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FUNDAMENTAL VALUE AND MARKET VALUE

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ABSTRACT

Much of James Tobin's professional life has been devoted to studying the interrelationship between the goods and financial markets. His general equilibrium approaches stresses the interaction of the demand for financial assets with the decision to accumulate productive capital. His emphasis on q, the ratio of market value of assets to their replacement cost, has shaped how students of the aggregate economy understand the link between the stock market and fixed investment.

This paper examines the empirical linkage between fundamental returns on physical corporate assets and market return on financial claims on those assets. It defines the fundamental return as real cash flow divided by replacement cost. It examines whether the market return on individual firms respond more to aggregate shocks to the fundamental return or to the market return itself. It then examines whether aggregate market risk or aggregate fundamental risk is priced. Although market risk is priced, the paper does find that fundamental risk is an important factor in explaining risk premia.

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> [T]he daily revaluations of the Stock Exchange, though they are primarily made to facilitate transfers of old investments between one individual and another, inevitably exert a decisive influence on the rate of current investment. For there is no sense in building up a new enterprise at a cost greater than that at which a similar existing enterprise can be purchased; whilst there is an inducement to spend on a new project what may seem an extravagant sum, if it can be floated off on the Stock Exchange at an immediate profit.
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> General Theory, Ch. 12.

This quotation from Keynes must be among Jim Tobin's favorites. Tobin traces the origins of his own thinking about the importance of market valuation for investment to Keynes. He also insists that as students we read that rich and fertile discussion of the relation of long term expectations and confidence to investment in Chapter 12. There Keynes suggests that the market gives noisy signals about fundamentals. But in the rest of the General Theory, rather than emphasize the required rate of return on capital, Keynes instead focusses on the rate of interest. Most of the profession followed him. Hence, for many of us it was reading Tobin's "Money, Capital and Other Stores of Value" that provided the moment of insight. It is one of those articles--simple, lucid and insightful--that permanently shifts ones perspective. Before we read it we were dimly aware that there was something unsatisfactory about treating financial claims and physical capital as one and the same, with a single interest rate giving the terms on which society would hold the stock of non-monetary wealth. After, it was obvious that the two differed in essential respects, that their rates of return would not always move together, and that it was not even self evident that increases in the stock of government debt were contractionary.

No one has been more insistent than Tobin about the importance of the stock and bond markets, markets for claims on physical assets, in providing guides to investment and an indication of the incentives for capital formation, nor has anyone contributed more to our understanding of the way monetary policy and financial institutions affect those markets. But it is also hard to find anyone who is more skeptical of those markets accurately reflecting fundamental returns on capital and wealth owners' preferences. Another of Tobin's favorite quotations is also from Chapter 12, where Keynes likens the stock market to "newspaper competitions in which the competitors have to pick out the six prettiest faces from a hundred photographs, the prize being awarded to the competitor whose choice most nearly corresponds to the average preferences of the competitors as a whole."

Only Tobin knows when his interest in the distinction between the returns on physical and financial assets first developed. From his writings one would guess that the importance of the idea grew while he was on leave in 1959. It plays a central motivating role in his manuscript, largely written that year, in which he filled so much of Hicks's prescription for monetary theory. In that manuscript, much of what was subsequently published in a series of classic articles, he discusses systematically the different characteristics of assets, their liquidity, reversibility, maturities and nominal and real risks. He analyzes the importance of those characteristics to the decisions of households, firms and financial institutions in making their allocation of wealth among different assets. Tobin's belief in the need to distinguish among the returns on his "minimum menu" of assets leads him, in the manuscript and in a succession of papers written by himself and together with students and colleagues, to develop a whole family of models of the balance sheet in which monetary events influence, but are not the sole determinants of the terms on which society is willing to hold its wealth.

This logic led Tobin to be skeptical of the interest rate as an accurate measure of the required returns on the entire menu of diverse assets populating the portfolios of private agents. This skepticism led him to search for a more appropriate measure than the bond rate for calibrating the stimulus to investment demand. In his theoretical work, he first emphasized the required rate of return on capital, the marginal revenue product of capital which would make wealth owners content to hold capital at its replacement cost, and then q, with its several attractions. Not only can q be measured, it avoids the need to measure separately expected profitability, risk premia and discount rates, and it can be used to measure both incentive and wealth effects.[1]

In spite of his skepticism about the efficiency of the stock market, Tobin looks for explanations of the market value of firms, and hence q and the required rate of return on capital, in terms of fundamental characteristics--for example, the expected values and risks of firms' earnings and measures of bankruptcy risk--rather than in terms of the distribution of market returns themselves. This approach has several

[1]The variable q was introduced into macroeconomic analysis by Brainard and Tobin (1968) and Tobin (1969). Ciccolo (1975) and Brainard and Tobin (1977) are early empirical implementations of the q-theory of investment.

related advantages. It focusses on the social outcomes that are being valued, it reduces the extent to which market adjustments to equilibrium contaminate estimates of the expected returns and the distribution of returns, and it provides the basis for estimating the extent to which market adjustments themselves are an important component of what gets valued.

In this paper, we examine the explanatory power of market and fundamental factors for risk premia on marketed claims on physical capital. For a panel of non-financial, non-extractive firms we examine the level and distribution of the physical returns and compare them to the level and variability of the financial returns on the marketed claims of the firm. In Section 1, we discuss measurement of fundamental and market value of a firm. We take the fundamental return on the firm to be the ratio of the net cash flow to the replacement cost of its physical assets. In Section 2, we compare this fundamental return to the return and risk faced by an investor who holds the aggregate stocks and bonds of the firm. We discuss how to estimate the risk premia and risk free rate implied in the variation in expected return across firms, assuming arbitrage pricing holds. In Section 3, we then estimate the risk-loading and the prices of risk for both market and fundamental factors. Thus, in the spirit of the asset pricing literature, we study the factors that explain rates of return. But in the spirit of Tobin's work, our object is to examine the explanatory power of fundamentals.

1. Replacement Cost, Market Value, and Fundamental Return

In this section, we discuss estimates of replacement cost, market value, and fundamental rates of return. These data allow us to compare market and fundamental returns at the firm level.

A. Data and Variables

The calculations in this paper are based on accounting and financial data for individual firms. Our data represent the 191 firms in non-petroleum, non-extractive industries on the Compustat tape from 1962 through 1985. We required that the data for key variables not be missing for a firm to be included in the sample.[2]

The firms report capital stocks, inventories, and debt at book value. We now discuss how we adjust these data to measure replacement cost, market value, and fundamental return.

Physical Capital and Depreciation: Firms report nominal investment and book value of depreciation. Based on these data, we estimate the age composition of the capital stock by fitting the implied book depreciation to that reported by firms subject to the constraint that investment less retirements sum to the book value of the gross capital stock. To convert current dollar capital stocks and depreciations into constant dollars, we use the BEA's industry-specific capital stock price indexes.

Inventory valuation: Firms report inventories at book value. We estimate their replacement cost using two-digit output price deflators and the firms's accounting methods. Other assets carried on the books at

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[2] More detail about variable construction is available in the conference draft of the paper.

historical cost are treated like LIFO inventories. Because revaluation of these assets has been such a major part of changes in value of petroleum and other extractive companies, we have excluded firms in these industries in the results reported here.

Replacement Cost: Replacement cost is defined as the sum of the capital stock and inventories and other assets.

Market Value: The market value of the firm is the sum of the market values of its preferred stock, common stock and debt, less net short term financial assets valued at par. The market value of debt is estimated from information about book values, interest payments and maturity structure. In a procedure similar to the one we use for the capital stock, we fit our estimated maturity structure of debt to the reported interest payments. Market values for each vintage of debt are then computed using McCulloch's (1990) bond prices.[3]

Cash Flow: Gross cash flow is reported income plus interest payments on long-term debt plus book depreciation minus the inventory valuation adjustment. For net cash flow, we subtract economic depreciation.

Fundamental Rate of Return: We define the fundamental rate of return as the ratio of cash flow to replacement cost, either net or gross of economic depreciation.

B. Summary of Returns and Valuation Data

Table 1 summarizes the fundamental rates of return, net and gross and

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[3]These are Treasury bond prices. Hence, our calculations presume that there is a constant premium of Treasury over corporate bonds.

before and after tax, for our sample of 191 firms.[4] For comparison, we include the net of corporate tax and depreciation rate of return series for the aggregate corporate sector. The net rates of return are inherently real. An economic depreciation allowance is deducted from cash flow; this deduction is the amount of cash flow that must be reinvested just to maintain the capital stock.

All of the series peak in 1965 through 1968 and in 1972 through 1974. The before tax series for both gross and net rate of return fall more over the sample than the after corporate income tax series, consistent with the fact that the corporate tax wedge fell over the 1963 to 1985 period.[5] For example, the average of the net before tax real rate of return fell 1.2 percentage points more than the corresponding after tax rate. The average net before tax rate was 13.3 percent for 1966 through 1970, increased slightly to 13.6 percent for 1971 through 1975, fell to 12.4 for 1976 through 1980, and finally fell to 9.1 percent for 1981 through 1985. The average of the net after tax rate fell from 7.7 percent for 1966 through 1970, to 6.3 percent in 1971 through 1975, to 5.3 percent in 1976 through 1980, and to 4.7 percent for 1981 through 1985. This decline was not as noticeable in Brainard, Shoven, and Weiss (1980) where the calculations ended in 1977 and is also not as dramatic in our estimates of the aggregate net after tax rate of return shown in the last column. For this series the

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[4]In the tables, the aggregates of our firm data are reported as weighted averages where the weights are given by the fraction of the firms net replacement cost in aggregate replacement cost. Consequently, the reported returns are for holding the aggregate of claims on our sample of firms. The standard deviation is the square root of the weighted squared deviations from means. The weights are recalculated each year.

[5]Most of the tax charges during this period relate to changes in the treatment of depreciation, hence are likely to be reflected per unit of capital.

decline appears to have taken place by the early 1970's. In part this difference may reflect the fact that our sample excludes extractive industries and financial firms, while the aggregate figures include them.

The cross-sectional standard deviation of our rate of return series is large and varies somewhat over the 23 years of our sample.[6] The standard deviation of the net after tax figures was nearly 80 percent of the average for the sample as whole. The average of firms' standard deviation of returns across time is reported in the last row of Table 1. For the net after tax return a typical firm's net rate of return has a time-series standard deviation of 3.2 percent, while the dispersion across firms in a given year is typically around 5 percent. Hence, although a substantial portion of the dispersion of returns across firms could reflect the large dispersion of individual firm's returns around the firm's average, differences in means across firms appear to be important. The increased dispersion of returns across firms in the 1980's suggests that firms' fundamental returns have become more variable while their average performance has worsened.

Table 2 shows the weighted average and dispersion of q for our sample of firms. The table also gives a reference series for q from the 1983 Economic Report of the President. Our q series corresponds closely with that of the Economic Report of the President. The q series suggests that assets on average were selling as much as 60 percent above replacement cost in the mid-1960's, whereas by 1981 they were selling, for our sample, at half price. Our figures indicate that by the end of 1985 average q had

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[6]The cross-sectional standard deviations are calculated by taking the weighted average of the squared deviations from means for a given period. The weights are the share in the denominator of the particular return.

recovered to about 0.8. From calendar years 1985 to 1987, the New York Stock Exchange composite index rose 50 percent. Assuming increases in nominal replacement cost of between 5 and 10 percent per year over that period would imply that q was between 1.1 and 1.2 during 1987.

2. Market and Fundamental Rates of Return

In this section of the paper we compare market returns on the financial claims on the firms and the fundamental rate of return on their physical assets. The market rate of return is measured by the stock return and the total market return. We define the total market return (r_{it}^{V}) as the return to owning a share of the entire firm, that is, a leverage-weighted average of a firm's stocks and bonds. If the Modigliani-Miller theorem holds, the expectation of total market return corresponds to the required rate of return relevant to a firm's investment decisions about projects with the same expected returns as its existing projects. In those circumstances, the distribution of returns and risks between stockholders and bondholders is of no relevance to the investment decision or the total value of the firm, and the required rates on stocks and bonds separately are not directly relevant to the firm's decisions.

Distributions of these market returns are contrasted with the distribution of the fundamental returns on firms' capital. We define the fundamental return (r_{it}^{F}) as the after tax net of depreciation cash flow of the firm divided by the net replacement cost of its physical assets.

Table 3 reports the market and fundamental returns for our panel of firms and for the aggregate corporate sector. The first column in Table 3 repeats from Table 1 the information on the distribution of the net rate of return on capital after tax, our measure of the fundamental real rate of return on the physical assets of the firm. The following columns report distributional information on the market rates across firms and time. Inspection of these series shows that fundamental return varies much less over time and across firms than the various market rates. We return later to an investigation of the extent to which market rates of return are related to the fundamental.

A firm considering expansion of its physical capital stock, or an observer who wants to understand how markets value fundamentals, should compare the firm's fundamental return with the return required by owners of the firm's stock and long term debt. The expected value of the total market return is a natural measure of the cost of funds relevant to the demand for capital. To our knowledge no one has ever attempted to use directly an estimate of that expected rate. In Table 3 we report estimates of the total market return calculated as the sum of dividends (common and preferred), interest, and capital gains or losses on a firm's stocks and bonds, as well as the separate returns on stocks and bonds.

The distribution of returns on total market value are noticeably different from the distributions for the returns on stocks, but at a very broad level they do move together. For the entire time period arithmetic averages of the real rate of return from ownership of all claims to a firm is only about 0.2 percentage points lower than from holding only stock. The returns on bonds during this period are only slightly less than on stocks. The riskiness of holding the entire firm is also less than from holding stocks alone. Redistributive changes which simply shift real returns between stock holders and bond holders should affect stock and bond returns, but not total return.

The last row of Table 3 gives the average time-series standard deviations of the returns series. These are the weighted average of the firm-by-firm standard deviation of returns. The standard deviation of individual firms' stock returns is 29 percent, which is greater that the 24 percent standard deviation of the total return.

The mean real total return for our population of firms is approximately one percentage point less than the total market return for the aggregate shown in Table 3. Given the selection of our sample, it is not surprising that the averages in our panel are below those of the aggregate; our sample includes mature firms which may have relatively low return.

Table 3 also reports the mean and standard deviation of the real returns from holding the common stock of firms in our sample. This series shows a high correlation with the comparable rate of return (real capital gains plus dividends) for the Standard and Poor's Composite shown in the sixth column; 1981 is unusual in that our sample of firms did much worse than the aggregate. The mean of our sample of firms' returns and the aggregate index both show large fluctuations year to year. While the average stock returns for our sample of firms are similar to those for the aggregate, both conceal an enormous amount of variation in the returns to individual firms. In the typical year, approximately a third of the stocks have real returns which are more than 25 percent above or below the average.

The market rates of return are much more volatile than fundamentals. The fundamental return varies a quarter to a third as much across firms as the various market rates; the differences in the time-series variability of returns is even more dramatic.

Differences in the average fundamental and total market returns are also of interest. It was a common view during the 1960's and 1970's, that the productivity of physical capital, for the aggregate U.S. economy and for the corporate sector was substantially in excess of the real returns available on market claims to that capital. This also appears to be true ex post for our sample, the average fundamental return is over three percent higher than the corresponding average total market return.

Table 4 compares book values with our estimates of economic or market values used in our various calculations. Book profits are substantially in excess of our estimates of economic profits, particularly during inflationary periods. Again, primarily because of inflation, the book value of net capital is substantially less than our estimates of its replacement cost.

The figures for the market and book value of bonds are not surprising. They show that the market value was less than book for almost all of this period, as interest rates were for the most part rising during these years. The ratio of market to book reached its lowest levels in the period of high nominal interest rates of 1980 and 1981.

3. Relation of Firm Returns to Aggregate Returns

A. Market Risk and Fundamental Risk

Although there has been an enormous amount of theoretical work on portfolio choice and risk since Tobin wrote his seminal paper "Liquidity Preference as Behavior Towards Risk," empirical attempts to estimate risk premia on securities would be quite understandable to someone who had read nothing since that classic article. Tobin's Separation Theorem lies at the foundation of modern finance. The familiar Sharpe-Lintner capital-asset pricing model (CAPM) simply recognizes the equilibrium implications of the portfolio separation derived in Tobin's original article.

That conventional CAPM relates risk premia on stock to undiversifiable risk in the stock market itself. Our work takes a broader view of the market. Risks that are priced should be undiversifiable, not just that within the stock market, but in financial markets generally. As a first step towards broadening the factor that is priced, we include aggregate bonds together with aggregate stocks in a measure of the total market.[7] Including the return on the sum of debt and equity as a factor is a minimal step toward encompassing the market.

At a theoretical level, the risk premium in financial markets should reflect the correlation between asset returns and the marginal utility of consumption. Under standard parametric assumptions on the utility function, the appropriate measure of marginal utility is the growth in aggregate consumption. An implementation of the CAPM based on aggregate consumption data finds that consumption risk gets a much smaller price than does stock

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[7] This approach to addressing Roll's critique of the CAPM is also taken by Stambaugh (1982).

market risk, so we do not pursue that route here.[8] Instead, we focus on aggregate fundamental return as an alternative to aggregate market return as a measure of risk. Variation in the fundamental return is indeed a substantial component of the variation in economy-wide consumption possibilities. Hence, this approach can be justified as an approximation to a consumption-based pricing model. Indeed, the cash flows generated by firms, our measure of fundamental return, might be better measures of the consumption opportunities of their owners than is the NIPA consumption data. These considerations of the appropriate measure of risk lead us to compare the performance of financial and fundamental measures in explaining the expected return on marketed assets. Alternatively, these variables simply could be identified as priced factors in the arbitrage pricing model.[9]

We also depart from traditional implementations of the CAPM by examining the risk premium on holding proportionately the firm's stocks and bonds rather than just equity. While investigating the pricing of firm's equity by itself is of inherent interest, it is not directly related to the firm's decision to undertake a risky investment project. The firm should discount the expected cash flows from these projects with a rate that takes into account the price of bearing the riskiness of the cash flows.[10] The conventional stock market beta does not provide the correct price of risk for this calculation because the stock is not the claim on the project. The

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[8] See Mankiw and Shapiro (1986).

[9] See Ross (1976). See Chen, Roll, and Ross (1986) for an empirical implementation.

[10] See Brainard, Shoven, and Weiss (1980) for an analysis of risk-adjustment in evaluating the present discounted value of a firm's cash flow.

stock beta will, among other things, depend on leverage. If the investment project has the same distribution of economic returns as the firm's existing projects, the beta based on valuing the total market return of the firm would give the appropriate measure of risk.

In this section of the paper, we compare both the betas of individual firms' stock and total market returns on aggregate market and aggregate fundamental returns. In the next section, we examine how these betas affect the average market returns of these firms.

B. Market Beta and Fundamental Beta

In this section, we specify the betas that we will use to study the pricing of risk. We consider three measures of aggregate risk: stock return, total market return (stocks plus bonds), and fundamental return. One or more of these measures is used to explain either the firm-level stock or total market return.

The equations for defining the conventional stock betas are

$$(1) \qquad r^S_{it} = \alpha^S_i + \beta^{SS}_i R^S_t + \epsilon^S_{it}$$

where r^S_{it} is the stock return on the individual stock, R^S_t is the aggregate stock return, ϵ^S_{it} is the idiosyncratic component to the stock return, and α^S_i and β^{SS}_i are regression coefficients.[11] Analogously with the stock market beta we define a total market beta based on the measure of total return on the marketed claims on the firm we introduced in the previous sub-section as

[11] As a notational convention, we define β^{IJ}_i as the slope coefficient from regressing the i^{th} company's I return on the aggregate J return where I return and J return are stock, total, or fundamental return.

(2) $$r_{it}^{S} = \alpha_{i}^{S} + \beta_{i}^{SV} R_{t}^{V} + \varepsilon_{it}^{S}$$

where R_{t}^{V} is the aggregate total return for our sample of firms. The coefficients β^{SS} or β^{SV} are measures of the riskiness of a firms equity where the aggregate risk is either taken to come just from the stock market or, more appropriately, from the total of marketed claims on firms.

As discussed above, we also want to examine the risk of holding all the marketed claims on a firm's assets, both its equity and debt. Consequently, we examine the beta defined by

(3) $$r_{it}^{V} = \alpha_{i}^{V} + \beta_{i}^{VV} R_{t}^{V} + \varepsilon_{it}^{V}$$

where r_{it}^{V} is the total market return of firm i.

In contrast with these market based measures of risk, we define fundamental betas for both the firm-level stock and total market return. These are

(4) $$r_{it}^{S} = \alpha_{i}^{S} + \beta_{i}^{SF} R_{t}^{F} + \varepsilon_{it}^{S}$$

and

(5) $$r_{it}^{V} = \alpha_{i}^{V} + \beta_{i}^{VF} R_{t}^{F} + \varepsilon_{it}^{V} .$$

where R_{t}^{F} is the aggregate fundamental return.

When we turn in the next sections to examining the pricing of these betas, we will want to relate jointly the market and fundamentals betas to expected returns. To do this appropriately, the betas need to be defined jointly as in

$$(6) \qquad r_{it}^{S} = \alpha_{i}^{S} + \beta_{i}^{SS2} R_{t}^{S} + \beta_{i}^{SF2} R_{t}^{F} + \epsilon_{it}^{S}$$

$$(7) \qquad r_{it}^{S} = \alpha_{i}^{S} + \beta_{i}^{SV2} R_{t}^{V} + \beta_{i}^{SF2} R_{t}^{F} + \epsilon_{it}^{S},$$

and

$$(8) \qquad r_{it}^{V} = \alpha_{i}^{V} + \beta_{i}^{VV2} R_{t}^{V} + \beta_{i}^{VF2} R_{t}^{F} + \epsilon_{it}^{V}.$$

Unless the market returns are orthogonal to the fundamental returns, the betas defined in the bivariate regression (6)-(8) will differ from those in the univariate regression (1)-(5).

The aggregate returns we use in the empirical analysis are based an aggregate data rather than averages of the firms in our sample. Use of these aggregates is appropriate: the market should be measured as broadly as possible. The aggregate stock return is the total return (dividend yield plus capital gain) on Standard and Poor's composite. The aggregate bond return is the coupon plus capital gain on ten-year Treasury bonds. This measure captures interest rate risk, but not default risk.[12] The total return is the weighted average of the stock and bond return using the

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[12]It is calculated using the real capital gain on McCulloch's zero-coupon bond series.

weights reported in Table 3. The fundamental return is measured as corporate profits from the NIPA (with the capital consumption and inventory valuation adjustments divided the by total assets of the corporate sector from the Flow of Funds Accounts. The stock and bond returns are deflated by the rate of change of the GNP deflator.[13]

Table 5 gives summary statistics for the aggregate returns. For the sample period of 1963 through 1985, the average annual return for stocks was 5.1 percent and for fundamental was 5.4 percent. The total return on the firm is somewhat lower because of the lower return on bonds. The fundamental return is much less variable than either the stock or total return.

The correlations reported in Table 5 show that the fundamental return is almost uncorrelated with either the stock or the total return. Consequently, the univariate estimates of the betas for the fundamental return and either the stock or total returns from equations (1)-(8) will yield nearly numerically identical results to a regression where the fundamental and one of the market factors were entered simultaneously. We estimate the betas defined in equations (1)-(8) based on our sample of 191 firms with data from 1963 through 1985 and the aggregates just discussed. The betas are estimated by ordinary least squares. A procedure that imposes nonlinear, cross-equation restrictions is discussed below.

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[13] The means and standard deviation of the aggregate returns and the weighted average of the corresponding returns for our firms are similar. Additionally, the correlations aggregate and firm-average measures of return are .94 for stock, .90 for total, and .85 for fundamental.

C. What Factors are Priced?

To study how risk and return are related, we examine the cross-section relationship between average returns and the betas. The relationship has been widely studied for the stock market, but analysis of the relationship for the total market value and the fundamentals is new. Specifically, we consider regressions of the form

$$(9) \qquad \bar{r}_i = a_0 + a_1 \beta_i + v_i$$

where $\bar{r}_i$ is the average return (either stock or total market) for company i over the time period 1963 to 1985 and where the regressor is the estimated betas. The slope coefficients are estimates of the price of bearing the systematic risk reflected in the betas. The intercept estimates the risk-free rate. We also estimate an equation introducing both betas which allows the regression to attribute expected return to either market or fundamental factors.

D. Econometric Issues

The standard procedure for estimating a market-line regression such as (9) is to first estimate the betas from time-series regressions for the individual stocks (such as equations (1)-(8)) and then estimate the risk premia by regressing average returns on the estimated betas. This procedure ignores the cross equation restriction implied by the equality of the risk-free rate and the price of risks across stocks. The two-step procedure is therefore inefficient. Moreover, least squares estimates of the cross-section regression will be biased because the betas are generated regressors. Previous work uses an instrumental variables procedure to address this problem.[14] Here, we estimate the betas and their prices simultaneously to attenuate the bias.

The asset pricing model can be expressed as the nonlinear regression

$$(10) \qquad r_{it} = r_f + \beta_i(R_t + \lambda)' + \epsilon_{it}$$

where $i = 1,\ldots, N$ indexes firms, $t = 1,\ldots, T$ indexes time. The variables are r_{it} = firm's return and R_t = (1xK) vector of aggregate factors, which are understood to have zero mean. The parameters to be estimated are r_f = risk-free rate, λ = (1xK) vector of prices of risk, and β_i = (1xK) vector of betas. The disturbances ϵ_{it} are mean zero and are serially and mutually uncorrelated, but heteroskedastic. Note that the α_i is equations (1)-(8) is restricted by

$$(11) \qquad \alpha_i = r_f + \beta_i \lambda,$$

which is just the expected return on asset i. In the cross-sectional regression (9), a_0 corresponds to r_f and a_1 corresponds to λ.

Mechanically applying nonlinear least squares is computationally intractable because of the large number of parameters (N(K+1)+1). We employ an iterative procedure as follows. We first estimate the betas by a linear regression of the aggregate factors on the returns firm-by-firm. (This

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[14] Mankiw and Shapiro (1986) use betas estimated from one sub-sample as instruments for betas estimated for another sub-sample. This procedure does not work very well in practice because the estimated betas are very unstable.

step solves the first-order conditions of NLLS for the parameters β.) These estimated betas are used to estimate the parameters r_f and λ where the estimated betas are treated as fixed. (This step solves the first-order conditions for the parameters r_f and λ). This procedure is iterated until convergence. Since the converged estimates simultaneously solve the first-order conditions, they are the NLLS estimates.[15,16]

3. Results

In this section, we report the OLS and NLLS estimates of the betas and the prices that correspond to them.

A. Estimated Betas

Table 6A reports summary statistics for the betas estimated by ordinary least squares. Table 6B reports the NLLS estimates. The tables contain the average estimated beta and the average t-statistic for the estimated beta for our panel of firms. The numbers is parenthesis are the sample standard deviations of these cross-sectional estimates, not the standard errors of the averages. They also report the correlation coefficients between the various betas. The market betas (β^{SS} or β^{VV}), of course, have by

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[15] The weighting matrix Σ is initially estimated from the residual variances of the firm-by-firm regressions of r_{it} on a constant and the factors. Once the iterative procedure just described converges, the estimate of the weighting matrix is updated and the parameters are re-estimated. This procedure is repeated until the coefficients converge. This iteration is not required for efficiency of the estimation procedure, but it may be preferable in finite sample to not iterating.

[16] Gibbons (1982) uses a linearization that is equivalent to the procedure discussed in this section. McElroy and Burmeister (1988) use the same estimator that we consider to study the arbitrage pricing model.

construction a mean close to one.[17] They are much less variable across firms than are either of the fundamentals betas. Not surprisingly, the correlation reported in Table 6 between the conventional stock market beta and our total return beta is quite high because stock returns are the major source of total return variation.

The low t-statistics of the estimated betas for the fundamentals betas equations compared to those for the market beta equations suggests that the fundamental factor explains relatively little of individual firms' stock or total market returns. In Table 6B the average t-statistic for the betas in the regression of either stock or total returns on the aggregate stock or total returns are above three. When the explanatory variable in the aggregate fundamental, the t-statistics average only about one. Much of the difficulty in getting the aggregate fundamental to enter significantly in the regressions can be traced to its low variance. The fundamentals betas are, on average, estimated quite imprecisely. Their ability to explain cross-sectional average return will consequently be impaired. The low explanatory power of the fundamental factor in the time series regression does imply that fundamentals play little role in explaining year-to-year movements in returns.

There is some positive correlation between the market betas and the fundamental betas. For example, the correlation of β^{SS} and β^{SF} is 0.34 when we rely on the NLLS estimates. Given both the lack of correlation of the aggregate market and fundamental factors and the imprecision of the estimated fundamental betas, one might have expected less of relationship

[17] As noted above, we use broader estimates of the aggregate return than average of returns for our sample, so the market betas need not average to one.

between the betas. Since both factors are positively related to expected returns, the univariate NLLS squares procedure induces correlation between the univariately estimated betas because they are chosen to explain expected returns. The OLS estimates imply a negligible correlation of this pair of betas, but these estimates are less efficient.[18] The NLLS estimates of the two factor model show, however, a small correlation between the market and fundamental factor. The correlation of β^{SS2} and β^{SF2} is -.07.

The lack of correlation between the aggregate market and fundamental factors also implies that the univariate estimates of the betas should be highly correlated with the bivariate estimates. Indeed, these correlations (between β^{SV} and β^{SV2}, β^{SF} and β^{SF2}, etc.) are over 0.98 for both the NLLS and OLS estimates.

Finally, the correlations of the betas across estimators are quite high. They are .97 for β^{SS}, .97 for β^{SV}, and .94 for β^{SF}, for example.

B. Estimated Risk Premia

The results of our comparison of risk and return are given in Table 7. For each equation, we present the estimates based on regressing the betas from unrestricted time-series regression on average returns (OLS). We also present estimates that impose the nonlinear constraint discussed in the previous section (NLLS). For both estimators, the equations are estimated with a heteroskedasticity correction proportional to the idiosyncratic risk (specifically the firm-specific variance of the estimated residuals from the

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[18]The NLLS estimates roughly half the number of parameters to be estimated. Thus those estimates of the betas are more reliable given that the restriction we impose is not rejected.

time-series regression (11)). The heteroskedasticity arises because of the sampling error in estimating expected returns.

The R^2 reported for NLLS give the fraction of the cross-sectional variation in average return explained. Neither the explained or unexplained sum-of-squares reflect the period-by-period variation in firms' returns. Thus, the OLS and NLLS R^2 are comparable. The R^2 statistic is problematic for regression with heteroskedasticity. The statistic is not well-defined because of the heterogeneity in the variance. Yet, it still is useful as a summary of goodness of fit. We report the R^2 based on the unweighted variables. It thus summarizes how well our equation fits for a firm without taking into account any knowledge about its idiosyncratic variance. Because the residuals need not have zero mean, the R^2 can be negative.

The stock market premia scales the slope coefficients related to market risk so they are comparable across equations. It gives the risk premia for holding a portfolio perfectly correlated with the aggregate stock market (namely with unit stock-market beta).[19] Because the correlation between the aggregate stock market and the aggregate fundamental is essentially zero, this adjustment implies, implausibly, that holding the stock market is riskless when the measure of risk is the fundamentals beta. In comparing the magnitudes of the coefficients of the market and fundamentals beta it is important to keep in mind the differences in the means of the variables. The market betas have means of between one and two, while the fundamental betas have means from three to more than four. Therefore, for equal values of their respective regression coefficients, the

[19]This correction is calculated by multiplying the slope coefficient in the market line regression by the beta obtained by regressing the aggregate stock market return on the aggregate total return.

fundamental beta contributes twice as much of the mean of expected returns as the market beta.

Lines 7.1 and 7.2 of Table 7 report the OLS and NLLS estimates of regression of estimated expected returns on the stock-market betas. These equations are analogous to the conventional empirical implementations of the CAPM. The OLS estimates yield results quite similar to other implementations of the CAPM. The point estimate of the risk-free rate is about one percent although it is estimated imprecisely. The risk premia is about five and one-half percent, which is also quite similar to other estimates. The risk premium is estimated with about the same precision as the risk-free rate. The standard error is small enough to overwhelming reject zero, but the ninety-five percent confidence interval ranges from 2.7 to 7.9 percent, which is quite wide.

Recall that the OLS estimates are biased downward because the betas are estimated. The NLLS estimates ameliorate this problem by reducing the sampling error in the estimated betas and by restricting the intercepts in the time-series representation of the pricing equation. The NLLS estimates do make the regression line steeper: the intercept is lower and the slope coefficient higher than in the OLS estimates. This outcome is precisely what one should expect given attenuation of errors in variables bias. The estimated negative risk-free rate is not significantly different from zero, although it is significantly different from one. The risk premium of 8.53 is somewhat higher than the usual estimates. The high risk premium is just the flip side of the negative risk-free rate. The expected return on the market implied by the estimates in (7.2) is 6.0, compared with 6.4 in (7.1).[20]

Note that the NLLS estimates fit much better than the OLS ones. This occurs in all the estimated equations, and is not a surprise. The NLLS betas are chosen specifically to fit this equation well.

Line (7.3) and (7.4) report the estimates for the betas based on the total market return (stocks plus bonds). The difference between the OLS and NLLS estimates mirrors those for the stock-beta based estimates. The slope coefficient in line (7.4) of 4.95 implies a risk premia for holding the aggregate stock market of 6.83, which is somewhat below the value of 8.53 where the stock market itself is used to summarize aggregate risk. Yet, given the size of the confidence bands on the slope coefficient, it would be a mistake to read too much into these estimated differences in the price of risk.

Lines (7.5) and (7.6) report the estimates that examine whether, taken alone, the fundamental factor is priced. These results are also presented in Figure 1. Note that the estimator jointly determines the slope of the regression line and the betas, which are "explanatory variables" in the cross-sectional representation of the regression. The NLLS procedure pulls betas towards the regression line that are outliers in the OLS estimates. The NLLS procedure thus ameliorates the errors-in-variables problem. The figure clearly displays the steeper regression line and better fit for the NLLS estimates.

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[20] We can test the restriction (11) on the coefficients in the stock-by-stock time series regressions. This restriction is not rejected. In fact, the value of the test-statistic is very low. Given the imprecision of the estimates of the firm-by-firm coefficients, this non-rejection should not be taken as powerful support for the restriction.

The fundamentals beta contributes little to the mean of the cross-sectional distribution of expected returns of stocks because the coefficients of the betas are small. In the OLS estimates, the coefficient of the fundamentals risk is significantly different from zero. In the NLLS estimates, although the estimated coefficient increases from 0.41 to 0.66, the standard error increases more than proportionately. Hence, in the NLLS estimates, the fundamentals factor is insignificantly different from zero based on conventional critical values.[21] Even taking into account that the mean of the fundamentals betas is larger than that of the market betas, the fundamentals account for little of the mean of expected returns. Put differently, the risk free rate implied by the fundamentals betas regressions are implausibly high.

The fundamentals betas explain less of the cross-sectional variation in expected returns than do the market betas. Yet, at least in the NLLS estimates reported in line 7.6, where the betas are chosen to improve the fit, they do explain more than expected given how imprecisely they are estimated. The R^2 for that equation is 0.19, compared with 0.34 and 0.24 for the corresponding equations with the stock and total market betas. The relatively high R^2 for line (7.6) combined with its relatively low slope coefficient is accounted for by the very high variability of fundamentals betas.

Line (7.7) and (7.8) report the results of including both the total

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[21]The NLLS procedure appropriately takes into account the joint estimation of the betas and the prices of risk. The OLS standard errors are conditional on the betas from the first stage.

market and fundamentals betas in regressions on average returns.[22] These estimates of the market and fundamentals risk premia are somewhat lower than in the respective univariate equations. There is enough sampling error that the NLLS estimate of the market premia is insignificant. With the NLLS estimate, the risk-free rate is estimated to be low, which means that the risk premia associated with the betas are accounting for more of the average expected returns. Overall, the patterns of the estimates from the univariate estimates remains. Despite the small fundamental risk premium, including the fundamentals beta raises the R^2 from 0.24 in line (7.4) to 0.38 in line (7.8).

Lines (7.9) through (7.14) repeat the estimates of the risk premia, but for the total assets of the firm rather than just its equity. In contrast to the expected stock returns, the aggregate fundamental explains more of the cross-sectional variation in return than does the total market aggregate. Still, the coefficient of the fundamental betas are small. They are insignificant in the NLLS estimates where we take into account their joint estimation with the betas. In equation (7.14), which includes both the fundamental and market factors, more of the explanatory power does however come from the fundamental factor. Given the imprecision of the estimates of the fundamental betas, it is remarkable how much they do explain in the NLLS estimates. In the OLS estimates, fundamentals are highly significant despite the measurement error.

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[22]The regressions including the two factor are based on first-stage regressions where both aggregate factors are included in the time-series regressions. Given that the aggregate market factors are approximately orthogonal to the aggregate fundamental factor (see Table 5), the betas from the bivariate regressions are roughly equal to the ones estimated from the univariate regressions.

Our finding that premia for holding financial claims are somewhat better explained by market risks rather than fundamentals risks contrasts with the finding that the consumption-risk also has a negligible price. Mankiw and Shapiro (1986) compare risk premia estimated from market betas and consumption betas. Notwithstanding theoretical arguments that imply that aggregate consumption growth should mirror undiversifiable risk, they find that consumption betas get very small coefficients in regressions. While our results are weak in terms of conventional statistical significance, Table 7 does show an important role for the fundamentals in addition to market factors.

C. Multi-year Returns

The one-year horizon for returns used in the previous analysis is arbitrary. Results using different horizons might differ for two reasons. First, the relationship between the firm's asset returns and the aggregate might differ for different horizons. Second, the pricing of risk at different horizons might differ. Table 8 reports the results analogous to those in Table 7, but where returns and the factors in the time-series regressions are averaged over three years. The choice of three years is a compromise between wanting to average over a long period and preserving degrees of freedom.

The results provide support for the view that fundamentals do better in explaining expected returns over the longer horizon. Overall, the estimates are more precise than for the one-year horizon. Except in the NLLS estimates in line (8.2) and (8.10), the market premia are much smaller in the long horizon estimates. On the other hand, the point estimates of the fundamental risk premium are somewhat larger. That, combined with the increase in the precision of the estimates, makes the fundamental factors significant in the NLLS estimates as well as in the OLS ones. In each of the stock and total return equations with both market and fundamental factors ((8.8) or (8.14)), most of the explanatory power comes from the fundamental betas.

These results imply that over longer horizons fundamental risk is the dominate factor in explaining expected returns on financial assets. The results should not be over-emphasized. The estimates are unstable across specifications and estimators; the total market beta seems to do unexpectedly poorly with the averaging (its univariate estimates do not converge). Yet, the fundamentals betas do explain an important part of the distribution of expected returns.

4. Conclusions

A central theme of Tobin's work is the role of financial and fundamental risk in the valuation of and the demand for marketed claims on physical capital. In this paper, we follow his work by estimating the extent to which risk premia depend on market and fundamental factors. Our results square well with Tobin's view that much of the risk to ownership of physical capital derives from financial-market fluctuations, but that it also depends on fundamental risks, particularly when measured over longer horizons. We find that both the market betas and fundamental betas have important roles in explaining cross-sectional variation in expected returns. Our results based on the longer horizons suggest, in contrast with other studies, that fundamental factors are more important in accounting for the distribution of expected returns than are market factors.

REFERENCES

Brainard, William C., John B. Shoven, and Laurence Weiss, "The Financial Valuation of the Return to Capital," Brookings Papers on Economics Activity (2:1980) 453-502.

Brainard, William C. and James Tobin, "Pitfalls in Financial Model Building," American Economic Review Proceedings 58 (May 1968) 99-122. [Reprinted in Tobin's Essays, I, ch. 20.]

________ and ________, "Asset Markets and the Cost of Capital," in Economic Progress, Private Values and Public Policy: Essays is Honor of William Fellner," Richard Nelson and Bela Balassa, eds. Amsterdam: North-Holland, 1977. [Essays, III, ch. 4.]

Chen, Nai-Fu, Richard Roll, and Stephen A. Ross, "Economic Forces and the Stock Market," Journal of Business 59 (1986) 383-403.

Ciccolo, J., "A Linkage between Product and Financial Markets--Investment and q," Essay III of unpublished Ph.D. dissertation, Yale University, 1975.

Fama, Eugene F. and J.D. MacBeth, "Risk, Return, and Equilibrium: Empirical Tests," Journal of Political Economy 81 (May/June 1973) 607-636.

Gibbons, Michael R., "Multivariate Tests of Financial Models: A New Approach," Journal of Financial Economics 10 (Mar. 1982) 3-27.

Mankiw, N. Gregory and Matthew D. Shapiro, "Risk and Return: Consumption Beta versus Market Beta," Review of Economics and Statistics 68 (Aug. 1986) 452-459.

McCulloch, J. Huston, "U.S. Term Structure Data, 1947-87," in Handbook of Monetary Economics, Benjamin Friedman, ed. Amsterdam: North-Holland, 1990.

McElroy, Marjorie B. and Edwin Burmeister, "Arbitrage Pricing Theory as a Restricted Nonlinear Multivariate Regress Model," Journal of Business and Economic Statistics 6 (Jan. 1988) 29-42.

Ross, Stephen A., "The Arbitrage Theory of Capital Asset Pricing," Journal of Economic Theory 13 (1976) 341-360.

Stambaugh, Robert F., "On the Exclusion of Assets from Tests of the Two-Parameter Model: A Sensitivity Analysis," Journal of Financial Economics 10 (1982) 237-268.

Tobin, James, "Money, Capital, and Other Stores of Value," American Economic Review Proceedings 51 (May 1961) 26-37. [Essays, I, ch. 13.]

________, "Liquidity Preference as Behavior towards Risk," Review of Economic Studies 25 (Feb. 1957) 54-86. [Essays, I, ch. 15.]

________, "A General Equilibrium Approach to Monetary Theory," Journal of Money, Credit, and Banking 1 (Feb. 1969) 15-29. [Essays, I, ch. 18.]

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Table 1

Fundamental Rates of Return

	Cross Section of Firms								Aggregate
	Before Tax				After Tax				Net
	Gross		Net		Gross		Net		After Tax
1963	13.3	(5.9)	13.9	(8.0)	9.5	(3.2)	7.9	(4.3)	6.3
1964	13.9	(6.8)	14.6	(8.8)	10.0	(3.9)	8.5	(4.9)	6.9
1965	14.5	(7.0)	15.4	(9.0)	10.3	(4.0)	9.1	(5.0)	7.8
1966	14.5	(6.6)	15.1	(8.3)	10.4	(3.8)	8.9	(4.7)	7.9
1967	13.2	(6.8)	13.0	(8.8)	9.8	(4.2)	7.8	(5.4)	7.3
1968	14.5	(7.2)	14.6	(9.1)	10.3	(4.1)	8.3	(5.1)	6.5
1969	13.4	(6.4)	13.0	(8.2)	9.7	(3.7)	7.4	(4.6)	5.8
1970	12.0	(6.2)	10.9	(8.2)	8.8	(3.7)	6.2	(4.8)	4.8
1971	12.2	(5.8)	11.2	(7.7)	8.8	(3.5)	6.0	(4.5)	5.2
1972	12.8	(6.0)	12.2	(8.0)	8.9	(3.6)	6.4	(4.7)	5.6
1973	14.7	(6.1)	15.2	(8.2)	9.8	(3.6)	7.8	(4.6)	5.2
1974	16.5	(7.8)	17.5	(11.4)	9.4	(3.5)	6.9	(4.5)	3.9
1975	12.9	(6.7)	12.1	(9.7)	7.7	(3.4)	4.3	(4.5)	4.4
1976	13.2	(5.6)	12.7	(7.6)	8.4	(3.1)	5.7	(3.8)	4.6
1977	13.1	(6.4)	12.5	(8.7)	8.3	(3.5)	5.4	(4.6)	5.3
1978	13.2	(5.8)	12.6	(7.9)	8.5	(3.3)	5.5	(4.4)	5.3
1979	13.8	(6.6)	13.5	(9.2)	8.7	(3.7)	5.8	(5.0)	4.8
1980	11.9	(6.4)	10.6	(9.1)	7.6	(4.2)	4.2	(5.9)	3.9
1981	10.7	(4.9)	9.0	(6.5)	7.4	(3.4)	4.1	(4.3)	4.3
1982	9.2	(5.9)	7.1	(8.1)	6.7	(3.9)	3.4	(5.4)	3.5
1983	10.2	(6.0)	8.8	(8.3)	7.4	(4.0)	4.6	(5.4)	4.6
1984	11.6	(6.3)	10.9	(8.7)	8.3	(4.2)	6.0	(5.8)	5.4
1985	10.9	(6.8)	9.9	(9.3)	7.9	(4.6)	5.3	(6.2)	5.4
geometric means:									
1963-1985	12.9	(6.3)	12.4	(8.6)	8.8	(3.8)	6.3	(4.9)	5.4
1966-1970	13.5	(6.6)	13.3	(8.5)	9.8	(3.9)	7.7	(4.9)	6.5
1971-1975	13.8	(6.5)	13.6	(9.0)	8.9	(3.5)	6.3	(4.5)	4.9
1976-1980	13.0	(6.2)	12.4	(8.5)	8.3	(3.6)	5.3	(4.7)	4.7
1981-1985	10.5	(6.0)	9.1	(8.2)	7.5	(4.0)	4.7	(5.4)	4.7

Addendum:

time-series standard error	4.1	5.8	2.3	3.2	

Table 1 (continued)

Note: Figures are mean returns for the sample of firms. Numbers in parentheses are cross-sectional standard deviations. Cross-sectional statistics are weighted by the share in the denominator of the respective returns. Geometric means are for the indicated subsamples. The standard errors given in the addendum are the weighted-average to the firm-by-firm time-series standard errors.

Table 2

q

	q		q (CEA)
1963	1.55	(1.14)	1.42
1964	1.64	(1.04)	1.52
1965	1.67	(1.22)	1.62
1966	1.33	(1.12)	1.47
1967	1.56	(1.52)	1.48
1968	1.55	(1.28)	1.52
1969	1.30	(1.37)	1.35
1970	1.20	(1.09)	1.09
1971	1.24	(1.17)	1.18
1972	1.36	(1.37)	1.26
1973	1.07	(0.91)	1.16
1974	0.67	(0.52)	.83
1975	0.74	(0.51)	.81
1976	0.82	(0.50)	.91
1977	0.69	(0.42)	.80
1978	0.64	(0.42)	.76
1979	0.61	(0.35)	.71
1980	0.61	(0.35)	.67
1981	0.48	(0.29)	.69
1982	0.55	(0.42)	.69
1983	0.67	(0.48)	na
1984	0.65	(0.44)	na
1985	0.78	(0.54)	na
geometric means:			
1963-1985	1.02	(0.80)	1.10
1966-1970	1.43	(1.27)	1.38
1971-1975	1.05	(0.93)	1.05
1976-1980	0.69	(0.42)	.77
1981-1985	0.62	(0.42)	na

Note: The variable q is the ratio of market value to replacement costs. The first column report the average for our sample of firms with cross-sectional standard deviations in parentheses. The last column gives the value of q calculated from aggregate data by the Council of Economic Advisers (source: Economic Report of the President).

Table 3

Market And Fundamental Rates of Return

	Cross-Section of Firm										Aggregate	
	Fundamental Return		Total Market Return		Stock Return		Bond Return		Leverage		Total Return	Stock Return
1963	7.9	(4.3)	18.7	(15.8)	20.3	(18.0)	3.6	(1.9)	0.07	(0.09)	14.2	20.5
1964	8.5	(4.9)	12.8	(14.7)	13.8	(16.3)	2.4	(2.1)	0.07	(0.08)	11.8	14.8
1965	9.1	(5.0)	8.6	(20.3)	9.2	(22.1)	1.7	(2.6)	0.07	(0.08)	6.2	9.1
1966	8.9	(4.7)	-13.5	(16.4)	-14.3	(17.8)	-4.4	(2.5)	0.10	(0.10)	-9.8	-11.8
1967	7.8	(5.4)	25.9	(26.3)	29.2	(29.5)	1.4	(2.3)	0.10	(0.09)	12.4	17.9
1968	8.3	(5.1)	5.1	(17.3)	6.4	(20.8)	-4.8	(2.5)	0.10	(0.10)	6.0	8.7
1969	7.4	(4.6)	-10.4	(18.3)	-11.0	(20.7)	-5.7	(2.8)	0.11	(0.12)	-13.3	-16.0
1970	6.2	(4.8)	-3.1	(17.8)	-3.1	(20.3)	-2.3	(3.1)	0.13	(0.13)	-0.8	-2.7
1971	6.0	(4.5)	9.3	(17.0)	8.9	(20.0)	12.5	(2.3)	0.13	(0.13)	10.0	7.1
1972	6.4	(4.7)	15.3	(14.5)	17.6	(16.4)	2.2	(2.2)	0.12	(0.13)	12.3	16.5
1973	7.8	(4.6)	-17.2	(19.4)	-19.0	(22.2)	-4.9	(2.2)	0.14	(0.13)	-13.2	-22.8
1974	6.9	(4.5)	-29.4	(13.6)	-33.1	(14.8)	-7.5	(3.1)	0.20	(0.16)	-16.6	-32.0
1975	4.3	(4.5)	20.0	(18.7)	25.0	(24.4)	1.8	(3.5)	0.18	(0.14)	17.6	27.3
1976	5.7	(3.8)	15.9	(13.9)	17.8	(18.7)	7.7	(2.8)	0.17	(0.13)	11.3	15.8
1977	5.4	(4.6)	-9.6	(11.2)	-12.7	(13.8)	4.4	(2.2)	0.20	(0.15)	-4.2	-11.9
1978	5.5	(4.4)	-0.2	(10.8)	1.0	(13.4)	-4.6	(2.1)	0.20	(0.16)	-2.6	0.0
1979	5.8	(5.0)	5.8	(18.8)	8.6	(24.9)	-4.4	(3.3)	0.19	(0.13)	2.2	8.5
1980	4.2	(5.9)	14.2	(22.7)	20.2	(28.1)	-10.3	(4.5)	0.16	(0.12)	7.8	18.2
1981	4.1	(4.3)	-31.0	(20.8)	-35.8	(24.1)	-5.7	(5.1)	0.19	(0.14)	-2.8	-9.9
1982	3.4	(5.4)	15.7	(26.4)	14.8	(33.7)	19.7	(7.6)	0.20	(0.17)	14.9	12.5
1983	4.6	(5.4)	22.1	(14.0)	22.3	(17.8)	21.4	(5.8)	0.18	(0.15)	17.8	18.7
1984	6.0	(5.8)	1.3	(12.6)	0.7	(15.9)	4.0	(6.3)	0.21	(0.19)	-1.1	1.2
1985	5.3	(6.2)	24.4	(16.8)	26.0	(21.0)	18.5	(8.8)	0.20	(0.18)	24.5	27.2
geometric means:												
1963-1985	6.3	(4.9)	3.0	(17.2)	3.2	(20.5)	1.7	(3.5)			3.9	3.8
1966-1970	7.7	(4.9)	-0.1	(19.1)	0.3	(21.7)	-3.2	(2.6)			-1.6	-1.6
1971-1975	6.3	(4.5)	-2.4	(16.6)	-2.8	(19.5)	0.6	(2.7)			1.0	-3.6
1976-1980	5.3	(4.7)	4.8	(15.4)	6.3	(19.7)	-1.7	(3.0)			2.6	5.5
1981-1985	4.7	(5.4)	4.2	(18.0)	2.7	(23.3)	11.0	(6.7)			10.2	9.1
addendum:												
time-series standard error	3.2		24.3		28.8		11.6					

See note to Table 1.

Table 4

Book Values versus Economic Values

	Net Book Profits ÷ Net Economic Profits		Book Value of Bonds ÷ Market Value of Bonds		Book Value of Capital ÷ Replacement Cost		Economic Depreciation Rate	
1963	1.18	(0.92)	1.05	(0.01)	0.76	(0.11)	0.10	(0.01)
1964	1.52	(3.00)	1.06	(0.01)	0.76	(0.10)	0.10	(0.01)
1965	1.23	(0.55)	1.05	(0.02)	0.77	(0.10)	0.09	(0.01)
1966	1.18	(1.05)	1.08	(0.02)	0.76	(0.09)	0.09	(0.01)
1967	1.35	(1.43)	1.08	(0.02)	0.77	(0.09)	0.09	(0.01)
1968	0.45	(4.78)	1.10	(0.04)	0.76	(0.09)	0.09	(0.01)
1969	0.57	(10.70)	1.16	(0.04)	0.74	(0.09)	0.09	(0.01)
1970	0.93	(2.98)	1.18	(0.05)	0.72	(0.08)	0.09	(0.01)
1971	1.48	(3.55)	1.05	(0.04)	0.70	(0.08)	0.09	(0.01)
1972	4.99	(53.66)	1.05	(0.03)	0.68	(0.08)	0.09	(0.01)
1973	0.49	(8.63)	1.10	(0.03)	0.67	(0.08)	0.09	(0.01)
1974	2.67	(6.43)	1.14	(0.04)	0.64	(0.08)	0.09	(0.01)
1975	0.90	(4.73)	1.12	(0.04)	0.61	(0.07)	0.09	(0.01)
1976	2.01	(16.25)	1.06	(0.03)	0.62	(0.07)	0.09	(0.01)
1977	3.04	(11.98)	1.04	(0.03)	0.63	(0.07)	0.10	(0.01)
1978	1.77	(4.38)	1.09	(0.03)	0.63	(0.08)	0.10	(0.01)
1979	1.78	(7.49)	1.14	(0.04)	0.63	(0.08)	0.10	(0.01)
1980	5.79	(27.80)	1.27	(0.07)	0.63	(0.08)	0.10	(0.01)
1981	2.21	(12.94)	1.34	(0.12)	0.63	(0.06)	0.10	(0.01)
1982	2.37	(6.27)	1.19	(0.10)	0.65	(0.06)	0.10	(0.01)
1983	0.98	(4.66)	1.07	(0.08)	0.67	(0.06)	0.10	(0.01)
1984	1.46	(4.50)	1.09	(0.07)	0.70	(0.07)	0.10	(0.01)
1985	0.76	(5.41)	0.99	(0.05)	0.72	(0.07)	0.10	(0.01)
geometric means:								
1965-1985	1.79	(8.87)	1.11	(0.04)	0.69	(0.08)	0.09	(0.01)
1966-1970	0.90	(4.19)	1.12	(0.03)	0.75	(0.09)	0.09	(0.01)
1971-1975	2.11	(15.40)	1.09	(0.03)	0.66	(0.08)	0.09	(0.01)
1976-1980	2.88	(13.58)	1.12	(0.04)	0.63	(0.08)	0.10	(0.01)
1981-1985	1.56	(6.76)	1.13	(0.08)	0.67	(0.07)	0.10	(0.01)

See note to Table 1.

Table 5

Aggregate Returns

Summary Statistics

	mean	standard deviation
fundamental	5.4	1.2
total	4.5	11.2
stock	5.1	16.1
bond	2.6	8.4

correlations

	fundamental	total	stock	bond
fundamental	1.00	-.02	.05	-.28
total		1.00	.96	.60
stock			1.00	.36
bond				1.00

Table 6A

Summary of OLS Estimates of the Betas

	estimated beta	t-statistic of estimated beta
β^{SS}	1.28 (0.52)	3.24 (1.20)
β^{SV}	1.75 (0.77)	3.03 (1.23)
β^{SF}	3.87 (6.70)	0.77 (0.70)
β^{VV}	1.46 (0.54)	3.44 (1.29)
β^{VF}	3.57 (5.53)	0.82 (0.74)
β^{SV2}	1.76 (0.77)	3.07 (1.22)
β^{SF2}	4.19 (6.69)	0.94 (0.81)
β^{VV2}	1.47 (0.54)	3.49 (1.26)
β^{VF2}	3.84 (5.54)	1.03 (0.86)

Correlation of Estimated Betas

	β^{SS}	β^{SV}	β^{SF}	β^{VV}	β^{VF}	β^{SV2}	β^{SF2}	β^{VV2}	β^{VF2}
β^{SS}	1.00								
β^{SV}	.96	1.00							
β^{SF}	-.02	-.10	1.00						
β^{VV}	.86	.90	-.04	1.00					
β^{VF}	.08	-.01	.95	.03	1.00				
β^{SV2}	.97	1.00	-.08	.90	.01	1.00			
β^{SF2}	.00	-.08	1.00	-.02	.96	-.06	1.00		
β^{VV2}	.86	.90	-.02	1.00	.06	.90	.00	1.00	
β^{VF2}	.09	.01	.95	.05	1.00	.03	.95	.07	1.00

Table 6B

Summary of NLLS Estimates of the Betas

	estimated beta	t-statistic of estimated beta
β^{SS}	1.30 (0.51)	3.76 (1.24)
β^{SV}	1.80 (0.76)	3.41 (1.21)
β^{SF}	4.41 (6.17)	0.90 (0.75)
β^{VV}	1.50 (0.52)	3.96 (1.26)
β^{VF}	3.93 (5.18)	0.97 (0.80)
β^{SV2}	1.78 (0.79)	3.30 (1.25)
β^{SF2}	4.42 (6.37)	1.05 (0.86)
β^{VV2}	1.48 (0.54)	3.73 (1.30)
β^{VF2}	3.98 (5.30)	1.15 (0.93)

Correlation of Estimated Betas

	β^{SS}	β^{SV}	β^{SF}	β^{VV}	β^{VF}	β^{SV2}	β^{SF2}	β^{VV2}	β^{VF2}
β^{SS}	1.00								
β^{SV}	.97	1.00							
β^{SF}	.34	.24	1.00						
β^{VV}	.87	.90	.32	1.00					
β^{VF}	.37	.27	.97	.37	1.00				
β^{SV2}	.94	.99	.10	.87	.13	1.00			
β^{SF2}	.18	.08	.99	.17	.95	-.07	1.00		
β^{VV2}	.84	.89	.12	.98	.17	.90	-.02	1.00	
β^{VF2}	.26	.16	.97	.24	.99	.01	.97	.04	1.00

Table 7

Market Line Regressions

	estimator	estimated equation: intercept	market risk	fundamental risk		stock market premia	R^2
7.1.	OLS	$\bar{r}_i^S$ = .99 (1.49)	+ 5.40 β_i^{SS} (1.26)		+ e_i^S	5.40	0.14
7.2.	NLLS	$\bar{r}_i^S$ = -2.53 (1.68)	+ 8.53 β_i^{SS} (1.42)		+ e_i^S	8.53	.34
7.3.	OLS	$\bar{r}_i^S$ = 2.38 (1.41)	+ 2.94 β_i^{SV} (0.85)		+ e_i^S	4.06	.07
7.4.	NLLS	$\bar{r}_i^S$ = -.73 (1.60)	+ 4.95 β_i^{SV} (0.98)		+ e_i^S	6.83	.24
7.5.	OLS	$\bar{r}_i^S$ = 5.98 (0.55)		+ 0.41 β_i^{SF} (0.09)	+ e_i^S		.00
7.6.	NLLS	$\bar{r}_i^S$ = 5.26 (2.88)		+ 0.66 β_i^{SF} (0.51)	+ e_i^S		.19
7.7.	OLS	$\bar{r}_i^S$ = 1.49 (1.41)	+ 2.82 β_i^{SV2} (0.85)	+ 0.40 β_i^{SF2} (0.10)	+ e_i^S	3.92	.17
7.8.	NLLS	$\bar{r}_i^S$ = -0.66 (6.19)	+ 3.88 β_i^{SV2} (3.68)	+ 0.57 β_i^{SF2} (0.43)	+ e_i^S	5.39	.38
7.9.	OLS	$\bar{r}_i^V$ = 0.74 (1.15)	+ 3.43 β_i^{VV} (0.85)		+ e_i^V	4.70	.03
7.10.	NLLS	$\bar{r}_i^V$ = -2.06 (1.30)	+ 5.61 β_i^{VV} (0.96)		+ e_i^V	7.74	.23
7.11.	OLS	$\bar{r}_i^V$ = 4.33 (0.43)		+ 0.49 β_i^{VF} (0.09)	+ e_i^V		.10
7.12.	NLLS	$\bar{r}_i^V$ = 3.85 (2.23)		+ 0.70 β_i^{VF} (0.48)	+ e_i^V		.30
7.13.	OLS	$\bar{r}_i^V$ = 0.36 (1.15)	+ 2.99 β_i^{VV2} (0.85)	+ 0.46 β_i^{VF2} (0.09)	+ e_i^V	4.15	.23
7.14.	NLLS	$\bar{r}_i^V$ = -0.97 (4.79)	+ 3.78 β_i^{VV2} (3.52)	+ 0.60 β_i^{VF2} (0.39)	+ e_i^V	5.25	.43

Table 7

(Continued)

Note: The left-hand side variables are time-series averages of the returns. The betas are as defined in the note to Table 6. See the text for an explanation of the OLS and NLLS estimators. The R^2 is the conventional multiple correlation statistic based on the unweighted variables.

Table 8

Market Line Regressions
Data are three-year moving averages

	estimator	estimated equation	intercept	market risk	fundamental risk		stock market premia	R^2
8.1.	OLS	$\bar{r}_i^S =$	3.41 (0.50)	+ 2.41 β_i^{SS} (0.45)		+ e_i^S	2.41	-.01
8.2.	NLLS	$\bar{r}_i^S =$	-4.29 (1.37)	+ 10.59 β_i^{SS} (1.35)		+ e_i^S	10.59	.62
8.3.	OLS	$\bar{r}_i^S =$	5.13 (0.44)	+ 0.33 β_i^{SV} (0.31)		+ e_i^S	0.42	.09
8.4.	NLLS	$\bar{r}_i^S =$		* β_i^{SV}		+ e_i^S	--	--
8.5.	OLS	$\bar{r}_i^S =$	4.53 (0.32)		+ 0.42 β_i^{SF} (0.05)	+ e_i^S		.02
8.6.	NLLS	$\bar{r}_i^S =$	3.53 (1.62)		+ 0.71 β_i^{SF} (0.27)	+ e_i^S		.26
8.7.	OLS	$\bar{r}_i^S =$	4.06 (0.49)	+ 0.27 β_i^{SV2} (0.32)	+ 0.39 β_i^{SF2} (0.05)	+ e_i^S	0.66	.02
8.8.	NLLS	$\bar{r}_i^S =$	2.08 (2.32)	+ 1.10 β_i^{SV2} (0.25)	+ 0.66 β_i^{SF2} (0.24)	+ e_i^S	1.93	.27
8.9.	OLS	$\bar{r}_i^V =$	2.86 (0.41)	+ 0.68 β_i^{VV} (0.33)		+ e_i^V	0.86	-.15
8.10.	NLLS	$\bar{r}_i^V =$		* β_i^{VV}		+ e_i^V	--	--
8.11.	OLS	$\bar{r}_i^V =$	2.96 (0.24)		+ 0.51 β_i^{VF} (0.05)	+ e_i^V		.13
8.12.	NLLS	$\bar{r}_i^V =$	2.35 (1.23)		+ 0.72 β_i^{VF} (0.25)	+ e_i^V		.36
8.13.	OLS	$\bar{r}_i^V =$	2.18 (0.43)	+ 0.37 β_i^{VV2} (0.34)	+ 0.50 β_i^{VF2} (0.05)	+ e_i^V	0.87	.12
8.14.	NLLS	$\bar{r}_i^V =$	1.33 (1.89)	+ 0.59 β_i^{VV2} (1.45)	+ 0.72 β_i^{VF2} (0.22)	+ e_i^V	1.33	.36

Table 8

(Continued)

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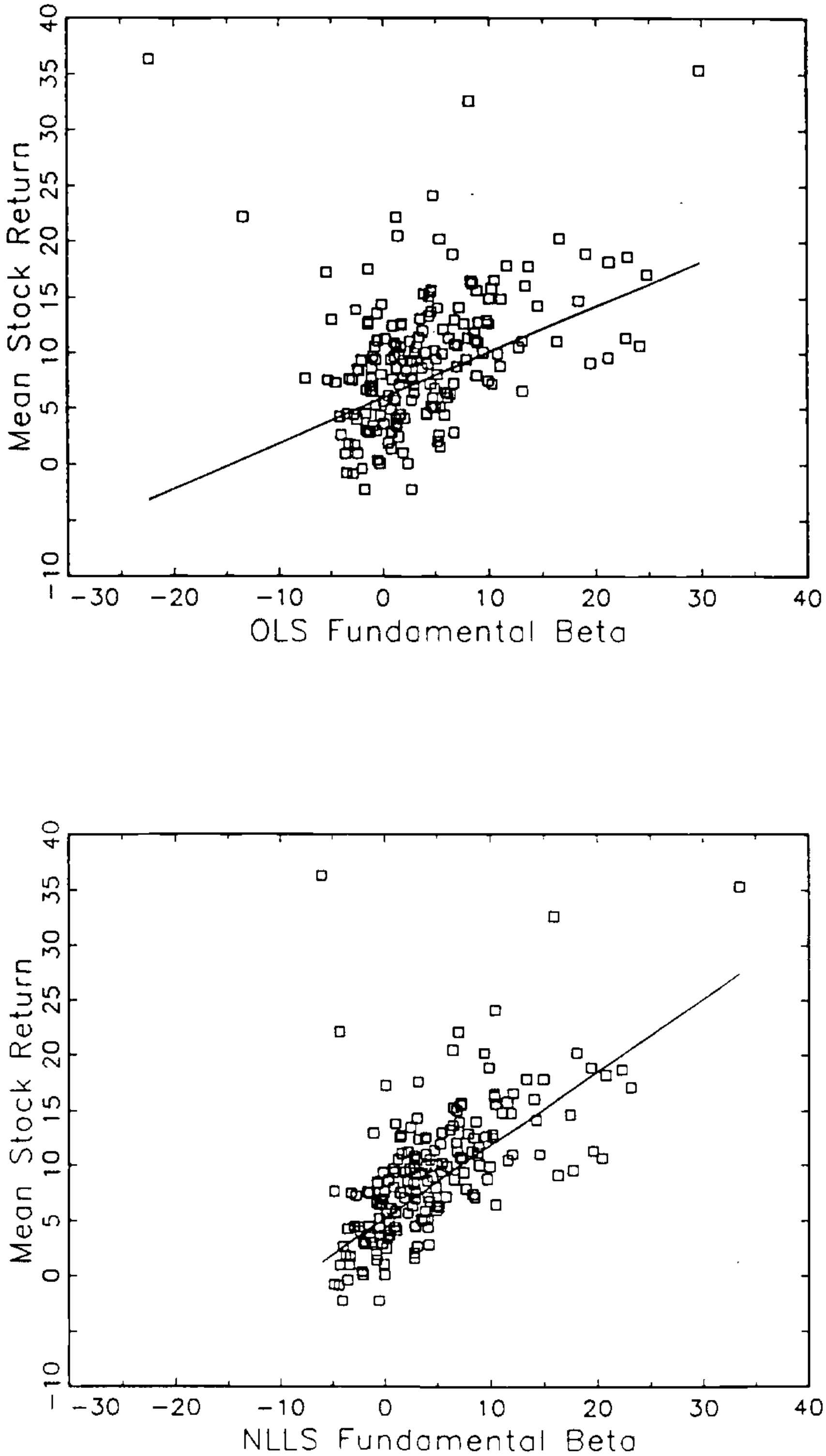
*These estimates did not converge after 100 iterations. Most others converged in under 20 iterations.

Note: The returns are three-year averages. See also note to Table 7.

Figure 1


Mean Stock Return
-10
0
5
10
15
20
25
30
35
40
-30
-20
-10
0
10
20
30
40
OLS Fundamental Beta
Mean Stock Return
-10
0
5
10
15
20
25
30
35
40
-30
-20
-10
0
10
20
30
40
NLLS Fundamental Beta