9.101)	.1570 (3.920)
LSIZE	-.1646 (9.073)	-.0417 (3.105)	-.1210 (3.669)	-.1659 (12.88)	-.066 (2.581)
LDIV	-.1623 (5.241)	-.1808 (7.882)	-.1637 (2.908)	-.1458 (7.543)	-.1972 (5.133)
U_1		.0236 (.5356)	.1636 (1.516)		.1090 (1.267)
U_2	.0494 (1.516)		.6423 (4.552)	.0276 (1.267)	
U_3	.0430 (.5356)	.1066 (4.552)			
F	43.9	27.8	14.3	100.0	16.9
D.F.	287	287	287	536	536
R^2	.438	.330	.203	.429	.113

capturing some dimensions external to the firm (its returns relative to the market, and its securities trading-intensity). At the same time there is little doubt that, being a long-term weighted average, EDRISK is a relatively more stable measure when compared to BETA and TOR; the latter are more prone to random variations and measurements errors.[13] Whether the "missing factor" in the explanation of BETA and TOR is part of their systematic components of risk, or part of the random noise in their estimation, is yet to be examined. Nevertheless, a search for the "missing variable" seems to be a worthwhile undertaking for future research, not only because an important determinant of risk might thus be identified, but also because in the process we may gain a better understanding of the different aspects of risk captured by man-made risk measures compared with market determined measures.

VI. Summary and Conclusions

The results of this paper demonstrate that Fisher's findings with respect to corporate bonds are also true for common stock: the firm's size and leverage are important determinants of its risk. In addition, the firm's dividend record proved to be a significant determinant of the firm's equity risk. The latter finding, however, should not be simply interpreted as bearing on the controversy of the effect of dividend policy on the cost of capital. Rather, in the context of this paper the firm's dividend record measures the firm's success in maintaining its target dividend policy, its underlying earnings stability and, to some extent, simply its age.

Despite our statistically significant results, the level of explanation was not always high, which suggests that more research is needed in analyzing additional determinants of risk as well as in refining and defining additional measures of risk. It also seems desirable to analyze the effects of leverage, size, and alternative risk measures on the actual performance of firms.

Finally, earlier empirical studies on risk and returns[14] point to the lack of a single universal risk measure which is operationally superior to all others. Our results show that the risk measures tested here appear, indeed, to capture different aspects of risk, with some overlap. The practical implication of this seems to be the desirability of using more than one risk measure in future empirical studies.

FOOTNOTES

*Technion - Israel Institute of Technology and University of Wisconsin-Milwaukee, respectively. We want to thank Walter Wadycki for his comments, and Robert Mullen for computer programming.

[1]For a more detailed bibliography, consult the reference sections of the articles surveyed below, particularly Beaver, et. al. [3].

[2]See Robichek and Cohn [18] for a complete survey.

[3]Although Rosenberg and McKibben [19] used two measures of risk, these measures were not independently derived, as the residual risk measure (σ_n^2) was influence by the choice of the explanatory variables for the Beta regressions.

[4]Equivalently, the investor's estimation of "risk of default" (insolvency) is associated with the extent to which the value of the firm's assets can decline and still cover its total liabilities. An appropriate measure of this factor must be based on market value.

[5]The firm's ex-post growth rate has been used as an explanatory variable in previous studies. However, there are no strong theoretical grounds for predicting its a priori effect on risk, nor do the empirical findings exhibit a uniform pattern. (compare: Beaver, et. al. [3], Breen and Lerner [7], Rosenberg and McKibben [19]). Indeed, our own findings were unaffected by the inclusion of a growth variable G, which was not statistically significant. We have approximated the growth rate by: G_1 = 1/5 Log (SPS1971/SPS1966), and G_2 = 1/5 Log (EPS1971/EPS1966), where SPS and EPS represent sales per share and earnings per share, respectively.

[6]See: Baxter [2], Bierman [6], Benishay [4], Ben-Zion and Balch [5] and Hamada [14].

[7]Regarding age, 78% of all business failures in 1970 were of firms under 10 years, whereas firms over 10 years of age accounted for only 22% of all failures. With respect to size, 75% of all business failures in 1970 were of a liability size under $100,000, whereas only 3% were of a liability size over $1 million. A very similar and consistent pattern emerges from the statistics on failures in every year and in every industry. (See, "The Failure Record Through 1970," Dun and Bradstreet, Inc. 1971).

[8]While firms in the size-class of over $50 million assets showed positive ratios of earnings/sales and earnings/assets during 1930, each and every size-class under $50 million assets displayed negative ratios, with larger negative ratios the smaller the size-class. For example, firms in the category under $50,000 assets had an earnings/sales ratio of -5.9, and an earnings/assets ratio of -11.1, whereas firms in the category over $50 million assets had corresponding ratios of +4.6 and +1.1. (Computed from: "The Statistical History of the United States from the Colonial Time to the Present," Fairfield Publishers, Inc., 1965).

[9]We have carefully checked the formula used by Standard & Poor's and verified that none of our explanatory variables was used in their ranking computations. (Consult: "Standard & Poor's Stock Guide," page 4).

FOOTNOTES

[10]Breen and Lerner [7] have used the total number of shares traded as a risk determinant. Our measure seems to be more appropriate, as it is not subject to a "scale effect." Thus, a stock-split would leave our measure of risk unchanged, but would increase their measure of risk.

[11]For a study which uses equity market value as a measure of risk, see Benishay [4].

[12]Note that the coefficients of X_1 to X_3 are not changed by the introduction of U_i, since by definition the residuals are orthogonal to the regressors.

[13]That BETA is estimated with an error has long been recognized (see, Miller and Scholes [17]). Similarly, the measured Turnover Ratio (TOR) is influenced by random factors which are not necessarily related to the stock's risk. A more appropriate measure would be a "permanent" Turnover Ratio which would abstract form transitory components.

[14]See, for example, Shalit and Ben-Zion [20].

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