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Systematic Risk and Market Power:
An Application of Tobin's q

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Abstract

We investigate the relationship between systematic risk and market power measured by Tobin's q, the ratio of market value to replacement cost. We demonstrate there is a one-to-one relationship between the Tobin's q ratio and the S&T measure of market power. Our theoretical model predicts that as a firm's market power increases the systematic risk will, ceteris paribus, decrease. Our empirical results ultimately confirm this negative association as predicted by S&T.

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I. Introduction

One of the most important advances in the field of financial economics has been the development of an equilibrium model of security price determination under uncertainty. This model, known as the capital asset pricing model (CAPM), was developed by Sharpe [1964], Lintner [1965] and Mossin [1966]. The CAPM holds that securities will be priced in equilibrium to yield an expected return that is a linear function of the systematic, or non-diversifiable, risk. As originally developed, the CAPM does not provide a direct linkage between a firm's systematic risk and the underlying microeconomic variables of the firm, e.g., demand uncertainty, input mix, market power, etc.

The lack of a well-defined model of the determinants of systematic risk has hampered the investigation of industrial organization economists in their ability to interpret rates of return across industries with different market structures. It is difficult to determine how much of the return variation is explained by systematic risk differential and how much is attributable to the existence of market power. Aggravating this problem is the fact that systematic risk itself may be influenced by market power. In fact, the work of Hurdle [1974], Melicher, et. al. [1976], Sullivan [1977, 1982], and Curley, et. al. [1982] have produced mixed results as to the direction and magnitude of the relationship between systematic risk and market power.

One of the difficulties with the empirical work stems from the lack of a precise measure of market power. Typically, concentration ratios have been used as proxies for market power but the difficulty of inferring the existence of economic rents from mere concentration ratios is well-known. Thus, the empirical work to date sheds little light on the relationship between systematic risk and market power. One of the purposes of this paper is to develop and test an integrated model of firm decisions that links systematic risk to a well-defined measure of market power.

Early attempts at integrating systematic risk and firm variables may be found in Thomadakis [1976], Hite [1977], and, most notably, Subrahmanyam and Thomadakis [1980]. While these papers vary widely in approach and emphasis, there is general agreement that for a given level of cashflow risk, greater market power results in lower systematic risk. As Subrahmanyam and Thomadakis [1980, p. 447] state, "Thus, irrespective of the source of uncertainty, monopoly power unambiguously reduces beta."

In this paper we model the production and output of a quantity-setting firm facing stochastic demand. We start with the Subrahmanyam and Thomadakis (henceforth, S&T) model and develop a precise form for the relationship between systematic risk and market power. We note that if a firm is earning economic rents, these will be capitalized into the market prices of the firm's outstanding securities. The existence of positive rents would result in the market value of the firm exceeding the replacement cost of its capital stock. Using the ratio of market value to replacement cost, a ratio commonly referred to as "Tobin's q,"[1] we have a measure of economic rents that can be more easily estimated than the S&T measure of market power. We demonstrate there is a one-to-one relationship between the q-ratio and the S&T measure of market power. Furthermore, we confirm the negative relationship between market power and systematic risk hypothesized by S&T.

Tobin introduced the q-ratio in an attempt to explain aggregate investment behavior in the economy. Thus, using q to measure economic rents represents an extension of Tobin's concept to microeconomic analysis. Recently, Lindenberg and Ross [1981] have used q-ratios to measure economic rents and market power. The current paper extends the Lindenberg and Ross insight to investigate the relationship between market power and systematic risk. Our theoretical model predicts that as a firm's market power increases the systematic risk will, ceteris paribus, decrease. Our empirical results ultimately confirm this negative association as predicted by S&T.

The rest of the paper is organized as follows. Section II presents the standard optimization problem of the firm in an economy in which uncertain return streams are priced according to the single-period CAPM. We derive an explicit expression for the firm's systematic risk as a function of its q-ratio. The third section describes the sample and the estimation of the variables for the empirical tests. Section IV contains our findings followed by a short summary.

II. The Model

A. Firm Equilibrium

Following the S&T approach, we consider a firm facing the following stochastic demand function:

$$\tilde{P} = P(Q)(1+\tilde{e}) \tag{1}$$

Here and throughout the paper a $\sim$ indicates a random variable. The function P(Q) is assumed to be a negatively sloped function but e is a random demand variable which is independent of the quantity of output with $E(\tilde{e}) = 0$ so that $E(\tilde{P}) = P(Q)$. The marginal revenue function is assumed to be given by

$$MR(Q) = (1-u)P \tag{2}$$

where u is the reciprocal of the price elasticity of demand. Note that $(1-u)^{-1}$ is the Lerner index of monopoly power. The firm makes its output decision before the price is known, i.e., before e is revealed.

For simplicity, assume that the firm has a constant proportions production function calling for labor L and capital K inputs given by

$$L = aQ \tag{3a}$$

and

$$K = bQ. \tag{3b}$$

It is assumed that capital is exhausted in the production process.

The net cashflow of the firm after paying the wage rate w on L units of labor is given by

$$\tilde{Y} = PQ(1+\tilde{e}) - wL. \tag{4}$$

Note that we assume that the wage rate w is deterministic and paid at end of the period when output is sold. According to the cashflow version of the CAPM the value of the firm V is the present value of the net cashflow given by

$$V = \frac{E(\tilde{Y}) - \lambda \operatorname{cov}(\tilde{Y},\tilde{R}_m)}{1 + r} \tag{5}$$

where λ is the market price of systematic risk, s_{em} is the covariance of e with the market portfolio, $\tilde{R}_m$ is the uncertain rate of return on the market portfolio, and r is the risk free rate of interest. If we define $\phi = E(1+\tilde{e}) - \lambda s_{em}$ as the certainty equivalent of $(1+\tilde{e})$, then since $\tilde{e}$ has a zero expected value the certainty equivalent price is simply $E(P(1+\tilde{e})) - \lambda s_{em} = \phi P$. The value of the firm simplifies to

$$V = \frac{\phi PQ - wL}{1 + r} \tag{5'}$$

$$= \frac{\phi P - wa}{1 + r} \cdot Q$$

Note that in the normal case we would expect firms to have positive systematic risk so with $s_{em} > 0$ the certainty equivalent term ϕ would be less than one. Consequently, uncertain revenue is valued at less than its expected value due to the discount for systematic risk.

The goal of the firm is to maximize its net present value, i.e., the difference between its market value and its capital expenditure,

$$NPV = V - K \tag{6}$$

Substituting the production requirements for L and K in (3) and defining $c = wa + (1+r)b$ as the constant marginal and average cost of production we have the net present value as

$$NPV = \frac{\phi PQ - cQ}{1 + r} \tag{7}$$

The first and second order conditions for maximizing (7) are

$$\frac{\partial NPV}{\partial Q} = \frac{\phi(1-u)P - c}{1 + r} = 0 \tag{8}$$

and

$$\frac{\partial^2 NPV}{\partial Q^2} = \frac{\phi(1-u)}{1 + r} \cdot \frac{dP}{dQ} < 0 \tag{9}$$

respectively. Downward sloping demand is sufficient to assure that (9) holds. Re-arranging (8) we have

$$\phi(1-u)P = c \tag{8'}$$

which states that the optimum is where the firm equates the certainty equivalent marginal revenue and marginal cost. Thus, the firm sets output such that the certainty equivalent price is

$$\phi P = \frac{c}{1 - u} \tag{10a}$$

or such that expected price is

$$P = \frac{c}{\phi(1-u)} \tag{10b}$$

Note that ϕP is the certainty equivalent price and c is average and marginal cost. If the firm possesses market power then $u > 0$ and the certainty equivalent price will be set above marginal cost c.

To see the meaning of u under uncertainty, we can solve (10) for u to yield $u = (\phi P-c)/\phi P$. Thus u represents in certainty equivalent form the spread between price and marginal cost as a proportion of price. In the competitive case, this spread should be non-existent and u would be zero. When the firm possesses monopoly power, a positive spread would exist indicating a positive value of u.

These equilibrium relationships can be used to express the systematic risk of the firm as a function of the firm's market power u.

B. Systematic Risk

According to the CAPM, systematic risk is measured by the relationship between the rate of return on the firm's securities and the rate of return on the market portfolio. Define the rate of return on the firm as $\tilde{R}$ where

$$\tilde{R} = \frac{\tilde{Y}}{V} - 1.$$

Then the firm's systematic risk, or β, is given by

$$\begin{aligned} \beta &= \mathrm{cov}(\tilde{R},\tilde{R}_m)/s_m^2 \\ &= \mathrm{cov}(\tilde{Y},\tilde{R}_m)/(Vs_m^2) \qquad (11) \end{aligned}$$

where $\mathrm{cov}(\tilde{R},\tilde{R}_m)$ is the covariance between the rates of return on the firm and the market portfolio and s_m^2 is the variance of the return on the market portfolio. This covariance term may be simplified to

$$\begin{aligned} \mathrm{cov}(\tilde{Y},\tilde{R}_m) &= PQs_{em} \\ &= \frac{cs_{em}}{\phi(1-u)} \cdot Q \qquad (12) \end{aligned}$$

from (10b). If we substitute (10a) into (5'), then the value of the firm can be written as

$$V = \frac{\frac{c}{1-u} - wa}{1 + r} \cdot Q. \tag{13}$$

Finally, using (12) and (13) we can express (11) as

$$\beta = \frac{1 + r}{\phi} \cdot \frac{s_{em}}{s_m^2} \cdot \frac{c}{c - wa(1-u)} . \tag{14}$$

Equation (14) shows that β is negatively related to market power u as S&T showed earlier. The difficulty with this relationship is that market power as measured by u is extremely difficult to observe from publicly available data. To be useful, S&T's insight must be translated into a form that can be estimated from market data.

C. Tobin's q

Recall that Tobin's q is defined as the ratio of the firm's market value to the replacement cost of its capital stock. A value of q exceeding unity implies that a firm is earning above a normal rate of return on its capital. To see this, consider a firm that has no monopoly power, i.e., u = 0. Then from (10) we see that the optimum calls for $\phi p = c$, i.e., the certainty equivalent price equals marginal cost. The value of the firm in (13) is simply

$$V = (c-wa)Q/(1+r) = bQ$$

$$= K$$

Thus, Tobin's q would be 1.

In the more general case, we have $\phi P(1-u) = c$ at the optimum yielding

$$q = V/K$$

$$= 1 + \frac{c}{(1+r)b} \cdot \frac{u}{1-u} . \tag{15}$$

Thus, for $u > 0$ we see that $q > 1$. Furthermore, q is positively related to u. Being able to estimate q obviates the difficulties associated with trying to estimate u.

If we solve (15) for u as a function of q we get

$$u = \frac{q - 1}{\frac{wa}{(1+r)b} + q} \tag{16}$$

which can be substituted into (14) to give

$$\beta = \frac{1 + r}{\phi} \cdot \frac{s_{em}}{s_m^2} \cdot [1 + \frac{wa}{(1+r)b} \cdot \frac{1}{q}] \tag{17}$$

Here it can be seen that β is negatively related to q. That is, there is a one-to-one positive relationship between u and q, and since β and u are negatively related, then β and q will also be negatively related.

In fact, we can compare this general result to the special case of the competitive firm for which $u = 0$ and, therefore, $q = 1$. In that case, the systematic risk β_c is given by

$$\beta_c = \frac{1 + r}{\phi} \cdot \frac{s_{em}}{s_m^2} \cdot [1 + \frac{wa}{(1+r)b}] . \tag{18}$$

Finally, we can write the systematic risk of the non-competitive firm as

$$\beta = \beta_c - \frac{1 + r}{\phi} \cdot \frac{s_{em}}{s_m^2} \cdot \frac{wa}{(1+r)b} \cdot [1 - \frac{1}{q}]. \tag{19}$$

The departure of β from β_c is negative and the spread increases in absolute magnitude with the size of q.

The expression for β in (17) shows that systematic risk is dependent on both q and s_{em} among other variables. The first of these relationships shows that β is negatively related to q. Thus, a firm that has market power as measured by q will, ceteris paribus, have lower systematic risk. The second relationship shows that β is positively associated with s_{em}. Note that s_{em} shows the covariance of the stochastic demand term with the return on the market portfolio. Thus, if the firm's stochastic demand is highly correlated with the demand for the output of other firms in the market portfolio, then the firm's systematic risk will, ceteris paribus, be higher. In other words, firms with product demands that are highly correlated with sales of other firms in the economy will have higher β's and higher risk premia in the CAPM context.

Our model indicates that systematic risk as measured by β should be negatively related to market power and positively related to the covariance of the firm's sales with the rest of the economy. To test these hypotheses requires that (17) be arranged into a more convenient form that can be estimated from available public data.

D. Estimable Forms

The difficulty with (19) in its current form is that s_{em}, or the covariance of price with the market portfolio, is not directly observable. Using aggregate sales revenue for the firm will overcome this problem. That is, re-write (12) as

$$\mathrm{Cov}(\tilde{Y},\tilde{R}_m) = \mathrm{Cov}(PQ(1+\tilde{e}),\tilde{R}_m)$$

$$= \mathrm{Cov}(\tilde{S},\tilde{R}_m) \tag{20}$$

where $\tilde{S}$ is the uncertain total revenue or dollar volume of total sales. Then from the definition of c we can express the value of the firm in (13) as

$$V = [\frac{c}{(1+r)b} \cdot \frac{u}{1-u} + 1]bQ$$

$$= [\frac{c}{(1+r)b} \cdot \frac{u}{1-u} + 1]K \tag{21}$$

where bQ is the capital requirement in (3b). Then if we substitute (20) and (21) into (11) we have systematic risk expressed as

$$\beta = \frac{\mathrm{Cov}(\tilde{S},\tilde{R}_m)}{[1 + \frac{c}{(1+r)b} \cdot \frac{u}{1-u}]Ks_m^2} \tag{22}$$

Finally, we can substitute for u in terms of q from (16) to give

$$\beta = \frac{1}{s_m^2} \cdot \mathrm{Cov}(\frac{\tilde{S}}{K}, \tilde{R}_m) \cdot \frac{1}{q}. \tag{23}$$

Here, the ratio S/K is the capital turnover ratio or the sales revenues generated per dollar of investment in capital. This is commonly referred to as the "asset turnover ratio."

The final difficulty in estimating the model is that the systematic risk in (23) is a "firm" β. Unfortunately, most major corporations have both debt and equity outstanding so there is no single security that allows us to estimate the overall firm β. Instead, we are left with estimating the β for a security instead of the entire firm. Specifically, we estimate the β for the equity of the firm which reflects both overall firm risk and the additional effects of financial leverage. To account for the effect of debt usage on the equity β of the firm we make an adjustment developed by Hamada [1972].

Denote the total value of the firm as the sum of the values of the outstanding securities

$$V = V_B + V_E \tag{24}$$

where V_B and V_E are the respective values of the bonds and the equity securities. Then as Hamada shows, the β for the equity can be expressed as

$$\beta_E = \beta\left(\frac{V_B + V_E}{V_E}\right). \tag{25}$$

In other words, the β for a levered firm's equity is the overall firm β multiplied by the ratio of firm value to equity value.

Finally, we can express the equity β as

$$\beta_E = \frac{1}{s_m^2} \cdot \mathrm{Cov}\left(\frac{\tilde{S}}{K}, \tilde{R}_m\right) \cdot \frac{1}{q} \cdot \left(1 + \frac{V_B}{V_E}\right). \tag{26}$$

The first firm-specific term, $\mathrm{Cov}(\frac{\tilde{S}}{K}, \tilde{R}_m)$, represents the systematic "business risk" of the firm as measured by the relationship of the firm's capital turnover in relationship to the rest of the market portfolio. The second term, $1/q$, is the inverse of the firm's market power as measured by Tobin's q. The final term, V_B/V_E, reflects the capital structure or leverage of the firm. This multiplicative relationship indicates that the firm's systematic risk is positively related to business risk and leverage and negatively related to the firm's market power.

Furthermore, as noted by Bowman [1980], the risk class concept of Modigliani and Miller [1958] points to the possibility of differential business risk across industries. That is, a portion of beta could be explained by the use of intercept dummy variables (D). In the context of multiple regression analysis, the intercept dummy variables based upon industries will capture that portion of beta which varies systematically between industries. Thus, the model at this point can be stated functionally as:

$$\beta_E = f(\mathrm{Cov}(\frac{\tilde{S}}{K}, \tilde{R}_m), q, \frac{V_B}{V_E}, D).$$

III. Sample Selection and Measurement of Variables

Because of the technical problem involved in the measurement of Tobin's q, firms comprising the 1978 Standard and Poor's 400 provide the initial sample for our empirical analysis. Then, data availability criteria are imposed to ensure continuous data on the COMPUSTAT and CRSP tapes for the period from 1969 to 1978. The remaining 116 firms are then classified according to their two-digit Standard Industry Classification (SIC) Code. Because of the use of dummy variables in the model, the inclusion of firms from industries with only a small number of firms is insufficient. In an attempt to preserve high degrees of freedom, the seven largest industry groups are chosen. This gives a sample of 94 firms distributed according to SIC Code as shown in Table 1.

Insert Table 1

In what follows we address the measurement issues. First, beta defined by the CAPM is not directly observable. The market model is commonly used empirically to obtain a surrogate. We employ 120 monthly excess returns in the market model so that the nonstationarity problem of beta is reduced to a minimum.

The systematic business risk variable COV is the covariance between capital turnover ratio and annual return on the market portfolio. This variable is very similar to the accounting beta used in the literature.

The firm's q ratio, it is recalled, is the ratio of the firm' market value to the replacement cost of its assets. The estimation of q is similar to procedures described in Lindenberg and Ross [1981] and Chappell and Cheng [1982, 1984]. It includes adjustments for the baises induced by inflation in the reported values of property, plant and equipment, and inventories and by interest rate changes in the reported value of debt. Details of the estimation procedure are available from the authors. For the firms in our sample, we have averaged q ratios for the period from 1969 to 1978.

As shown in section II, the leverage variable $\frac{V_B}{V_E}$ is measured as the ratio of market value of debt to market value of common equity. Since the book value measure of leverage has been intensively used in the literature, both market value and book value measures (LM and LB) are tested. In order to obtain a stable measure, we average the debt to equity ratio over the ten year period.

IV. Hypothesis and Empirical Results

As shown in section II of this paper, market power as measured by Tobin's q is theoretically negatively correlated with beta. Hence, the primary null hypothesis is:

> H_0: Market power as measured by Tobin's q is not statistically correlated with market beta.

A multiple regression analysis of the full model presented in (26) constitutes the principal test of the null hypothesis. Since all three variables, COV, q, and LM (or LB) are in a multiplicative relationship with β_E, we take natural logarithms on all variables and add industry dummy variables in the following multiple regressions:

$$\ln \beta_E = \alpha_0 + \alpha_1 \ln \text{COV} + \alpha_2 \ln \text{LM} + \alpha_3 \ln q + \sum_{i=1}^{6} \alpha_{i+3} D_i + \varepsilon \qquad (27)$$

where $\hat{\alpha}_1$ and $\hat{\alpha}_2$ are hypothesized to be positive and $\hat{\alpha}_3$ negative. The significance of $\hat{\alpha}_3$ is a direct test of the null hypothesis.

To investigate the hypothesized relationship further, we first examine the correlation matrix for the variables used as shown in Table 2. It is found that there is a problem of multicollinearity between market power and leverage measures, with a correlation coefficient of -0.526. This finding has been documented in industrial organization studies.[2]

Insert Table 2

Furthermore, examination of the latent vectors and roots of the nine independent variables in equation (27), which are presented in Table 3, indicates more precisely that these variables are highly correlated and that the market power and leverage variables are the main sources of multicollinearity. Because the presence of multicollinearities in a data base generally inflates ordinary least squares (OLS) estimator variances, the OLS estimates are very unstable, even though unbiased.

The principal component regression (PCR) technique[3] is used to alleviate the problem of multicollinearity. Gunst and Mason [1980] show that principal component coefficient estimates eliminate multicollinearities from the OLS estimators, thereby greatly reducing estimator variance while attempting to introduce only a small amount of bias. Principal component estimates are biased, but more stable with smaller variances than the OLS estimate. We first transform the independent variables into an equal number of components that are linear combinations of the independent variables and then eliminate the components associated with very small (near zero) latent roots. The critical value (the small cutting-off value) for the latent roots should be large enough to eliminate multicollinearity, yet small enough to minimize the bias resulting from the omitted components.[4]

The PCR results of equation (27) are shown in Table 4.[5] The coefficient of the market power variable, $\hat{\alpha}_3$, is negative and significant at 5 percent level.[6] Therefore, the null hypothesis is rejected. Market power as measured by Tobin's q indeed is statistically correlated with market beta. This finding is important in the sense that it supports Sullivan [1978, 1982] in that market power reduces a firm's systematic risk and thus its cost of equity capital. Most importantly, this result supports the hypothesis testing derived from an integrated theoretical model, which was absent in Sullivan and Curley, et. al.

Furthermore, our results confirm the existence of other variables in addition to market power as determinants of systematic risk. First, the coefficient of the systematic business risk term is positive although not statistically significant. Second, the leverage variable is positive and significant at the 1% level, a result consistent with earlier findings in the finance literature. Finally, the industry dummy variables play a significant role in explaining inter-industry differences in betas. In fact, the industry dummy variables may pick up systematic risk differences between industries more effectively than the business risk term, COV. Nevertheless, firm-specific variables explain a significant portion of individual firm betas.

Insert Table 3

Insert Table 4

VI. Summary

In this paper we investigate the relationship between a firm's systematic risk and it's market power as measured by Tobin's q, the ratio of market value to replacement cost of the capital stock. Starting from the earlier theoretical work of Subrahmanyam and Thomadakis [1980], we develop a testable model relating the firm's beta to its q-ratio. Our model predicts and our empirical results confirms that beta is positively related to business risk as measured by the sensitivity of firm sales to aggregate economy sales, positively related to financial leverage as measured by debt-equity ratios, and negatively related to market power as measured by Tobin's q.

Our results would seem to have several implications for the study of industry structure and performance. First, it is important to understand the underlying cause of the relationship between systematic risk and market power. Note that by virtue of using the capital asset pricing model as the description of the underlying security market equilibrium we are assuming that the firm is a price-taker in the capital market. In other words, the existence of market power in the product market in no way produces market power in the securities market. The lower systematic risk and resultant lower cost of equity capital, ceteris paribus, for a firm with a q-ratio in excess of unity arises because it generates higher expected dollar returns per unit of product price risk, s_{em}, and not from any non-competitive access to the capital market. Thus, it is the higher expected return per unit risk that produces a lower beta and a lower cost of equity capital.

Second, it should be noted that assuming that there exists a common cost of capital for an entire industry is not appropriate even as an approximation. While our empirical results indicate that there is a strong industry effect, or "business risk" component in beta, it can also be seen that individual firm variables, in particular leverage and market power, have significant influences on individual firm betas. Thus, there is good reason to believe that assigning a single "industry beta" to individual firms within an industry will obscure important cross-sectional differences between firms.

Footnotes

[1] See Tobin and Brainard [1968, 1977] and Tobin [1969, 1978].

[2] For example, see Curley, Hexter, and Choi [1982].

[3] The critical value for the latent roots in the PCR is 0.2.

[4] For more detailed information on principal component regression analysis, see Mansfield, Webster, and Gunst [1977], and Gunst and Mason [1980].

[5] Because the PCR results with book value leverage measure, LB, are analogous, we do not report them here.

[6] We also include two ad hoc variables in the test, growth (the geometric mean annual rate of growth in sales from 1969 through 1978) and size (1978 sales in natural logarithm). The coefficient of the market power variable is still negative and significant at 10 percent level.

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Table 1

Firms Distribution by SIC Code

2-Digit SIC Code	Industry Description	Firms
20	Manufacturing-Food	15
28	Apparel and other Finished Products	11
29	Petroleum Refining	8
35	Manufacturing-Machinery	30
36	Electrical & Electronic Machinery	8
37	Transportation Equipment	14
38	Measuring and Analyzing Instruments	8
		94

Table 2

Correlation Matrix

	β_E	COV	LB	LM	q
β_E	1.000	0.234	0.273	0.282	-0.031
COV		1.000	0.251	0.095	-0.220
LB			1.000	0.594	-0.414
LM				1.000	-0.526
q					1.000

Table 3

Latent Vectors and Roots of the Independent Variables of (27)

$$\ln \beta_E = \alpha_0 + \alpha_1 \ln COV + \alpha_2 \ln LM + \alpha_3 \ln q + \sum_{i=1}^{6} \alpha_{3+i} D_i^{\phi} + \varepsilon$$

Latent Roots	Corresponding Latent Vectors of Independent Variables								
	lnCOV	lnLM	lnq	D_1	D_2	D_3	D_4	D_5	D_6
.25756982+001	-.12132	-.56150	.58361	.27244	-.08506	-.15344	.03122	-.31614	.35139
.14015676+001	.39020	-.04747	-.07294	.05319	.16583	-.73258	.10045	.44673	.25201
.11805583+001	.37678	-.07833	-.03749	-.57956	-.12748	.28745	-.23948	-.03899	.59737
.11223237+001	-.04598	-.04606	-.06546	-.34249	.74387	-.09138	.34681	-.43842	-.00030
.10981577+001	-.01935	.03418	.03698	-.26482	-.49670	-.02604	.82423	.01446	-.00002
.91537346+000	.77615	.05921	-.06845	.37809	-.06940	.12110	.10984	-.42874	-.17629
.37030893+000	-.25202	.56976	-.21599	.33563	-.05822	-.10934	.05466	-.29651	.58848
.19213911+000	.04588	-.13024	-.01737	.36326	.34557	.56506	.34189	.46651	.27467
.14387292+000	.14331	.57266	.77161	-.10988	.14607	.04712	-.00309	.13103	-.05768

ϕ: D_1 = industry SIC Code #28;

D_2 = industry SIC Code #29;

D_3 = industry SIC Code #35;

D_4 = industry SIC Code #36;

D_5 = industry SIC Code #37;

D_6 = industry SIC Code #38.

Table 4

PCR Regression Results for (27)

$$\ln \beta_E = \alpha_0 + \alpha_1 \ln COV + \alpha_2 \ln LM + \alpha_3 \ln q + \sum_{i=1}^{6} \alpha_{3+i} D_i + \varepsilon$$

$\hat{\alpha}_0$	$\hat{\alpha}_1$	$\hat{\alpha}_2$	$\hat{\alpha}_3$	$\hat{\alpha}_4$	$\hat{\alpha}_5$	$\hat{\alpha}_6$	$\hat{\alpha}_7$	$\hat{\alpha}_8$	$\hat{\alpha}_9$	R^2	F
0.313	0.021 (1.09)	0.053 (3.06)**	-0.036 (-2.08)*	0.029 (0.48)	-0.407 (-6.54)*	0.091 (2.97)**	0.160 (2.51)*	-0.063 (-1.26)	0.178 (2.15)*	0.41	8.56**

t values are in parentheses.

**: Significant at 1% level.
*: Significant at 5% level.
+: Significant at 10% level.