Accounting Rates of Return As Proxies for the Economic Rate of Return: an Empirical Investigation

Dr. Richard G. Elmendorf, Accounting, University of Wyoming

Abstract

Accounting rates of return have been criticized by theoretical researchers as biased estimates of the economic rate of return. If true, results of past industrial organization research utilizing accounting measures of profitability are called into question. Using Tobin's q to proxy for the economic rate of return, this study empirically investigates whether accounting rates of return are biased proxies for the economic rate of return. The empirical results support the findings of theoretical research.

I. Introduction

Observed values of firms' reported accounting numbers are among the most frequently used data in empirical work on industrial organization. Analyses of the systematic properties of these numbers are used as a basis for making inferences about various market structure and market performance factors...(Gonedes and Dopuch, 1979, p. 395).

Beginning with the seminal work of Bain (1951) economists have studied the relationship between profitability and structural variables such as concentration, growth, economies of scale, advertising, and research and development. This research has employed a number of rate of return measures, which until recent years have almost always been based upon historical cost accounting numbers. See Comanor and Wilson (1967); Collins and Preston (1968); Imel and Helmberger (1971; Shepherd (1972); Weiss (1974); Caves et al. (1975); Porter (1979); Marvel (1980); and Bradburd and Caves (1982). Most of this research has shown a positive relationship between profitability and industry concentration.

Two issues have provided the impetus for a great deal of industrial organization (IO) research: (1) Is there a relationship between concentration and return? and (2) If so, is it due to efficiency or collusion?

An important issue in the debate surrounding the first question is that of the appropriate return measure. Economists have expressed concern over the use of accounting rates of return (ARR) as proxies for the economic rate of return (ERR). Fisher and McGowan (F&M) (1983) point out that

It is an economic rate of return (after risk adjustment) above the cost of capital that promotes expansion under competition and is produced by output restriction under monopoly. (p. 82) They define the ERR as ...that discount rate that equates the present value of its expected net revenue stream to its initial outlay. (p.82)

F&M are harsh in their criticism of using accounting rates of return for economic research. They state:

...accounting rates of return, even if properly and consistently measured, provide almost no information about economic rates of return. (p. 82)

The literature which supposedly relates concentration and economic profit rates does no such thing, and examination of absolute or relative accounting rates of return to draw conclusions about monopoly profits is a totally misleading enterprise. (p. 90)

In addition to F&M a number of studies (Harcourt (1965); Solomon (1966); Stauffer (1971); Gordon (1974); Kay (1976)) which, like F&M employ either analytical modelling or simulation, show that in general ARR do not equal the ERR, that only when the ERR equals the steady state growth rate of the firm does the ARR equal the ERR, and that there is no simple way to adjust the ARR so that it will equal the ERR. These studies raise serious questions about the suitability of ARR as surrogates for the ERR.

Fisher and McGowan's conclusions, which were based on a simulation study, were challenged by Long and Ravenscraft (1984) who claim:

...for most uses it is sufficient if accounting profits are a reasonable proxy for economic profits....F-M's examples, therefore, do not appear to represent the typical industry. (p. 497) (Emphasis added)

Long and Ravenscraft's position is similar to that of Whittington (1979, p. 204). Whittington argues that when used as a comparative measure, an ARR is an adequate proxy for the ERR if (1) the ARR is correlated with the ERR, and (2) if the variance in the ARR that is not explained by the ERR is not correlated with the independent variables being studied. Consequently, if the ARR is correlated with the ERR and if the measurement error of the ARR is not correlated with the explanatory variables, then the ARR would be an unbiased estimator of the ERR. However, if the measurement error of the ARR is correlated with the independent variables of interest, then the ARR would be a biased estimator of the ERR.

Fisher (1984) in his reply to Long and Ravenscraft (1984) reiterated F&M's earlier point that the profit rate of economic theory is the internal or economic rate of return. On page 509 he states:

It is that rate, if any, which provides the signal for the entry or exit of firms and resources. Hence, studies which use profit rates as though they were the objects analyzed in the theory must use profit rates which measure the economic rate of return if those studies are to be worth anything at all. This is particularly true of studies either of individual firms or of cross-firm-or-industry comparisons which seek to identify high rates of return with monopoly power. (p. 509)

He points out that without the use of Hotelling (economic) depreciation ARR will not be related to the ERR, and further states:

Since our examples merely illustrate some general theorems, that burden cannot be sustained by arguing that our examples are unrealistic; one must show rather than presume that the problems do not arise for real firms. (p. 512) ...the issue in not how high the correlation (between ARR and ERR) is but whether differences between accounting and economic rates of return are related to variables used in statistical studies. (p. 513) (emphasis added)

In this, Fisher echoes Whittington (1979). Clearly, Fisher was not moved by those who criticized his and McGowan's 1983 paper. He challenged those who would use ARR in empirical research to provide evidence that their results are not affected by the choice of return metric.

In the past few years Tobin's q has been suggested as an alternative to ARR for purposes of IO research.

James Tobin (1969, 1978); Tobin and Brainard, (1968, 1977) developed a measure they called 'q', where:

q = market value of the firm/replacement cost of its assets

The market value of the firm is the combined market values of common stock, preferred stock, and debt, and the replacement cost is for tangible assets. Tobin argued that as long as a firm's q is greater than 1, it will continue to invest because the security market value of investment is greater than the cost of investment; that is, the return is greater that the opportunity cost.

In the past few years a number of researchers have utilized q as a market based measure of economic rents (Smirlock, Gilligan, and Marshall (1984); Salinger (1984); Hirschey (1985); Hirschey and Wichern (1984); McFarland (1987); Helmuth (1990); Shepherd (1986); Lustgarten and Thomadakis (1987); Chen, Hite, and Cheng (1989)).

In addition to controversy over the choice of return, in recent years past IO research has been brought into question because of its use of cross sectional data. It has been found that the relationships between return and structural variables is not constant over time. For example, Schmalansee (1987) used data from cyclically similar years, 1963 and 1972. Lustgarten and Thomadakis (1987) used data from 1964 through 1978, and Domowitz et al. (1986a, 1986b) used a panel from 1958 through 1981. Of these, only Lustgarten and Thomadakis (1987) employed q as the return measure and they did not include an ARR for comparison. These researchers concluded that the relationship between profitability and structural variables are not stable over time, and suggested that panel data rather than cross sectional data should be used for IO research.

While some studies have used ARR and q in the same study (Salinger (1984); Shepherd (1986); Hirschey and Wichern (1985), there has not been a systematic evaluation the measurement error of various ARR metrics in the same context using panel data. Furthermore, no one has employed q computed with SFAS 33 inflation adjusted accounting numbers.

The purpose of this paper is to determine whether ARR are biased proxies for the ERR in industrial organization research. Because the focus is on evaluating the measurement error in the return measure, I will utilize a 'typical' IO study, in which the explanatory variables are representative of those used in past IO research. This will be done using panel data from 1980 through 1984, incorporating SFAS 33 current cost data. As such, the focus is on an evaluation of the returns, rather than on the structural variables themselves.

The paper is organized as follows. First the return measures are discussed, second the explanatory variables are explained, third, the sample is identified, followed by a discussion of the methodology. Fifth, the results are explained, followed by conclusions and suggestions for further research.

II. Returns

II.A. Economic Rate of Return

In an efficient capital market, the market value of the firm will measure the discounted future returns expected to be generated by the firm. Consequently, a $q > 1$ indicates that investors expect the firm to earn economic rents and these have been capitalized into the firms value.

Can q be used to measure the ERR? The following will demonstrate that it can be.

The amount of current investment will depend, in turn, on what we shall call the inducement to invest; and the inducement to invest will be found to depend on the relation between the schedule of the marginal efficiency of capital and the complex of rates of interest on loans of various maturities and risks. (Keynes 1936, pp. 27-28)

I define the marginal efficiency of capital as being equal to that rate of discount which would makes the present value of the series of annuities given by the returns expected from the capital-asset during its life just equal to its supply price. ...supply price ...sometimes called its replacement cost. (Keynes 1936, p. 135)

Thus, the marginal efficiency of capital (MEC) of Keynes is the ERR as defined by Fisher and McGowan (1983):

It is an economic rate of return (after risk adjustment) above the cost of capital that promotes expansion under competition and is produced by output restriction under monopoly. (F&M 1983, p. 82)

It follows that q reflects the ERR.

One way to look at q is that it represents the comparison between, on the one hand, the marginal efficiency of capital, the internal rate of return on investment at its cost in the commodities markets, and on the other, the financial cost of capital, the rate at which investors discount the future returns from such investment. (Tobin 1978, p. 422)

Thus, while q isn't equal to the ERR, it moves with the ERR, so that if the ERR changes, q will change appropriately.

While q reflects the ERR, is it superior to ARR? It is recognized that while ARR contain measurement error, q does as well. Areas where measurement errors can enter the computation of q include estimation of the value of non-traded debt, measurement of the replacement cost of assets, and the omission of intangible assets such as the capitalized value of research and development and advertising. Are these measurement errors more severe that the known measurement errors in ARR?

McFarland (1988) conducted Monte Carlo experiments comparing ARR and q. He correctly points out that q reflects expected future profits while ARR measures past profits. Further, q is risk adjusted and is less sensitive to inflation than are ARR.

McFarland argues that to assess q and ARR in econometric models requires answers to two questions: (1) how close is the (measured) estimate to its true value? and (2) are the errors in the estimates related to the independent variables used? From his experiments, McFarland concluded that (1) both q and ARR are useful measures of profit, and (2) q has a much higher correlation with its true measure than ARR does (p. 622). This suggests that measurement error in q is less severe than for ARR.

Recent papers have used q as the return measure. Helmuth (1990) in evaluating the effectiveness of electric utility regulation uses q as long run measure of economic profit. McFarland (1987) in a study of whether railroad deregulation allowed monopoly pricing employed q as his return measure. McFarland used q because first, q is risk adjusted, second because q is affected by expectations about long run profitability and therefore is a measure of long run monopoly profits, and third, because q is less sensitive to depreciation errors than are ARR. Salinger (1984) measured profitability with q because of the following advantages of q over ARR for structure-performance studies: (1) q measures long run monopoly power, (2) q is risk adjusted, (3) q generally embodies more information, and (4) q can be measured more precisely. Salinger (1984) argues that q can be measured more precisely than ARR because accounting profits are small compared with revenues and costs. Thus small measurement errors lead to large measurement errors in profit rates. This is not true for q.

It thus seems that q is a theoretically a better measure of ERR than are ARR. The advantage of using accounting rates of return is that they are easy to calculate.

The computation of Tobin's q requires determination of the market valuation for a firm's common stock, preferred stock, and debt and for its asset replacement

cost. The methodology used in this research is an improvement over previous industrial organization work in the approach to the computation of the market value of preferred stock and debt as well as for the asset replacement cost. One improvement is in the valuation of traded preferred stock and bonds directly from market trading prices. Previous research has followed Lindenberg and Ross (1981) in estimating the value of traded preferred stock and bonds by capitalizing dividends and interest. A second improvement is the differentiation made here between convertible and non-convertible securities, which has not been made in prior research. A third improvement is estimation of the value of non-traded debt based on the relationship between price, coupon, maturity, and risk of the traded debt. Previous research estimated the value of non-traded debt by the capitalization of interest cost based on an estimated maturity structure for debt and discount rates based on risk class. This study takes a new approach, to be discussed shortly.

All measurements are taken at December 31, the last day of each of the sample firm's fiscal years. The reason for choosing the year-end is to ensure that, as much as possible, equal information about each company was available to the securities markets. Other researchers (Lindenberg and Ross (1981)) have also taken their measurements at 12/31.

The details of the procedures used to compute the market valuation of the firm's debt and equity will now be explained. First, the valuation of common and preferred stock will be discussed, followed by a description of the method used to determine values for traded and non-traded debt. Finally, the measurement of asset replacement cost is described.

II.A.1. Common Stock

Determination of the market value for the common stock is straightforward. The common stock value equals the final stock price multiplied by the number of shares outstanding on December 31.

II.A.2. Preferred Stock

II.A.2.a. Traded

The value of the traded preferred stock was computed in the same manner as the common: that is, by the final trading price multiplied by the number of shares outstanding.

II.A.2.b. Non-traded

IIA.2.b.1. Non-convertible

Since preferred stock provides a known stream of cash

flows, its value is equal to the present value of the dividend stream discounted at the appropriate rate. Because preferred stock dividends are assumed to be constant, they can be discounted as a perpetuity, yielding the following valuation equation:

Price = Annual dividend/Moody's Preferred Stock Yield

The year-end preferred stock yield was determined by the (Moody's) risk class (A, B) of each firm's bonds. Total value equals the price multiplied by the number of shares.

II.A.2.b.2. Convertible

Since a convertible preferred stock can be exchanged for common stock, its value is influenced not only by interest rates, but also by the value of the common stock. Valuation thus requires a two part process. First, the discounted value was computed in the same manner as for non-convertible preferred stock. Second, the conversion value was calculated as the 'conversion ratio' times the common stock price. The imputed price was taken to be the higher of the conversion value or discounted present value Total value was then computed as price multiplied by the number of shares. Previous research has treated convertible securities in the same manner as non-convertible securities.

II.A.3. Debt

While the valuation of common and preferred stock was straightforward, the valuation of debt presented great difficulty, because a large portion of long term debt was not traded. Thus, no market values could be directly observed. It was therefore necessary to develop a method to estimate these unobservable market values. While previous research has followed Lindenberg and Ross (1971) and Ciccolo and Baum (1983), in estimating the value of non-traded debt by capitalizing interest expense, the valuation approach used here, to be described in detail below, improves on their methods by utilizing the actual maturity structure, risk, and coupon of each firms' debt, as well as information contained in trading prices for traded debt.

II.A.3.a. Current Liabilities, Deferred Income Taxes, and Other Liabilities

Since the market value of a firm depends not only on the value of equity and long term debt, but short term debt as well, a valuation for current and 'other' liabilities must be determined. Following past research by Lindenberg and Ross (1971) and Ciccolo and Baum (1983), these were valued at book value. Since current liabilities result in a near-term cash outflow, the book value closely approximates the present value for these liabilities.

Computing a present value for deferred income taxes and 'other' liabilities would be very difficult because not only would a discount rate have to be imputed, but a maturity structure as well. Furthermore, some analysts argue that deferred income taxes do not represent a liability provided firms continue to add to their plant and equipment. Because of these difficulties, it was decided to use book value for deferred income taxes and 'other' liabilities.

II.A.3.b. Long term debt

II.A.3.b.1. Traded

Traded long term debt was valued at market price in the same manner as for traded stocks.

II.A.3.b.2. Non-Traded

The approach used here to value non-traded debt is based on the assumption that if the non-traded debt instruments were traded, they would sell at prices equal to those of traded debt with similar maturity, coupon, and risk. While the non-traded debt might not have the same relationship between price, maturity, risk and coupon as the traded debt, it is unclear as to why this would be, as well as to what extent the valuation would differ and in which direction.

Of the non-traded debt, capital leases and debt with a variable interest rate were measured at book value. For debt with a variable interest rate, as market interest rates change, the interest rate on the debt issue will also change appropriately, causing the present value of the cash flows represented by the obligation to approximately equal its book value. Capital leases are already stated at present values. While their present values will change with shifts in interest rates, such computations would have to be done for each individual lease. In addition, the interest rate implicit in a lease is usually not disclosed.

The remaining non-traded long term debt was valued by a regression model based on the characteristics of the traded debt of the sample firms. The procedure was as follows: first, for traded long term debt cross-sectional regressions with bond price as a function of risk, coupon, and term to maturity were estimated. Second, these estimated coefficients were used to predict the value of each non-traded debt issue. This procedure was based on the assumption that if the non-traded debt were traded, its pricing would follow the same relationships as those for the traded debt.

The estimating model has the general form:

$$P_{Tt} = f(Maturity_{Tt}, Coupon_{Tt}, Risk_{Tt})$$

Where the subscript T indicates traded debt and the subscript t indicates time period, 1980 through 1984. For the investor a longer maturity indicates less liquidity and a greater chance of loss from interest rate increases. Thus, the expected sign on term to maturity was negative. A negative sign was also expected for the risk coefficient because of the known positive relationship between risk and return, indicating that the higher the risk, the lower the present value of the cash flows. Because the cash flows from holding debt are directly related to the coupon rate of interest, the coupon was expected to have a positive sign.

Separate regressions for the relationship between bond price as the dependent variable, with term to maturity, coupon, and risk class as the independent variables were run for each of the years, 1980-1984. A total of thirty six alternate specifications were estimated for each year, eighteen with a constant, and eighteen with the constant suppressed. The equations without the constant term performed very 'poorly', with unexpected signs and low R^2. The alternate specifications were evaluated on the basis of coefficient signs, R^2, F-statistic, and Theil's Inequality[1]. It was expected that the 'best' model specification would differ over time due to changes in the underlying valuation relationships. However, the form of the estimating equation proved to be the same for each of the five years[2]:

$$P_{Tt} = a_{Tt} - b_{Tt}Lnt_T + c_{Tt}Cp_T - d_{Tt}Rclb_T$$

Where:

P_{Tt} = price of a traded issue in year t
a_{Tt} = the intercept for traded securities in year t
b_{Tt} = the coefficient for the natural logarithm of term to maturity for traded securities in year t
c_{Tt} = the coefficient for the coupon for traded debt in year t
d_{Tt} = the coefficient for risk class B[3] for traded debt in year t

The term to maturity for the non-traded debt was computed by the same method used for the traded debt. The final step was to apply the coefficients for the best fitting model for each of the five years to the characteristics of each non-traded issue as shown below. This was done by solving the following equation:

$$P_{NTt} = (X_{NTt})(V_{Tt})$$

Where:

P_{NT} = estimated price of non-traded debt
X_{NT} = matrix of independent variables from the sample of non-traded debt: maturity, coupon, risk class
V_T = vector of regression coefficients from the sample of traded debt

Following the estimation of the non-traded debt price, the market value for each issue was computed as follows:

Market value = $(P_{NT}/100)$(book value)

II.A.4. Replacement Costs

The previous section discussed the measurement of the numerator of q. The denominator, replacement costs, must be measured as well. Past research utilizing replacement costs have estimated them, generally by the technique introduced by Lindenberg and Ross (1971). This study differs in that the replacement cost information for inventories and property plant & equipment is taken from the supplemental current cost data provided under SFAS 33. Even though SFAS 33 information has been criticized as inaccurate, it is expected that the measurement error in the published data is less severe than in ex-post estimates made by a researcher.

II.B. Accounting Rates of Return

A number of accounting rates of return have been used in industrial organization research. These include various specifications for return on assets (ROA), return on equity (ROE), and return on sales (ROS), virtually all of which have been based on historical cost (hc) accounting numbers.   While there has been some discussion of the appropriate measure, particularly for ROS, most research has implicitly assumed that the returns are interchangeable, that is, that they are all equally acceptable for economic research.

As a result of this diversity, in order to determine whether ARR are biased estimates of the ERR, I will evaluate historical cost based return on assets (ROAhc), return on equity (ROEhc), and return on sales (ROS). In addition I will include return on assets measured in current cost from SFAS 33 disclosures (ROAcc).

The ARR are specified as follows:

ROAhc = IFCOhc/TAhc
ROAcc = IFCOcc + Δ(INV + PPE)cc + PPG/TAcc
ROEhc = IFCOhc/NAhc
ROS   = IFCOhc/Sales

Where:

IFCO = Before tax income from continuing operations. It is computed in historical costs (hc) and current costs (cc).   Pre-tax income is used to avoid confounding caused by tax losses, changing tax rates, and so on.

TA = Total assets. It is measured in historical costs and current costs.

NA = Net assets (owners equity). It is measured in historical costs.

Δ(INV + PPE) = Unrealized holding gain (loss) from holding inventories and property, plant, and equipment during periods of price change.   It is measured in current costs.

PPG = Purchasing power gain from holding net monetary assets during periods of price change.

Historical cost information is taken from the primary financial statements. Current cost information is taken from the supplementary disclosures required by SFAS 33.

III.Independent Variables

The objective of this study is to determine whether measurement error in accounting rates of return have potentially introduced bias into the results of empirical research in industrial organization. As a result the focus is on evaluating properties of the dependent variables (ARR) rather than the independent (structural) variables. Therefore, it was desired to select a more or less 'standard' set of independent variables which have been commonly used in past IO research. A review of the past IO literature led to the selection of the following set of structural variables measuring concentration, barriers to entry, growth, and risk.

III.A. Concentration

Concentration is measured by the Hirschman--Herfindahl Index (HH) as provided in the 1982 Census of Manufactures.

III.B. Barriers to entry

A number of factors can make entry into an industry difficult. For example, an industry might require a production process in which economical levels of output require very large plant sizes. Another barrier to entry could be caused by patent protection. Consequently, a number of variables have been employed in an attempt to capture the effects of various barriers, reflecting different economic influences. This study includes four variables of the type that are commonly used in industrial organization research to measure barriers to entry. Since barriers to entry make competition more difficult, they are expected to be positively related to returns.

III.B.1. Fixed Capital/Sales (PPE/S)

This variable is intended to reflect barriers to entry caused by heavy capital requirements. The higher the ratio, the greater the barrier caused by the need for a large investment in plant and equipment. The data is

taken from the primary financial statements and supplemental SFAS 33 disclosures. In order to have asset measures which are consistent with the profit measure, property, plant, and equipment is measured at historical cost for the ROAhc, ROEhc, and ROS regressions and at current cost for the q and ROAcc regressions. Sales is measured at historical cost.

III.B.2. Advertising/Sales (ADV/S)

This variable is intended to reflect barriers to entry caused by heavy investment in advertising, which a new entrant would have to match in order to be competitive in marketing. A higher ratio indicates a greater barrier. The data is taken from the Compustat tapes and annual reports. It is measured in historical costs.

III.B.3. Research and Development Expense/Sales (R&D/S)

This variable reflects barriers to entry caused by investments in R&D, with a higher ratio indicating greater barriers. R&D expenditures provide future benefits to firms in the form of new and better products. The data is taken from the Compustat tapes and annual reports. It is measured in historical costs.

III.B.4. Minimum Efficient Scale (MESD)

Since Bain (1956), a variable representing minimum efficient scale (MES) has often been used in industrial organization studies. MES is considered to be a barrier to entry because it represents the smallest plant size that yields competitive unit costs. A problem with the Bain measure of MES, however, is that while it gives the minimum efficient size plant, it does not incorporate the cost disadvantage of operating a plant of suboptimal scale. It is reasonable to assume that as the cost penalty of small plant size increases, the barrier to entry from this source also increases.

MESD is a dichotomous minimum efficient scale variable developed by Caves, Khalilzadeh-Shirazi and Porter (1975), which improves upon minimum efficient scale, MES, as a barrier to entry. The improvement comes about because MESD not only reflects the minimum efficient plant size, but also the cost disadvantage of operating plants of suboptimal scale. It is a discontinuous (dummy) variable triggered by the cost disadvantage ratio (CDR), which is the cost penalty from small plant size. While the use of a dichotomous variable to represent diseconomies of scale, which is a continuous construct, is a rough measure, Caves et al. (1975) showed that in comparison to MES, MESD is less correlated with other commonly used independent variables, such as the concentration ratio and the advertising/sales ratio, and increased the explanatory power of regressions. They found that using a cost

disadvantage ratio cutoff of 20% yielded the best results, indicating that operating a suboptimal plant only becomes a barrier to entry when its cost penalty is large (10% to 20%). In the present study a 20% cutoff is used.

To compute MESD it is first necessary to compute the minimum efficient scale of plant (MES) and the cost disadvantage ratio (CDR).

Where:

MES = average size of largest plants accounting for 50% of industry output/industry sales

CDR = average value added per worker in plants supplying approximately the bottom 50% of industry value added/average value added per worker in plants supplying the top 50% of industry value added

MESD = MES(dummy) where the dummy = 1 if CDR < .80 0 otherwise

The data to compute MESD is taken from the concentration data for four digit industries in the Census of Manufactures.

III.C. Growth

Growth is measured by the 5 year compound annual growth rate of sales. Rapid sales growth is believed to indicate a market disequilibrium in which sellers can raise prices, and hence increase profits. Therefore, growth is expected to bear a positive relation to return. The sales data is taken from the Compustat tapes.

III.D. Risk

Firm's are subject to various types of risk, including financial risk and market risk. Variables representing both types of risk are included in this study. Increased risk is expected to be negatively related to return.

III.D.1. Beta (BETA)

Beta represents the market risk of the firm's stock, and as such is expected to capture a different dimension of risk than the debt to equity ratio. Beta's are taken from the final issue of the Value Line Investment Survey for each sample year.

III.D.2. Debt/Equity (D/E)

This variable is measured at historical cost in the ROAhc and ROEhc regressions. It is measured at current cost in the q and ROEcc regressions. The data comes from the annual reports.

IV. Sample

The sample consists of sixty five non-regulated manufacturing firms randomly selected from the 1980 FASB 33 Data Bank Manual. Because the inflation adjusted data is taken from supplemental SFAS 33 disclosures, it was necessary to choose only firms subject to the reporting requirements of SFAS 33. SFAS 33 applied only to firms with inventories and property, plant, & equipment (before deducting accumulated depreciation) of more than $125 million or with total assets (after deducting accumulated depreciation) of more than $1 billion.

Selecting only manufacturing firms provides as homogeneous a sample as is reasonably possible, increasing the internal validity of the results at the risk of reduced generalizability. Thus, the results should be interpreted only within the context appropriate to the sample. The choice of manufacturing firms also facilitates obtaining measurements of the variables measuring concentration (HH) and scale economies (MESD). The computation of HH and MESD are based on market concentration data which are available for manufacturing industries, but not for non-manufacturing industries. The requirement for non-regulated firms was imposed so that profit rates would represent market forces, unconstrained by regulatory ceilings.

The sample period is 1980 through 1984. Although SFAS 33 was in effect for 1979, not all companies disclosed the proper information in the first year.

Because of the demonstrated high degree of error[4] in the FASB 33 data tapes, all of the financial data except for advertising expense, research and development expense, and sales was manually collected from annual reports. Research and development and advertising are generally found in footnote disclosures, making their manual extraction extremely time consuming and difficult, therefore this information was obtained from the Compustat tapes. Computation of sales growth required ten years' of sales data, therefore sales was also obtained from Compustat. The manual extraction of the data greatly increased the labor involved, but also insured a more accurate data base, particularly for the SFAS 33 data.

V. Methodology

The methodology used in this research is based on Whittington's (1979) argument that an ARR is a good proxy for ERR as long as the ARR is correlated with the ERR, but its measurement error is not correlated with the independent variables being studied.

The procedure to be used is as follows. First, each of the returns are regressed on the set of independent variables. This will show the relationships which exist between each of the returns and the explanatory variables. If ARR are good proxies for the ERR, then the independent variables that are significant in the q regression should also be significant in the ARR regressions. This is done using two model specifications: first, OLS and second, a 'covariance model' specification with dummy variables for year and industry.

The second stage is to evaluate the measurement error in the ARR. This is done by first regressing each ARR on q. Second, the estimated coefficients are then used to estimate the ERR from the ARR. Third, the measurement error (ME) of each of the ARR is computed, and fourth, the measurement error is regressed on the set of independent variables. If ARR are unbiased estimators of the ERR, then there will not be a significant relationship between ME and the independent variables.

VI. Results

The first step in the analysis was to determine whether the ARR were correlated with q. As shown in Table 1 all of the returns are correlated. The lowest correlation coefficient (.248) is between q and ROEhc. Interestingly, the correlation between q and ROAcc (.483) is lower than that between q and ROAhc (.501). This might help explain why earlier stock market research failed to demonstrate the information content of SFAS 33 current cost disclosures. The results reported in Table 1 indicate that Whittington's (1979) first criteria for ARR to be useful proxies for the ERR is met.

Next, each of the returns was regressed on the set of independent variables using ordinary least squares regressions (OLS). These results are reported in Table 2. These regressions indicate that important differences exist, both between the q and the ARR regressions, and also among the ARR regressions. First, concentration is significantly negative in the q and ROS regressions, but not in the ROAcc, ROAhc, and ROEhc regressions. While the sign on concentration was expected to be positive, other research[5] (Salinger (1984); Hirschey (1985); Hirschey and Weygandt (1984); Chen et al. (1989)) has produced results in which concentration is negatively related to q. The only variables that are significant in the q as well as in each of the ARR regressions is Growth and Debt/Equity.

It is possible that non-random error terms arising from the use of panel data are distorting the OLS results as reported in Table 2. In order to mitigate these possible problems, covariance regressions (Pindyck and Rubenfeld 1976, pp. 203-206) were estimated using dummy variables for year and for each two digit industry. Underlying the use of the covariance model is the

Table 1
Correlation Matrix: Returns

	q	ROAcc	ROAhc	ROEhc
ROAcc	.483			
ROAhc	.501	.826		
ROEhc	.248	.671	.612	
ROS	.559	.758	.822	.630

Table 2
OLS Regressions: Returns on Structure

	q	ROAcc	ROAhc	ROEhc	ROS
Constant	1.3249**	.1730**	.1731**	.3037**	.1003**
	.000	.000	.000	.033	.000
HH	-.1134**	-.0056	-.0036	-.0188	-.0061*
	.002	.211	.486	.349	.093
PPE/S	-.2164	-.0608**	-.0405	-.1166	-.0309*
	.175	.001	.221	.362	.093
MESD	-.6036*	-.0452	-.0226	-.0157	-.0463
	.076	.237	.648	.935	.180
R&D/S	4.126**	-.0574	.2128	.1340	.4872**
	.024	.782	.421	.896	.009
ADV/S	2.664*	.1451	.3218	.7391	.3821**
	.051	.481	.106	.337	.006
G	1.6872**	.4384**	.4452**	1.3252**	.3961**
	.002	.000	.000	.000	.000
B	-.2103	-.0453	-.1033**	-.2173	-.0805**
	.410	.135	.004	.111	.001
D/E	-.1619**	-.0439**	-.0052**	-.0135**	-.0035**
	.017	.000	.000	.007	.000
Adj. R^2	12.1	27.5	18.7	9.1	26.0

p values below coefficients
* = Significant at p <= .10
** = Significant at p <= .05

assumption that the constant terms shift over time and industry, but the slope coefficients do not. An F test was used to determine whether a covariance model or OLS regression without the dummy variables was appropriate (Pindyck and Rubenfeld 1976, p. 205). The results of the F test indicated that the covariance specification is superior to OLS for all returns except ROEhc. Note that, except for ROEhc the covariance regressions provide a much higher adjusted R^2 than the OLS regressions. The results of the covariance regressions are reported in Table 3[6]. The results reported in

Table 3 differ from those in Table 2 in important ways. First, the concentration variable (HH), which was negatively significant in the q and ROS OLS regressions are no longer significant with the covariance specification. In the ROAhc regression, however, HH is close to significance (p=.125) with a positive sign. This result is consistent with the majority of IO research using ARR as the return measure. The only variables which are significant for all returns are Growth and Beta. The only ARR that shows results similar to q is ROS: each regression has the same significant variables except for

Table 3
Covariance Regressions: Returns on Structure

	q	ROAcc	ROAhc	ROEhc	ROS
Constant	1.4633**	.2543**	.2062**	.3646*	.1365**
	.000	.000	.000	.061	.000
HH	-.0141	.0055	.0092	.0039	.0038
	.697	.287	.125	.875	.320
PPE/S	-.2130	-.0647**	-.0695*	-.2132	-.0063
	.185	.002	.055	.156	.784
MESD	-.7675**	-.0802**	-.0796	-.1876	-.1062**
	.012	.040	.120	.377	.001
R&D/S	6.2980**	.3598	.4533	.4330	.6073**
	.001	.170	.139	.733	.002
ADV/S	-1.7390	-.6647**	-.2953	-.7355	-.1954
	.203	.010	.189	.431	.169
G	1.4450**	.3826**	.4207**	1.5368**	.3946**
	.005	.000	.000	.000	.000
B	-.5046**	-.0810**	-.1085**	-.2588*	-.0875**
	.027	.007	.003	.082	.000
D/E	-.0665	-.0276**	-.0034**	-.0096*	-.0022**
	.267	.004	.006	.064	.005
Adj.R^2	43.9	41.0	32.3	12.7	49.5

p value below coefficients
*   = Significant at p <= .10
** = Significant at p <= .05

the Debt/Equity ratio, which is significant in the ROS regression but not for q. Furthermore, considerable differences exist among the ARR, even though Growth, Beta, and Debt to Equity are significant, with the same sign, for each of the ARR.

The previous analysis suggests two conclusions: (1) that the ARR, with the possible exception of ROS, are not very good proxies for the ERR, and (2) that the ARR are not very good proxies for one another. This analysis, however, does not demonstrate whether the ARR are biased estimators of the ERR.

An ARR is an unbiased estimator of the ERR if its measurement error is not correlated with the explanatory variables of interest (Whittington (1979)). Accordingly, in the current study if the measurement error in the ARR is significantly related to the independent variables then it can be concluded that they are biased measures of the ERR.

The calculation of the measurement error in the ARR follows the method used by Salamon (1982). First, each of the ARR were regressed on q. The results, reported in Table 4, show that each of the ARR is significantly related to the ERR measure q. Table 4 also shows that considerable variation (94% to 69%) in the ARR is explained by factors other than q. The second step was

to use the estimated coefficients, along with q, to estimate an ERR for each firm. The measurement error (ME), was then calculated as the difference between the ARR and the estimated ERR[7]. Last, the ME was regressed on the set of independent variables. If ARR are unbiased estimates of the ERR, none of the independent variables will be significantly related to the ME. The results from the ME regressions are reported in Table 5. Table 5 shows that of the 18 variables (indicated by a *) which are significant in the ARR regressions from Table 3, 13 are also significantly related to the measurement error. In Table 3, Growth, Beta, and D/E are significant for each of the ARR. These variables are also significantly related to ME of each of the ARR (except ROAcc in which Beta is not significant). Of the six variables that are significant in the ROAcc regressions from Table 3, three are not significant in the ME regression for ROAcc, but the other three are. Furthermore, study of Tables 3 and 5 fail to provide evidence of systematic effects which could be used to adjust ARR.

Taken as a whole, these results suggest that ARR are biased estimators of the ERR, and that, as F&M (1983) argue, there seems to be no way to adjust ARR to make them consistent with the ERR.

Table 4
Regressions of ARR on Q

ARR	β_0	β_1	Adj. R^2
ROAhc	.0177	.0786	24.8
	.072	.000	
ROAcc	.0389	.0612	23.0
	.000	.000	
ROEhc	.0163	.1390	5.8
	.687	.000	
ROS	.0084	.0639	31.0
	.221	.000	

p values below coefficients

Table 5
Covariance Regressions - Measurement Error

	ME-ROAcc	ME-ROAhc	ME-ROEhc	ME-ROS
Constant	.1046	.0737	.1391	.0348
	.004	.088	.459	.216
HH	.0027	.0098(1)	.0017	.0042
	.587	.076	.945	.240
PPE/S	-.0518*	-.0540(2)	-.2157	.0076
	.009	.104	.137	.725
MESD	-.0257(2)	-.0152	-.0700	-.0551*
	.482	.745	.731	.072
R&D/S	-.0992	-.0975	-.951	.1552(2)
	.690	.730	.440	.400
ADV/S	-.2091(2)	-.1354	-.3792	-.0599
	.385	.510	.672	.656
G	.2831*	.2802*	1.2056*	.2906*
	.000	.000	.000	.000
B	-.0361(2)	-.0572*	-.1317*	-.0459*
	.211	.083	.358	.033
D/E	-.0275*	-.0076*	-.0416*	-.0047*
	.002	.000	.000	.000
Adj.R^2	33.7	26.0	16.5	36.4

p values below coefficients

1= Significant in ME regression but not in return regression
2= Significant in return regression but not in ME regression

VII. Conclusions

This research was designed to empirically test the results of analytical and simulation studies conducted by Fisher and McGowan (1983) and others. This body of research has led to the conclusions that accounting rates of return do not accurately measure the economic rate of return, and that the differences between ARR and the ERR cannot be reconciled. The results of this empirical research lend support to these earlier findings and suggest that ARR are biased estimators of the ERR in industrial organization studies.

VIII. Suggestions for Future Research

One line of research would be to investigate the types of questions which might usefully be answered by reference to accounting rates of return. As Ross (1983) pointed out, ARR might provide useful information for certain decisions, while the ERR might be preferable in other contexts. For example, in evaluating anti-trust issues, it appears that the ERR is superior to ARR. Since ARR are poor substitutes for the ERR, they should not be relied on for anti-trust analysis. For evaluating investment and credit decisions, however,

ARR might provide useful information at low cost compared to calculating the ERR.

Another line of research would be to evaluate alternate measures of the ERR. While this study utilized Tobin's q as the proxy for the ERR, Ijiri (1979, 1980) and Salamon(1985) have suggested computing the ERR based on a firm's cash recovery rate. Future research could evaluate these measures of the ERR. ⮿

✻✻✻Endnotes✻✻✻

1. Theil's inequality coefficient (U) was used to evaluate the performance of ex-post forecasts. It represents that portion of the total U caused by unsystematic error. See H. Theil (1961, pp. 30-37).
2. The natural logarithm of the term to maturity was used because the natural log gives a curve that is shaped like the yield curve. See Thies (1982) and Isley (1986).
3. The sample was divided into two risk classes, A and B, by combining all issues with various A ratings into one class, and all those with various B ratings into another.
4. See Stone and Bublitz (1984) and Thomas and Swanson (1986) for an evaluation of the accuracy of the FASB 33 Data Tapes.
5. Chen et al. (1989) employed interaction terms for concentration with barriers to entry. Their results showed that only when concentration interacted with very high barriers to entry was the relationship with q significantly negative. Hirschey and Weygandt (1985) found that the relationship between concentration and q differed between durable goods and non-durable goods industries.
6. Table 3 reports the covariance specification for ROEhc.
7. ME = ARR - β_0 + β_1q, where β_0 and β_1 are the estimated coefficients for each ARR reported in Table 4.

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