Empirical Evidence on Capital Investment, Growth Options, and Security Returns

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ABSTRACT

Growth in capital expenditures conditions subsequent classification of firms to portfolios based on size and book-to-market ratios, as in the widely used Fama and French (1992, 1993) methods. Growth in capital expenditures also explains returns to portfolios and the cross-section of future stock returns. These findings are consistent with recent theoretical models (e.g., Berk, Green, and Naik (1999)) in which the exercise of investment growth options results in changes in both valuation and expected stock returns.

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Fama and French (1992, 1993) observe size and book-to-market effects in the cross-section of stock returns and identify factors based on market value of equity and book-to-market ratios that explain returns over time. Size and book-to-market, in general, and the Fama-French factor model, in particular, are now routinely used to benchmark returns in studies of long-run stock performance. For example, recent studies report that anomalies such as the "new issues puzzle" attenuate when benchmarks incorporate size and book-to-market (Brav, Geczy, and Gompers (2000)). Whether observed book-to-market and size effects as distinguished by Fama and French result from an equilibrium asset-pricing model remains a controversial issue, however.[1]

Recently, a number of theorists have developed models that directly relate risk and return to firm-specific characteristics such as firm size and the book-to-market ratio. These models suggest that firm valuation and valuation ratios evolve in response to optimal corporate investment decisions and, more specifically, that size and book-to-market help explain the cross-section of average stock returns because these variables proxy for time-varying systematic risk. In particular, Berk, Green, and Naik (1999) develop a model in which expected returns are conditioned by the prevailing interest rate, the average systematic risk of assets in place, and the number and value of growth options. The relative importance of assets in place and growth options changes over time in response to optimal investment decisions, thereby changing the risk exposure of the firm's equity. Berk, Green, and Naik also show that the expected return equation can be written in terms of size and book-to-market. In the model, book-to-market proxies for systematic risk, which changes over time as assets turn over, and size proxies for the relative value of growth options. In addition, both size and book-to-market vary over time with the relative importance of growth options relative to existing assets. Subsequent papers further develop models that relate risk and return to changes in valuation induced by microeconomic or macroeconomic factors (Gomes, Kogan, and Zhang (2003), Carlson, Fisher, and Giammarino (2004), Zhang (2004)).

In this study we empirically investigate broad implications of these recent theoretical models that link expected returns to corporate investment and related changes in valuation. Our contribution is two-fold. First, we document empirical relations among firm-level investment, market values, and book-to-market ratios. Specifically, we find that classification of stocks to valuation portfolios by Fama-French methodologies is implicitly conditioned by prior growth rates in firm-specific capital expenditures. Controlling for size, firms categorized as growth (low book-to-market) stocks significantly accelerate investment prior to the portfolio classification year. In addition, their market values rise and their book-to-market ratios decrease. Value (high book-to-market) firms slow investment and increase their book-to-market ratios. Since market value increases following investment in sufficiently positive net present value projects, and by more than book value, firms classified as growth stocks appear to be exercising investment options around the portfolio formation period while firms classified as value stocks appear to be disinvesting. In short, we find an empirical relation between past firm-specific investment activity and valuation ratios.

As our second contribution, we demonstrate that stock returns are related to firm-level investment both for portfolios based on sorts and for returns on individual stocks in the cross-section. Specifically, we form portfolios based on investment growth rates and find that subsequent monthly returns are significantly lower for firms that have recently accelerated investment spending. The evidence for an independent value effect is weakened within portfolios sorted on past investment growth. Finally, we find that firm-specific growth in corporate investment helps explain monthly stock returns in the cross-section in a manner similar to book-to-market. In short, firm-specific capital investment appears to condition not only valuation ratios, but also expected stock returns.

Section I motivates our investigation with a brief review of related literature. In Section II we demonstrate that classifying firms by size and book-to-market is implicitly conditioned on firm-specific growth rates in capital expenditures. In Section III we document how investment growth affects the returns on portfolios. Section IV shows that growth rates in capital expenditures help explain returns to individual stocks in the cross-section. Section V summarizes our findings and discusses implications for additional research.

I. Related Literature

Our study is related to several areas of research on capital markets. Foremost, our research is directly related to a number of recent studies that explicitly link the so-called value and size effects with optimal corporate investment decisions under time-varying expected returns. A somewhat broader literature provides related explanations for why size and book-to-market ratios proxy for systematic risk and hence stock returns. Our study of firm-specific capital investment also complements the literature that links stock market performance to measures of aggregate investment activity. In this section we discuss these related literatures and their implications for our investigation.

We derive the primary motivation for our investigation from recent theoretical literature that suggests direct links exist among firm-specific investment patterns, valuation, and expected returns. In an innovative article, Berk, Green, and Naik (1999) develop a model that dynamically relates average stock returns, systematic risk, and firm characteristics such as firm size and the book-to-market ratio. In the model, the value of the firm is equal to the value of assets in place and growth options. Each period, firms find new investment opportunities, make investment decisions, and lose exhausted assets in place. Investment opportunities with low systematic risk are attractive to the firm and lead to large increases in market value, ceteris paribus. Making such investments reduces the average systematic risk of the firm's cash flows in subsequent periods, which on average leads to lower realized returns. Book-to-market value of equity therefore summarizes the firm's risk relative to the scale of the asset base. Changes in the firm's asset portfolio over its life cycle also lead to an explanatory role for market value because such changes alter the relative importance of growth options versus existing assets within the firm. Firms with higher market value tend to have relatively more assets in place and greater current cash flows. In short, the model develops implications of the exercise of real investment options for the dynamics of returns and risk across firms that are related to observable firm-specific characteristics such as size and the book-to-market ratio. We find strong support for these implications.

Berk, Green, and Naik's model has been complemented by other recent studies. Gomes, Kogan, and Zhang (2003) extend the model to a general equilibrium setting and emphasize that size and book-to-market can explain the cross-section of stock returns because they are correlated with true conditional betas, which are estimated with error in empirical studies. In the model of Gomes, Kogan, and Zhang, growth options are riskier than assets in place, which suggests that the association between capital spending (i.e., exercise of growth options) and subsequent returns should be negative. In addition, the models predict that the strength of the association will depend on the firm's number of ongoing projects vis-à-vis growth options.

Carlson, Fisher, and Giammarino (2004) model the optimal dynamic investment behavior of monopolistic firms facing stochastic product market demand conditions. Focusing on the cash flow decomposition among fixed costs, revenues from assets-in-place, and growth opportunities, the authors show that there can be book-to-market and size effects in stock returns even if there is no cross-sectional dispersion in project risk. In their model, the book-to-market ratio summarizes market demand conditions relative to invested capital and relates to risk through operating leverage; size captures the importance of finite growth opportunities relative to assets-in-place.

Cooper (2003) develops a dynamic model in which the book-to-market ratio is informative of the deviation of a firm's actual capital stock from its target capital stock, which in turn measures the sensitivity of the return on the firm to aggregate market conditions. If capital investment is irreversible, the book value of assets of a distressed firm remains constant but its market value falls, thus increasing its book-to-market ratio. Such a firm is sensitive to aggregate shocks because its extra installed capacity allows it to expand production easily without new investment, thus providing a high payoff to equity holders; low book-to-market stocks, in contrast, would need to undertake investment providing a lower payoff. Therefore, high book-to-market stocks have higher systematic risk.

Zhang (2004) examines equilibrium in competitive product markets and shows that firms' optimal investments, together with asymmetry in capital adjustment costs and the countercyclical price of risk, can generate the observed value premium. Specifically, he emphasizes that capital invested is riskier than growth options in economic downturns because it is difficult to disinvest. In contrast, assets-in-place are as risky as growth options in economic booms. Hence, value stocks have countercyclical betas while growth stocks have procyclical betas. Consistent with this model, Petkova and Zhang (2003) find that conditional betas of value (growth) stocks vary positively (negatively) with the expected market risk premium. Value stocks are more (less) risky than growth in bad (good) times when the expected risk premium is high (low).[2]

Our research provides evidence relevant to this body of literature. Examining firm-level data, we find that classification of stocks according to firm-level fundamentals such as size and book-to-market is implicitly conditioned on recent investment growth. In particular, growth stocks appear to be exercising investment options around portfolio formation while value stocks appear to be disinvesting. Firms that accelerate investment spending experience lower subsequent stock returns, on average, than firms that slow investment spending. In general, these associations among a firm's capital investment, its size, and its book-to-market ratio are consistent with several proposed models.

A link between investment activity and stock returns is proposed and tested in many related investigations, but investment activity is modeled and measured at the aggregate level. Cochrane (1991, 1996) develops an asset pricing model based on aggregate capital investment and finds that it performs as well as the CAPM and the Chen, Roll, and Ross (1986) models. Li, Vassalou, and Xing (2002) extend Cochrane's model to a four-factor sector investment growth model and find that their model outperforms the Fama-French three-factor model. In addition, pricing factors derived from size and book-to-market portfolios lose their explanatory ability in the presence of sector investment growth. Additionally, Lamont (2000) and Lettau and Ludvigson (2002) investigate the effect of time-varying discount rates on aggregate investment. Lamont emphasizes short-term lags between returns and investment expenditures, while Lettau and Ludvigson emphasize long-term implications of Q-theory when expected excess returns vary through time. In particular, Lamont (2000) shows that time-varying discount rates and investment lags may be responsible for the existing evidence that aggregate investment and stock returns are contemporaneously negatively correlated, and that investment and future stock returns are not significantly correlated. According to theory, there should be a positive contemporaneous association between investment and stock returns, and investment and future stock returns should negatively covary over time.[3]

In addition, there is also evidence that pricing factors derived from size and book-to-market are related to time-varying expected returns related to macroeconomic factors, including variables derived from aggregate measures of corporate investment activity. Our research complements these studies that rely on aggregate investment by focusing on firm-specific and portfolio-specific capital investment data and returns.[4] Lettau and Ludvigson (2001) report that a powerful predictor of excess returns on aggregate stock market indexes, the log consumption-wealth ratio, can explain the value premium. Liew and Vassalou (2000) find that returns to extreme size and book-to-market portfolios contain information about future GDP growth in a sample of ten countries. However, Vassalou (2003) reports that these portfolio factors lose their ability to explain average asset returns when innovations on future GDP growth are included in the cross-section. Petkova (2002) finds that the Fama-French factors are related to innovations in variables predicting future stock returns. This evidence is supportive of a risk-based explanation for the Fama-French three-factor model in which the size and value factors contain information about changes in the investment opportunity set. Specifically, Petkova finds that the book-to-market factor appears to be related to a term spread, and the size factor to a default spread. The usual economic interpretation of the term and default spreads is in connection to the business cycle (Fama and French (1989)). Lettau and Ludvigson (2001) argue that value stocks earn higher average returns because they are more highly correlated with consumption growth in bad times, when risk premia are high. In addition, Petkova and Zhang (2003) offer a theoretical explanation of why value and growth stocks may react differently to the business cycle. [5]

Finally, other studies with findings similar or more directly complementary to ours have emerged contemporaneously. Titman, Wei, and Xie (2004) and Xing (2002) also find a negative association between firm-level investment and future stock returns. Titman, Wei, and Xie, however, focus on whether that negative association suggests overinvestment. In a paper closely related to ours, Xing finds that investment and stock returns are negatively related both in the cross-section and in time-series, and that the value effect can be explained by the dynamics of business investment. She offers an interpretation of the value effect as a result of a Q-theory of investment with stochastic discount rates. Our work is different from Xing in that we inspect the evolution of firm characteristics around Fama-French style portfolio classifications and interpret our overall findings in the context of proposed models such as Berk, Green, and Naik. Our work contributes to this line of research because we report that size and book-to-market lose part of their ability to explain the cross-section of realized stock returns once we control for firm-level investment activity. As mentioned above, we also find a significant negative relation between investment growth and subsequent stock returns. Taken together, our evidence supports recent models that link the size and value effects in security returns with firms' optimal investment decisions over time.

II. Capital Investment and Valuation Sorts

In this section we investigate empirically how exercise of investment options conditions firm-specific characteristics such as book-to-market and size. Our findings suggest that sorting of stocks to portfolios based on size and book-to-market is implicitly conditional on recent firm-specific capital expenditures.

As mentioned, a number of recently proposed models suggest that firms that undertake new investments subsequently experience changes in size and book-to-market that are also related to the size and book-to-market effects in the cross-section of expected stock returns. To detect these relations, we rely on stock price and return data from the Center for Research on Securities Prices (CRSP) and financial statement data from COMPUSTAT over the period 1976 to 1999. We do not include firms until they are on the COMPUSTAT database for three years to reduce survival biases. In addition, in computing returns we require 36 months of data before a company is included in a portfolio. These requirements should reduce the influence of small, young growth stocks on the results (Loughran (1997)). Finally, only non-financial firms (SIC other than in the 60s) and firms with ordinary common equity (security type 10 or 11 in CRSP) are considered. We employ the conventions in Fama and French (1992, 1993) to segment firms by fundamental factors, adapted when necessary for variables based on firm-level capital expenditures.[6]

We utilize various growth rates in capital expenditures to proxy for the exercise of growth options (Mayers (1998)). These variables escape Berk's (1995) criticism of characteristic variables based on transformations of price (such as market value or book-to-market). Most frequently, we measure investment growth as capital expenditures at the end of fiscal year -1 relative to fiscal year -3, where year 0 is the year of portfolio sorting. We refer to this variable as *cegth2*. By portfolio sorting, we refer to the widely used Fama-French method of classifying stocks to portfolios based on firm size and book-to-market ratios. Our results do not materially change when we use the following alternative variables to measure firm-level investment activity: one- or two-year growth in capital expenditures scaled by total assets; change in capital expenditures scaled by sales; and capital expenditures relative to the simple average of capital expenditures two, three, and four years prior to the year of portfolio sorting. We omit full reporting of these alternative results.

To introduce our investigation, Table I presents preliminary evidence on the associations among investment, size as measured by market value of equity (*size*), and book-to-market (*b/m*) over the 1976 to 1999 period for CRSP- and COMPUSTAT-listed stocks. Table I displays mean and median values of investment growth rates for 25 portfolios sorted by *size* and *b/m* following Fama and French (1993). Two patterns are distinguishable in Panel A, in which investment growth is measured by *cegth2*. First, controlling for *size* (across rows), investment consistently decreases as *b/m* increases. For the smallest quintile, *cegth2* decreases from an average of 85% for low *b/m* firms to 34% for high *b/m* firms. For the largest quintile, *cegth2* decreases from 51% for low *b/m* firms to 16% for high *b/m* firms. Second, controlling for *b/m* (across columns), firm size and investment growth are inversely related. For the lowest (highest) *b/m* quintile, *cegth2* decreases from 85% (34%) for the smallest firms to 51% (16%) for the largest firms. These patterns are evident whether one looks at means or medians, and also when one-year growth rates (*cegth*) are examined, as in Panel B. Consequently, sorting of stocks to portfolios based on firm size and book-to-market ratios appears to be conditioned on prior investment growth rates.

[Insert Table I about here]

Next, Figure 1 plots growth rates in capital expenditures (COMPUSTAT item #128) around the portfolio formation year for portfolios based on *size* and *b/m*. We compute portfolio growth rates similar to the method of Fama and French (1995). In particular, to deal with the problem that earnings are sometimes negative for small-stock portfolios, they look at the evolution of the ratio of equity income for a portfolio to equity income for the market, $EI_p(t)/ EI_m(t)$, relative to the same ratio for year 0. The two ratios are averaged separately across portfolio formation years. In addition, the ratios are standardized so that they are equal to 1.0 for all portfolios in the year of portfolio formation. We follow the same approach to compute growth rates in capital expenditures for the graph shown in Figure 1. Figure 1 shows that high *b/m* firms reduce their investment activity for the three years prior to portfolio formation, while low *b/m* firms accelerate capital spending. Thus, low *b/m* firms appear to be exercising growth options prior to year zero.

[Insert Figure 1 about here.]

Evolution of other fundamentals also conditions assignation to Fama-French portfolios. Figure 2 plots the evolution of ln(*size*) prior to and subsequent to portfolio formation. The average market values of low *b/m* firms (S/L and B/L) increase significantly prior to portfolio formation. These low *b/m* firms are also the ones that appear to be accelerating investment, as seen in Figure 1. If *size* is a measure of growth opportunities, as Berk, Green, and Naik argue, low *b/m* stocks seem to be exercising investment options around year 0. Alternatively, size may be an inverse measure of risk, in which case the risk of low *b/m* stocks decreases (*size* increases) prior to portfolio formation, particularly for large firms. Although not shown, we also examine the evolution of *b/m* according to whether we assign stocks to high, medium, or low investment growth portfolios. High and medium investment growth firms show declining *b/m* prior to portfolio formation year, while low investment growth firms show a rise in *b/m* that peaks just prior to the year of portfolio formation.

[Insert Figure 2 about here.]

Although the figures are suggestive of patterns in the evolution of firm characteristics around portfolio formation, they do not provide formal evidence. In Table II we compare the investment activity of firms classified by *size* and *b/m*. Specifically, we independently classify firms into five groups based on *size* and five groups based on *b/m* as in Table I, and compare the two extreme high *b/m* and low *b/m* groups within the smallest and largest quintiles. We look at the evolution of median values of capital expenditures divided by total assets (*ce/ta*), the one-year growth rate in capital expenditures (*cegth*), equity capitalization (*size*), *b/m*, and the annual change in *b/m* (*b/mgth*) around the time of portfolio formation. In the table, variables dated to year 0 are for the year ending immediately prior to portfolio sorting.

Small firms with low *b/m* ratios consistently invest more than those with high *b/m* ratios around portfolio formation. For example, median *ce/ta* for low *b/m* stocks is 4.42% two years prior to portfolio formation (year -1), 4.55% the year prior to portfolio formation (year 0), and 4.40% at the end of the portfolio formation fiscal year (year +1). Respective numbers for high *b/m* stocks are 4.20, 3.91, and 3.77%. Using the Wilcoxon sum-rank test, the two groups are significantly different at the 1% level from two years prior (year –1) to one year after (year +2) portfolio formation. Furthermore, low *b/m* stocks appear to be accelerating investment while high *b/m* stocks seem to be disinvesting around portfolio formation. Annual growth rates in capital expenditures (*cegth*) for low *b/m* stocks are 5.57% in year –2, 11.02% in year –1, and 16.87% in year 0, while growth rates for high *b/m* stocks are 3.53, 0.00, and -3.48%, respectively. Z-statistics for the Wilcoxon test reveal that the two groups are significantly different at the 1% level from year –1 to year +1. Similar evidence can be observed for large firms. Consistent with Figure 1, low *b/m* stocks seem to exercise investment options around portfolio formation, while high *b/m* stocks appear to disinvest.

[Insert Table II about here]

Table II also indicates that firms that exercise investment growth options experience subsequent increases in *size* and decreases in *b/m*. For example, the *size* of small and low *b/m* stocks increases from a median $15.00 million in year –3 to $29.04 million in year +1 while the market value of small and high *b/m* stocks decreases from a median $18.45 million in year –3 to $15.82 in year +1. In fact, low *b/m* stocks change from being significantly smaller to being significantly larger than high *b/m* stocks two years prior to portfolio formation (year –1). In addition, median *b/m* decreases from 0.31 in year -3 to 0.22 in year 0 for small and low *b/m* stocks while median *b/m* increases from 1.09 in year –3 to 1.41 in year 0 for small and high *b/m* stocks. Similar patterns are discernible for large stocks. Moreover, annual changes in book-to-market ratios (*b/mgth*) for low *b/m* stocks are negative prior to portfolio formation while they are positive for high *b/m* stocks.

[Insert Figure 3 about here]

Finally, Figure 3 provides additional time-series evidence on corporate investment growth by *size* and *b/m* portfolios. Over these 23 sample years, firms that researchers would classify as high *b/m* consistently experience lower rates of investment growth (*cegth2*) prior to portfolio classification than firms that would be classified as low *b/m* firms. The evidence from Figure 3 and the other exhibits in this section supports implications of proposed models along the lines of Berk, Green, and Naik (1999). Classification of stocks according to firm-level fundamentals such as *size* and *b/m* is implicitly conditioned on recent levels of investment growth. In particular, stocks classified under Fama-French methods as low *b/m* stocks show increases in investment activity prior to the classification year, consistent with exercise of growth options. For these stocks, *size* increases and *b/m* decreases prior to portfolio formation. For high *b/m* stocks, the opposite pattern seems to hold. In short, exercise of growth options conditions commonly used portfolio sorting methods that are based on valuation measures.

III. Capital Investment and Portfolio Returns

Recent theoretical studies such as Berk, Green, and Naik imply an association between investment spending, valuation, and subsequent stock returns. In addition, models such as Gomes, Kogan, and Zhang (2003) assume that growth options are riskier than assets-in-place and suggest that the exercise of investment options reduces future stock returns. In this section we investigate whether returns vary across portfolios sorted by firm-specific growth rates in capital investment. We look at investment of individual firms because we seek to explain the size and value premiums by considering corporate investment, and most of the evidence on such premiums comes from firm-level data. We also employ the standard portfolio-based methodology common in the literature on market "anomalies" so that our findings can be directly compared to the results of that literature.

We follow the methods of Fama and French (1992, 1993) in sorting stocks into portfolios and investigating the influence of firm-specific characteristics on future returns. Monthly portfolio returns are computed from July of each year t to June of year t+1. To mitigate survivorship bias in returns for firms delisted from CRSP for performance reasons, we follow the prescriptions of Shumway (1997) and Shumway and Warther (1999). Specifically, for sample firms delisted for performance reasons, we substitute –30% as the last return for NYSE/AMEX firms and –55% as the last return for Nasdaq firms. Because many soon-to-be delisted firms are likely to have low growth rates in capital expenditures, this adjustment appears prudent. The bias adjustment reduces the average returns of small firms, but overall results are not sensitive to the adjustment.

Table III shows that two-year investment growth (*cegth2*), our proxy for the exercise of growth options, varies inversely with realized monthly returns. We first assign stocks to one of five portfolios based on prior two-year investment growth. Panel A of Table III shows some characteristics of these portfolios, including *beta*, *b/m*, *size*, and standard deviation of returns (*sigma*). Panel A shows that *b/m* increases monotonically as we move from high to low investment groups. For example, the average (median) *b/m* for the high investment group is 0.73 (0.60) while it is 0.90 (0.77) for the low investment group. This is consistent with the findings of the previous section. The average (median) *size* value is $392 ($53) million for the high investment group; it then increases in the middle quintiles, peaking at a mean (median) of $1,566 ($138) million, and then decreases to $244 ($27) million for the lowest investment group. Therefore, high investment growth stocks are predominantly small and have low *b/m* values, and low investment growth firms are small and have high *b/m* values.

Panel B shows that for the year after portfolio formation, average monthly returns are 1.18% for the highest *cegth2* portfolio versus 1.75% for the lowest *cegth2* portfolio.[7] In addition, the average monthly return difference between low and high *cegth2* portfolios is 0.57%, which is significantly different from zero (t-stat=5.05). We interpret these results as consistent with recent models linking risk and return with firm characteristics. Specifically, Berk, Green, and Naik predict that conditional expected returns depend on the average systematic risk of assets-in-place, the number of the firm's active projects relative to growth opportunities, and the level of interest rates. Holding interest rates constant, firms have a small number of ongoing projects early in their lives, and hence their risk and return will be relatively more affected by the exercise of investment options. Thus, it is not surprising to observe smaller firms, on average, in the two extreme investment groups. In addition, when a small firm exercises a growth option, its subsequent risk is likely to equal the risk of the investment project, which would have a very low systematic risk, ceteris paribus. Small firms with high book-to-market ratios and low investment could very well be distressed firms for which market value has decreased relative to its book value, as in Cooper (2003). To the extent possible, however, these companies try to disinvest. Exercise of investment options has a less dramatic effect on the risk and return of large firms because they have more ongoing projects, and that is why they fall in the middle investment groups.

[Insert Table III about here]

Intuitively, exercise of growth opportunities should have a larger impact on the risk and return characteristics of small rather than large firms. This is what we find in Panel B of Table III, where we present evidence on the association between investment and subsequent stock returns, controlling for market value of equity. Stocks are classified into three groups based on *size* each June, and then into five quintile portfolios based on prior investment growth. The return difference (t-stat) between the lowest and the highest investment groups is 0.56% (3.82) for small stocks, 0.48% (4.02) for midsize stocks, and 0.43% (3.11) for large stocks. Hence, even among medium and large firms, high rates of past investment growth predict lower subsequent average returns.

Panel C of Table III shows results when returns are value weighted within portfolios on a monthly basis.[8] The primary reason for displaying value-weighted returns is to investigate whether results based on equally weighted portfolios are confined largely to small firms, an attribute that has characterized many studies of expected returns. For investors or money managers who approximately value weight stocks, especially large-cap stocks, a relevant question is whether any portfolio skew toward or away from high investment stocks materially affects portfolio performance. Again, many return anomalies observed in equally weighted portfolios tend to attenuate when value-weighting methods are used, and so we expect some such attenuation in our results. Indeed, we find that the return difference between the lowest and highest quintile portfolios by *cegth2* is reduced to 0.34% (t-stat=2.07). Nevertheless, average value-weighted returns increase monotonically across *cegth2* portfolios. Dividing firms by market value of equity into small, medium, and large groups reveals that significant differences between value-weighted returns on extreme *cegth2*-sorted portfolios persist for small and medium sized firms, with differences in extreme portfolios of 0.36% for small firms (t-stat=2.36) and 0.37% for medium sized firms (t-stat=3.04). Although the lowest returns are observed in the high growth portfolios, returns do not increase monotonically across *cegth2* portfolios of small and medium sized firms. In contrast, among large firms returns increase monotonically from high to low *cegth2* portfolios, but the 0.32% difference in returns between the extreme portfolios is significantly different from zero at merely the 10% level (t-stat=1.83).

Finally, Panel D and Panel E of Table III report equally and value-weighted raw returns for portfolios sorted by an alternative definition of investment growth, *cegth3*. This measure is the growth rate in capital expenditures in year t-1 over the simple average of capital expenditures in years t-2, t-3, and t-4, again, where t-1 is the year prior to portfolio formation.[9] Panel D shows that equally weighted portfolio raw returns remain significantly lower for high investment groups (1.15%) than for low investment groups (1.75%). Consistent with the results for *cegth2*, return differences tend to attenuate somewhat when *cegth3* portfolios are conditioned on firm size (Panel D) or returns are value weighted within portfolios of large stocks (Panel E).

IV. Capital Investment and the Cross-section of Stock Returns

In this section, we investigate associations between firm-level investment, book-to-market, size, and average stock returns using regression analysis of monthly returns. Table IV contains the results of Fama and MacBeth (1973) regressions, where parameter estimates are time-series averages of the cross-sectional slopes of monthly returns regressed on *size*, *b/m*,and growth rates in capital expenditures (*cegth2* or *cegth3*). For each explanatory variable, the reported t-statistic is the time-series average of monthly t-statistics divided by their standard error. Following Fama and French (1992) for each independent variable, the top and bottom 1% are deleted each year to exclude extreme observations.[10]

Similar to the results of Fama and French (1992), *size* and *b/m* have significant explanatory power for the cross-section of average stock returns during 1976 to 1999. When returns are regressed on ln(*size*), the parameter estimate is -0.17%, with a t-statistic of -3.40. When returns are regressed on ln(*b/m*), the parameter estimate is 0.93%, with a t-statistic of 4.29. In the regression that includes both ln(*size*) and ln(*b/m*), the parameter estimates (t-statistics) are -0.15% (-2.73) and 0.53% (2.43), respectively. In contrast, *beta* computed as in Fama and French (1992) is not significant, alone or with other variables. The parameter estimate for *beta* is 0.02%, with a t-statistic of 0.05. Although not shown in Table IV, *beta* is not significant when *size*, *b/m*, or both are included in the regressions.

[Insert Table IV about here]

When variables that measure growth rates in capital expenditures are included in the Fama-MacBeth regressions, associated parameter estimates are highly significant and have the expected negative sign. The regression of stock returns on ln(1+*cegth2*) produces an estimate of -0.44%, with a t-statistic of -6.08. In other words, higher growth is followed by lower subsequent returns. Furthermore, when *size*, *b/m*, and *cegth2* are included in the regression, *cegth2* appears to subsume part of the information present in *b/m*. Parameter estimates (t-statistics) for *size*, *b/m*, and *cegth2* are, respectively, -0.15% (-2.77), 0.43% (1.98), and -0.34% (-5.22). If *beta* is included, it has a negative parameter estimate, -0.30%, which is not significant (the t-statistic is -0.93), and the parameter estimate for *b/m* becomes insignificant. When *beta* is present, parameter estimates (t-statistics) for logged values of *size*, *b/m*, and 1+*cegth2* are -0.17% (-3.23), 0.32% (1.76), and -0.35% (-5.51), respectively. In all the specifications, *cegth2* is highly significant, with a stable parameter estimate.

Table IV also reports results when investment growth is measured by capital expenditures in t-1 relative to the simple average of capital expenditures in years t-2, t-3 and t-4 (*cegth3*). The parameter estimate for ln(1+*cegth3*) is always negative and significantly different from zero at the 1% level. Although size is also significantly different from zero, ln(*b/m*) becomes only marginally significant (t-stat of 1.94) when *cegth3* is included, and insignificant when *beta* enters the regression.

Researchers have long reported that the size effect is most pronounced at the turn of the year (Hawawini and Keim (1995)). Consequently, we also investigate whether the exclusion of January returns affects the significance of the investment growth variable. In unreported results, the coefficient on *size* is not significant when January is excluded from the regressions, as expected. However, coefficients for *b/m* and *cegth2* remain significant, alone or with other variables. We also examine the stability of the association between investment growth and average stock returns across two subperiods, 1976 to 1987, and 1987 to 1999. In unreported results, we find that *size* is only significant in the first subperiod, and *b/m* is significant in both subperiods when no other variable is included in the regressions. If either *size* or *cegth2* enters the regression specification, however, *b/m* becomes insignificant for both subperiods. In contrast, the inverse relation between investment growth and subsequent average stock returns persists and remains highly significant in both subperiods.

To further investigate how investment growth conditions returns, Table V breaks down the returns on the *size* and *b/m* portfolios by investment-growth groups. We form five portfolios based on the growth rate in corporate investment two years prior to portfolio formation (*cegth2*). Within each investment-activity group, stocks are allocated to the intersection of two independent sorts, one based on *size* (S~small, B~big), and another based on *b/m* (H~high, M~medium, L~low).[11]

Panel A of Table V reports equally weighted average monthly returns as well as p-values for comparisons between portfolios characterized by differences in *cegth2*, *size*, and *b/m*. The average monthly stock return for the highest investment group is 1.18% while it is 1.75% for the lowest group. Returns also decrease monotonically with *cegth2* for stocks classified as S/H and B/H. Returns do not decrease monotonically for B/L and S/L firms, but the lowest returns are observed among such firms with the highest investment growth. Panel A also shows evidence of size and value effects in stock returns. Average returns for S/H and B/L stocks are 1.94% and 1.24%, respectively, and are significantly different from each other at the 1% level (the p-value is 0.0001). Controlling for size, however, there is a value effect separate from the size effect only among small stocks. The p-value for a t-test comparing average returns between S/H and S/L stocks is 0.003, while it is 0.109 for the comparison of B/L and B/H stocks. Controlling for *b/m*, on the other hand, leaves evidence of a size effect independent of the value effect only for high *b/m* stocks. P-values for t-tests are 0.077 when we compare S/H and B/H stocks and 0.931 when we compare S/L and B/L stocks.

[Insert Table V about here]

Most importantly, consistent with the hypothesis that the value and size effects are related to recent exercise of growth opportunities as proxied by growth in capital expenditures, there are few significant differences between *size*- and *b/m*-sorted portfolios after controlling for *cegth2*. Significant differences can be found only between the returns of S/H versus B/L for the highest and lowest quintiles based on growth in capital expenditures (p-values of 0.081 and 0.050, respectively), and for S/H versus S/L for the highest growth portfolio (p-value of 0.042).

Panel B of Table V reports results when stock returns are value weighted within each portfolio. Consistent with results discussed above, average value-weighted returns are lowest among the highest *cegth2* portfolios regardless of additional division by *size* and *b/m*. For example, for firms classified as small and high *b/m* (S/H), returns are 1.43% for the high investment group and 2.00% for the low investment group. Two additional conclusions can be drawn from the comparisons of value-weighted portfolio returns in Panel B of Table V. First, controlling for size, there is evidence of a book-to-market effect only among small firms. Average value-weighted returns of 1.76% for small and high *b/m* stocks are significantly different than returns of 1.04% for small and low *b/m* stocks at the 1% level (p-value 0.002). In contrast, average returns of 1.34% for large and low *b/m* stocks are not different than average returns of 1.45% for large and high *b/m* stocks (p-value 0.570).

Second, although stock returns are not significantly different after controlling for book-to-market, they are significantly different when firms differ in terms of both *size* and *b/m*. Average returns of 1.76% and 1.34% for S/H and B/L stocks, respectively, are different at the 5% level (p-value 0.040). Differences between value-weighted returns for portfolios sorted by *size* and b*/m* disappear within most investment growth groups, however. For example, p-values for comparisons of average returns for S/H and B/L stocks are 0.687% for the highest investment-growth group, 0.300% for the second highest, 0.35%4 for the third, 0.254% for the fourth, and 0.253% for the lowest investment growth group.[12]

Panel C and Panel D repeat the comparisons of equally and value-weighted returns for portfolios sorted by *cegth3*. Results are very similar to those in shown for *cegth2* in Panel A and Panel B. In particular, within portfolios formed on the basis of past investment growth (*cegth3*), differences in returns attributable to *size* and *b/m* appear to diminish.

V. Summary and Discussion

Recent theoretical research implies that the explanatory power of the size and book-to-market factors for the cross-section of stock returns arises from return predictability associated with businesses' optimal investment decisions. In the models, book-to-market ratio and size change as firms exercise investment options and their existing assets depreciate. As a result, exposure to systematic risk and hence expected stock returns evolve in a predictable manner (Berk, Green, and Naik (1999), Gomes, Kogan, and Zhang (2003), Carlson, Fisher, and Giammarino (2004), Cooper (2003)).

In this study we report empirical support for the recently proposed models. First, we examine the empirical associations among firm-level corporate investment, market value of equity, and the book-to-market ratio. We show that stocks of firms classified as low book-to-market by the widely used Fama and French methods significantly accelerate capital investment and experience increases in market value prior to the classification year. Stocks of firms classified as high book-to-market tend to reduce investment and decrease their market value. Valuation is not independent of recent growth in capital expenditures, and neither are portfolio sorting methods such as those popularized by Fama and French (1992, 1993). Second, we form portfolios based on prior investment growth and find that average returns are significantly lower for portfolios composed of firms that have recently accelerated investment spending. We document that firm-specific investment growth is robustly significant in cross-sectional regressions and appears to contain information similar to that of the book-to-market ratio. Among portfolios sorted by prior investment growth rates, evidence for independent value premium is weakened.

Overall, the evidence is consistent with recent models and complements existing interpretations of book-to-market and size as firm-specific characteristics related to risk. For example, Fama and French (1995) find that the profitability of growth stocks increases prior to portfolio formation and subsequently decreases, while the opposite is true for value stocks. Fama and French conjecture that the average return on capital of growth firms increases prior to portfolio formation (i.e., these firms find some profitable investment opportunities) and thus they expand investment and output until marginal earnings return to competitive equilibrium levels. In contrast, value stocks' average returns on capital decreases prior to portfolio formation and so these firms contract investment until earnings return to equilibrium levels.

Our findings suggest several avenues for future research. First, the robustness of long-run return anomalies to valuation benchmarks has generated substantial controversy (Fama (1998), Loughran and Ritter (2000)). Our results suggest that it may prove useful to benchmark long-run returns for firm-level investment patterns in some event-study applications. Although not reported, we investigate the performance of a pricing factor based on investment growth to explain returns on portfolios over time. Specifically, we construct an investment factor by subtracting monthly returns on a high investment growth portfolio from returns on a low investment growth portfolio. Consistent with the evidence in Xing (2002), we find that the investment factor and the high-minus-low (HML) book-to-market factor contain similar information. Nevertheless, preliminary work that we do not report suggests that adding an investment-growth factor to the Fama-French three-factor model helps explain otherwise anomalous returns for portfolios characterized by unusually high or low capital investment growth. Many studies examine long-run returns to firms subsequent to new security offerings and report negative abnormal returns. Benchmarking long-run returns to changes in investment spending that may coincide with financing events might attenuate abnormal returns.

Second, Titman, Wei, and Xie (2004) also report a negative association between investment and stock returns after benchmarking for factors such as size and book-to-market, but they interpret this as evidence of widespread agency problems of overinvestment. We interpret our evidence as consistent with a risk-based explanation. Nevertheless, whether over-investment is partially responsible for the observed relation between investment and stock returns should be subject to additional investigation.

Third, the international evidence on the three-factor model of Fama-French is mixed. Specifically, country-specific versions of the Fama-French factor model perform better than a global factor model (Griffin (2002)). If changes in investment opportunity sets and corporate investment activity are imperfectly correlated across countries, then expected stock returns should demonstrate country-specific trends under proposed models. In particular, country-specific patterns in capital investment might help to explain country-specific patterns in stock returns.

Finally, empirical tests appear to support asset pricing models that employ variables derived from macroeconomic data on aggregate measures of corporate investment (Cochrane (1991, 1996), Li, Vassalou, and Xing (2002)). Investigation of the relations between these models and specifications based on factors derived from firm-specific characteristics such as size, book-to-market, and corporate investment seems a fruitful area for future research.

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Table I

Corporate Investment Growth by Sorts on Size and Book-to-Market Ratio, July 1976 to June 1999

Each year, we divide NYSE, AMEX and NASDAQ stocks into five groups based on their *size* (price times shares outstanding) at the end of June of year t, and into five groups based on ranked values of book-to-market ratio (*b/m*, the ratio of book value of equity at the end of fiscal year t-1 divided by market value of equity at the end of December of calendar year t-1). Only positive values of *b/m* are considered. We use NYSE stocks to determine the *size* and *b/m* breakpoints. We form 25 portfolios by combining the sorts by *size* and by *b/m*. Prior two-year investment growth (*cegth2*) is the difference between capital expenditures at the end of fiscal year t-1 minus capital expenditures at the end of fiscal year t-3 divided by capital expenditures in t-3. Prior one-year growth (*cegth*) is the growth rate between capital expenditures in year t-1 and year t-2. Growth rates have been winsorized at the 1% and 99% tails of the distributions. Means/medians are shown as percentages (e.g., 50 means 50%).

Panel A: Prior Two-Year Investment Growth % (*cegth2*) by *size* and *b/m* Sorts

	Low *b/m*	2	3	4	High *b/m*
Small *size*	85/20	81/25	65/19	60/13	34/-5
2	103/52	75/33	57/26	45/16	35/7
3	96/54	62/30	45/21	30/13	22/1
4	77/47	45/25	35/16	26/9	21/3
Large *size*	51/31	40/24	26/17	20/6	16/3

Panel B: Prior-Year Investment Growth % (*cegth*) by *size* and *b/m* Sorts

	Low *b/m*	2	3	4	High *b/m*
Small *size*	59/12	52/13	41/8	37/7	26/-5
2	57/23	41/18	31/13	20/6	17/1
3	49/27	32/15	24/12	12/5	14/0
4	38/23	21/11	16/8	13/6	6/1
Large *size*	25/14	16/11	11/7	8/3	5/0

Table II
Investment Measures for Stocks Sorted on 25 Portfolios based on Size and Book-to-Market, July 1976 to June 1999

The table reports median values of capital expenditures divided by total assets (*ce/ta*), one-year growth in capital expenditures (*cegth*), market value of equity (*size*), book-to-market ratio (*b/m*), and annual growth rate in *b/m* (*b/mgth*) for stocks grouped into 25 portfolios based on *size* and *b/m* as described in Table I. Only values for stocks in the smallest/largest *size* groups and the lowest/highest *b/m* groups are shown. Year 0 is the fiscal year prior to that of portfolio formation. Firm *size* is in millions of dollars and *b/m* is reported as a decimal number. All other table entries are shown as percentages (e.g., 50 implies 50%). Superscripts a, b, and c refer to 1, 5, and, 10% significance levels, respectively, for Wilcoxon sum-rank z-statistics testing the equality of distributions between the two groups, high and low *b/m* stocks.

Panel A: Small Stocks by *size*

	Low *b/m*					High *b/m*				
Year	*ce/ta*	*cegth*	*size*	*b/m*	*b/mgth*	*ce/ta*	*cegth*	*size*	*b/m*	*b/mgth*
-4	4.79	--	13.93	0.32	--	4.73	--	19.24[a]	1.03[a]	--
-3	4.71	9.43	15.00	0.31	-5.71	4.66	8.69	18.45[a]	1.09[a]	6.65[a]
-2	4.51	5.57	17.15	0.28	-8.40	4.48	3.53	17.20[c]	1.20[a]	8.02[a]
-1	4.42	11.02	21.22	0.25	-11.64	4.20[a]	0.00[a]	16.17[a]	1.29[a]	7.43[a]
0	4.55	16.87	27.77	0.22	-17.50	3.91[a]	-3.48[a]	14.74[a]	1.41[a]	7.68[a]
+1	4.40	11.31	29.04	0.26	13.54	3.77[a]	-2.59[a]	15.82[a]	1.29[a]	-7.94[a]
+2	4.23	5.44	28.92	0.29	9.54	3.85[a]	5.65	17.20[a]	1.18[a]	-8.22[a]
+3	4.41	3.79	29.28	0.33	6.92	3.97	7.83	19.00[a]	1.09[a]	-6.78[a]
+4	4.01	2.97	29.80	0.36	6.30	4.12	7.84[a]	21.85[a]	1.01[a]	-5.91[a]

Panel B: Large Stocks by *size*

	Low *b/m*					High *b/m*				
Year	*ce/ta*	*cegth*	*size*	*b/m*	*b/mgth*	*ce/ta*	*cegth*	*size*	*b/m*	*b/mgth*
-4	7.79	--	2,314	0.32	--	8.23	--	3,182[a]	1.06[a]	--
-3	7.75	14.8	2,695	0.31	-4.24	8.24	10.7[b]	3,325[a]	1.06[a]	-1.88[a]
-2	7.75	13.8	3,049	0.30	-4.53	7.93	8.96[a]	3,336	1.14[a]	0.11[a]
-1	7.62	13.7	3,786	0.28	-6.91	7.04[a]	5.05[a]	3,539	1.14[a]	3.17[a]
0	7.50	14.6	4,691	0.26	-8.39	6.33[a]	0.38[a]	3,707[a]	1.18[a]	2.29[a]
+1	7.46	15.4	5,279	0.26	0.82	6.13[a]	-0.40[a]	4,423[a]	1.04[a]	-10.54[a]
+2	7.48	12.1	5,204	0.28	3.22	5.69[a]	0.76[a]	4,425[a]	0.96[a]	-8.49[a]
+3	7.31	9.80	5,345	0.30	-0.31	5.68[a]	2.09[a]	4,693[a]	0.89[a]	-9.53[a]
+4	7.27	9.46	5,474	0.30	-2.74	6.09[a]	2.91[a]	4,698[a]	0.85[a]	-4.75[b]

Table III
Average Monthly % Returns and Characteristics for Quintile Portfolios based on Growth Rates in Capital Expenditures

At the end of June of each year t, t = 1976 to 1998, five quintile portfolios are formed based on growth rates in capital expenditures from the end of fiscal year t-3 to the end of fiscal year t-1 (Panels A, B, and C) or capital expenditures in t-1 relative to the simple average over the previous three years (Panels D and E). Year t is the year of portfolio formation. Returns are computed over the twelve months following portfolio formation (total of 276 months). Returns for stocks delisted for performance reasons are adjusted as per Shumway (1997) to mitigate bias. Value-weighted returns (Panels C and E) are based on monthly rebalancing. Quintile portfolios are ranked in descending order. The variable *beta* is estimated as in Fama and French (1992). The book-to-market ratio (*b/m*) is book value of equity at the end of the fiscal year t divided by market equity in December of calendar year t. The variable *size* is market value of equity in millions of US dollars. The variable *sigma* is the standard deviation of monthly returns. The last column of Panels B-E shows the average monthly return difference between low and high investment groups (t-stat in parentheses).

Panel A: Characteristics of Portfolios based on *cegth2*;
cegth2 = (*capexp* t-1- *capexp* t-3) / *capexp* t-3

	High *cegth2*	2	3	4	Low *cegth*
beta	1.25	1.18	1.14	1.16	1.23
b/m mean	0.73	0.72	0.79	0.85	0.90
(median)	(0.60)	(0.63)	(0.65)	(0.71)	(0.77)
size mean	392	1046	1566	1085	244
(median)	(52.5)	(115.2)	(138.2)	(84.9)	(26.6)
sigma (%)	5.66	5.07	4.78	4.90	5.75

Panel B: Average Equally Weighted Monthly Percent Returns by *cegth2* and *size; cegth2* = (*capexp* t-1- *capexp* t-3) / *capexp* t-3

	High cegth2	2	3	4	Low *cegth2*	Low-High *cegth2*
All (%)	1.18	1.50	1.62	1.63	1.75	0.57 (5.05)
Small *size*	1.42	1.79	1.84	1.87	1.98	0.56 (3.82)
Medium *size*	1.03	1.50	1.64	1.60	1.51	0.48 (4.02)
Large *size*	1.12	1.35	1.47	1.50	1.55	0.43 (3.11)

Panel C: Average Value-Weighted Monthly Percent Returns by *cegth2* and *size*; *cegth2* = (*capexp* t-1- *capexp* t-3) / *capexp* t-3

	High *cegth2*	2	3	4	Low *cegth2*	Low-High *cegth2*
All (%)	1.17	1.28	1.40	1.43	1.51	0.34 (2.07)
Small *size*	1.15	1.66	1.71	1.64	1.51	0.36 (2.36)
Medium *size*	1.09	1.53	1.58	1.57	1.46	0.37 (3.04)
Large *size*	1.16	1.26	1.39	1.42	1.48	0.32 (1.83)

Table III (cont.)

Panel D: Average Equally Weighted Monthly Percent Returns by *cegth3* and *size*; *cegth3*= *capexp* t-1 / [(*capexp* t-2 + *capexp* t-3 + *capexp* t-3)/3]

	High *cegth3*	2	3	4	Low *cegth3*	Low-High *cegth3*
All (%)	1.15	1.48	1.60	1.66	1.75	0.60 (4.71)
Small *size*	1.37	1.77	1.82	1.82	2.00	0.62 (4.22)
Medium *size*	1.02	1.44	1.60	1.63	1.49	0.47 (3.99)
Large *size*	1.07	1.37	1.48	1.54	1.44	0.37 (2.64)

Panel E: Average Value-Weighted Monthly Percent Returns *cegth3* and *size*; *cegth3*= *capexp* t-1 / [(*capexp* t-2 + *capexp* t-3 + *capexp* t-3)/3]]

	High *cegth3*	2	3	4	Low *cegth3*	Low-High *cegth3*
All (%)	1.14	1.31	1.39	1.44	1.37	0.22 (1.34)
Small *size*	1.10	1.61	1.64	1.70	1.51	0.41 (2.78)
Medium *size*	1.05	1.56	1.52	1.63	1.42	0.37 (3.02)
Large *size*	1.14	1.29	1.39	1.42	1.31	0.18 (0.98)

Table IV
Average Parameter Values from Cross-Sectional Regressions of Monthly Returns on Firm Size, Book-to-Market Ratio, and Growth Rates in Capital Expenditures

Monthly returns are regressed on *beta*, *size*, *b/m*, and alternative measures of capital expenditure growth (*cegth2* and *cegth3*). Returns for stocks delisted for performance reasons are adjusted as per Shumway (1997) to mitigate bias. The variable *beta* is estimated as in Fama and French (1992). Firm *size* is measured as the market value of equity (price times shares outstanding) at the end of June of each year t, t = 1976 to 1998. Book-to-market ratio (*b/m*) is the ratio of book value equity at the end of fiscal year t-1 divided by the market value of equity at the end of December of calendar year t-1. One measure of growth rate in capital expenditures is *cegth2*, calculated as the percentage difference in capital expenditures at the end of fiscal year t-1 relative to capital expenditures at the end of fiscal year t-3. An alternative measure for capital expenditure growth is *cegth3*, calculated as the percentage difference in capital expenditures in t-1 relative to the simple average of capital expenditures in years t-2, t-3, and t-4. Averages parameter values are the time-series averages, and t-statistics are time-series averages divided by time-series standard errors (276 months). Ln denotes natural logarithm. Explanatory variables are winsorized at the 1% and 99% levels.

	Regression specification, average parameter values (%) and t-statistics									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
beta	0.02						-0.30			-0.28
	(0.05)						(-0.93)			(-0.86)
Ln(*size*)		-0.17		-0.15		-0.15	-0.17		-0.14	-0.16
		(-3.40)		(-2.73)		(-2.77)	(-3.23)		(-2.89)	(-3.11)
Ln(*b/m*)			0.93	0.53		0.43	0.32		0.42	0.33
			(4.29)	(2.43)		(1.98)	(1.76)		(1.94)	(1.79)
Ln(1+*cegth2*)					-0.44	-0.34	-0.35			
					(-6.08)	(-5.22)	(-5.51)			
Ln(1+ *cegth3*)								-0.63	-0.46	-0.46
								(-5.81)	(-5.22)	(-5.34)

Table V
Average Monthly Percent Returns for Portfolios based on Growth in Capital Expenditures, Book-to-Market, and Size

At the end of June of each year t, t = 1976 to 1998, stocks are allocated to five groups based on growth rates in capital expenditures from the end of fiscal year t-3 to the end of fiscal year t-1 (*cegth2*) or capital expenditures in t-1 relative to the simple average of capital expenditures in years t-2, t-3, and t-4 (*cegth3*). Within each investment group, stocks are allocated to two groups based on their market values at the end of June (S, B), and, independently of the size sort, to three groups based on book-to-market equity (H, M, L). We do not use firms with negative book values when calculating the breakpoints or when forming the *size* and *b/m* portfolios. Raw returns are computed over the twelve months following portfolio formation. Returns for stocks delisted for performance reasons are adjusted as per Shumway (1997) to mitigate bias. Value-weighted returns (Panels B and D) are based on monthly rebalancing.

Panel A: Equally Weighted Returns Across Portfolios Based on *cegth2*, *size*, and *b/m*

	Average Percent Returns					p-value for comparisons					
cegth2 Portfolio	All Stocks	B/L	S/H	S/L	B/H	S/H vs. S/L	B/L vs. B/H	S/H vs. B/H	S/L vs. B/L	S/H vs. B/L	S/L vs. B/H
High *cegth2*	1.18	0.78	1.68	0.55	1.46	0.042	0.201	0.644	0.696	0.081	0.110
2	1.50	1.29	1.83	1.24	1.48	0.255	0.673	0.434	0.918	0.244	0.631
3	1.62	1.43	1.94	1.48	1.57	0.370	0.745	0.389	0.918	0.233	0.865
4	1.63	1.40	1.97	1.43	1.64	0.304	0.591	0.466	0.952	0.201	0.687
Low *cegth2*	1.75	1.28	2.29	1.38	1.74	0.137	0.378	0.273	0.877	0.050	0.560
Average	1.54	1.24	1.94	1.22	1.58	0.003	0.109	0.077	0.931	0.000	0.138

Panel B: Value-Weighted Returns Across Portfolios Based on *cegth2*, *size*, and *b/m*

	Average Percent Returns					p-value for comparisons					
cegth2 Portfolio	All Stocks	B/L	S/H	S/L	B/H	S/H vs. S/L	B/L vs. B/H	S/H vs. B/H	S/L vs. B/L	S/H vs. B/L	S/L vs. B/H
High *cegth2*	1.17	1.23	1.43	0.45	1.21	0.077	0.961	0.630	0.188	0.687	0.183
2	1.28	1.25	1.70	1.19	1.40	0.320	0.721	0.493	0.914	0.300	0.680
3	1.40	1.41	1.80	1.42	1.47	0.457	0.876	0.454	0.975	0.354	0.922
4	1.43	1.36	1.84	1.32	1.51	0.310	0.712	0.458	0.940	0.254	0.707
Low *cegth2*	1.51	1.45	2.00	0.81	1.67	0.036	0.641	0.523	0.247	0.253	0.130
Average	1.36	1.34	1.76	1.04	1.45	0.002	0.570	0.142	0.203	0.040	0.080

Table V (continued)

Panel C: Equally Weighted Returns Across Portfolios Based on *cegth3*, *size*, and *b/m*

	Average Percent Returns					p-value for comparisons					
cegth3 Portfolio	All Stocks	B/L	S/H	S/L	B/H	S/H vs. S/L	B/L vs. B/H	S/H vs. B/H	S/L vs. B/L	S/H vs. B/L	S/L vs. B/H
High *cegth3*	1.15	0.81	1.66	0.48	1.33	0.032	0.315	0.485	0.577	0.096	0.127
2	1.48	1.25	1.72	1.19	1.50	0.307	0.584	0.598	0.913	0.292	0.558
3	1.60	1.40	1.95	1.41	1.62	0.282	0.600	0.441	0.977	0.198	0.674
4	1.66	1.49	1.93	1.41	1.70	0.272	0.646	0.605	0.800	0.328	0.517
Low *cegth3*	1.75	1.21	2.29	1.36	1.78	0.170	0.280	0.320	0.709	0.038	0.588
Average	1.53	1.23	1.82	1.44	1.59	0.002	0.096	0.113	0.826	0.001	0.094

Panel D: Value-Weighted Returns Across Portfolios Based on *cegth3*, *size*, and *b/m*

	Average Percent Returns					p-value for comparisons					
cegth3 Portfolio	All Stocks	B/L	S/H	S/L	B/H	S/H vs. S/L	B/L vs. B/H	S/H vs. B/H	S/L vs. B/L	S/H vs. B/L	S/L vs. B/H
High *cegth3*	1.14	1.17	1.41	0.33	0.98	0.047	0.714	0.362	0.146	0.628	0.235
2	1.31	1.29	1.65	1.30	1.42	0.491	0.762	0.594	0.988	0.404	0.811
3	1.39	1.39	1.71	1.40	1.56	0.539	0.662	0.727	0.978	0.431	0.745
4	1.44	1.41	1.88	1.39	1.60	0.342	0.658	0.534	0.967	0.270	0.687
Low *cegth3*	1.37	1.26	1.98	0.79	1.60	0.039	0.484	0.462	0.393	0.145	0.157
Average	1.33	1.30	1.72	1.04	1.43	0.004	0.519	0.154	0.263	0.036	0.098

Figure 1. Growth Rates in Capital Expenditures Relative to Year of Portfolio Sorting

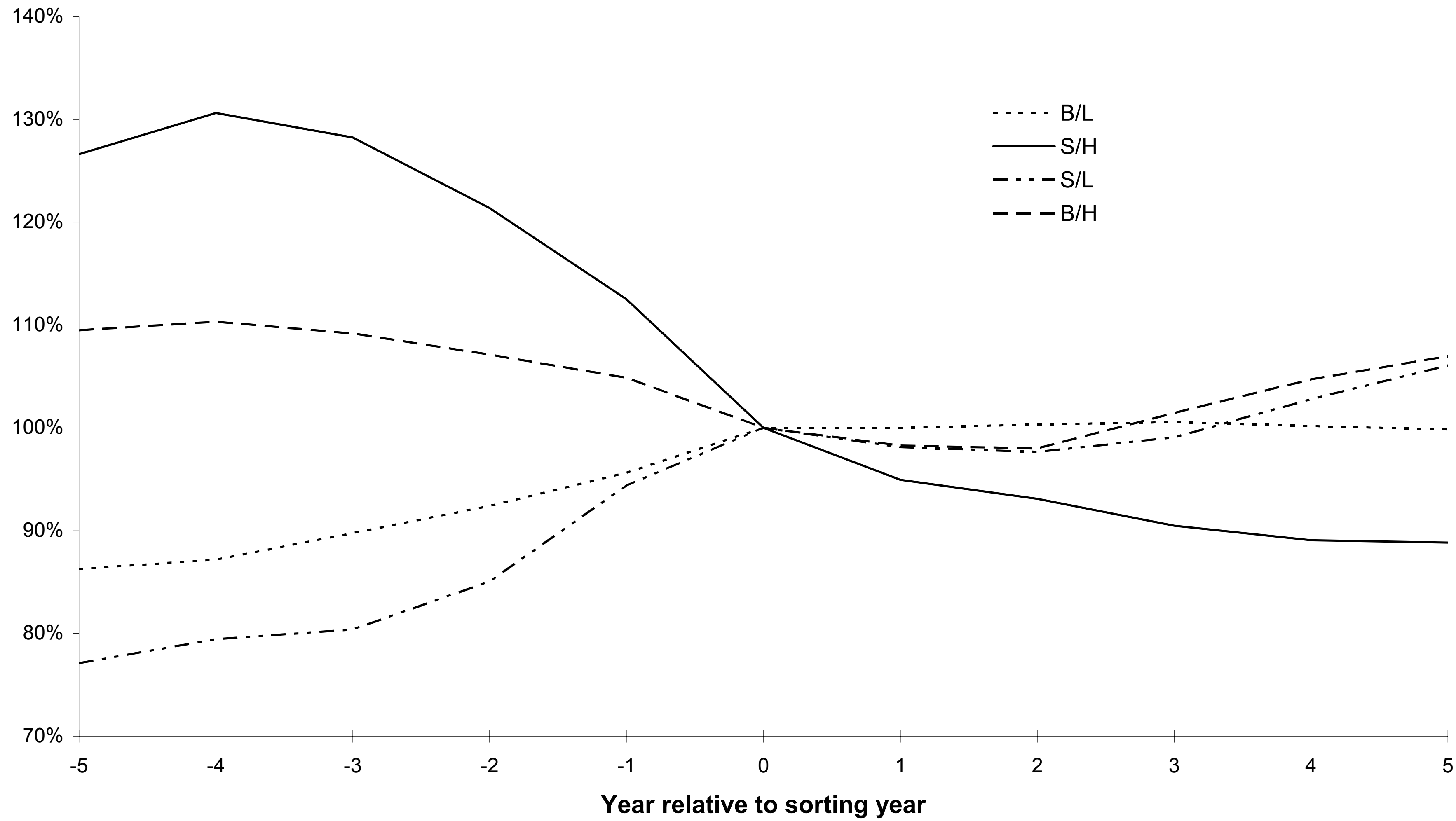


Figure 2. Evolution of ln(MVE)

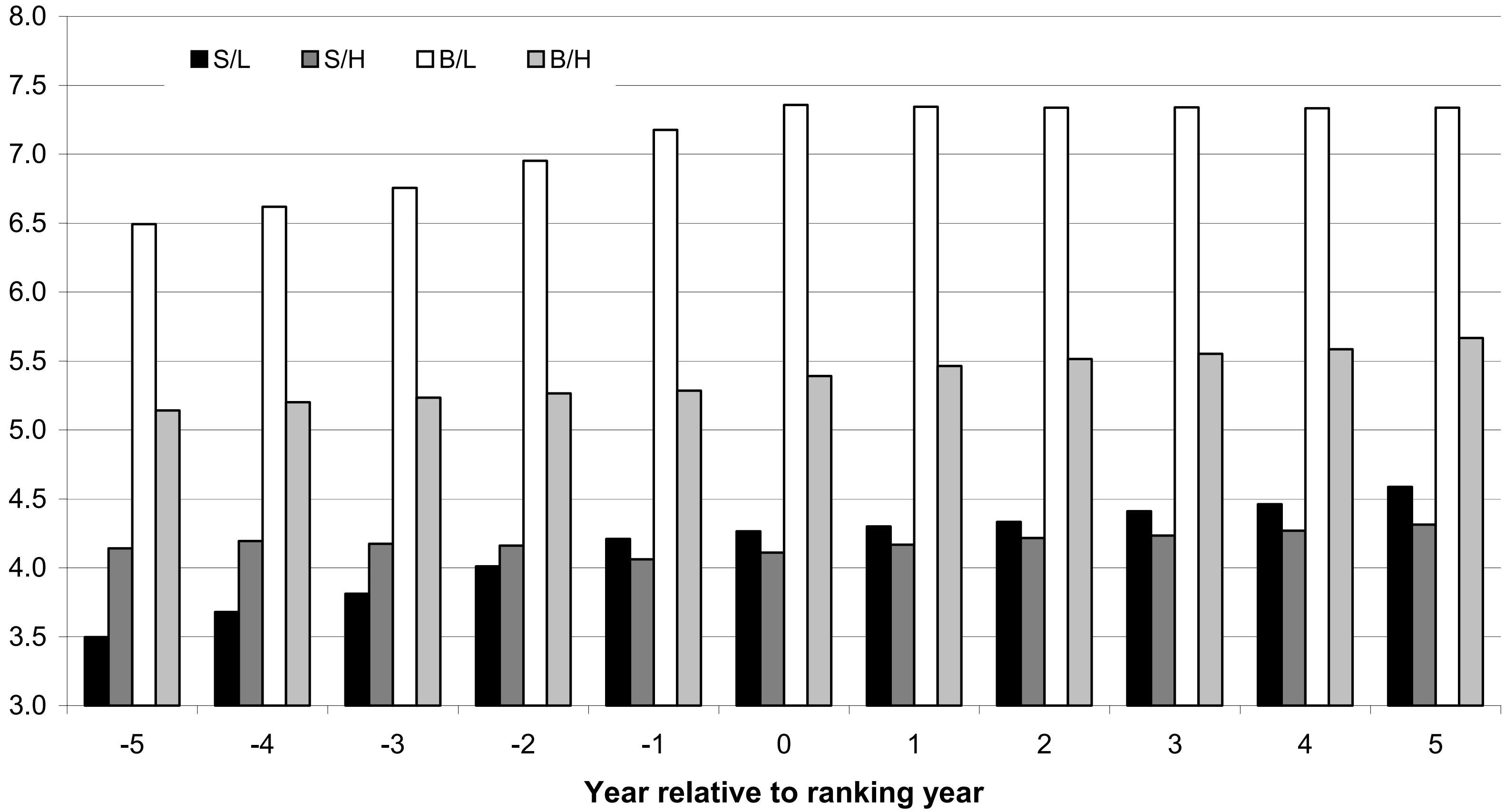
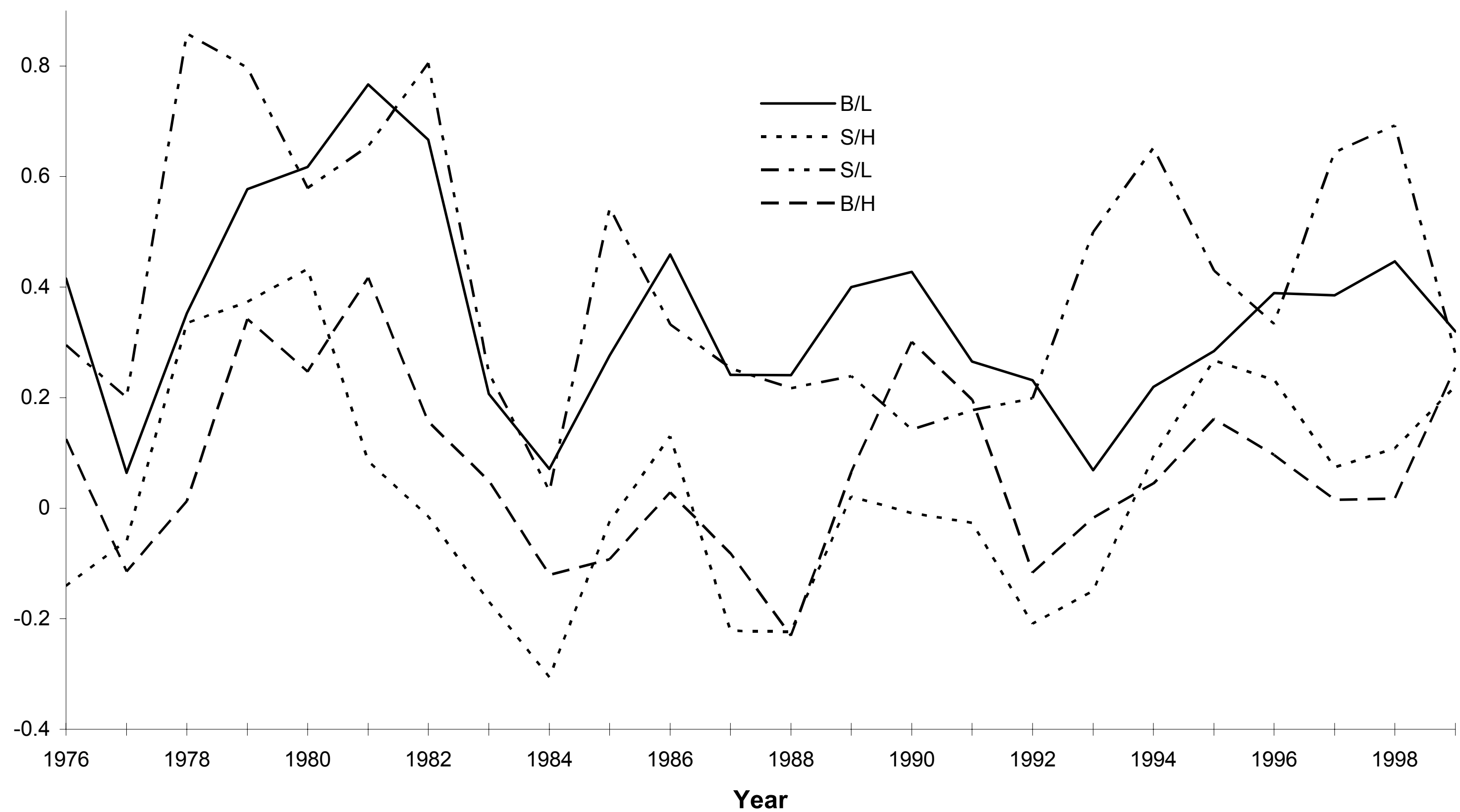


Figure 3. Growth Rate in Corporate Investment by Size and B/M



[1] Alternative explanations for the Fama-French results include risk premia for omitted state variables (Ball (1978), Fama and French (1993, 1996)) and security mispricing (Lakonishok, Shleifer, and Vishny (1994), Daniel and Titman (1997)). Other possible explanations include biases attributable to data snooping or data sources (Black (1993), Lo and Mackinlay (1990), Kothari, Shanken, and Sloan (1995), and an expected inverse relation between expected return and market value (Berk (1995, 1996)).

[2] In contrast to these papers, our investigation does not consider risk changes across the business cycle. We find no evidence that the association between investment spending and subsequent stock returns varies over the business cycle in our sample period, using NBER data and the Lettau and Ludvigson (2001) *cay* variable.

[3] Our investigation is also related to a long strand of literature that looks at the association between stock returns and subsequent capital investment. Existing literature, however, uses aggregate data to investigate the influence of market valuations (i.e, Tobin's Q) or stock returns on business investment (Barro (1990), Blanchard, Rhee, and Summers (1993), Morck, Shleifer, and Vishny (1990)). These articles find that lagged returns are positively related to aggregate investment. In contrast, we examine the association between firm-level investment and subsequent stock returns and find a significant negative relation.

[4] Our research differs in that we do not report tests for a factor pricing model that includes a factor based on returns to investment growth portfolios. We do test, however, a pricing factor derived from portfolios sorted by investment growth. In unreported results, we find evidence consistent with the existing literature.

[5] Johnson (2002) develops a model that can explain momentum through time-varying growth rates in dividends or earnings, and Chordia and Shivakumar (2002) find evidence of an association between momentum profits and business cycle macroeconomic variables.

[6] Detailed descriptions of classification procedures are included in the tables. Also, our sample period differs from Fama and French (1992, 1993), but in an appendix available from the authors we show that the results from their sample period are present in our sample period, too.

[7] There is also evidence that high growth rates in corporate investment are related to lower returns for five years following the portfolio formation year, but we only report returns for the first year.

[8] We also investigate weighting returns by equity value at the time of portfolio formation without subsequent re-weighting. Results and inferences do not change materially.

[9] Titman, Wei, and Xie (2004) and Cooper (2003) measure investment activity using a similar variable.

[10] We exclude extreme observations so that our evidence is directly comparable to that of Fama and French (1992). Results are similar when these observations are included, but t-stats for size, book-to-market, and investment growth variables increase.

[11] The average number of firms ranges from 121 firms classified as small and high *b/m* in the third quintile in terms of investment growth rates to 40 stocks classified as large and high *b/m* and also in the third investment-growth quintile. Results are similar when we use independent sorts for *cegth2*, *b/m*, and *size*, when we use NYSE breakpoints to form the size and B/M groups, and when we form three investment groups instead of five.

[12] Berk (2000) shows that sorting data into groups based on a variable that is correlated with returns, and then running tests within the groups, can produce biased results. Although not reported, we have first sorted stocks by market value and B/M, and then by investment growth rates. Results are similar.