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by

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Abstract

This paper examines the relationship between expected returns and Tobin's q, β and market value. Our basic idea is to use Tobin's q ratio, the ratio of the market value of a firm to the replacement cost of its assets, as an additional variable to explain the expected common stock returns. The results support the single risk CAPM specifications in an unconditional form for stocks listed on the London Stock Exchange from July 1975 to June 1996. The unbalanced sample consists of 1420 UK quoted non-financial firms. In contrast to Fama and French's (1992) US study, for the sample of UK non-financial firms, β is able to explain cross-sectional differences of expected returns at the individual stock level. We find the relationship between β and the average monthly return is significant, and that the Tobin's q ratio and market value are strongly significant. These results confirm the existence of a Tobin's q effect; stocks with a smaller Tobin's q yield a higher average return.

Key words: stock returns, stock market anomalies, Tobin's q

JEL classification: G12, G31

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1. Introduction

One important problem in modern financial economics is the quantification of the trade-off between risk and expected return. Although common sense suggests that risky investments such as the stock market will generally yield higher returns than investments free of risk. Many theoretical models are proposed to address this issue. The Capital Asset Pricing Model (CAPM) of Sharpe (1964), Lintner (1965) and Black (1972) is probably viewed as the most important of these. According to the CAPM, in equilibrium, the expected returns on securities are a positive linear function of their market βs and also that the market βs suffice to describe the cross-section of expected returns. Over the past twenty years a number of empirical studies have examined the CAPM. These studies find that when the return on the value-weighted index of stocks is used as a proxy for the return on the market portfolio of all assets in the economy, there is little empirical support for the CAPM.

The general reaction to the this has been to focus on alternative asset pricing models. These models include the Intertemporal Capital Asset Pricing Model of Merton (1973), the Arbitrage Pricing Theory of Ross (1976) and the Consumption Capital Asset Pricing Model of Breeden (1979). The empirical support for the consumption based models has been equally weak[1]. The support for the linear factor models and the Intertemporal Capital Asset Pricing Models has been more promising[2].

At the same time, there are many empirically motivated models which propose some firm-specific variables as explanations of the cross-sectional differences of expected returns. Some remarkable examples in this category include size (Banz, 1981), earning-to-price (Basu, 1983), leverage (Bhandari, 1988), book-to-market equity (Rosenberg, Reid and Lanstein, 1985; Fama and French, 1992), cash flow-to-price (Chan, Hamao and Lakonishok, 1991) and past sales growth (Lakonishok, Shleifer and Vishny, 1994). A common feature in all these models is that the expected returns are linear in some firm-specific variables. In the face of so many competing models, one of the important tasks of empirical researchers is to find out which model does the best job in explaining the cross-section of average stock returns. In practice, this question is often addressed using regression methodologies such as Cross-Sectional Regressions (CSR),

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[1] Cochrane and Hansen (1992) give a literature review and a summary of the empirical failure of the consumption based model.
[2] Fama (1991) and Connor and Korajczyk (1995) provide recent selective reviews.

Generalized Method of Moments (GMM) or Seemingly Unrelated Regressions (SUR). The most widely used methodology is the CSR developed by Fama and MacBeth (1973), in which the accepted practice is to test whether a variable (or variables) has explanatory power not captured by the CAPM beta. Thus in the recent debate on the validity of the CAPM, the main point at issue is whether or not the betas and firm-specific variables are statistically, significantly priced. However, little attention is paid to whether or not these variables are economically significant in explaining the cross-section of average stock returns.

A number of explanations for the observed predictive ability have been suggested. One explanation is that certain fundamental variables measure the riskiness of stocks so the correlation between the variables and subsequent returns reflects compensation for bearing risk (Fama and French, 1993). Others have argued that the variables allow investors to identify stocks that are mispriced, thus creating opportunities for realised returns in excess of what is required to compensate investors for risk (Lakonishok, Shleifer and Vishny, 1994). A third explanation is that the observed predictive ability is an artifact of the research design and database of the conducted study (data snooping bias, selection bias and survivorship bias). Hence, the predictive ability of certain variables would be reduced or would vanish if different methodology and data were used. Amihud, Christensen and Mendelson (1992) find that when a different statistical methods (joint pooled cross-section and time-series estimation, and generalised least squares estimation) are used, the estimated relation between average return and β is positive and significant. Black (1993a) and (1993b) suggests that the size effect noted by Banz (1981) could simply be a sample period effect: it is observed in some periods and not in others. Breen and Korajczyk (1993) find that the effect of the book to market equity ratio is much weaker than that reported by Fama and French (1992). Jagannathan and Wang (1996) abandon the assumption that the broad stock market indexes are adequate. Following Mayers (1972), they include human capital in their measure of wealth. Since human capital is, of course, not directly observable, they use a proxy for it. They choose the growth of labour income. Kothari, Shanken and Sloan (1995) claim that using βs estimated from annual rather than monthly returns produces a stronger positive relation between average returns and β. Also they find that the relation between average return and book to market equity observed by Fama and

French (1992) and others is seriously exaggerated by survivorship bias in the COMPUSTAT sample.

The purpose of our study is to use Tobin's q ratio, as an additional variable in explaining the expected common stock returns and trying to assess whether it possible to predict stock returns using Tobin's q ratio. The results of this study suggest that this is the case. Additionally, we use the market value of equity (a proxy for size) and β as the control variables in the regressions. The selection of such fundamental variables has been guided more by intuition than by any explicit theoretical model. We chose the Tobin's q as an explanatory variable because it is underpinned by a theory which allows us to suggest that this variable is a proxy for more fundamental sources of risk. Low Tobin's q suggests poor firm performance requiring higher expected returns. So that stocks with a smaller Tobin's q ratio yield a higher average return. Another reason for undertaking this study is that little, if any, empirical research evidence is available in the literature at this moment about the relationship between the fundamental variables referred to above and the stock returns of firms in the UK. The main empirical studies that have been reported, referred to above, are based on data of firms in the US.

Tobin's q has gained broad acceptance as a measure of firm performance. Tobin (1969) originally introduced the Tobin's q ratio in attempt to explain aggregate investment behaviour in the economy. He argued that if the Tobin's q exceeded unity, firms would have an incentive to invest since the value of their new capital investment would exceed its cost and that they would stop investing only when q is less than unity since the value of their new capital investment is worth less than its replacement cost. When Tobin's q is less than 1, it may be cheaper to acquire assets through merger rather than through buying new assets. An increasing number of empirical studies have occupied the Tobin's q ratio to classify firms according to their relative performances. In Table 1 some of those empirical studies are listed.

Our findings indicate that in the univariate regression, β can explain cross-sectional variations in returns on the London Stock Exchange over the period from July 1980 to June 1996. The results are consistent with the size effect (smaller stocks have higher average returns). Our results confirm the existence of a Tobin's q effect; stocks with a smaller Tobin's q yield a higher average return.

Table 1. Empirical Studies which have Employed the Tobin's q

Industry Structure-Performance Relationship:
- Lindenberg and Ross (1981)
- Smirlock, Gilligan and Marshall (1984)
- Hirschey (1985)

The Impact of Taxes on Investment Decisions:
- Salinger and Summers (1983)

The Relationship between Managerial Performance and Tender Offer Gains:
- Chappell and Cheng (1984)
- Hasbrouck (1985)
- Lang, Stulz and Walkling (1989); (1991)
- Servaes (1991)

Market Power-Systematic Risk Relationship:
- Chen, Cheng and Hite (1986)
- Lee, Liaw and Rahman(1990)
- Sun (1993)
- Peyser (1994)
- Lee, Chen and Liaw (1995)
- Wong (1995)

The Relation between Management Ownership Structure and Corporate Value:
- Morck, Shleifer and Vishny (1988)
- McConnell and Servaes (1990)
- Chen, Hexter and Hu (1993)

The Impact of the Announcement of Dividend Changes on Market Value:
- Lang and Litzenberger (1989)
- Denis, Denis and Sarin (1994)

The Role of Boards of Directors in Disciplining Senior Management:
- Morck, Shleifer and Vishny (1989)

The Agency-Cost Motivations for Recapitalizations and Leveraged Buyouts:
- Lehn, Netter and Poulsen (1990)

The Payoff from Sophisticated Capital Budgeting Techniques:
- Myers, Gordon and Hamer (1991)

Management's Financial Reporting Decisions:
- Skinner (1993)

Board Size and Firm Value:
- Yermack (1996)

The Benefits-or Lack Thereof-of Corporate Diversification:
- Lang and Stulz (1994)

The remainder of the paper is organised as follows. Section 2 describes our data and estimation of Tobin's q. In Section 3, we present the methodology for testing the relationship between stock returns and fundamental variables. Section 4 contains our results from both one-way and two-way classification by financial attributes of each firm and the results from regression models. Section 5 offers conclusions.

2. Data Description and Estimation of Tobin's q

2.1. Data Description

We rely on data from the London Share Price Database (LSPD) and Datastream to conduct our empirical analysis. The unbalanced sample consists of 1,420 UK non-financial companies. We excluded financial companies because their leverage is strongly influenced by explicit (or implicit) investor insurance schemes such as deposit insurance. Furthermore, their debt-like liabilities are not strictly comparable to the debt issued by non-financial companies. The study also takes into account companies that have been delisted. In this way, we prevent the sample from suffering from survivorship bias which, as Banz and Breen (1986) find, might lead to distorted results.

We took monthly returns from the LSPD and all other variables from the Datastream. In the sample there exist companies with different accounting year-ends. Since we match accounting data for all accounting year-ends in calendar year t-1 with returns for July of year t to June of year t+1, the gap between matching returns and the accounting data varies across firms. We excluded companies with more than one class of ordinary share from our sample. We use a firm's market value (ME) at the end of December of year t-1 to compute the Tobin's q and market value at the end of June of year t to measure its size. We also use a firm's accounting variables at the end of December of year t-1. This means forming portfolios at the end of June year t (for each year), ensuring that our tests are predictive in nature - i.e. that we do not use information that is not actually available to the investor at the time of portfolio formation. We thus avoid a possible look-ahead bias (see Banz and Breen 1986).

The returns on the LSPD returns file are monthly, continuously compounded returns:

Continuously: $R_{it} = \ln\{(P_{it} + D_{it})/P_{it-1}\}$

where, P_{it} = the last traded price in month t;

D_{it} = dividends paid during month t; and

P_{it-1} = the last traded price in month t-1, adjusted for any capitalisation in order to make it comparable to P_{it}

In order to allow direct comparison with the US studies, because the latter have used discretely compounded, monthly returns, we convert all LSPD returns back to a discrete basis:

$$R_{it} = \exp[\ln\{(P_{it} + D_{it})/P_{it-1}\}] - 1 \Leftrightarrow$$

$$R_{it} = \{(P_{it} + D_{it})/P_{it-1}\} - 1 \Leftrightarrow$$

Discrete: $$R_{it} = (P_{it} + D_{it} - P_{it-1})/P_{it-1}$$

Where ln(.) denotes the natural logarithm, market value (lnME) and Tobin's q (lnq) is used in natural logarithm form[3].

2.2. The Estimation of Tobin's q

In our empirical analysis, we use an approximation of Tobin's q which requires[4] only basic financial and accounting information so as to avoid the data availability problems created by the estimation of the more theoretically correct Lindenberg and Ross (1981) (hereafter LR) Model[5]. The approximation of Tobin's q is defined as follows, based primarily upon the methodology developed by LR.

$$\text{Approximate Tobin's q} = \frac{\text{Comval} + \text{Prefval} + \text{Debt}}{\text{TA}}$$

where,

Comval = the year-end market value of the firm's common stock;

Prefval = the year-end book value of the firm's preferred stock;

Debt = the year-end book value of the firm's debt; and

TA = the firm's year-end book value of total assets.

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[3] Log transformation very often reduces heteroscedasticity. This is because log transformation compresses the scales in which the variables are measured, thereby reducing a ten-fold difference between two values to a two-fold difference.

[4] See Chung and Pruitt (1994) and Perfect and Wiles (1994).

[5] See Appendix for the estimation of this model.

Chung and Pruitt (1994) find that at least 96.6% of the total variability in the LR method is explained by Tobin's q the approximate ($R^2 = 0.966$). Similarly, Perfect and Wiles (1994) find that the correlation coefficients between the LR method and simple Tobin's q (very similar to approximate Tobin's q) is 0.931.

3. Methodology

We apply a somewhat similar methodology as Fama and French (1992) to our data set of non-financial firms. In the present research, 25 portfolios are formed. For every calendar year, firms are classified into five size portfolios[6], based on their market value of equity at the end of June of year t. For each size group, the β of each firm estimated using 24 to 60 months of past return data ending in June of year t and using the equally-weighted index of all quoted companies on the LSPD database. Firms that have less than 24 continuous monthly return observations are omitted. To avoid problems of "thin-trading" we employ a generalized Scholes and Williams estimator. Fowler and Rorke (1983) find that sum βs are biased when the market return is autocorrelated. Since our market index proxy is autocorrelated, to ensure a consistent estimate of βs, we divide the sum of βs (using five leading, one matching and five lagged market returns) by the τth-order autocorrelation coefficient of the monthly market returns. Thus,

$$\hat{\beta}_{it} = \frac{\sum_{\tau=-5}^{5} \hat{\beta}_{i\tau}}{1 + 2\sum_{\tau=1}^{5} \hat{\rho}_{m}^{\tau}}$$

where,

$\hat{\beta}_{i\tau}$ is the slope in the regression of R_{it} on $R_{m,\tau-t}$; and

$\hat{\rho}_{m}^{\tau}$ is an estimate of the τth-order autocorrelation coefficient of the monthly market returns.

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[6] Chan and Chen (1988) find that size produces a wide spread of βs within each group. As explained subsequently, this helps to reduce the errors in variables problem.

To make the variation of β unrelated to size, each size portfolio will be sub-divided into five portfolios on the basis of pre-ranking βs for individual stocks. In this way, we construct 25 portfolios that provide wide variations in these two variables. These grouping procedures produce portfolios with smaller estimated errors in β than those originally estimated at the individual firm level. Thus, the portfolio grouping method is applied to estimate the post-ranking βs in order to minimise the errors-in-variables (EIV) problem. The true βs are unobservable and, thus, estimated βs are used as a proxy for the unobservable βs. Since the independent variable in the CSR is measured with error, the second-pass estimator is subject to an EIV problem. Handa, Kothari, and Wasley (1989) and Kim (1995) show that the EIV problem induces an under-estimation of the price of beta risk and an over-estimation of the other CSR coefficients associated with fundamental variables that are observed without error such as firm size, book to market equity and earning to price. A greater correlation between the estimated βs and the fundamental variables causes more downward bias in the price of beta risk estimate and more exaggeration of the explanatory power of the fundamental variables. Several methods have been proposed to address the EIV problem. Aware of this problem Black, Jensen and Scholes (1972), Blume and Friend (1973) and Fama and MacBeth (1973) employ elaborate portfolio grouping procedures designed to minimise measurement error. A second method, developed by Litzenberger and Ramaswamy (1979) and refined by Shanken (1992), provides an adjustment for the standard errors to correct for the biases introduced by the EIV. Another method developed by Kim (1995) provides direct correction factors for the least squares CSR coefficients. However, whilst the above mentioned methods eliminate the EIV problem it is still subject for research which one does the best job.

Next the monthly returns on each of these portfolios for the next 12 calendar months (July t to June t+1) is computed. Portfolio monthly returns are calculated by equally weighting the returns on stocks in the portfolio. Firms with less than six observations during this 12 months period are excluded. This procedure is repeated for each calendar year from 1980 to 1995. This gives a time-series of equally weighted post-ranking monthly returns (192 observations) from July 1980 to June 1996 for each size-β portfolio. We used these post-ranking monthly returns to estimate the full-period, post-ranking βs for each size-β portfolio. In order to account for the fact that βs may vary over time we allocate the full-period post-ranking β of a size-β portfolio to each stock in the portfolio. Notice that this procedure does not mean that an individual company's β is constant through time; rather its β can change from one 12 month period to the next if it switches among the 25 size-β portfolios. So we create time-series for individual firms' βs.

The time-series averages of the slopes are calculated from the month-by-month Fama-MacBeth (1973) regressions of the cross-section of stock returns on the fundamental variables (β, Tobin's q and market value) to explain average returns. For each month in the sample period, a set of cross-sectional regressions is run using various combinations (see Table 4) of the above fundamental variables as explanatory variables and the monthly returns to each stock as the dependent variable. We use data on individual stock levels. As Lo and MacKinlay (1990) point out, the portfolio approach may bias test statistics and parameter estimates. Thus, it is preferable to use data on individual assets.

The average of cross-sectional estimates are used to present the coefficient of the variables and the t-test technique is used to assess the statistical significance of the independent variables where the value of the t-statistic is calculated as follows:

Defining $\hat{t}(\hat{\gamma}_j)$ as the t-statistic, we have

$$\hat{t}(\hat{\gamma}_j) = \frac{\hat{\gamma}_j}{\hat{\sigma}_{\gamma_j}}$$

where,

$$\hat{\gamma}_j = \frac{1}{T}\sum_{t=1}^{T}\hat{\gamma}_{jt}$$

and

$$\hat{\sigma}^2_{\gamma_j} = \frac{1}{T(T-1)}\sum_{t=1}^{T}(\hat{\gamma}_{jt} - \hat{\gamma}_j)^2$$

where,

$\hat{\gamma}_{jt}$ = the cross-sectional estimates for each t; $t = 1,\ldots,T$

$\hat{\gamma}_j$ = average of the cross-sectional estimates of $\hat{\gamma}_{jt}$;

$\hat{\sigma}_{\gamma_j}$ = the standard error of the $\hat{\gamma}_{jt}$;

T = the number of cross-sectional estimates (i.e. 192); and

T-1 = the degrees of freedom;

4. Empirical Results

4.1. Return Behaviour of One-Dimensional Classified Portfolios

Table 2 shows properties when 10 portfolios are formed every year on pre-ranking β (Panel A), on Tobin's q (Panel B) and on market value (Panel C). Definitions of each variable are as follows. Pre-ranking β is estimated using 24-60 monthly observations over the five year period ending June of year t. Tobin's q ratios are defined as the market value of the firm at the end of year t-1 plus the book value of the preferred stock plus the book value of the total debt divided by the book value of the total asset. Market value is measured by the natural log (lnME) at the end of June of year t which is denominated in millions of pounds. Returns is the time-series average of 192 monthly, equal-weighted portfolio returns from July 1980 to June 1996, in percent terms. β is the full-period, post-ranking equally-weighted portfolio β, estimated using monthly data from July 1980 to June 1996.

In Panel A of Table 2, we can see that there is no obvious relationship between average returns and pre-ranking βs. Similarly, there is no clear relation between market value and pre-ranking β. However, the highest β decile gives the highest average return and smallest market value. The second column shows that the post-ranking βs reproduce the ordering of the pre-ranking βs. Column one shows the negative relationship between Tobin's q and pre-ranking βs (see also Figure 1A).

From the second panel formed on Tobin's q in Table 2 we can see the negative relationship between Tobin's q and average returns. The smallest Tobin's q ratio portfolio earns 2.75% per month while the largest Tobin's q ratio portfolio earns 1.35% per month. The Tobin's q variable generates a return differential of 1.40% each month (16.80% on an annualised basis) between these extreme portfolios. We document that this will called a Tobin's q effect. We also find that the market value increases with the Tobin's q and β decreases with Tobin's q, leading us to believe that Tobin's q is related to both β and market value (see also Figure 1B).

In Panel C of Table 2 when portfolios are formed on market value alone, we can see a strong negative relationship between market value and average returns, commonly referred to as the size effect. Average returns fall from 3.32% for small-ME portfolio to 1.56% for large-ME portfolio. There is a strong positive relationship between post-ranking β and average returns. Note that the portfolio βs decline with increasing market value (almost perfectly correlated), from 1.28 for small-ME portfolio to 0.60 for large-ME portfolio. The relationship between Tobin's q and average returns is consistent with the results in Panel B (see also Figure 1C).

In summary, with this one-dimensional classification scheme, we find that the post-ranking βs reproduce the ordering of the pre-ranking βs, a negative relationship between average returns and market value and a strong negative relationship between average returns and Tobin's q. Since βs of market value portfolios are perfectly correlated with market value, we can further rank portfolios by a two-dimensional classification scheme and analyse this sample further.

4.2. Return Behaviour of Two-Dimensional Classified Portfolios

Table 3 summarises the portfolio statistics when 25 portfolios are formed by the two-way classification scheme by market value and pre-ranking β. Average monthly returns are shown in Panel A, average market value in Panel B and post-ranking βs in Panel C (see also Figure 2).

Panel A of Table 3 shows that smaller market value portfolios generally produce higher average monthly returns. The pre-ranking β sort produces no obvious relation between β and average returns. In Panel B of Table 3, it is clear that the pre-ranking β sort is not a refined market value sort. So in any market value quintile, the average market value are almost similar across the pre-ranking β sorted portfolios.

Panel C of Table 3 shows that forming portfolios on market value and pre-ranking βs rather than on market value alone produces wide variation in post-ranking βs. It was our original intention to produce 25 two-way classification portfolios. Let us investigate whether we have succeeded in producing them. From Panel C in Table 2, sorted on market value alone, the variation in post-ranking βs is from 0.60 to 1.28 (spread 0.68). Across all 25 two-way classification portfolios, the variation in post-ranking βs ranges from 0.55 to 1.58 (spread 1.03), a spread of 1.5 times that produced with market value portfolios alone.

In summary, with this two-dimensional classification scheme, we find that the pre-ranking β sort produces strong variation in post-ranking βs that is unrelated to market value and that market value was strongly related to average returns while this was not obvious for β.

4.3. Fama-MacBeth type Cross-Sectional Regressions

From the informal analysis of the data in the previous subsections, we find that Tobin's q and market value are strongly related to average returns, while β is not obvious. To confirm this, we run the month-by-month Fama-MacBeth regressions of the cross-section of stock returns on Tobin's q, market value, and β. Table 4 presents the results for these regressions at the individual security level. The Table shows the average coefficients from 192 monthly (July 1980 to June 1996) cross-sectional regressions of stock returns on various combination of those variables. The figure in parenthesis is the t-statistic which is the average slope divided by its time-series standard error.

The first three models are the univariate regressions on β, Tobin's q and market value. When β is the only explanatory variable, the relationship between average returns and β is significant, with a t-statistic of 2.74. This indicates that β has the power to explain average returns. This result contrasts with the insignificant positive coefficient found by Fama and French (1992) for the period 1963 to 1990 in the US, and is similar to the results of a study by Strong and Xu (1997) for the period 1973 to 1992 in the UK. However, when Tobin's q and market value are included in the regressions as the control variables (model D, F and G), the coefficient of β has no explanatory power and eventually changes its sign, except in model D where its sign remains positive.

Model B of Table 4 confirms the importance of Tobin's q in describing the cross-sectional differences of expected returns. The average slope from the monthly regressions of returns on Tobin's q alone is -0.64%, with a t-statistic of -6.37. This Tobin's q relation is stronger than the small-firm effect. The Tobin's q does not replace

Table 2. Properties of Portfolios Formed on Pre-Ranking β or Tobin's q or Market Value: July 1980 to June 1996

In each panel the stocks are grouped in to 10 portfolios by a different variable, and the grouping procedure is repeated every year at the end of June. Tobin's q is measured using accounting variables and market value (ME) at the end of December of year t-1. Pre-ranking β is estimated using 24-60 monthly observations over the five year period ending June of year t. Market value is measured by using the natural log (lnME) at the end of June of year t which is denominated in millions of pounds. Returns is the time-series average of 192 monthly, equal-weighted portfolio returns, in percent terms. β is the time-series average of the full-period, post-ranking equally-weighted portfolio β, estimated using monthly returns. Tobin's q and lnME are the time-series average of the annual values of these variables in each portfolio. N denotes the average number of securities in each portfolio.

Panel A: Portfolios Formed on Pre-Ranking β

	Tobin's q	β	Return %	lnME	N
Small-β	1.10	0.96	1.82	2.98	81.6
β-2	0.99	0.86	1.84	3.70	81.6
β-3	0.96	0.78	1.70	3.77	81.6
β-4	0.98	0.78	1.81	3.77	81.6
β-5	0.92	0.80	1.76	3.69	81.6
β-6	0.94	0.86	1.93	3.49	81.6
β-7	0.88	0.93	1.94	3.33	81.6
β-8	0.87	1.02	1.79	3.13	81.6
β-9	0.89	1.14	1.92	2.77	81.6
Large-β	0.97	1.32	2.10	2.35	81.7

Panel B: Portfolios Formed on Tobin's q

	Tobin's q	β	Return %	lnME	N
Small-q	0.31	1.15	2.75	1.73	81.6
q-2	0.43	1.06	2.34	2.40	81.6
q-3	0.52	1.00	2.15	2.80	81.6
q-4	0.60	0.96	2.03	3.11	81.6
q-5	0.70	0.91	1.78	3.47	81.6
q-6	0.79	0.90	1.70	3.60	81.6
q-7	0.93	0.87	1.74	3.81	81.6
q-8	1.10	0.87	1.44	3.92	81.6
q-9	1.42	0.86	1.32	4.01	81.6
Large-q	2.71	0.86	1.35	4.13	81.7

Panel C: Portfolios Formed on Market Value

	Tobin's q	β	Return %	lnME	N
Small-ME	0.58	1.28	3.32	0.46	81.6
ME-2	0.66	1.26	2.21	1.32	81.6
ME-3	0.76	1.14	2.02	1.87	81.6
ME-4	0.82	1.10	1.54	2.36	81.6
ME-5	0.95	0.96	1.77	2.84	81.6
ME-6	1.03	0.94	1.60	3.32	81.6
ME-7	1.16	0.78	1.51	3.86	81.6
ME-8	1.19	0.77	1.47	4.51	81.6
ME-9	1.21	0.62	1.60	5.43	81.6
Large-ME	1.15	0.60	1.56	7.02	81.7

Table 3. Portfolios Formed on Market Value and then on Pre-Ranking β: July 1980 to June 1996

In each panel the stocks are first sorted into five size portfolios based on market value of equity (lnME). Within each size portfolio firms are sorted into five portfolios based on pre-ranking β to form 25 size-pre-ranking β portfolios. The monthly equal-weighted returns on each of these portfolios for the next 12 calendar months (July t to June t+1) are then computed. This grouping procedure is repeated every year at the end of June from 1980 to 1995. Pre-ranking β is estimated using 24-60 monthly observations over the five year period ending June of year t. Market value is measured by the natural log (lnME) at the end of June of year t which is denominated in millions of pounds. Returns is the time-series average of 192 monthly, equal-weighted portfolio returns, in percent terms. lnME is the time-series average of the annual values of the market value in each portfolio. Post-ranking β is the time-series average of the full-period, post-ranking equally-weighted portfolio β, estimated using monthly returns.

Panel A: Average Monthly Returns (in Percent)

	Low-β	β-2	β-3	β-4	High-β
Small-ME	1.48	1.26	1.55	1.20	1.40
ME-2	1.01	1.04	1.26	0.83	1.15
ME-3	0.46	1.24	1.06	1.15	0.62
ME-4	0.73	1.12	1.05	0.97	0.63
Large-ME	1.02	1.14	1.17	1.04	0.60

Panel B: Average Market Value (lnME)

	Low-β	β-2	β-3	β-4	High-β
Small-ME	1.21	1.18	1.23	1.22	1.12
ME-2	2.34	2.35	2.35	2.32	2.31
ME-3	3.28	3.31	3.28	3.28	3.25
ME-4	4.38	4.42	4.41	4.40	4.44
Large-ME	7.10	7.15	6.95	7.12	6.88

Panel C: Full-Period Post-Ranking βs

	Low-β	β-2	β-3	β-4	High-β
Small-ME	1.23	1.02	1.31	1.23	1.58
ME-2	1.01	0.98	0.93	1.17	1.54
ME-3	1.00	0.81	0.83	1.08	1.11
ME-4	0.80	0.69	0.66	0.80	0.92
Large-ME	0.58	0.55	0.59	0.56	0.78

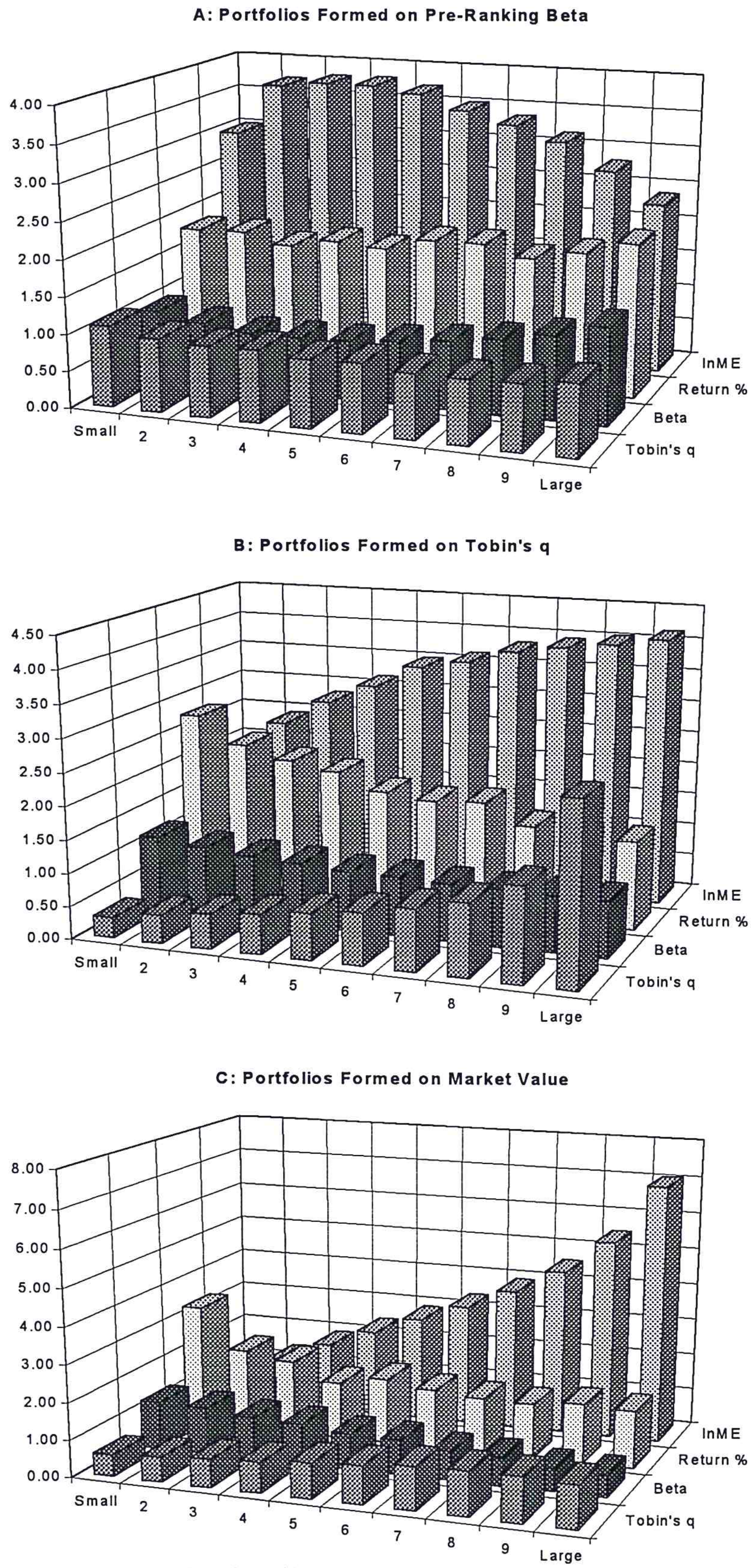

Figure 1. Properties of Portfolios Formed on Pre-Ranking Beta, Tobin's q and Market Value

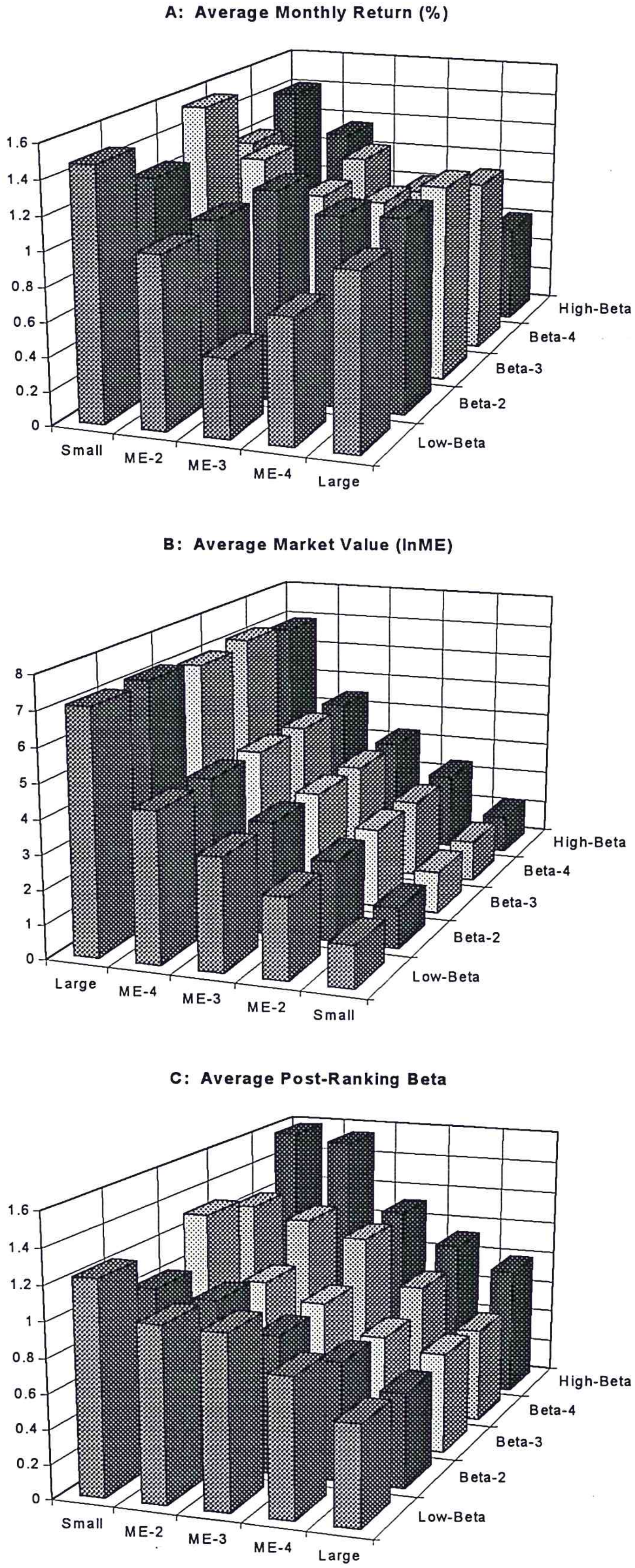

Figure 2. Portfolios Formed on Market Value and then on Pre-Ranking Beta

market value in describing average returns. However, when both Tobin's q and market value are included in the regressions (Model E and G), Tobin's q is more significant (t-statistic of -5.11 and -5.22) than market value (t-statistic of -2.36 and -3.08). The Tobin's q effect (stocks with a smaller Tobin's q yield a higher average return) is thus robust in the July 1980 to June 1996 returns on UK stocks.

Model C of Table 4 shows that the market value has a significant negative coefficient of -0.20%, with a t-statistic -3.48. This reliable significant negative correlation remains when other explanatory variables are incorporated into the regression (Model E, F and G). This result is consistent with the size effect.

Table 5 reports the results of the empirical analysis for two subperiods: Pre-Big Bang period from July 1980 to June 1986 (Panel A) and the Post-Big Bang period from July 1986 to June 1996 (Panel B). We choose the Big Bang event as a breakpoint to divide the time period into two subperiods because the reforms were important in the London Stock Exchange with consequences such as substantial gain in its cost efficiency and volume. The sign of the coefficients in both subperiods remain the same as those in the Table 4 which presents the results for the full sample period. The significance level in each subperiod is lower than in the full period but the coefficients are still significant except in one case (Panel B Model E) where the coefficient of market value alter insignificant (t-statistic of -1.57).

Table 6 shows results from the yearly cross-sectional OLS regressions at the individual stock level. We follow the same procedure that we used to construct Table 4. The only difference is that here we use yearly stock returns instead monthly stock returns. A serious problem can be created by the fact that the coefficients and the t-statistics are based on 16 observations. This bases the interpretation of the coefficients on the small sample properties of the time-series t-statistics. Moving to annual regressions does not affect the signs of the coefficients and it affects t-statistics only slightly.

4.4. Seasonal variation

A growing number of empirical studies have documented unusual price behaviour in the month of January. In studying the impact of firm-specific variables on stock returns, it is therefore of interest to examine January separately from other months. Keim (1983), who first documented the January effect, shows that the size effect is stronger in January. Tinic and West (1984) report that the return premium of β is also higher in January and not statistically significant in non-January months.

Table 7 presents average regression coefficients separately for January and non-January months. Focusing on the univariate regressions, we can see that the coefficient for β and market value are significant only in non-January while that for Tobin's q is significant in both January and non-January months. The average January slopes for Tobin's q are essentially larger than during the rest of the year. However, the strong relationship between Tobin's q and average stock returns is not a phenomenon specific to the month of January, with higher t-values in non-January months.

5. Conclusions

Although the Capital Asset Pricing Model (CAPM) is a theoretically attractive model, the literature points to a number of empirical difficulties, with the result that a variety of empirical models have been put forward. Prominent among these are those that use variables that relate to firm market value and book to market equity. This paper examines the relationship between average returns and Tobin's q, β and market value. We find that in the univariate regression, β is able to explain cross-sectional differences of expected returns on the London Stock Exchange for the period July 1980 to June 1996. However, this become insignificant when Tobin's q and market value are included in a multivariate regression. We then find that Tobin's q and market value are strongly significant. These results are consistent with the size effect. Our findings confirm the existence of a Tobin's q effect (stocks with a smaller Tobin's q yield a higher average return). In addition, the predictive role of the Tobin's q is not a phenomenon specific to the month of January.

The sign of the coefficients in both subperiods are still the same as for the full period. The significance level in each subperiod is lower than in full period. However, the coefficients are still significant. The results reported in Table 4 are thus not period-specific. The subperiod results thus support the conclusion that Tobin's q is consistently the most powerful variable for explaining the cross-section of average stock returns. Further research will be taken into different estimation methodologies and the idea that international data can not lead to different conclusions about the Tobin's q effects.

Table 4. Average Slopes (t-Statistics) for Fama-MacBeth Type Regressions of Stock Returns on β, Tobin's q and Market Value: July 1980 to June 1996 (using monthly returns)

The Tobin's q is measured using accounting variables and market value (ME) in December of year t-1. Firm market value lnME is measured in June of Year t. The average slope is the time-series average of the monthly regression slopes for July 1980 to June 1996, and the t-statistic is the average slope divided by its time-series standard error. The numbers in parentheses are t-values.

(A): $R_{it} = \gamma_{0t} + \gamma_{1t}\hat{\beta}_{it} + \varepsilon_{it}$

(B): $R_{it} = \gamma_{0t} + \gamma_{1t}\ln q_{it} + \varepsilon_{it}$

(C): $R_{it} = \gamma_{0t} + \gamma_{1t}\ln ME_{it} + \varepsilon_{it}$

(D): $R_{it} = \gamma_{0t} + \gamma_{1t}\hat{\beta}_{it} + \gamma_{2t}\ln q_{it}+\varepsilon_{it}$

(E): $R_{it}= \gamma_{0t} +\gamma_{1t}\ln q_{it} +\gamma_{2t}\ln ME_{it}+\varepsilon_{it}$

(F): $R_{it} = \gamma_{0t} + \gamma_{1t}\hat{\beta}_{it} + \gamma_{2t}\ln ME_{it}+\varepsilon_{it}$

(G): $R_{it} = \gamma_{0t} + \gamma_{1t}\hat{\beta}_{it} + \gamma_{2t}\ln q_{it} +\gamma_{3t}\ln ME_{it} + \varepsilon_{it}$

Variables	γ_0	β	lnq	lnME	Avg. R^2
(A)	0.93	0.97			0.011
	(2.06)	(2.74)			
(B)	1.60		-0.64		0.006
	(4.58)		(-6.37)		
(C)	2.48			-0.20	0.015
	(5.94)			(-3.48)	
(D)	1.16	0.51	-0.55		0.017
	(2.54)	(1.47)	(-6.16)		
(E)	2.12		-0.46	-0.14	0.019
	(5.36)		(-5.11)	(-2.36)	
(F)	3.13	-0.49		-0.26	0.019
	(6.75)	(-1.51)		(-4.03)	
(G)	2.82	-0.55	-0.47	-0.20	0.023
	(6.19)	(-1.69)	(-5.22)	(-3.08)	

Table 5. Subperiods Average Slopes (t-Statistics) for Fama-MacBeth Type Regressions of Stock Returns on β, Tobin's q and Market Value (using monthly returns)

The Tobin's q is measured using accounting variables and market value (ME) in December of year t-1. Firm market value lnME is measured in June of Year t. The average slope is the time-series average of the monthly regression slopes for each subperiod, and the t-statistic is the average slope divided by its time-series standard error. The numbers in parentheses are t-values.

(A): $R_{it} = \gamma_{0t} + \gamma_{1t}\hat{\beta}_{it} + \varepsilon_{it}$

(B): $R_{it} = \gamma_{0t} + \gamma_{1t}\ln q_{it} + \varepsilon_{it}$

(C): $R_{it} = \gamma_{0t} + \gamma_{1t}\ln ME_{it} + \varepsilon_{it}$

(D): $R_{it} = \gamma_{0t} + \gamma_{1t}\hat{\beta}_{it} + \gamma_{2t}\ln q_{it} + \varepsilon_{it}$

(E): $R_{it} = \gamma_{0t} + \gamma_{1t}\ln q_{it} + \gamma_{2t}\ln ME_{it} + \varepsilon_{it}$

(F): $R_{it} = \gamma_{0t} + \gamma_{1t}\hat{\beta}_{it} + \gamma_{2t}\ln ME_{it} + \varepsilon_{it}$

(G): $R_{it} = \gamma_{0t} + \gamma_{1t}\hat{\beta}_{it} + \gamma_{2t}\ln q_{it} + \gamma_{3t}\ln ME_{it} + \varepsilon_{it}$

Variables	γ_0	β	lnq	lnME	Avg. R^2
Panel A: Pre-Big-Bang Period (July 1980 to June 1986)					
(A)	1.65	1.01			0.009
	(2.38)	(2.06)			
(B)	2.13		-0.74		0.007
	(4.68)		(-4.44)		
(C)	3.25			-0.25	0.012
	(7.37)			(-3.09)	
(D)	1.81	0.36	-0.69		0.015
	(2.60)	(0.73)	(-4.30)		
(E)	2.68		-0.54	-0.16	0.017
	(6.80)		(-3.34)	(-1.93)	
(F)	4.36	-0.92		-0.35	0.017
	(6.12)	(-1.60)		(-3.40)	
(G)	3.83	-0.97	-0.56	-0.27	0.022
	(5.55)	(-1.68)	(-3.48)	(-2.53)	
Panel B: Post-Big-Bang Period (July 1986 to June 1996)					
(A)	0.50	0.95			0.013
	(0.85)	(1.95)			
(B)	1.28		-0.58		0.005
	(2.63)		(-4.59)		
(C)	2.03			-0.18	0.017
	(3.31)			(-2.20)	
(D)	0.77	0.59	-0.46		0.016
	(1.28)	(1.27)	(-4.43)		
(E)	1.78		-0.41	-0.13	0.020
	(3.04)		(-3.86)	(-1.57)	
(F)	2.39	-0.23		-0.21	0.020
	(3.99)	(-0.60)		(-2.50)	
(G)	2.22	-0.29	-0.41	-0.17	0.023
	(3.73)	(-0.76)	(-3.89)	(-1.95)	

Table 6. Average Slopes (t-Statistics) for Fama-MacBeth Type Regressions of Stock Returns on β, Tobin's q and Market Value: July 1980 to June 1996 (using yearly returns)

The Tobin's q is measured using accounting variables and market value (ME) in December of year t-1. Firm market value lnME is measured in June of Year t. The average slope is the time-series average of the yearly regression slopes for July 1980 to June 1996, and the t-statistic is the average slope divided by its time-series standard error. The numbers in parentheses are t-values.

(A): $R_{it} = \gamma_{0t} + \gamma_{1t}\hat{\beta}_{it} + \varepsilon_{it}$

(B): $R_{it} = \gamma_{0t} + \gamma_{1t}\ln q_{it} + \varepsilon_{it}$

(C): $R_{it} = \gamma_{0t} + \gamma_{1t}\ln ME_{it} + \varepsilon_{it}$

(D): $R_{it} = \gamma_{0t} + \gamma_{1t}\hat{\beta}_{it} + \gamma_{2t}\ln q_{it} + \varepsilon_{it}$

(E): $R_{it} = \gamma_{0t} + \gamma_{1t}\ln q_{it} + \gamma_{2t}\ln ME_{it} + \varepsilon_{it}$

(F): $R_{it} = \gamma_{0t} + \gamma_{1t}\hat{\beta}_{it} + \gamma_{2t}\ln ME_{it} + \varepsilon_{it}$

(G): $R_{it} = \gamma_{0t} + \gamma_{1t}\hat{\beta}_{it} + \gamma_{2t}\ln q_{it} + \gamma_{3t}\ln ME_{it} + \varepsilon_{it}$

Variables	γ_0	β	lnq	lnME	Avg. R^2
(A)	0.95	0.96			0.033
	(3.18)	(1.77)			
(B)	1.61		-0.64		0.025
	(4.35)		(-5.22)		
(C)	2.49			-0.20	0.035
	(3.97)			(-2.71)	
(D)	1.17	0.50	-0.55		0.050
	(4.32)	(0.95)	(-5.06)		
(E)	2.12		-0.46	-0.14	0.047
	(3.56)		(-4.81)	(-1.99)	
(F)	3.14	-0.50		-0.26	0.053
	(4.52)	(-0.79)		(-3.21)	
(G)	2.84	-0.55	-0.47	-0.21	0.065
	(4.24)	(-0.88)	(-4.89)	(-2.61)	

Table 7. Average Slopes (t-Statistics) for Fama-MacBeth Type Regressions of Stock Returns on β, Tobin's q and Market Value for January and non-January Months: July 1980 to June 1996

The Tobin's q is measured using accounting variables and market value (ME) in December of year t-1. Firm market value lnME is measured in June of Year t. The first two rows in each model shows average slopes and t-statistics for January only (16 observations) and the last two rows in each model shows average slopes and t-statistics for February to December (176 observations). The average slope is the time-series average of the monthly regression slopes for July 1980 to June 1996 and the t-statistic is the average slope divided by its time-series standard error. The numbers in parentheses are t-values.

(A): $R_{it} = \gamma_{0t} + \gamma_{1t}\hat{\beta}_{it} + \varepsilon_{it}$ (B): $R_{it} = \gamma_{0t} + \gamma_{1t}\ln q_{it} + \varepsilon_{it}$

(C): $R_{it} = \gamma_{0t} + \gamma_{1t}\ln ME_{it} + \varepsilon_{it}$ (D): $R_{it} = \gamma_{0t} + \gamma_{1t}\hat{\beta}_{it} + \gamma_{2t}\ln q_{it} + \varepsilon_{it}$

(E): $R_{it} = \gamma_{0t} + \gamma_{1t}\ln q_{it} + \gamma_{2t}\ln ME_{it} + \varepsilon_{it}$ (F): $R_{it} = \gamma_{0t} + \gamma_{1t}\hat{\beta}_{it} + \gamma_{2t}\ln ME_{it} + \varepsilon_{it}$

(G): $R_{it} = \gamma_{0t} + \gamma_{1t}\hat{\beta}_{it} + \gamma_{2t}\ln q_{it} + \gamma_{3t}\ln ME_{it} + \varepsilon_{it}$

Variables		γ_0	β	lnq	lnME
(A)	January	3.30	1.70		
		(2.16)	(1.21)		
	February-December	0.72	0.91		
		(1.52)	(2.48)		
(B)	January	4.24		-1.24	
		(3.88)		(-3.15)	
	February-December	1.36		-0.59	
		(3.74)		(-5.68)	
(C)	January	5.64			-0.24
		(3.78)			(-1.10)
	February-December	2.20			-0.20
		(5.11)			(-3.30)
(D)	January	3.69	0.62	-1.10	
		(2.42)	(0.48)	(-3.66)	
	February-December	0.93	0.50	-0.50	
		(1.95)	(1.39)	(-5.39)	
(E)	January	4.51		-1.12	-0.06
		(3.30)		(-4.21)	(-0.30)
	February-December	1.90		-0.40	-0.15
		(4.63)		(-4.25)	(-2.37)
(F)	January	4.46	0.92		-0.13
		(2.64)	(0.82)		(-0.66)
	February-December	3.01	-0.62		-0.28
		(6.23)	(-1.83)		(-3.99)
(G)	January	3.66	0.67	-1.109	0.02
		(2.18)	(0.59)	(-4.05)	(0.09)
	February-December	2.75	-0.66	-0.41	-0.22
		(5.79)	(-1.95)	(-4.38)	(-3.19)

Appendix

Lindenberg and Ross (1981) Methodology

Lindenberg and Ross (1981) (LR) have used Tobin's q ratios to measure economic rents and market power. They have described their computational procedures in detail. As we have seen, the Tobin's q is the ratio of the firm's market value to the replacement cost of its assets. LR have calculated values for each of these components of the Tobin's q ratio separately.

Market Value

LR determine the market value of the firm by taking the sum of the market value of (1) common stock, (2) preferred stock, (3) short-term debt and (4) long-term debt.

$$MV = Comval + Prefval + STDebt + LTDebt$$

1. The market value of common stock is estimated by multiplying the price per share by the number of shares outstanding.

2. The market value of preferred stock is estimated by dividing the amount of preferred dividends by Standard & Poor's preferred stock yield index.

3. The market value of the firm's short-term debt with maturity less than one year is assumed to be equal to its book value.

4. The market value of long-term debt depends on the coupon rate, the current market yield and the number of years to maturity. Thus, to estimate its value, first, the fractions of the book values of the current long-term debt issued in prior years are estimated. The fractions, $f_{t,t-i}$, represent the proportion of the book value of the time t when long-term debt newly issued at time t-i. Second, bond yields are used with this debt maturity distribution to estimate the market value of the firm's long-term debt. The following formula is used by LR to estimate the LTDebt variable:

$$LTDebt = SBond_t \sum_{j=0}^{n-2} f_{t,t-j}\{(\rho_{t-j}^{z} / \rho_t^{z})[I - (1+\rho_t^{z})^{-(n-j)}] + (1+\rho_t^{z})^{-(n-j)}\}$$

where,

$SBond_t$ = the year-end book value of the firm's long-term debt in year t,

j = t - n + 2, t-n + 1,..., t-1, t,

$f_{t,t-i} = N_{t-i} / \sum_{k=0}^{n-2} N_{t-k}$; i = 0,...,n-2,

N_t = the sum of all new debt issued in year t,

ρ_t^z = the yield to maturity of a firm's debt at time t, when the firm's bond rating is z.

n = 20,

Replacement Costs

The approach developed by LR, both for net plant and equipment and inventories, involves the selection of an initiation date on which the replacement cost of the assets is assumed to be equal to their book values.

The replacement cost of the firm's assets, RC, is defined as:

$$RC_t = TA_t + (RNP_t - HNP_t) + (RINV_t - HINV_t)$$

where,
TA_t = the book value of total assets in year-end t,

RNP_t = the estimated replacement cost of net plant and equipment in year-end t,

HNP_t = the historical book value of net plant and equipment in year-end t,

$RINV_t$ = the firm-reported replacement value of inventories in year-end t,

$HINV_t$ = the historical book value of inventories in year-end t,

The replacement cost of plant and equipment RNP_t is computed as:

$$RNP_t = RNP_{t-1}\left[\frac{(1+\phi_t)}{(1+\delta_t)(1+\theta_t)}\right] + (GNP_t - GNP_{t-1}), \text{ for } t > 0,$$

where,

$RNP_{t=0} = HNP_{t=0}$,

GNP_t = the book value of gross plant and equipment as of year-end t,

ϕ_t = the rate of growth of capital goods prices in year-end t,

δ_t = the real depreciation rate in year-end t,

θ_t = the rate of cost-reducing technical progress,

The growth of capital goods prices in year-end t, ϕ_t, is estimated by the Gross National Product (GNP) deflator for nonresidential fixed investment. The real depreciation rate in year-end t is estimated by:

$$\delta_t = \frac{DEP_t}{HNP_{t-1}}$$

where DEP_t is the book depreciation in year-end t.

The replacement cost of inventories, $RINV_t$, is computed as:

The replacement value of inventory is dependent upon the firm's selection of its inventory accounting method. If the firm uses more than one method, the LR rule is to assume that the dominant method reported applies to all inventories.

Last In, First Out (LIFO). This method underestimates the replacement cost of inventory in inflationary periods. Thus, the beginning inventory is adjusted for a full year's inflation and any change in reported inventory is adjusted for one-half year's inflation. The adjustment for this method is given by:

$$RINV_t = RINV_{t-1}\left(\frac{P_t}{P_{t-1}}\right) + (HINV_t - HINV_{t-1})\left(\frac{0.5(P_t + P_{t-1})}{P_{t-1}}\right)$$

where P_t is the wholesale price index appropriate to inventories. If year $t = 0$ is the initialisation date for the calculations, $RINV_o$ is set equal to $HINV_o$ to begin the inventory series.

First In, First Out (FIFO). If the firm in question accounts on this inventory accounting method basis, replacement cost is taken to be equal to book inventory:

$$RINV_t = HINV_t$$

Average Cost Method. In this method, inventory is reported at time t is approximately equal to the average of the prices at t-1 and t. Then the approximation to replacement cost of inventories in this case is:

$$RINV_t = HINV_t\left(\frac{2P_t}{P_t + P_{t-1}}\right)$$

Retail Cost Method. Under this method, inventory quantities are priced at the expected retail prices. The adjustment for this method is given by:

$$RINV_t = HINV_t\left(\frac{P_t}{R_t}\right)$$

where R_t is the retail price index.

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