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CAPM for Estimating the Cost of Equity Capital: Interpreting the Empirical Evidence[1]

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Abstract

We argue that the CAPM may be a reasonable model for estimating the cost of capital for *projects* in spite of increasing criticisms in the empirical asset pricing literature. By following Hoberg and Welch (2007), we first show that there is more support for the CAPM than has been previously thought. We then present evidence that is consistent with the view that the option to modify existing projects and undertake new projects available to firms may be an important reason for the poor performance of the CAPM in explaining the cross section of returns on size and book-to-market sorted stock portfolios. That lends support to the McDonald and Siegel (1985) and Berk, Green and Naik (1999) observation that stock returns need not satisfy the CAPM even when the expected returns on all individual projects do. From the perspective of a person who believes that the CAPM provides reasonable estimate of the required return on elementary individual projects, the empirical evidence in the literature is not sufficient to abandon the use of the CAPM in favor of other models.

1. Introduction

The Sharpe-Lintner Capital Asset Pricing Model (CAPM) is the workhorse of finance for estimating the cost of capital for *project* selection. In spite of increasing criticism in the empirical academic literature, the CAPM continues to be the preferred model for classroom use in managerial finance courses in business schools, and managers continue to use it. Welch (2008) finds that about 75% of finance professors recommend using the CAPM for estimating the cost of capital for capital budgeting purposes. The survey of CFOs by Graham and Harvey (2001) indicates that 73.5% of the responding financial executives use the CAPM. We review the theoretical and empirical results in the literature in order to understand why that may be the case. While the evidence suggests that the popular Fama and French (1993) three-factor model may be better for explaining the cross section of *stock returns*, there is little evidence against the use of the CAPM for estimating the cost of capital for *projects, especially from the perspective of a person whose prior beliefs are in favor of the CAPM.*

Some of the poor empirical performance of the CAPM may be due to measurement issues. The CAPM is a static model, so firms have constant betas. The real world is dynamic, and in practice the systematic risk, as measured by the CAPM betas of firms, will change over time. An unanticipated increase in beta will cause the firm's stock price to fall due to the increase in the return investors require to bear the increased risk. Whereas in a hypothetical ideal world, prices will adjust instantaneously, in the real world price discovery involves aggregating different views about the systematic risk in a stock through trading among investors. Thus, convergence is likely to be slow and takes place over time. Illusory profitable trading opportunities based observed transactions prices may appear, even though they may not be realizable given the price impact of trades through which price discovery takes place. In that case an increase in the systematic risk of a stock will lead to lower returns in the immediately following months. In order to take into account such possible slow diffusion of information, Hoberg and Welch (2007) suggest using aged betas (betas estimated using data from two to ten years back) in evaluating the empirical support for the CAPM. When we follow their suggestion, we find reasonably strong empirical support for the CAPM.

In particular, we find that the CAPM performs well in pricing the average returns on ten CAPM-beta-sorted portfolios during the period 1932-2007 once we skip two years after portfolio formation. The CAPM cannot be rejected using the Gibbons, Ross, and Shanken (1989) GRS test. The CAPM beta explains 81% of the cross-sectional variation in average returns across the ten portfolios. The additional explanatory power of the Fama-French three-factor model, with two additional factors, is small and limited.

The primary empirical challenge to the CAPM comes from several well-documented anomalies: several managed portfolios constructed using various firm characteristics earn very different returns on average than those predicted by the CAPM. The question we want to examine is whether these anomalies should stop us from using the CAPM for estimating the cost of capital for undertaking a project. Therefore, we limit attention to anomalies that are (1) pervasive and not driven by stocks of very small firms; (2) persistent over longer horizons; and (3) robust in the sense that the anomaly does not disappear soon after its discovery. The size and book-to-market effects are probably the most important anomalies satisfying these criteria.

There are sound theoretical reasons to expect high book-to-market (cheap) stocks to earn higher returns. By definition stocks that are cheaper, other things remaining the same, should earn higher returns on average. Ball (1978) argues that one way to keep other things the same is to compare stock prices after scaling by accounting measures of the size of the cash flow to a stock, like earnings, dividends, and book value of equity. Berk (1995) makes Ball's arguments precise by showing that under reasonable assumptions the relative size and relative book-to-market ratio of a firm's stock will be a good proxy for its expected return. So, sorting stocks based on their size and book-to-market ratios is a natural way to separate stocks that are expected to earn higher returns from those that are expected to earn low returns.

Fama and French (1993) provide the strongest empirical evidence against the CAPM by constructing 25 size and book-to-market sorted benchmark portfolios. All the 25 portfolios that Fama and French constructed should earn about the same return, because their stock market betas are about the same. However, those 25 portfolios earn vastly different returns on average, especially those with different book-to-market ratios. A natural question that arises is whether managers and regulators should move away from using the CAPM for estimating the cost of equity capital. The answer to that question will depend on the reasons for the inability of the CAPM to explain why value firms (i.e., firms which are relatively "cheap," with high book-to-market ratios) earn a higher return on average than growth firms (i.e., firms which are relatively "expensive," with low book-to-market ratios,) and whether there are superior alternatives to the CAPM.

Fama and French (1993) conjecture that two additional risk factors, in addition to the stock market factor used in empirical implementations of the CAPM, are necessary to fully characterize economy wide pervasive risk in stocks. Their HML factor captures the higher systematic risk in stocks with higher book-to-market ratios; their SMB factor captures the higher systematic risk of smaller firms. The Fama and French (1993) three-factor model has received wide attention and has become the standard model for computing risk adjusted returns in the empirical finance literature.

Lakonishok, Shleifer and Vishny (1994) argue that high book-to-market stocks earn a higher return because they are underpriced to start with, and not because they have higher exposure to systematic risk. Consistent with that point of view, Daniel and Titman (1997) find that firms' characteristics help explain the cross-section of returns. Piotroski (2000) provides evidence consistent with the presence of mispricing by showing that among high book-to-market stocks firms with better fundamentals outperform the rest. Mohanram (2005) reaches a similar conclusion for low book-to-market stocks. Ferguson and Shockley (2003) argue that the market portfolio should include all bonds in addition to all stocks; and effect of misspecification of the market portfolio increases with a firms' choice of leverage.

When the high returns to high book-to-market stocks are due to firm characteristics like choice of capital structure, mispricing, etc., the cost of capital will be firm specific.

Different firms will have different costs of capital for undertaking the same project. In those cases, the decision to undertake a project is also likely to affect the firm's cost of capital, and the firm's managers may well have to obtain reliable information about the cost of capital directly from the capital market instead of relying on the CAPM, or for that matter any other model. However, even in those situations, regulators may be concerned with providing a fair rate of return for *projects* undertaken by firms in a regulated industry based on the industry wide average cost of capital for such *projects*.

We therefore examine the performance of the CAPM on the 10 Fama and French (1997) industry portfolios. In the cross section, the CAPM explains about 50% of the average returns on the 10 industry portfolios. The inclusion of two additional factors -- SMB and HML (SMB in particular) -- improves the adjusted R-square to be more than 83%. However, such higher R-square is accompanied by counterfactually negative risk premia for the additional factors. When we use time-series regressions, we find that during 1932-2007, the CAPM explains the return variation slightly better than Fama-French three-factor model does. However, neither model does well, confirming the observations to that effect made by Fama and French (1997). In part, that may be due to the temporal instability of an industry's share of economy wide cash flows (see Figure 1) and the resulting difficulties associated with measuring expected returns and betas of industry portfolios sufficiently accurately using their sample counterparts in the data.

McDonald and Siegel (1985) observe that a firm can be viewed as a collection of projects with associated real options to terminate or modify existing projects and to undertake or defer new projects. Berk, Green and Naik (1999) (BGN) present a model where book-to-market ratios (but not CAPM betas) explain the cross section of stock returns even though the expected returns on all primitive *projects* satisfy the CAPM. That is because, as Dybvig and Ingersoll (1982) show, while the CAPM will assign the right expected returns to the primitive assets (projects), it will in general assign the wrong expected returns to options on those primitive assets. The intuition behind the Berk, Green and Naik (1999) result is illustrated through a stylized numerical example in Appendix A. When the sensitivity of firms' stock returns to economy wide risk factors changes in nonlinear ways due to the presence of such real options, it may be necessary to use excess returns on certain cleverly managed portfolios (like the Fama and French (1993) SMB and HML factors) as additional risk factors to explain the cross section of stock returns, even when returns on individual primitive projects may satisfy the CAPM. If that were the case, the continued use of the CAPM for estimating the cost of capital for projects would be justified, in spite of the inability of the CAPM to explain the cross-section of average returns on the 25 size and book-to-market sorted benchmark stock portfolios.

We therefore examine the extent to which book-to-market ratios may proxy for the cross section of stock returns because of the existence of real options. We find that book-to-market ratio is positively related to financial leverage, a measure of the real options associated with financial distress, and negatively related to measures of growth options available to a firm. When we examine the book-to-market effect – i.e., the positive association between book-to-market ratio and average return -- using within-industry debt-to-equity/book-to-market double-sorted portfolios, we find that the book-to-market effect is concentrated within high debt-to-equity portfolios. Further, once we control for variations in leverage and capital expenditure intensity across firms in the same industry, book-to-market effects are only significant for firms that are small, with high debt-to-equity ratios and lower interest coverage, i.e., firms that are likely to have higher value for their real options. All this is consistent with a major part of the within industry book-to-market effect being due to a firm's option to terminate or modify existing projects and to undertake or defer new projects[2].

We also reexamine the book-to-market effect using implied cost of capital (ICC) as an alternative measure of expected return that may be more relevant for long lived projects. We follow the procedure in Pastor, Sinha and Swaminathan (2007) in constructing the ICC estimates for our 10 CAPM-beta-sorted, 10 Fama-French industry, as well as 10

[2] As Guasoni, Huberman, and Wang (2008) show, the CAPM's mispricing of a call option on the market index portfolio becomes significant only for options with maturities longer than a year when the market portfolio's returns are generated by a lognormal diffusion calibrated to data. However, when traded options on the S&P500 index are used, the mispricing by the CAPM (with the S&P500 as the market proxy) becomes significant even for shorter lived options. That may be the case with options to shut down and undertake projects available to firms.

within-industry book-to-market sorted portfolios. For these three sets of 10 portfolios, there is limited variation in the computed ICCs. In the cross-sectional analysis of firm-level ICCs, firm size, debt-to-equity, and capital expenditure intensity are all significant predictors of ICCs, while the significance of book-to-market ratio is mostly subsumed by other explanatory variables that capture potential real options effects. Again, these findings suggest that the failure of the CAPM to explain the cross section of returns on book-to-market sorted stock portfolios does not invalidate the use of the CAPM-based estimates of projects' cost of capital.

Following this introduction, we briefly review the related literature in Section 2. Section 3 describes our data. Section 4 presents empirical evidence that performance of the CAPM in explaining returns improves when we follow the suggestions of Hoberg and Welch (1999). Section 5 evaluates performance of the CAPM and the Fama-French three-factor model in pricing industry portfolios. Section 6 examines the relevance of book-to-market effect in the project cost of capital calculation, and Section 7 concludes.

2. Related Studies

The Sharpe (1964) and Linter (1965) capital asset pricing model (CAPM) becomes the premier tool for project cost of capital calculations in large part due to the strong empirical support in Black, Jensen, and Scholes (1972) and Fama and MacBeth (1973). However, with a large number of investigators examining vast amount of data, over time the empirical evidence against the CAPM accumulated. Notable among the anomalies that challenge the validity of the CAPM are the findings that the average returns on stocks is related to firm size (Banz (1981)), earnings to price ratio (Basu (1983), book-to-market value of equity (BM) (Rosenberg, Reid, and Lanstein (1985)), cash flow to price ratio, sales growth (Lakonishok, Shleifer and Vishny (1994)), past returns (DeBondt and Thaler (1985) and Jegadeesh and Titman (1993)), and past earnings announcement surprise (Ball and Brown (1968)). Numerous subsequent studies confirm the presence of similar patterns in different datasets, including those of international markets.

We focus on the BM anomaly for the following reasons. Schwert (2003)[3] argues that most of the anomalies are more apparent than real and often disappear after they have been noticed and publicized. Stein (1996) points out that those anomalies that are due to mispricing do not invalidate the use of the CAPM's use in cost of capital calculations. Berk (1995) shows that there are theoretically sound reasons to expect size and BM to be related to expected returns. Therefore, the ability of BM to identify stock portfolios that will earn abnormal return relative to CAPM predictions is an indication of the inadequacy of the CAPM. Fama and French (1993) take the stand that size and BM anomalies represent two risk factors missing from the CAPM.

Most firms have the option to turn down, undertake or defer a new project, in addition to the option to modify or terminate existing project. Therefore, a firm can be viewed as a collection of existing and future projects and complex options on those projects. McDonald and Siegel (1985) observe that a firm should optimally exercise these real options to maximize its total value. The resulting firm value will consist of both the NPVs of the projects and the value of associated real options which is determined by how those options are expected to be exercised by the firm. Berk, Green and Naik (1999) build on that insight and present a model where the expected returns on all projects satisfy the CAPM but the expected returns on the firm's stocks do not. Gomes, Kogan and Zhang (2003), Carlson, Fisher and Giammarino (2004), Cooper (2006), and Zhang (2005) provide several additional insights by building on the Berk, Green and Naik (1999) framework. Xing (2007) finds that the BM effect disappears when one controls for firms' capital expenditures. Jagannathan and Wang (1996) argue that because of the nature of the real options vested with firms their systematic risk will vary depending on economic condition, and the stock returns of such firms will exhibit option like behavior. An econometrician using standard time series methods may conclude that the CAPM does not hold for such firms, even when the returns on such firms satisfy the CAPM in a conditional sense.

[3] The interested reader is referred to Schwert (2003) for an excellent and comprehensive survey of financial markets anomalies literature.

Most of the asset pricing tests use average historical returns to measure the expected returns. Recent studies (Elton (1999), Lewellen and Shanken (2002)) have viewed realized return as a poor and biased proxy for investor expectation, and have proposed that direct measure of *expected* return should be used for asset price tests. There is a fairly large literature in accounting (See Easton (2008) and the reference therein) that computes the implied cost of capital (ICC) using equity analysts' earnings forecasts. As these forecasts are *ex-ante*, ICC may measure the expected returns better, provided the assumptions supporting the ICC estimates are valid. Claus and Thomas (2001) and Pastor, Sinha and Swaminathan (2007) argue that ICC may capture the dynamics of the equity risk premium well. Since ICC, by definition, is the internal rate of return at which the stock price equals the present value of all expected future dividends, it would be a more appropriate measure of the expected return on long lived projects that firms may encounter in their capital budgeting decisions. For those reasons, we also investigate the book-to-market effect using ICC as a measure of expected return.

In this paper, our primary interest is in evaluating the empirical evidence against the use of CAPM based estimates of costs of capital for elementary projects while making capital budgeting decisions. In contrast, the focus of most of the studies in the asset pricing literature is in understanding the determinants of expected returns on stocks. In view ot hat, we refer readers interested in the broader asset pricing literature to the excellent surveys by Campbell (2003), Ferson (2003), Mehra and Prescott (2003), and Duffie (2003).

3. Sample Construction

We start with firms covered by CRSP with common shares outstanding over the period of 1932-2007. We focus on large and mature firms. As many market constituents actively produce and gather information for large firms, information asymmetry would be minimal and market investors are more likely to share common beliefs on firm prospects. Similarly, large firms are less likely to experience extended period of mispricing. At the time we form portfolios of stocks, we therefore exclude firms with market capitalization less than the NYSE 10th percentile breakpoint, firms with price of less than $5, as well as firms that are listed for less than 5 years. To minimize effects of temporary price movement, we further exclude firms in the deciles with the highest/lowest *prior* 12-month stock returns (momentum stocks) in each June of the sample period. All the filters we applied make use of information that is available at the time of portfolio formation, thus should not introduce any look-ahead bias. After applying these filters, our sample still covers 75% of the entire universe of CRSP stocks in terms of market capitalizations. In computing portfolio returns, we use CRSP delisting returns whenever appropriate. For stocks that disappear from the dataset due to delisting, merger or acquisition, we assume that we invest the proceeds from such events in the remaining portfolio.

For each sample firm in June of a given sample year, the following variables are constructed: Beta estimate (Beta) is obtained as the slope of the CAPM regression, using the prior 60 months of return records from CRSP. Size is measured as the market capitalization (in million) for a sample firm on the last trading day of June each year.

Our CSRP sample is further intersected with COMPUSTAT data where the book values in June of the portfolio formation year are available. We require a minimum of 3-month gap in matching the accounting data of calendar year t-1 and return data of calendar year t to ensure that the accounting information is known for the use of portfolio construction in June. In our study, we match accounting data of firms with fiscal end before/in March of calendar year t-1 with returns for July of year t to June of year t+1. The following variables are constructed using information available from annual COMPUSTAT files: BE is the book value (in million) as the sum of stockholders equity, deferred tax and investment tax credit, and convertible debt, subtracted by liquidation value of preferred stocks[4] (Kayhan and Titman (2003)). The data is further supplemented with historical equity data (Davis, Fama, and French, (2000)) available from Ken French's website. BM is the book-to-market ratio (BE/SIZE), while DE is the debt-to-equity ratio calculated as difference of total assets and book value of equity, scaled by Size.

[4] If the value of stockholder's equity is missing, we replace the value of BE with (total assets – total liabilities –liquidation value of preferred stocks+ deferred tax and investment tax credit, and convertible debt).

Our CRSP/COMPUSTAT sample is further merged with I/B/E/S to obtain information on earnings forecasts provided by financial analysts. We extract records each June from the I/B/E/S summary file, the number of analysts providing one-year-ahead earnings forecasts for a given firm (Nayst), average long-term growth rate forecasts for a given firm (Grow), as well as analyst forecast dispersion (Disp). Disp is measured as the standard deviation of analyst one-year-ahead earning forecasts outstanding in each June, scaled by the median forecast from the summary files. Rdisp is the rank variable for Disp with a value of 10 (1) for firms in the top/bottom deciles ranked by Disp. We also collect monthly records on median values of one-year and two- year-ahead earnings forecasts, as well as long-term growth forecasts for the use of computing estimates on implied costs of capital.

The majority of our empirical analysis is conducted using our CRSP/COMPUSTAT sample as described above. For our portfolio analysis on Beta-sorted portfolios, we also make use of sample available from Valueline for the period of 1990 to 2006. The information of $Beta_{VL}$ is the most recent beta in the prior 12-month period from Valueline. For the analysis conducted using implied cost of capital, we focus on a sample of stocks covered by the I/B/E/S in the period of 1981 to 2006.

For the ease of comparison, we summarize the variable definition in Table 1.

4. Stronger empirical support for the CAPM

In this section, we provide new evidence in support of the standard CAPM as a reasonable model in describing the average returns on large and mature stocks, which presumably are less prone to “mispricing.”

4.1 Full Sample (1932 – 2007)

We work with beta-sorted portfolios. Specifically, we sort stocks in our sample, which consists mostly of large and mature firms, into ten portfolios by Beta in each June of 1932-2007. Again, Beta is estimated as the slope of the CAPM regression, using monthly return records in the previous five years of trading. On average, each of our ten beta-sorted portfolios consists of approximately 108 firms.

The descriptive statistics of characteristics for the Beta-sorted portfolios are presented in Panel A of Table 2. By construction, there is a monotonic decrease in Beta across the ten portfolios, with an average Beta of 2.09 for portfolio 1 (high Beta), and an average beta of 0.36 for portfolio 10 (low Beta). Other characteristics with a monotonic trend across portfolio 1 to 10 include Grow and Rdisp. Among the high Beta firms, analysts are more likely to provide higher growth estimates, while at the same time have more disagreement in their one-year ahead earnings forecasts. High Beta firms also tend to have lower book-to-market (BM) and leverage (DE) ratios, with the average DE increasing monotonically from portfolio 2 to portfolio 9. There is no noticeable trend in Size and the number of analysts providing earnings forecasts (Nayst) across the ten portfolios.

The value-weighted monthly returns of the 10 Beta-sorted portfolios are used in our asset pricing tests. The average portfolio returns are computed up to the third year subsequent to portfolio formation. Our first-year average return ($Vwret_1$) corresponding to average of monthly return in the period of July (t) to June (t+1); similarly, $Vwret_3$ corresponds to the average return of July (t+2) to June (t+3). For Beta-sorted portfolios, the first-year average return ($Vwret_1$) ranges from 1.25% for portfolio 6 to 0.99% for portfolio 10, while the third-year average return ($Vwret_3$) ranges from 1.17% for portfolio 1 to 0.90% for portfolio 10. While portfolio returns positively correlate with Beta in the first year subsequent to portfolio formation, the correlation becomes stronger in the third year.

We compare the standard CAPM and the Fama-French three-factor models in our time series regression analysis on the 10 Beta-sorted portfolios. For each model, we compute the average pricing error as well as the Gibbons-Ross-Shanken (GRS) statistics for testing whether all the intercepts for 10 portfolios are jointly zero. We analyze the correlation between the first-year portfolio returns and risk factors (as presented in Panel B of Table 2). There exists significant pricing error of 17 basis points per month with the standard CAPM, and the GRS statistics reject that all 10 intercepts are jointly zero. Including two more factors (SMB and HML) does not reduce the pricing error.

Hoberg and Welch (2007) argue that investors may be slow in adjusting to the recent change in market risk, and recommend the use of aged beta (beta from 2 to 10 years ago). Table 1 gives the relative performance of the CAPM and the Fama and French three factor model using aged betas. The descriptive statistics in Panel A of Table 2 is consistent with Hoberg and Welch (2007). There is stronger relation between Beta and $Vwret_3$. Panel B of Table 2 gives the alphas and betas of the beta sorted portfolios formed without skipping two years. The average absolute value of the ten alphas is 17 bp/month for both the CAPM and the Fama and French three factor model; both models are rejected by the Gibbons, Ross and Shanken (1989) (GRS) F test at conventional significance levels. As can be seen from Panel C of Table 2, When we use aged betas (i.e., skip two years before forming portfolios based on their historical betas), the average absolute alpha drops to 10bp/month for both models; there is no evidence against eigher model using the GRS statistic.

Notice that while the stock market betas of the ten portfolios exhibit substantial variation -- from a low of 0.61 to a high of 1.41 – there is little variation in the Fama and French SMB and HML factor betas. Even thought that will work against the Fama and French (1993) three factor model when we use the cross sectional regression method (but not when we use the GRS time series method), we still report the results obtained using the cross sectional regression method in Panel D of Table 2 for completeness. For the CAPM, the cross sectional adjusted R-Square increases from 38.8% to 80.99% with the use of adjusted betas. There is not much gain to moving to the Fama and French three factor model for these ten portfolios.

4.2 Value Line Sample (1990 – 2007)

If the superior support for the CAPM when we use aged betas to form beta sorted portfolios were indeed due to the delay in market reaction to account for changes in betas, then the support for the CAPM should be stronger even without the use of aged betas for stocks with betas that are more stable over time. We therefore examine stocks covered by Value Line Investment Survey (VL). VL is the largest and perhaps best-known buy side investment advisory service, which maintains an excellent reputation among practitioners. With dissemination of their research results on approximately 1,700 firms on a weekly basis, VL service contributes to the pricing efficiency of those firms (Huberman and Kandel, 1990). For the covered firms, VL provides detailed earnings and cash flow forecasts up to 5 years. Presumably, Valueline would elect to provide coverage for firms with more stable cash flow. We evaluate the CAPM and the three-factor model based on VL-covered firms. Since the VL universe available to us covers a shorter period (1990-2007), we also examine the performance of the universe of stocks we examined earlier during the same subperiod.

In the VL sample, sorting on beta provided by VL ($Beta_{VL}$) generates large spread in portfolio returns even during the first year: the average monthly return spread between the highest-beta portfolio and the lowest beta portfolio is 59 bps (143bps – 84bps) (Panel A1 of Table 3). The result is not driven by the use of $Beta_{VL}$, as sorting based on our CAPM beta estimate produces very similar results. In fact, the two beta measures are highly correlated as shown in Panel A1 of Table 3. We also compute an annualized expected return implied by the 3-5 year target prices provided by VL (TPER). TPER, which can be interpreted as an alternative measure of expected return, is increasing with beta, again supporting the prediction of the CAPM. Sorting our sample firms in 1990-2007 on beta generates larger spread in portfolio returns when we calculate portfolio returns beyond the first-year of portfolio formation. The average monthly return spread between the highest-beta portfolio and the lowest beta portfolio is 78 bps during the second year (156bps – 78bps) and 66 bps (142bps – 76bps) during the third year (Panel A2 of Table 3) since portfolio formation.

We compare the standard CAPM and the Fama-French three-factor models with and without aging the betas before portfolio formation in Table 3 Panel B. As can be seen, aging helps in our universe of all stocks, whereas there is little to gain from aging in the

VL sample. We examine the performance of the CAPM and the Fama and French three factor model in Table 3 Panel B using time series methods. There is little evidence against the two models with or without aging the betas before forming portfolios. That should not come as a surprise; realized average returns are very noisy measures of corresponding expected returns.

Notice that the use of the Fama and French three factor model leads to a substantial decrease in the pricing errors – the average absolute alpha values for the Fama and French three factor model are on average about half the corresponding numbers for the CAPM. This is consistent with the results reported in the literature. The important observation is that the performance of the CAPM is not as bad as that reported in the literature either, when we use aged betas or work with the VL sample of stocks.

We provide consistent evidence using cross-sectional regression analysis (Panel C of Table 3). The CAPM has an adjusted R-square of 68% in the VL sample even using first-year returns, again likely because the VL sample consists of firms with more stable cash flow and whose betas are likely to be measured more precisely. In addition, using the third-year return improves the performance of CAPM in our sample. The risk premium on the MKT factor is about 40 bps, closer to the average MKT return of 64bps during this period. Including two more factors (SMB and HML) increases the adjusted R-square of the regression by less than 4% in our sample and reduces the adjusted R-square in the VL sample.

Overall, the evidence in this section suggests that the CAPM is not as unreasonable a model as has been interpreted in the literature, once measurement issues have been taken into account.

5. CAPM performs similar to the Fama-French three-factor model in industry portfolios

We focus our attention on industry portfolios for several reasons. First, the composition of an industry portfolio is more stable over time, in contrast to that of a managed portfolio. Second, projects are more likely to be similar within industry groups than across industry groups. By grouping firms within an industry we are more likely to group similar projects together. Finally, regulators are more likely to be concerned with providing a fair rate of return for *projects* undertaken by firms in a regulated industry. For understanding the determinants of industry-wide average cost of capital, it makes sense to group firms based on their industry affiliation.

We evaluate the performance of the standard CAPM using industry portfolios categorized by Fama-French 10 industry classification. Characteristics of the 10 industry portfolios are presented in Panel A of Table 4. Among the 10 industries, the average of Size is highest in telecom industry, and lowest in utilities. The industry classification generates a reasonable variation in Beta: Beta ranges from an average of 0.7 for the utility firms to 1.42 for firms producing high tech business equipment. There is more variation in BM and DE ratios than that of Beta-sorted portfolios. The average BM ratio ranges from 0.98 for utility firms to 0.47 for firms in healthcare industry, while the DE ratio ranges from 4.28 for other industry (including financial firms) to 0.36 for firms in healthcare industry. Capital investment is most intensive in energy industry (with highest Capex of 0.40), and least in Wholesale/Retail/Service industries (with lowest Capex of 0.04). While analysts provide the highest long-term growth forecasts (Grow) for firms in healthcare industry, they disagree most on near-term earnings forecasts (Rdisp) on energy industry. The one-year stock return is highest in consumer nondurables, and lowest in Wholesale/ Retail/Service industries.

We compare the standard CAPM and the Fama-French three-factor model in both time series and cross-sectional regression analysis on the 10 industry portfolios. For time series analysis, the average pricing error as well as the Gibbons-Ross-Shanken (GRS) statistics for testing whether all the intercepts for 10 portfolios are jointly zero are tabulated (as in Panel B of Table 4). For industry portfolios, the market return is again an important determinant for the returns across time with high statistical significance, with adjusted R-square ranging from 52.4% for utilities to 89.3% for manufacturing firms. However, there still exists significant pricing error (11 bp per month) with standard CAPM, with the GRS statistics rejecting that all 10 intercepts are jointly zero. Including two more factors (SMB and HML) even increases the pricing errors. In the cross-section, the CAPM explains more than 50% of the average returns on industry portfolios. The inclusion of two additional factors--- SMB and HML (SMB in particular)--- improves the adjusted R-square to more than 83%. However, such higher R-square comes with counterfactual negative risk premium on SMB and HML factors.

Overall, the Fama-French three-factor model is not significantly better than the CAPM in explaining returns on the industry portfolios. This finding is consistent with the evidence reported by Fama and French (1997). Using a finer 48 industry classification, they show that both the CAPM and the three-factor model provide imprecise industry cost-of-capital estimates. The inadequacy of both models may be in part due to the temporal variation of an industry's share of economy-wide cash flows. In Figure 1, we plot the time series (five-year trailing average) of industry cash flow share of an economy, which is defined as the ratio of the aggregated corporate earnings (Compustat data item 172) in a given industry over the aggregated corporate earnings for all sample firms. To account for firm's entry into and exit from the economy, we also plot the times series of cash flow-to-price ratios (aggregated corporate earnings over the aggregated market capitalization) at industry level. Across industry, both time series display considerable variations. Such a variation of cash flow through time will result in imprecise estimates of expected returns and betas of the industries.

6. Book-to-market effect, growth option and firm leverage

One of the most prominent empirical challenges to the CAPM is the book-to-market (value) effect, in that stocks with higher book-to-market ratios tend to earn higher returns. In this section, we examine the book-to-market (BM) effect and its relevance for project cost of capital calculation. We first separate the *within-industry* BM effect from the *cross-industry* BM effect.

6.1 BM effect is stronger within industry

We investigate the book-to-market effects within industries. We first create terciles sorted by BM within each industry portfolio. Asset pricing tests are conducted on the value-weighted monthly portfolio returns in the first year of these 30 portfolios. To save space, we only tabulate the absolute pricing errors and GRS statistics of the time series regressions on these 30 portfolios in Panel A of Table 5. In time series analysis, the CAPM generates a monthly pricing error of 17 basis points, with the GRS statistics rejecting that all 30 intercepts are jointly zero. However, the Fama-French three-factor model produces a larger pricing error of 19 basis points per month and increases GRS statistics. In cross-sectional tests, the CAPM explains 33% of the average returns on BM-industry portfolios. The Fama-French three-factor specification adds 3% to the adjusted R-square, but weakens the significance of the MKT factor and increases the intercept term. The intercept in the three-factor model is now significantly different from zero. Despite the added dispersion in the Industry-BM portfolios (created by additional sorting by BM), the Fama-French three-factor model does not significantly outperform the CAPM.

The variation of BM ratio across the 30 portfolios can be decomposed into *within-industry* and *cross-industry* components. We isolate the *cross-industry* variation in BM ratio, by selecting one portfolio from each industry terciles such that the resulting 10 portfolios achieve the highest dispersion in BM ratio. The characteristics of these 10 sub-industry portfolios are presented in Panel B in Table 5. The variation in BM ratio of these sub-industry portfolios (ranging from 0.34 to 2.85) is noticeably larger than that of the 10 industry portfolios. If the BM effect is driven by *cross-industry* variation in BM, we would expect to see a stronger relation between BM and return across the 10 sub-industry portfolios. That is clearly not the case. Sub-industry portfolio 10 with the highest BM of 2.85 has an average monthly return of 1.27%, which is only slightly higher than the 1.20% return of sub-industry portfolio 8 with an average BM of only 0.34. The pattern is consistent with the argument that value effect is mainly driven by *within-industry* variation in book-to-market ratios rather than the *cross-industry* variation

(Cohen and Polk (1998)). However, in their study, there is little *cross-industry* variation in BM.

We conduct asset price tests on these sub-industry portfolios. Results of time series and cross-sectional analysis are presented in Panel C and D of Table 5. In time series analysis, the CAPM generates a monthly pricing error of 22 basis points, with the GRS statistics rejecting that all 10 intercepts are jointly zero. Although the Fama-French three-factor model produces a slightly lower pricing error of 19 basis points per month, the GRS statistics still reject that all 10 intercepts are jointly zero. In cross-sectional tests, the CAPM explains 45% of the average returns on BM-industry portfolios, the MKT factor is highly significant in capturing the cross-sectional variation of stock returns with a statistically non-significant intercept term. The Fama-French three-factor specification adds only 6.5% to the adjusted R-square despite the large variation of BM across the test portfolios. The loadings on HML does seem to drive out the CAPM beta. However, the CAPM betas and the factor loadings on HML are highly correlated across the 10 portfolios. As a result, problem of multicolinarity emerges. As a potential sign of such problem, the intercept in the three-factor model is now significantly different from zero. In other words, the small improvement of the three-factor model over the standard CAPM in the cross-sectional analysis here has to be interpreted with caution.

To summarize, we find that the BM effect is driven by *within-industry* (rather than a*cross-industry*) variation in book-to-market ratios in this subsection. We examine the determinants of the *within-industry* BM effect and its relevance for project cost of capital calculation.

6.2 Evaluating the within-industry BM effect

We examine the book-to-market effects within industry. To capture within industry variation in BM, we construct BM-deciles within each industry. Those industry deciles are then merged into 10 portfolios, with firms with the highest/lowest BM within each industry sorted into portfolio 1/10. In other words, portfolio 1(10) contains stocks with the highest(lowest) BM from each industry. Characteristics of these 10 portfolios are presented in Panel A of Table 6.

Among the within-industry BM portfolios, Size increases monotonically from $711 million for portfolio with the highest BM to $3,699 million for portfolio with lowest BM, while DE declines monotonically from the highest- to the lowest- BM portfolio. Capex ratio ranges from 0.08 to 0.23 with the highest ratios among two lowest-BM portfolios. Growth forecasts (Grow) increases monotonically from 12% for the highest- to 18% for the lowest- BM portfolio. Analysts also tend to disagree more on firm's near-term future earnings for firms in high BM portfolios. The first-year average return ($Vwret_1$) ranges from 1.32% for portfolio 1 (high BM) to 0.91% for firms in portfolio 9 (low BM), confirming the presence of within-industry BM effect.

We find that BM is highly correlated with financial leverage (DE) and capital expenditure (Capex). That is consistent with the view that the BM effect is to a large extent due to the nature of the real options available to a firm, since it is reasonable to expect financial leverage to be related to a firm's real options in the event of financial distress, and Capex to proxy for a firm's growth option.

We first investigate the interaction between the book-to-market ratio and the financial leverage in affecting stock returns. We construct portfolios sorted with DE and BM within industry. Sample firms are first categorized into portfolios by Fama-French 10 industry classification in each June. Within each industry portfolio, firms are double-sorted into terciles first by DE and then by BM. Characteristics of these double-sorted portfolios are presented in Panel B of Table 6. The first-year average return ($Vwret_1$) ranges from 1.41% of the high-DE/ high-BE portfolio to 0.93% for firms of the low-DE/low BE portfolio. Consistent with the empirical results in Griffin and Lemmon (2002), we find that sorting on BM generates dispersion in stock returns only among stocks with higher financial leverage. While high-BM stocks earn 34 bps per month higher than low-BM stocks among high-DE stocks, they do not earn much higher returns than the low-BM stocks among stocks with low and medium financial leverage.

We then investigate the interaction among BM and other stock characteristics using Fama-MacBeth cross-sectional analysis at individual stock level. Each year, we regress the average monthly stock returns on various stock characteristics including aged Beta, Size, DE, Capex and BM. We focus on within-industry variations by first demeaning all the variables within industry. All explanatory variables except beta are then cross-sectionally demeaned and standardized. As a result, the regression coefficients can be interpreted as the effects associated with one-standard-deviation change in the explanatory variables on the stock returns. We apply log-transformation to Size, BM and DE. The regression coefficients are then averaged across time and the t-values are computed using Newey-West formula with a lag of 6. The results are presented in Panel C of Table 6.

BM exhibits significant positive correlation with individual stock returns, capturing 1.75% of the cross-sectional return variation. When aged Beta, Size, DE and Capex are incorporated into the model, the adjusted R-square increases to 5.32%. Both DE and Capex are highly significant in capturing the cross-sectional return variation. To test whether the DE and Capex could fully capture the BM effect, we create a fitted BM variable. Such fitted BM variable is generated in a cross-section regression of actual BM ratio as a linear function of aged Beta, size, DE and Capex. The fitted BM is significantly related to stock returns, and captures slightly higher percentage of cross-sectional return variation than the actual BM does. However, when including all three variables in the regression, BM and Capex are both significant predictors of stock returns, while significance of DE is mostly subsumed by BM.

We examine whether the BM effect is more pronounced among firms with certain characteristics. We incorporate in the cross-sectional analysis, product terms of the BM ratio with indicator variables of Large/Small stocks, High/Low DE stocks, stocks with High/Low Icov. The variable of inverse interest coverage (Icov) is the ratio of interest expense over the operating income before depreciation. Our results indicate that BM effects are significant among small stocks, stocks with higher financial leverage (DE), and firms with lower interest coverage (higher Icov).

We perform similar analysis during the more recent periods (1990-2007). We highlight two interesting results. First, the aged Beta is significant in explaining stock returns even in the presence of other stock characteristics, confirming the usefulness of the CAPM in the more recent period. The t-value of aged beta is 2.67 in our sample and is above 7 in the VL sample. Second, BM effect is weakened once controlling for other stock characteristics such as DE and Capex. The fitted BM does better than the original BM variable in terms of adjusted R-square. In the VL sample, the BM variable is not significant at all.

The results in the subsection suggest that within-industry variation in BM is related to financial leverage and Capex – measures of real options available to a firm. Once these two *firm* characteristics are controlled for, the BM effect is significantly reduced; and the BM effect important mostly for firms that are more likely to be affected by financial distress. All this indicate that BM effect is likely driven by the firm specific characteristics and not the characteristics of the underlying *projects*.

6.3 Measuring expected return using the Implied Cost of Capital

In this subsection, we examine the Implied Cost of Capital (ICC) estimated based on firm's current market valuation and expected future cash flows (proxied by analyst earnings forecasts). There are two important advantages of using ICCs for project cost of capital calculation. First, asset pricing models produce hypotheses on the correlation between *expected* returns and risk measures. However, the majority of asset price tests are conducted using realized return as a proxy for *expected* return. Recent studies (Elton (1999), Lewellen and Shanken (2002)) have viewed realized return as a poor and biased proxy for investor expectation, and have proposed that direct measure of *expected* return should be used for asset price tests. ICC is an *ex ante* measure of stock return. Second, computed as the internal rate of return at which the stock price equates the present value of future dividends, ICC captures the nature of long life span of a typical project. This is in contrast to the one-period returns we have examined so far. One-year return might not be sufficient in evaluating the cost of capital on long-term project.

We follow the procedure in Pastor, Sinha and Swaminathan (2007) in constructing the ICC estimates:

$$P_t = \sum_{k=1}^{T} \frac{FE_{t+k}(1-b_{t+k})}{(1+ICC_t)^k} + \frac{FE_{t+T+1}}{ICC_t(1+ICC_t)^T}$$

where $\mathrm{P_t}$ is the stock price,
FE_{t+k} is the earnings forecast,
and $\mathrm{b_{t+k}}$ is the forecast of plow back rate for the period of t + k available at t.

A fifteen (T=15) year horizon is used in our analysis, as in Pastor, Sinha and Swaminathan (2007). The earnings forecasts of the first three years in our ICC estimation are based on analyst forecast data available from I/B/E/S. In each month from 1981 to 2006, median values of one-year- and two-year- ahead earnings forecast are gathered from I/B/E/S summary files and utilized as FT_{t+1} and FT_{t+2} in the ICC estimation procedure. The third-year forecast is computed as the product of FT_{t+2} and Grow (I/B/E/S long-term growth forecast). The earnings forecasts for the remaining periods of (t=4-15) are specified as:

$$FE_{t+k} = FE_{t+k-1} * (1 + g_{t+k})$$
$$g_{t+k} = g_{t+k-1} * \exp(\log(g / g_{t+3}) / (T-1))$$

The earnings growth follows an exponential rate of decline from g_{t+3} to the steady state growth rate (g). In our estimation, we assume that g equals the GNP growth rate.

In the first three years, the plow back rate is computed as one minus the firm's most recent net payout ratio, calculated as the sum of dividends and common/preferred stocks repurchased subtracted by common/preferred stocks newly issued, scaled by the net income in the year .The plow back rate forecasts for the remaining periods of (t=4-15) are specified as:

$$b_{t+k} = b_{t+k-1} - \frac{b_{t+2} - b}{T - 1}$$

The sustainable growth rate formula then implies that the steady plow back rate equals the ratio of steady state growth (*g*) over ICC. With inputs of I/B/E/S earnings forecasts, prior year of payout ratio, and historical GNP growth, the ICC is computed as the rate at which the stock price equates the present value of future dividends either for each individual firm.

We generate the ICC estimates for our 10 Beta-sorted, 10 Fama-French industry, as well as 10 within industry BM-sorted portfolios. For each portfolio, the earnings and dividend payout data are aggregated across firm, and the ICC is computed as the rate at which the portfolio value equates the present value of future dividends. For these three sets of 10 portfolios, there is limited variation in the computed ICCs at the portfolio level. In particular, the ICC on the highest BM portfolio (11.44%) is only 1.55% higher than that on the lowest-BM portfolio (9.89%). This illustrates that once the life span of the project is taken into consideration, the BM effect is less important.

We do not directly test the standard one-period CAPM using the ICCs. The test will be mis-specified since ICCs correspond to expected returns over an infinite horizon. Magill and Quinzii (2000) and Cochrane (2008) lay out the theoretical foundation for an infinite-horizon CAPM equilibrium. Instead, we investigate whether firm characteristics such as aged Beta, Size, DE, Capex, and BM could be potentially related to the cross-sectional variation in ICCs of individual stocks. We conduct a similar Fama-MacBeth cross-sectional regression. As indicated in the results in Panel B of Table 7, BM exhibits significant positive correlation with individual stock ICCs, capturing 1.5% of the cross-sectional variation in ICCs. When aged Beta, Size, DE and Capex are incorporated into the model, the adjusted R-square increases to 3.2%. Size, DE, and Capex are highly significant in capturing the cross-sectional variation in ICCs. To test whether the DE and

Capex could fully capture the BM effect, we create a fitted BM variable. Such fitted BM variable is generated in a cross-section regression of actual BM ratio as a linear function of aged beta, size, DE and Capex. The fitted BM is significantly related to ICCs, and captures a slightly higher percentage of cross-sectional ICC variation than the actual BM does. When including all three variables in the regression, Size, DE, and Capex are all significant predictors of ICCs, while significance of BM is mostly subsumed by other explanatory variables. These regression results again suggest that the BM effect is mostly driven by the characteristics of the *firm*, not the risk associated with the underlying *projects*.

To summarize, we examine the book-to-market effect on ICCs, arguably better estimates for the project cost of capital. Again, we find that while the BM effect is an important factor in determining the ICC of a *stock*, it might be less crucial for the *project* cost of capital calculation. The BM effect on ICC mostly disappears when including firm characteristics (such as growth option and financial distress), not the underlying projects, in support for our hypothesis that the BM effect is less important for project cost-of-capital analysis.

7. Conclusion

In this paper, we evaluate the empirical evidence against the standard CAPM from the perspective of a person who believes that it provides reasonable estimates of a project's cost of capital. For that we differentiate the required expected return on potential elementary projects available to a firm from the required expected return on a firm's stocks.

We first show that there is more support for the CAPM than has been previously reported in explaining cross-sectional variation in stock returns, by following the suggestions of Hoberg and Welch (2007). We document that the CAPM beta does a reasonable job in explaining the returns on CAPM-beta-sorted portfolios once we skip the first two years after portfolio formation.

We then compare the performance of CAPM and the Fama-French three-factor model for estimating industry costs of capital and find that the two models perform about equally well (or not well). We find that the BM effect is driven by within-industry (rather than across-industry) variations in the book-market value of equity ratios. The within-industry BM effect disappears or significantly weakens once we control for firm-specific characteristics that proxy for real options available to a firm. Those findings are consistent with the view that the BM effect may in a large part due to the option a firm has to modify/abandon existing projects and/or undertake new projects. So, there is little evidence in the data to change one's prior beliefs that project cost of capital estimates provided by the CAPM are satisfactory.

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Appendix A
Stylized Example of Model by Berk, Green and Naik (1999)

To illustrate the main intuition in Berk, Green, and Naik (1999), we consider an economy with a constant risk premium of 5% per year, an annual risk free rate of 5%, and a flat yield curve.

All existing projects in the economy are identical, with an initial cost of \$1. Once undertaken, the project pays out an expected perpetual cashflow of \$0.2. All projects carry a CAPM beta of 1 (as the market consists of those identical projects), with an appropriate discount rate of 10% (5% + 1× 5% = 10% as predicted by CAPM). The market value of each project is therefore 0.2/10% = \$2.

Consider a firm which has undertaken I projects. The book value of the firm is \$I and its market value is \$2I. The firm also has a CAPM beta of 1, as a portfolio of I projects with CAPM betas of 1. The expected return for the firm would be 10% per year, as described by the CAPM. It is noted that the book-to-market ratio (\$I/\$2I = 0.5) does not have additional predictive power of the firm expected return.

We now introduce a "growth option" (GO) to the same firm. In addition to its asset-in-place (AIP, or the I existing projects), the firm also has the capacity for investing in at most one more new project, with discretion of investing in the new project either this year or two years later. The investment opportunity disappears after two years. The firm's option to invest in this case resembles the "option-to-wait" analyzed in McDonald and Siegel (1985) and discussed in Jagannathan and Meier (2002).

The option to choose the timing of the new project introduces additional variation in cash flows. If the firm chooses to invest now, it will get a project identical to its existing project (with an expected perpetual annual cash flow of \$0.2). However, if the firm chooses to wait, the cash flow of the project can either double in the "Good" state or reduce by half in the "Bad" state in each year, as described in the following chart:

year 0	year 1	year2
		(G,G): \$0.8
	(G): \$0.4	
\$0.20		(G, B) or (B, G): \$0.2
	(B): \$0.1	
		(B, B): \$0.05

To facilitate further calculations, we assume the following characteristics associated with the two states:

state	Probability	Riskfree rate	market return	Risk-Neutral Probability
Good	0.5	0.05	0.3	0.375
Bad	0.5	0.05	-0.1	0.625
Expected ret		0.05	0.1	

The risk-neutral probability, used for option pricing, is computed as:

$$RN\ prob\ in\ Good\ state = \frac{risk\ free\ rate - market\ return\ in\ Bad\ state}{market\ return\ in\ Good\ state - market\ return\ in\ Bad\ state}$$

Since the CAPM beta associated with the new project is always 1, the correct discount rate is always 10%. As a result, if the firm chooses to invest in year 2. The NPV of the project will be \$0.8/0.10- \$1 = \$7 in (G,G) state; \$0.2/0.10 - \$1= \$1 in (G,B) or (B,G) states; and \$0.05/0.10 - \$1 = -\$0.5 in the (B,B) state.

The project has a negative NPV in the (B,B) state and will therefore not be taken. Working backwards the binomial tree, we can solve for the value of this option:

year 0	year 1	year2
		(G,G): \$7
	(G): \$3.095	
\$1.318		(G, B) or (B, G): \$1
	(B): \$0.357	
		(B, B): \$0

The value at each node is computed as risk-neutral expected payoff next year discounted at risk-free rate. For instance, the value in state (G) is computed as: (7*0.375+1*0.625)/1.05 = $3.095. The value of the option is higher than the NPV of taking the project now ($0.2/10%-$1 = $1), thus the optimal decision for the firm is to wait.

Given the value of the growth option V_{GO} of $1.318 and the year-2 option payoff, we can compute the two-year realized returns on the option and the market in various states as follows:

State	Probability	Growth Option Return	market return
(G,G)	0.25	431.1%	69.0%
(G, B) or (B, G)	0.50	-24.1%	17.0%
(B, B)	0.25	-100.0%	-19.0%
expected ret		70.7%	21.0%

Given the returns and associated probabilities, the variance associated with the market return and the covariance between market return and the option return would be 0.0984 and 0.6221, with a CAPM beta of 6.32 for the GO (0.6221/0.0984). According to CAPM, the two-year expected return on the GO component should be:

$$1.05^2 - 1 + 6.32(1.21 - 1.05^2) = 76.22\%,$$

which is higher than the actual expected return on the option of 70.7%. In other words, CAPM fails to predict the expected option return. This result is not surprising at all. Since the option lasts for two periods, its payoff cannot be replicated with that on the market and a riskfree bond with constant weights and a dynamic rebalance is needed. (On each node in the binomial tree however, CAPM works for one-period option return.)

Since the firm now consists of two components: asset in place and the growth option, its value is equal to:

$$V = V_{AIP} + V_{GO} = 2I + 1.318.$$

The firm's expected return is a weighted average of the expected returns on its two components:

$$ER = \frac{2I}{V}10\% + \frac{1.318}{V}70.7\%.$$

The firm's CAPM beta will be a weighted average of the CAPM betas of its two components. Since CAPM fails on the GO component, CAPM will not be able to explain the expected return on the firm despite the fact that costs of capital on all projects in this example are correctly computed by the CAPM. Finally, as pointed by Berk, Green and Naik (1999), the BM (I/V in this example) and size effect arise since ER = BM*20% + 0.93/Size.

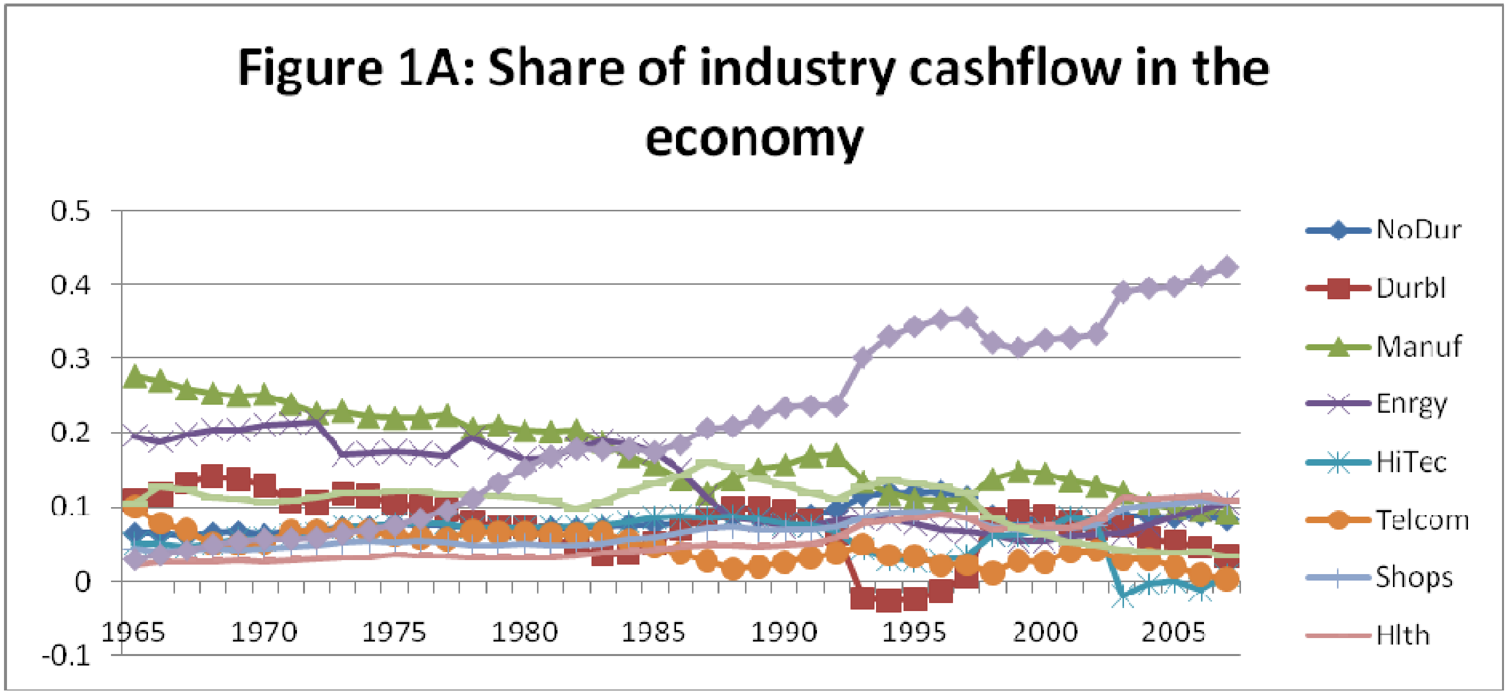
Figure 1A: Share of industry cashflow in the economy
0.5
0.4
0.3
0.2
0.1
0
-0.1
1965
1970
1975
1980
1985
1990
1995
2000
2005
NoDur
Durbl
Manuf
Enrgy
HiTec
Telcom
Shops
Hlth

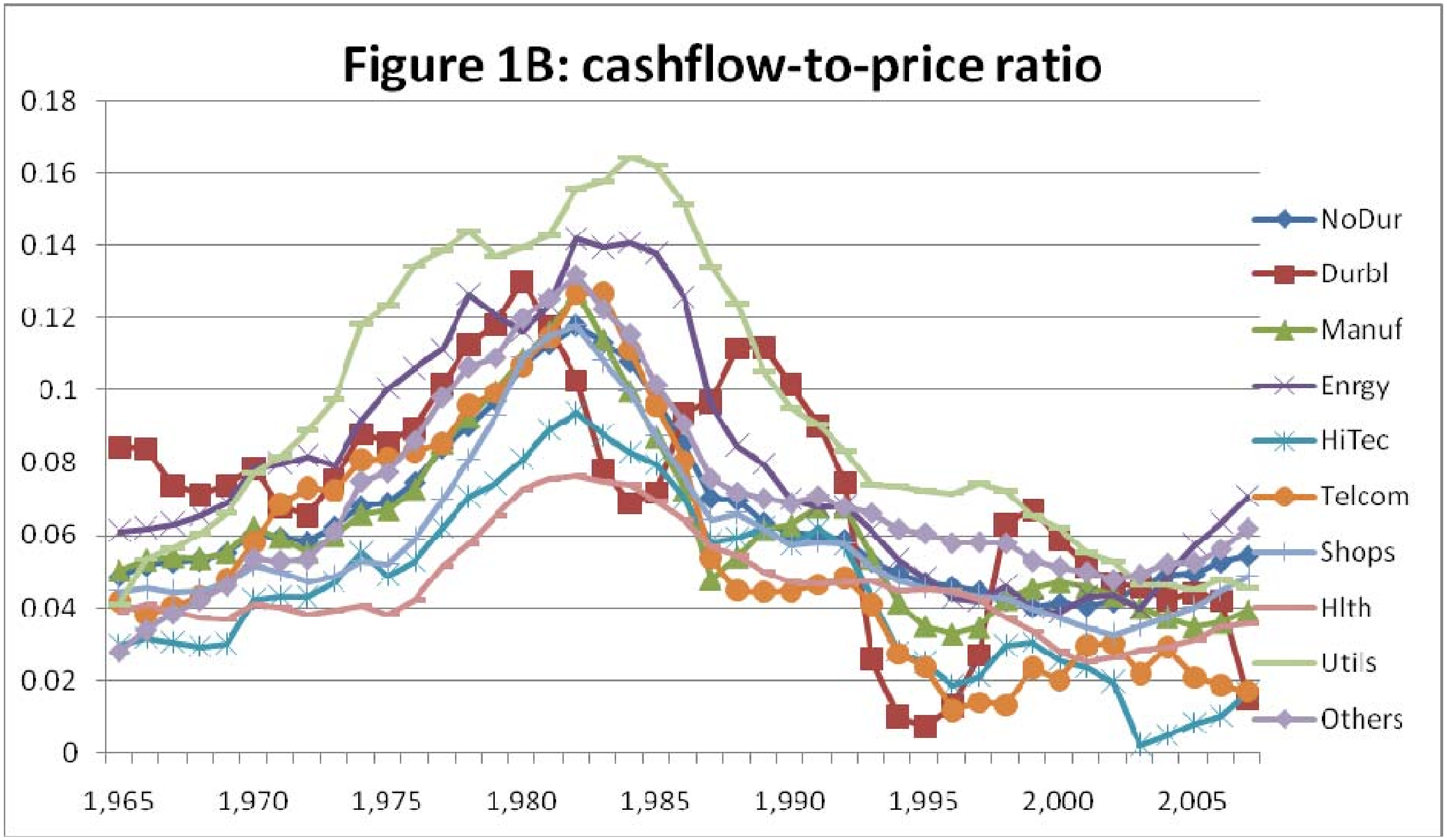

Figure 1: Time Series of Industry Cash Flow Shares and Cash flow-to-Price Ratios

The industry cash flow share of an economy is the ratio of the aggregated corporate earnings (Compustat data item 172) in a given industry over the aggregated corporate earnings for all sample firms. Industry cash flow-to-price ratio is the ratio of the aggregated corporate earnings over the aggregated market capitalization for a given industry. The time series are five-year trailing averages.

Table 1 Variable Definition

Variable	Definition
Beta	Slope of The CAPM regression, estimated in each June using the prior 60 months of returns from CRSP
$Beta_{VL}$	Most recent beta value from Valueline from July (t-1) to June (t)
$Beta_{aged}$	Aged beta, old Beta calculated two years prior to portfolio formation
Size	Market capitalization (in million) measured at the last trading day of June
BE	Book value (in million). If the data item of Compustat Data216 is not missing, then BE= Data216-Data10+Data35+Data79, otherwise BE =Data6-Data181-Data10+Data35+Data79. The data is further supplemented with historical equity data (Davis, Fama, and French, (2000)) from Ken French's website.
BM	Ratio of BE over Size
DE	Difference of total assets (Data6) and book value of equity (Data216), scaled by Size.
Capex	Ratio of capital expenditure (Data128) over sales (Dat12).
Icov	Inverse interest coverage as the ratio of interest expense (Data15) over the operating income before depreciation (Data13).
BM_{fitted}	Predicted value generated in a cross-section regression of actual BM ratio as a linear function of DE and Capex
Nayst	Number of analysts providing one-year-ahead earnings forecasts for a given firm in each June from I/B/E/S.
Grow	Long-term growth rate forecasts for a given firm in each June provided by I/B/E/S
Rdisp	Rank variable (1-10) for analyst forecast dispersion, measured as the standard deviation of analyst one-year-ahead earning forecasts outstanding in each June, scaled by the median forecast from I/B/E/S.
TPER	Annualized expected return from Valueline TPER=[average of high and low target prices in the next 3-5 years)/recent price]$^{1/4}$ -1.
$VWRET_i$	Average value-weighted monthly portfolio return in the *i*th year subsequent to portfolio formation
MKT, SMB, and HML	Fama-French three-factor. MKT is the CRSP value-weighted return on all stocks, SMB and HML are the size and value factors constructed by Fama and French.
Fama-French 10 industry classification	1 (Consumer NonDurables); 2 (Consumer Durables); 3 (Manufacturing); 4 (Energy); 5 (HiTec Business Equipment); 6 (Telcom); 7 (Wholesale, Retail, and some Services); 8 (Healthcare, Medical Equipment); 9 (Utilities); 10 (others)

Table 2 Beta-Sorted Portfolios

This table provides results of analysis on portfolios sorted by Beta: descriptive statistics on portfolio characteristics (Panel A), time-series analysis on the monthly returns in the first year (Panel B) and the third year (Panel C) subsequent to portfolio formation, and cross-section analysis (Panel E) on value-weighted monthly portfolio returns in the first and third year. The sample firms consists of firms covered by CRSP monthly files, with exclusion of firms with market capitalization less than the NYSE 10^{th} percentile breakpoint, firms with price of less than $5, firms with less than 36 monthly trading records in the prior 5 years, and firms in the deciles with the highest/lowest prior 12-month stock returns in each June of 1932-2007. Firms are sorted into portfolios by Beta in each June, rebalanced yearly. In Panel C and D, coefficient estimates are presented with *t* statistics in parenthesis. Average absolute errors and GRS statistics are also presented. In Panel E, coefficient estimates are presented with *t* statistics in parentheses and Shanken *t* in brackets. The time series averages of the factors MKT, SMB, and HML in the corresponding sample period are also presented.

Panel A Portfolio Characteristics

	Nos	Beta	Size	BM	DE	Capex	Nayst	Grow	Rdisp	$Vwret_1$	$Vwret_2$	$Vwret_3$
High	107.30	2.09	795.99	0.78	1.39	0.19	9.69	0.20	6.30	1.21%	1.14%	1.17%
2	107.72	1.63	1,206.93	0.80	1.31	0.10	10.10	0.17	5.70	1.17%	1.14%	1.16%
3	107.87	1.41	1,464.17	0.79	1.36	0.16	10.57	0.16	5.29	1.11%	1.07%	1.15%
4	107.86	1.25	1,523.69	0.79	1.43	0.09	10.66	0.15	5.01	1.19%	1.06%	1.08%
5	107.63	1.12	1,451.04	0.80	1.50	0.07	10.36	0.14	4.88	1.22%	1.21%	1.12%
6	107.95	1.00	1,407.44	0.81	1.67	0.07	10.13	0.13	4.68	1.25%	1.12%	1.10%
7	107.93	0.88	1,515.97	0.82	1.89	0.07	9.92	0.13	4.57	1.22%	0.99%	1.09%
8	107.79	0.75	1,716.31	0.82	2.15	0.06	9.19	0.12	4.34	1.00%	0.93%	0.95%
9	107.80	0.60	1,420.27	0.84	2.46	0.07	8.89	0.11	4.21	1.03%	0.98%	0.93%
Low	107.42	0.36	1,079.54	0.87	2.01	0.11	9.09	0.09	4.13	0.99%	0.84%	0.90%

Panel B Time Series Regression Analysis on First-Year Monthly Portfolio Return

	intercept	MKT	adj R^2		intercept	MKT	SMB	HML	adj R^2
	-0.0038	1.62			-0.0046	1.51	0.3861	0.15	
High	(-3.33)	(73.72)	85.7%	High	(-4.40)	(67.87)	(11.67)	(5.04)	87.9%
	-0.0025	1.40			-0.0033	1.34	0.1541	0.20	
2	(-2.72)	(79.71)	87.5%	2	(-3.82)	(73.09)	(5.65)	(8.22)	88.8%
	-0.0017	1.24			-0.0024	1.21	0.0143	0.17	
3	(-2.25)	(82.97)	88.4%	3	(-3.18)	(76.77)	(0.61)	(8.31)	89.2%
	-0.0003	1.16			-0.0009	1.15	-0.0353	0.15	
4	(-0.45)	(81.02)	87.9%	4	(-1.18)	(75.42)	(-1.56)	(7.54)	88.6%
	0.0006	1.08			0.0001	1.08	-0.0977	0.15	
5	(0.81)	(79.14)	87.4%	5	(0.15)	(75.62)	(-4.58)	(8.03)	88.4%
	0.0016	0.99			0.0012	1.00	-0.1141	0.15	
6	(2.57)	(81.35)	88.0%	6	(1.98)	(79.21)	(-6.09)	(8.73)	89.3%
	0.0018	0.93			0.0012	0.94	-0.1322	0.20	
7	(2.70)	(71.44)	84.9%	7	(1.94)	(71.48)	(-6.78)	(11.48)	87.3%
	0.0007	0.79			0.0006	0.82	-0.1659	0.06	
8	(1.10)	(63.31)	81.6%	8	(1.01)	(62.83)	(-8.52)	(3.48)	83.1%
	0.0016	0.72			0.0014	0.76	-0.2132	0.10	
9	(2.13)	(50.87)	74.1%	9	(1.98)	(52.08)	(-9.85)	(5.23)	77.1%
	0.0023	0.57			0.0018	0.57	-0.1151	0.18	
Low	(3.07)	(38.48)	62.1%	Low	(2.46)	(37.17)	(-5.01)	(8.70)	65.7%
Average absolute error 0.0017				Average absolute error 0.0017					
GRS statistics 2.88				GRS statistics 3.23					
p-value *0.001*				p-value *0.000*					

Panel C Time Series Regression Analysis on Third-Year Monthly Portfolio Return

	Intercept	MKT	adj R^2		intercept	MKT	SMB	HML	adj R^2
	-0.0018	1.53			-0.0028	1.41	0.5198	0.18	
High	(-1.66)	(66.07)	83.2%	High	(-3.08)	(65.94)	(16.15)	(6.08)	87.4%
	-0.0005	1.31			-0.0011	1.23	0.3334	0.11	
2	(-0.56)	(71.79)	85.4%	2	(-1.45)	(69.12)	(12.43)	(4.28)	87.8%
	0.0003	1.18			-0.0007	1.16	0.1212	0.22	
3	(0.45)	(79.20)	87.7%	3	(-1.15)	(78.23)	(5.42)	(10.56)	89.4%
	0.0000	1.12			-0.0010	1.15	-0.0739	0.23	
4	(-0.02)	(77.07)	87.1%	4	(-1.59)	(79.16)	(-3.39)	(11.33)	88.8%
	0.0009	1.05			0.0003	1.07	-0.0559	0.14	
5	(1.47)	(77.07)	87.1%	5	(0.51)	(75.55)	(-2.62)	(7.18)	87.9%
	0.0012	0.98			0.0004	1.03	-0.1549	0.19	
6	(1.95)	(72.79)	85.7%	6	(0.77)	(77.15)	(-7.74)	(10.16)	87.9%
	0.0015	0.92			0.0010	0.96	-0.1875	0.14	
7	(2.34)	(66.64)	83.4%	7	(1.64)	(70.20)	(-9.06)	(7.01)	85.5%
	0.0008	0.81			0.0006	0.86	-0.2140	0.08	
8	(1.30)	(59.15)	79.9%	8	(0.98)	(62.77)	(-10.32)	(4.01)	82.3%
	0.0010	0.75			0.0006	0.82	-0.2743	0.14	
9	(1.47)	(48.47)	72.7%	9	(0.85)	(54.57)	(-12.16)	(6.73)	77.6%
	0.0017	0.60			0.0013	0.65	-0.1731	0.12	
Low	(2.28)	(36.29)	59.9%	Low	(1.77)	(37.77)	(-6.71)	(4.85)	62.7%
Average absolute error 0.0010				Average absolute error 0.0010					
GRS statistics 1.37				GRS statistics 1.41					
p-value *0.190*				p-value *0.171*					

Panel D Fama-MacBeth Cross-sectional Analysis

	First-year Monthly Return		Third-year Monthly Return		Average Factor Return
	Model 1	Model 2	Model 1	Model 2	
Intercept	0.0063	0.0026	0.004	0.0024	
	(4.14)	(1.23)	(2.39)	(1.04)	
	[4.14]	[1.18]	[2.39]	[1.03]	
MKT	0.0019	0.0041	0.0033	0.0048	0.0067
	(0.84)	(1.61)	(1.46)	(1.63)	
	[0.67]	[1.30]	[1.27]	[1.44]	
SMB	-	-0.0041	-	-0.006	0.0021
		(-1.44)		(-0.31)	
		[-1.29]		[-0.27]	
HML	-	0.0082	-	0.0002	0.0042
		(1.83)		(0.03)	
		[1.70]		[0.03]	
adj R^2	38.8%	54.88%	80.99%	80.63%	

Table 3 Beta-Sorted Portfolios, Value Line Universe (1990-2007)

This table provides results of analysis on beta-sorted portfolios of our sample firms and firms covered by Valueline in the period of 1990-2007. The Valueline sample is sorted by $Beta_{VL.}$ The descriptive statistics on portfolio characteristics is presented in Panel A, time-series analysis on the monthly returns in the third year subsequent to portfolio formation for 1990-2007 subsample and in the first year subsequent to portfolio formation for the Valueline sample in Panel B, and cross-section analysis on value-weighted monthly portfolio returns in the third year subsequent to portfolio formation for 1990-2007 subsample and in the first year subsequent to portfolio formation for the Valueline sample in Panel C. Sample firms are sorted by Beta and valueline sample firms are sorted into portfolios by $Beta_{VL}$ in each June, rebalanced yearly. In Panel C, coefficient estimates are presented with *t* statistics in parenthesis. Average absolute errors and GRS statistics are also presented. In Panel D, coefficient estimates are presented with *t* statistics in parentheses and Shanken *t* in brackets. The time series averages of the factors MKT, SMB, and HML in the corresponding sample period are also presented.

Panel A Portfolio Characteristics

A1: Firms Covered by Valueline

	Nos	$Beta_{VL}$	TPER	Beta	Size	BM	DE	Capex	Nayst	Grow	Rdisp	$Vwret_1$	$Vwret_2$	$Vwret_3$
High	116.44	1.66	0.19	2.15	5,232.38	0.54	1.77	0.32	14.36	0.21	5.89	1.43%	1.47%	1.24%
2	107.81	1.36	0.17	1.56	7,609.98	0.51	1.82	0.12	14.74	0.17	5.28	1.08%	1.25%	1.28%
3	127.19	1.22	0.15	1.27	8,614.66	0.58	1.61	0.07	13.64	0.15	4.91	1.02%	1.12%	0.96%
4	105.06	1.12	0.15	1.11	7,527.71	0.57	1.55	0.06	13.68	0.14	4.65	1.01%	1.04%	1.17%
5	119.44	1.05	0.14	0.99	7,792.60	0.55	1.39	0.06	13.13	0.14	4.37	1.24%	1.04%	0.79%
6	112.31	0.97	0.14	0.90	5,571.70	0.58	1.50	0.07	11.72	0.13	4.39	0.92%	1.15%	0.90%
7	124.25	0.90	0.13	0.82	4,411.65	0.61	1.17	0.07	10.25	0.13	4.54	0.66%	0.86%	1.16%
8	112.56	0.82	0.13	0.71	4,575.91	0.70	1.07	0.09	9.48	0.12	4.62	0.94%	0.75%	0.98%
9	114.69	0.73	0.11	0.56	3,397.14	0.77	1.25	0.08	9.23	0.10	4.31	0.86%	1.12%	0.92%
Low	115.69	0.58	0.08	0.36	3,094.26	0.78	1.17	0.10	9.71	0.08	4.03	0.84%	0.87%	0.96%

A2: 1990-2007 Subsample

	Nos	Beta	Size	BM	DE	Capex	Nayst	Grow	Rdisp	$Vwret_1$	$Vwret_2$	$Vwret_3$
High	179.44	2.32	2,821.99	0.48	1.35	0.34	9.74	0.21	6.29	0.98%	1.56%	1.42%
2	179.89	1.61	4,256.69	0.55	1.47	0.11	10.17	0.18	5.56	1.04%	1.24%	1.02%
3	180.06	1.31	5,066.78	0.56	1.57	0.34	10.44	0.16	5.05	0.87%	1.08%	1.04%
4	180.11	1.11	5,142.63	0.57	1.83	0.10	10.40	0.15	4.76	1.17%	1.13%	1.05%
5	179.89	0.96	4,840.89	0.58	1.71	0.08	10.13	0.14	4.70	1.02%	1.22%	1.02%
6	180.06	0.82	4,676.62	0.58	1.79	0.08	9.69	0.13	4.47	1.00%	1.03%	1.02%
7	180.28	0.69	4,847.46	0.59	1.98	0.07	9.52	0.13	4.34	1.02%	0.97%	1.04%
8	179.89	0.56	5,294.40	0.63	2.18	0.07	8.98	0.12	4.24	0.82%	0.92%	0.91%
9	180.06	0.40	4,283.71	0.67	2.29	0.09	8.46	0.11	4.15	0.70%	0.90%	0.92%
Low	179.61	0.13	3,199.36	0.67	2.03	0.13	8.32	0.10	4.14	0.97%	0.78%	0.76%

Panel B Time Series Regression Analysis

B1: First-year Return of Firms Covered by Valueline

	Intercept	MKT	adj R^2		intercept	MKT	SMB	HML	adj R^2
	-0.0001	1.81			0.0026	1.62	0.1266	-0.39	
High	(-0.02)	(30.79)	83.2%	High	(1.13)	(26.15)	(1.92)	(-4.79)	86.1%
	-0.0002	1.26			0.0002	1.24	-0.0111	-0.06	
2	(-0.14)	(34.16)	85.9%	2	(0.15)	(28.97)	(-0.24)	(-1.08)	85.9%
	0.0008	1.00			-0.0001	1.12	-0.2415	0.15	
3	(0.44)	(24.11)	75.3%	3	(-0.05)	(26.33)	(-5.34)	(2.68)	80.8%
	0.0006	1.02			0.0002	1.06	-0.0709	0.07	
4	(0.36)	(24.36)	75.6%	4	(0.12)	(22.16)	(-1.39)	(1.07)	76.0%
	0.0037	0.88			0.0039	0.94	-0.2445	0.01	
5	(2.29)	(22.76)	73.1%	5	(2.53)	(22.83)	(-5.60)	(0.18)	77.4%
	0.0014	0.73			-0.0001	0.89	-0.2426	0.25	
6	(0.79)	(16.73)	59.4%	6	(-0.08)	(20.95)	(-5.37)	(4.51)	71.5%
	-0.0004	0.61			-0.0026	0.77	-0.1260	0.32	
7	(-0.22)	(14.34)	51.9%	7	(-1.58)	(17.90)	(-2.73)	(5.56)	63.2%
	0.0028	0.56			-0.0009	0.80	-0.1092	0.53	
8	(1.34)	(11.28)	40.0%	8	(-0.55)	(18.02)	(-2.30)	(9.00)	63.3%
	0.0027	0.42			-0.0005	0.63	-0.0728	0.47	
9	(1.35)	(8.70)	28.4%	9	(-0.29)	(13.35)	(-1.44)	(7.40)	48.8%
	0.0035	0.26			-0.0008	0.53	-0.0432	0.61	
Low	(1.51)	(4.79)	10.7%	Low	(-0.42)	(10.29)	(-0.79)	(8.94)	41.6%

Average absolute error 0.0016	Average absolute error 0.0012
GRS statistics 1.17	GRS statistics 1.06
p-value *0.312*	p-value *0.392*

B2: First-year Return of 1990-2007 Subsample

	Intercept	MKT	adj R^2		Intercept	MKT	SMB	HML	adj R^2
	-0.0036	1.63			-0.0018	1.49	0.1140	-0.30	
High	(-1.55)	(28.26)	79.3%	High	(-0.79)	(23.69)	(1.69)	(-3.55)	81.2%
	-0.0009	1.29			-0.0019	1.35	0.0195	0.15	
2	(-0.49)	(28.15)	79.1%	2	(-0.99)	(25.90)	(0.35)	(2.20)	79.4%
	-0.0011	1.04			-0.0026	1.18	-0.1985	0.24	
3	(-0.65)	(25.42)	75.6%	3	(-1.71)	(28.79)	(-4.51)	(4.46)	81.3%
	0.0026	0.93			0.0013	1.05	-0.2001	0.21	
4	(2.01)	(28.96)	80.0%	4	(1.22)	(35.69)	(-6.30)	(5.48)	87.0%
	0.0019	0.82			-0.0005	1.01	-0.1651	0.39	
5	(1.07)	(19.27)	64.0%	5	(-0.37)	(25.53)	(-3.90)	(7.39)	76.2%
	0.0024	0.70			0.0003	0.87	-0.1467	0.33	
6	(1.50)	(18.15)	61.2%	6	(0.26)	(23.30)	(-3.67)	(6.64)	72.7%
	0.0031	0.61			0.0006	0.81	-0.2106	0.40	
7	(1.68)	(13.36)	46.0%	7	(0.41)	(19.64)	(-4.73)	(7.36)	65.8%
	0.0015	0.56			-0.0007	0.74	-0.2138	0.34	
8	(0.86)	(13.45)	46.4%	8	(-0.48)	(19.58)	(-5.26)	(6.87)	65.9%
	0.0010	0.43			-0.0012	0.62	-0.2422	0.36	
9	(0.53)	(9.31)	29.3%	9	(-0.78)	(14.63)	(-5.29)	(6.36)	53.7%
	0.0043	0.33			0.0010	0.56	-0.0938	0.53	
Low	(2.12)	(6.53)	16.9%	Low	(0.60)	(11.94)	(-1.86)	(8.52)	44.2%

Average absolute error 0.0020	Average absolute error 0.0012
GRS statistics 1.39	GRS statistics 0.87
p-value *0.188*	p-value *0.558*

B3: Third-year Return of 1990-2007 Subsample

	Intercept	MKT	adj R^2		Intercept	MKT	SMB	HML	adj R^2
	0.0012	1.54			0.0029	1.38	0.2084	-0.29	
High	(0.51)	(27.46)	80.3%	High	(1.41)	(23.73)	(3.38)	(-3.89)	84.1%
	-0.0010	1.27			0.0002	1.17	0.0885	-0.19	
2	(-0.58)	(28.69)	81.7%	2	(0.09)	(24.12)	(1.72)	(-3.07)	83.3%
	0.0014	0.92			0.0004	0.99	0.0009	0.15	
3	(1.10)	(30.09)	83.0%	3	(0.32)	(28.86)	(0.03)	(3.37)	84.0%
	0.0019	0.85			0.0009	0.98	-0.2609	0.17	
4	(1.22)	(22.44)	73.1%	4	(0.71)	(28.16)	(-7.07)	(3.86)	83.0%
	0.0020	0.79			0.0013	0.88	-0.1875	0.13	
5	(1.42)	(22.40)	73.1%	5	(1.00)	(24.65)	(-4.92)	(2.79)	79.0%
	0.0028	0.67			0.0008	0.85	-0.2188	0.33	
6	(1.70)	(16.44)	59.4%	6	(0.62)	(24.91)	(-6.01)	(7.45)	78.1%
	0.0028	0.69			0.0008	0.87	-0.1937	0.33	
7	(1.53)	(15.32)	55.9%	7	(0.51)	(20.49)	(-4.28)	(5.94)	70.5%
	0.0025	0.54			0.0008	0.71	-0.2275	0.28	
8	(1.38)	(12.04)	43.9%	8	(0.51)	(16.76)	(-5.09)	(5.19)	62.4%
	0.0033	0.43			0.0002	0.68	-0.2158	0.50	
9	(1.68)	(8.70)	29.0%	9	(0.15)	(17.77)	(-5.29)	(10.00)	66.9%
	0.0013	0.50			-0.0028	0.76	0.0657	0.62	
Low	(0.60)	(9.64)	33.5%	Low	(-1.63)	(15.92)	(1.30)	(10.06)	58.3%

Average absolute error 0.0020	Average absolute error 0.0011
GRS statistics 1.01	GRS statistics 0.88
p-value *0.441*	p-value *0.555*

Panel C Cross-sectional Analysis

	First-year Return 1990-2007 Subsample		Third-year Return 1990-2007 Subsample		First-year Return Valueline Sample		Average Factor Return
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	
Intercept	0.0053	0.0016	0.0038	-0.0019	0.0034	0.0062	
	(1.97)	(0.37)	(1.20)	(-0.25)	(1.22)	(1.11)	
	[1.97]	[0.35]	[1.19]	[-0.24]	[1.21]	[1.10]	
MKT	0.0012	0.0039	0.0040	0.0091	0.0039	0.0015	0.0064
	(0.30)	(0.84)	(0.91)	(1.19)	(0.99)	(0.26)	
	[0.24]	[0.70]	[0.76]	[1.07]	[0.79]	[0.25]	
SMB	-	0.0033	-	-0.0039	-	0.0005	0.0018
		(0.54)		(-0.73)		(0.08)	
		[0.48]		[-0.63]		[0.07]	
HML	-	0.0049	-	0.0003	-	-0.0043	0.0037
		(0.99)		(0.07)		(-0.83)	
		[0.87]		[0.06]		[-0.74]	
Adj R^2	12.63%	12.56%	70.68%	74.57%	67.65%	60.57%	

Table 4 Fama-French Industry Portfolios

This table provides results of analysis on Fama-French 10 industry portfolios: descriptive statistics on portfolio characteristics (Panel A), time-series analysis on the monthly returns in the first year (Panel B) subsequent to portfolio formation, and cross-section analysis (Panel C) on value-weighted monthly portfolio returns in the first year. The sample firms consists of firms covered by CRSP monthly files, with exclusion of firms with market capitalization less than the NYSE 10^{th} percentile breakpoint, firms with price of less than $5, firms with less than 36 monthly trading records in the prior 5 years, and firms in the deciles with the highest/lowest prior 12-month stock returns in each June of 1932-2007. In Panel C, coefficient estimates are presented with *t* statistics in parenthesis. Average absolute errors and GRS statistics are also presented. In Panel D, coefficient estimates are presented with *t* statistics in parentheses and Shanken *t* in brackets. The time series averages of the factors MKT, SMB, and HML in the corresponding sample period are also presented.

Panel A Portfolio Characteristics

Industry	nos	Beta	Size	BM	DE	Capex	Nayst	Grow	Rdisp	$Vwret_1$
1	104.97	0.92	1,421.84	0.85	0.78	0.04	9.65	0.13	4.25	1.43%
2	43.72	1.26	2,230.42	0.82	0.88	0.04	8.38	0.14	5.02	1.08%
3	257.93	1.19	1,069.31	0.82	0.83	0.06	8.75	0.14	5.23	1.02%
4	53.01	1.08	2,459.84	0.76	0.71	0.40	14.16	0.15	7.46	1.01%
5	97.21	1.42	1,465.17	0.61	0.59	0.14	9.99	0.19	5.33	1.24%
6	17.97	1.02	3,741.83	0.73	1.08	0.24	12.89	0.16	5.89	0.92%
7	101.05	1.06	1,086.50	0.76	0.90	0.04	10.01	0.16	4.25	0.66%
8	47.05	1.09	2,092.09	0.47	0.36	0.11	12.77	0.20	4.40	0.94%
9	84.79	0.70	1,055.20	0.98	1.62	0.12	11.56	0.06	4.38	0.86%
10	269.55	1.11	1,097.94	0.88	4.28	0.09	8.92	0.13	4.72	0.84%

Panel B Time Series Regression Analysis

Industry	intercept	MKT	adj R^2	Portid	Intercept	MKT	SMB	HML	adj R^2
	0.0019	0.76			0.0019	0.79	-0.1044	0.03	
1	(2.40)	(49.14)	72.7%	1	(2.37)	(46.55)	(-4.15)	(1.45)	73.2%
	0.0006	1.21			0.0001	1.22	-0.1390	0.18	
2	(0.51)	(51.35)	74.4%	2	(0.07)	(48.26)	(-3.70)	(5.40)	75.5%
	-0.0002	1.09			-0.0008	1.08	-0.0614	0.18	
3	(-0.36)	(87.01)	89.3%	3	(-1.35)	(83.56)	(-3.18)	(10.43)	90.5%
	0.0029	0.90			0.0021	0.92	-0.2506	0.27	
4	(2.30)	(36.83)	60.0%	4	(1.78)	(36.44)	(-6.63)	(7.98)	64.0%
	0.0002	1.15			0.0011	1.18	0.0454	-0.25	
5	(0.24)	(57.67)	78.6%	5	(1.10)	(56.04)	(1.45)	(-8.90)	80.3%
	0.0010	0.62			0.0013	0.66	-0.1059	-0.05	
6	(0.91)	(30.05)	49.9%	6	(1.17)	(29.11)	(-3.14)	(-1.79)	50.6%
	0.0008	0.93			0.0011	0.94	0.0067	-0.09	
7	(0.87)	(49.62)	73.1%	7	(1.18)	(46.04)	(0.22)	(-3.21)	73.4%
	0.0024	0.83			0.0032	0.90	-0.2014	-0.17	
8	(1.99)	(35.10)	57.6%	8	(2.69)	(35.94)	(-5.37)	(-5.08)	60.0%
	0.0008	0.73			-0.0004	0.71	-0.1372	0.36	
9	(0.67)	(31.54)	52.4%	9	(-0.35)	(30.30)	(-3.92)	(11.61)	59.0%
	-0.0005	1.11			-0.0017	1.06	-0.0218	0.36	
10	(-0.58)	(71.60)	85.0%	10	(-2.57)	(74.04)	(-1.02)	(18.98)	89.2%
Average absolute error 0.0011				Average absolute error 0.0014					
GRS statistics 2.25				GRS statistics 3.45					
p-value *0.014*				p-value *0.000*					

Panel C Cross-sectional Analysis

	Model 1	Model 2	Average Factor Return
Intercept	0.0037	0.0010	
	(1.87)	(0.41)	
	[1.86]	[0.38]	
MKT	0.0049	0.0070	0.0067
	(1.87)	(2.44)	
	[1.57]	[0.38]	
SMB	-	-0.0084	0.0021
		(-1.87)	
		[-1.72]	
HML	-	-0.0012	0.0042
		(-0.60)	
		[-0.49]	
Adj R^2	52.16%	83.49%	

Table 5 Fama-French Industry Portfolios Sorted by BM

Panel A provides results of analysis on Fama-French 10 industry portfolios sorted further by BM. First, Sample firms are sorted into 10 portfolios by Fama-French 10 industry classification in each June. Within each industry portfolio, firms are further categorized into terciles by BM. Asset pricing tests are conducted on the value-weighted monthly portfolio returns in the first year of these 30 portfolios. Average absolute errors and GRS statistics of the time-series analysis, as well as coefficient estimates cross-sectional analysis (with *t* statistics in parentheses and Shanken *t* in brackets) are presented. The time series averages of the factors MKT, SMB, and HML in the corresponding sample period are also presented.

Panel B to D provide results of analysis on Fama-French 10 industry portfolios with maximum BM dispersion: descriptive statistics on portfolio characteristics (Panel B), time-series analysis on the monthly returns in the first year (Panel C) subsequent to portfolio formation, and cross-section analysis (Panel D) on value-weighted monthly portfolio returns in the first year. Sample firms are sorted into 10 portfolios by Fama-French 10 industry classification in each June. With each industry portfolio, firms are further categorized into terciles by BM. The industry portfolio with the maximum BM dispersion is selected for analysis. In Panel C, coefficient estimates are presented with *t* statistics in parenthesis. Average absolute errors and GRS statistics are also presented. In Panel D, coefficient estimates are presented with *t* statistics in parentheses and Shanken *t* in brackets. The time series averages of the factors MKT, SMB, and HML in the corresponding sample period are also presented.

Panel A: 30 Industry-BM Portfolios

Time Series Regression Analysis		
	CAPM	FF 3 Factor
Absolute pricing error	0.0017	0.0019
GRS statistics	2.27	2.76
(p-value)	(0.00)	(0.00)

Cross-sectional Analysis			
	CAPM	FF 3 Factor	Average Factor Return
Intercept	0.0034	0.005	
	(1.76)	(2.41)	
	[1.75]	[2.39]	
MKT	0.0058	0.0038	0.0067
	(2.22)	(1.41)	
	[1.85]	[1.18]	
SMB	-	0.0041	0.0021
		(1.98)	
		[1.72]	
HML	-	0.0017	0.0042
		(1.11)	
		[0.88]	
adj R^2	32.51%	35.91%	

Panel B Ten Fama-French Industry Portfolios with Maximum BM Dispersion: Portfolio Characteristics

Industry	Nos	Beta	Size	BM	DE	Capex	Nayst	Grow	Rdisp	$Vwret_1$
1	33.76	1.00	404.58	1.87	1.32	0.04	6.20	0.12	5.96	1.36%
2	12.74	1.27	990.08	1.68	1.53	0.04	6.56	0.12	6.33	1.33%
3	88.63	1.18	783.84	0.88	0.70	0.06	8.38	0.13	5.22	1.30%
4	14.58	1.12	1,498.76	2.12	1.15	0.23	13.16	0.13	7.80	1.93%
5	19.77	1.50	509.64	1.56	1.48	0.08	8.10	0.16	6.73	1.68%
6	5.42	1.19	3,111.33	2.19	1.37	0.25	12.61	0.12	5.66	1.42%
7	38.11	1.03	2,089.68	0.44	0.43	0.04	12.66	0.18	3.40	1.12%
8	31.57	1.06	2,953.64	0.34	0.22	0.12	14.29	0.21	4.02	1.20%
9	13.82	0.81	1,698.42	0.52	1.13	0.11	11.95	0.13	5.58	0.81%
10	96.07	1.19	798.73	2.85	6.17	0.07	8.47	0.12	5.65	1.27%

Panel C: Ten Fama-French Industry Portfolios with Maximum BM Dispersion:
Time Series Regression Analysis

Industry	Intercept	MKT	adj R^2	Industry	Intercept	MKT	SMB	HML	adj R^2
	0.0025	1.02			0.0006	0.88	0.3217	0.45	
1	(2.09)	(44.14)	68.3%	1	(0.62)	(40.88)	(10.05)	(15.67)	77.2%
	0.0009	1.19			-0.0006	1.07	0.3117	0.32	
2	(0.46)	(32.95)	54.5%	2	(-0.31)	(28.02)	(5.49)	(6.33)	57.8%
	0.0002	1.23			-0.0012	1.16	0.0641	0.38	
3	(0.22)	(66.07)	82.8%	3	(-1.39)	(64.38)	(2.39)	(15.68)	86.6%
	0.0066	1.20			0.0035	1.08	0.0205	0.88	
4	(2.84)	(26.61)	43.9%	4	(1.64)	(24.17)	(0.31)	(14.80)	54.8%
	0.0028	1.33			0.0012	1.17	0.4531	0.34	
5	(1.49)	(36.11)	59.0%	5	(0.69)	(30.71)	(8.00)	(6.73)	63.5%
	0.0001	1.22			-0.0023	1.11	0.0530	0.67	
6	(0.06)	(27.73)	45.9%	6	(-1.08)	(24.60)	(0.79)	(11.11)	52.4%
	0.0025	0.80			0.0034	0.89	-0.2529	-0.19	
7	(1.97)	(32.51)	53.9%	7	(2.77)	(34.38)	(-6.57)	(-5.63)	57.4%
	-0.0019	0.80			-0.0017	0.80	0.0497	-0.08	
8	(-0.97)	(21.15)	33.1%	8	(-0.84)	(19.30)	(0.80)	(-1.46)	33.1%
	-0.0012	1.01			-0.0010	1.04	-0.0721	-0.05	
9	(-1.31)	(57.44)	78.5%	9	(-1.05)	(53.98)	(-2.51)	(-1.90)	78.7%
	0.0029	0.52			0.0041	0.58	-0.0465	-0.32	
10	(1.78)	(16.52)	23.2%	10	(2.57)	(17.21)	(-0.93)	(-7.20)	27.3%
Average absolute error 0.0022				Average absolute error 0.0019					
GRS statistics 3.03				GRS statistics 2.65					
p-value *0.001*				p-value *0.003*					

Panel D: Ten Fama-French Industry Portfolios with Maximum BM Dispersion:
Cross-sectional Analysis

	Model 1	Model 2	Average Factor Return
Intercept	0.0006	0.0073	
	(0.23)	(2.35)	
	[0.23]	[2.31]	
MKT	0.0088	0.0008	0.0067
	(2.76)	(0.22)	
	[2.40]	[0.20]	
SMB	-	0.0010	0.0021
		(0.30)	
		[0.28]	
HML	-	0.0062	0.0042
		(2.57)	
		[2.28]	
Adj R^2	45.16%	51.65%	

Table 6 BM Effects within Industry

Panel A provides descriptive statistics of the 10 BM-sorted portfolios within industries. Sample firms are first categorized into 10 portfolios by Fama-French 10 industry classification in each June. Within each industry portfolio, firms are into deciles by BM. Those industry deciles are then merged into 10 portfolios, with firms with the highest/lowest BM within each industry in portfolio 1/10. on portfolio characteristics are presented.

Panel B provides descriptive statistics of portfolios sorted with DE and BM within industry. Sample firms are categorized into 10 portfolios by Fama-French 10 industry classification in each June. With each industry portfolio, firms are double-sorted into terciles first by DE and then by BM.

Panel A Within Industry BM-sorted Portfolios

BM	nos	Beta	Size	BM	DE	Capex	Nayst	Grow	Rdisp	$Vwret_1$	$Vwret_2$	$Vwret_3$
High	109.79	1.11	710.65	1.81	3.34	0.08	7.92	0.12	6.85	1.32%	1.18%	1.24%
2	114.68	1.05	894.22	1.23	2.55	0.08	8.95	0.13	6.01	1.14%	1.22%	1.18%
3	115.58	1.05	1,097.83	1.03	2.15	0.08	9.07	0.13	5.48	1.09%	1.15%	1.21%
4	114.86	1.04	1,314.35	0.88	2.09	0.08	9.45	0.13	5.14	1.06%	1.07%	1.03%
5	113.56	1.02	1,396.40	0.78	1.81	0.07	9.70	0.13	4.82	1.10%	1.20%	1.03%
6	116.68	1.04	1,608.65	0.68	1.57	0.08	9.93	0.14	4.53	0.96%	1.10%	1.15%
7	115.86	1.04	2,073.81	0.59	1.33	0.08	10.70	0.14	4.37	1.03%	1.01%	1.06%
8	114.58	1.06	2,654.20	0.50	1.06	0.09	11.35	0.15	4.16	1.00%	0.98%	1.01%
9	115.68	1.08	3,269.22	0.40	0.70	0.13	11.41	0.16	4.11	0.91%	1.02%	0.99%
Low	110.82	1.11	3,698.76	0.22	0.51	0.23	11.23	0.18	4.19	0.92%	0.94%	0.98%

Panel B Within Industry DE/BM -sorted Portfolios

DE	Beta			Size			BM		
	L	M	H	L	M	H	L	M	H
L	1.10	1.08	1.04	3,484.22	1,896.90	835.68	0.29	0.51	0.85
M	1.07	1.03	1.06	3,275.60	1,589.36	897.05	0.49	0.76	1.17
H	1.05	1.02	1.08	2,386.43	1,506.41	887.34	0.64	1.01	1.64
	DE			Capex			Nayst		
L	0.23	0.33	0.37	0.19	0.12	0.10	11.37	10.43	8.41
M	1.09	1.09	1.05	0.11	0.08	0.08	12.01	10.22	8.82
H	2.94	3.52	4.83	0.09	0.06	0.06	10.52	9.48	8.47
	Grow			Rdisp			$Vwret_1$		
L	0.18	0.16	0.15	3.96	4.42	5.41	0.93%	0.89%	0.99%
M	0.14	0.13	0.13	4.17	4.63	5.83	1.04%	1.00%	1.02%
H	0.13	0.12	0.11	4.68	5.22	6.34	1.07%	1.20%	1.41%

Panel C: Cross-sectional Regression

	1932-2007						
$Beta_{aged}$	-	0.02	-	0.03	0.03	0.02	0.02
		(0.23)		(0.29)	(0.29)	(0.29)	(0.22)
Size	-	-0.08	-	-0.07	-0.07	-0.07	-0.07
		(-1.87)		(-1.51)	(-1.58)	(-1.52)	(-1.48)
DE	-	0.09	-	0.03	0.03	0.03	0.04
		(3.40)		(0.96)	(0.97)	(0.96)	(1.03)
Capex	-	-0.07	-	-0.07	-0.07	-0.07	-0.07
		(-3.64)		(-3.76)	(-3.70)	(-3.80)	(-3.71)
BM	0.15	-	-	0.09	-	-	-
	(5.22)			(2.46)			
BM_{fitted}	-	-	0.22	-	-	-	-
			(4.14)				
BM*(Small Stock)	-	-	-	-	0.12	-	-
					(3.04)		
BM* (Large Stock)	-	-	-	-	0.06	-	-
					(1.40)		
BM* (Low DE)	-	-	-	-	-	0.09	-
						(1.79)	
BM* (High DE)	-	-	-	-	-	0.10	-
						(2.32)	
BM* (Low Icov)	-	-	-	-	-	-	0.06
							(1.51)
BM* (High Icov)	-	-	-	-	-	-	0.13
							(3.33)
R_{adj}^2	1.75%	5.32%	1.94%	6.13%	6.21%	6.29%	6.31%

	1990-2007							Valueline Sample						
$Beta_{aged}$	-	0.16	-	0.18	0.18	0.18	0.18	-	0.37	-	0.35	0.35	0.35	0.35
		(2.58)		(2.67)	(2.67)	(2.67)	(2.66)		(6.78)		(7.07)	(6.99)	(7.16)	(7.14)
Size	-	-0.04	-	-0.02	-0.03	-0.02	-0.02	-	-0.17	-	-0.18	-0.18	-0.18	-0.18
		(-0.64)		(-0.45)	(-0.54)	(-0.46)	(-0.45)		(-1.67)		(-2.19)	(-2.13)	(-2.21)	(-2.20)
DE	-	0.13	-	0.11	0.11	0.11	0.11	-	0.17	-	0.19	0.19	0.20	0.20
		(2.75)		(2.11)	(2.19)	(2.15)	(2.11)		(2.97)		(4.48)	(4.54)	(4.82)	(4.95)
Capex	-	-0.11	-	-0.11	-0.11	-0.11	-0.11	-	-0.07	-	-0.06	-0.06	-0.05	-0.05
		(-4.85)		(-5.00)	(-5.01)	(-5.02)	(-5.01)		(-2.88)		(-2.42)	(-2.45)	(-2.15)	(-2.33)
BM	0.14	-	-	0.07	-	-	-	0.17	-	-	-0.02	-	-	-
	(3.05)			(2.14)				(1.46)			(-0.42)			
BM_{fitted}	-	-	0.30	-	-	-	-	-	-	0.41	-	-	-	-
			(2.94)							(1.98)				
BM*(Small Stock)	-	-	-	-	0.10	-	-	-	-	-	-	0.04	-	-
					(2.17)							(0.53)		
BM* (Large Stock)	-	-	-	-	0.03	-	-	-	-	-		-0.09	-	-
					(0.97)							(-1.75)		
BM* (Low DE)	-	-	-	-	-	0.03	-	-	-	-	-	-	-0.15	-
						(0.65)							(-3.35)	
BM* (High DE)	-	-	-	-	-	0.10	-	-	-	-	-	-	0.08	-
						(4.05)							(1.09)	
BM* (Low Icov)	-	-	-	-	-	-	0.06	-	-	-	-	-	-	-0.12
							(1.77)							(-2.14)
BM* (High Icov)	-	-	-	-	-	-	0.08	-	-	-	-	-	-	0.05
							(2.26)							(0.74)
R_{adj}^2	1.14%	3.66%	1.64%	3.98%	4.00%	4.04%	3.99%	1.83%	5.56%	2.87%	5.84%	6.02%	6.05%	5.98%

Table 7 Implied Cost of Capital

The computed ICCs for our beta-sorted, industry, and within industry BM-sorted portfolios are presented in Panel A.

Panel B presents the results of Fama-MacBeth cross-sectional analysis on ICC of individual stocks. The explanatory variables except beta are demeaned within industry and cross-sectionally, and log-transformation is applied to to Size, BM and DE. The regression coefficients are then averaged across time and the t-values are computed using Newey-West formula with a lag of 6.

Panel A ICCs of Beta-Sorted Portfolios

Beta	ICC	Industry	ICC	BM	ICC
High	10.76%	1	10.91%	High	11.44%
2	11.03%	2	11.96%	2	11.24%
3	11.08%	3	11.04%	3	11.14%
4	10.72%	4	10.41%	4	11.51%
5	11.01%	5	10.19%	5	11.03%
6	10.99%	6	9.30%	6	10.94%
7	10.99%	7	10.67%	7	10.78%
8	10.77%	8	10.08%	8	10.82%
9	10.89%	9	9.56%	9	10.47%
Low	10.10%	10	11.63%	Low	9.89%

Panel B Cross-sectional Regression

$Beta_{aged}$	Size	DE	Capex	BM	BM_{fitted}	R_{adj}^2
-	-	-	-	0.70	-	1.45%
				(4.04)		
-0.26	-0.57	0.08	-0.26	-	-	3.22%
(-1.90)	(-5.52)	(6.03)	(-3.12)			
-	-	-	-	-	1.50	2.50%
					(8.56)	
-0.21	-0.57	0.71	-0.24	0.11	-	3.40%
(-1.71)	(-5.43)	(10.72)	(-3.20)	(0.71)		