Recovery Risk in Stock Returns

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ABSTRACT

In this paper we argue that book-to-market and size attributes represent sensitivities of firm returns to several risk factors, and in so doing they subsume the information in other attributes. Although this gives them high cross-sectional explanatory power, they are not very indicative if we are concerned with testing whether an individual risk factor is priced. In that regard, claiming that financial distress is not priced, by only considering probability of bankruptcy, seems premature. Rational investors may also care about recovery rates and the relatively higher mean returns observed for small firms with very low book-to-market ratios is consistent with this view. To analyse recovery risk, we construct mimicking portfolios by sorting stocks on less noisy attributes such as fixed-assets and intangible-assets ratios. We find that recovery risk mimicking portfolios exhibit typical risk factor characteristics, and perform well in explaining the cross-section of returns. The results suggest that recovery risk factor is a good candidate to be priced, and much of the explanatory power of the size attribute comes from the fact that it embodies useful information regarding recovery risk. Overall, our findings have important portfolio management implications.

JEL Codes : G11, G12, G14

Keywords : Stock market anomalies, factor-mimicking portfolios, book-to-market, size, recovery risk, bankruptcy risk, fixed assets ratio, intangible assets ratio, Ohlson’s score.

EXECUTIVE SUMMARY

The Book-to-market ratio of a firm is defined as the book value of its assets relative to their market value. Size attribute simply refers to a firm’s total market value. Both of these attributes, along with other firm characteristics, have been subject to considerable analysis in the finance literature. It has been shown through empirical studies that these attributes have considerable power in explaining and predicting the cross-section of expected stock returns. Although researchers generally accept the success of these attributes in explaining stock returns, there is disagrement concerning the reasons for this success. Leaving aside the arguments about investors’ irrationality and data related biases, for these attributes to have such explanatory power, they should represent sensitivities to some risk factors in an APT like model. That is, we can view stock returns as a form of compensation for different kinds of risks this firm is exposed to. It is then natural to expect that such firms’ attributes reveal important information regarding the risk factors in its environment. For instance, high debt is likely to be associated with bankruptcy risk, a growth firm is likely to be more vulnerable to technological risk, etc… If we know that an attribute is not very noisy, in an informational sense, that is, it is uniquely related to a risk factor, then we can construct a mimicking portfolio for this factor by sorting stocks with respect to the given attribute and taking the return differences of fractions of stocks at both ends of the spectrum. Fama and French (1993) construct mimicking portfolios in this way, by sorting stocks on their book-to-market and size. They argue that their mimicking portfolios are priced along with the market factor. That is, the excess returns of these portfolios are required by investors because holding them generates risk. However, they did not explicitly name which risk factors those portfolios were aiming to mimic, apart from stating that the return premium of high book-to-market firms may represent a compensation for increased financial distress. Their argument is

based on the empirical fact that high book-to-market (bm) firms are, in general, bad recent performers in terms of earnings growth, profitability etc. In order to test whether default risk is priced in stock returns, Dichev (1998) constructed a mimicking portfolio by sorting stocks with respect to their ex-ante probability of default (measured by Ohlson (1980) score) and found that this portfolio is not assigned a significant risk premium in her regressions. Such an indeterminacy does not necessarily mean that default risk is not priced. We believe that book-to-market and size attributes represent loadings to several risk factors ; hence although they contain enough information to explain the cross-section of returns, they are much too noisy if the goal is to determine whether an individual risk factor is priced. Investors care not only about the probability of default but also about the recovery rate and thus the liquidity of the firms' assets after bankruptcy. When one orders stocks with respect to their Ohlson scores, high bm firms will be assigned higher probability of default scores because of their large debt ratios. However, such firms are also likely to have high recovery rates in the event of default. Similarly, growth firms with low bm ratios will be assigned low Ohlson scores and they will generally have low recovery ratios since such firms mainly have value as an on-going concern, that is, tangible assets constitute a smaller portion of their total assets. Moreover, because of increased technological uncertainty their assets are more exposed to obsolescence, and thus are less liquid. In the light of this discussion we use less noisy attributes to obtain a better answer to the question of which risk factors are priced. We mimic recovery risk with two attributes, namely firms' fixed-assets and intangible-assets ratios and check whether the recovery risk mimicking portfolios constructed from these attributes are priced.

We find that especially small growth firms (which are in the very low end of the bm spectrum) provide higher mean returns than the corresponding firms which are in the middle of the bm spectrum if one defines returns as capital gains only. But once returns are calculated with dividends then the observed recovery risk effect is less pronounced. This finding also suggests that investors may well be taking distant recovery risk into account. Indeed, the mimicking portfolios for assuming recovery risk, that is, the portfolios formed by going long with the shares of firms having low fixed assets ratio (high intangible assets ratio) and by going short those of firms with high fixed assets ratio (low intangible assets ratio) are rewarded over several investment horizons which may have important investment applications. The returns to these portfolios exhibit substantial variability, and their average returns are in general negative or relatively lower during recessionary periods. Moreover, recovery risk mimicking portfolios do very well in explaining the cross-section of stock returns. All these findings suggest that recovery risk factor is a priced risk factor. We also find that the cross-sectional explanatory power of these attributes is subsumed successfully by bm and size. Hence, we have been able to clear up some of the ambiguity concerning the explanatory power of bm and size by relating them to more fundamental attributes describing firms' recovery risk.

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The success of some attributes such as size, book-to-market, and earnings-per-share in explaining the cross-section of expected returns is by now well-known. (Fama and French (1992)) Although there is a general agreement on this empirical observation, academics disagree strongly on whether portfolios constructed by sorting stocks on these attributes can be viwed as risk factors. Such portfolios are called factor-mimicking portfolios and they are constructed so as to maximize the exposure to a proposed risk factor. Fama and French (1993) formed factor-mimicking portfolios based on book-to-market and size attributes, and argued that these portfolios are priced in a multifactor linear asset pricing model. That is, the excess returns of these portfolios are required and expected by investors because holding such a portfolio exposes one to risk. However, they did not explicitly name which risk factors those portfolios were aiming to mimic, apart from stating that the return premium of high book-to-market firms (called value premium) may be representing a compensation for increased financial distress. Their argument is based on the empirical fact that high book-to-market firms are, in general, bad recent performers in terms of earnings growth, profitability etc.[1]

To account for the explanatory power of the attribute-sorted portfolios some authors have put forward non-risk based explanations. In particular, Haugen and Baker (1996), Lakonishok, Shleifer, and Vishny (1994), and more recently Daniel and Titman (1997) are the ardent supporters of this school of thought. Their arguments, which rely on the irrationality of investors, in a sense say that people underestimate the bankruptcy probability of growth firms (which have low book-to-market ratios) and tend to extrapolate negative and positive past returns into the future. Overoptimism about the prospects of growth firms peters out as competitive market forces drive down profits, and pessimism about value firms dissipates as those firms recover quicker than expected. The notorious book-to-market effect ensues as a result of such price corrections.

To verify the correctness of such arguments, Fama and French (1996, 1998) rerun the tests of Lakonishok et al. (1994), and Daniel and Titman (1997) in slightly different contexts and found out that irrationality stories are not completely supported empirically, while Berk (1998) argued against the methodology of Daniel and Titman (1997), saying that their sorting procedure biased the tests in favor of rejecting the underlying asset pricing model. From a different perspective Berk (1995) says that any anomaly in expected returns are transferred to accounting ratios involving price (or market value) since price is the value of future cash flows discounted by return. Hence, he argues, the attribute-sorted portfolios can explain the cross-section of expected stock returns even when they are not mimicking any risk factor because the attributes themselves contain the relevant information. In this paper we adopt a different approach to answer the question : Where does the explanatory power of book-to-market and size factors come from?. Our hypothesis is that book-to-market and size attributes represent loadings or sensitivities of stock returns to several risk factors, hence the information provided by them is somewhat noisy. Moreover, in the light of the diverse arguments put forward so far, it seems that a more explicit modeling of the relationship between an attribute and the relevant risk factor is necessary. To achieve this we try to find other, more informative firm attributes that are related to risk factors.[2] Two of these are fixed assets ratio, and intangible assets ratio which are probably uniquely related to the recovery risk factor that we describe later. Along with the factors that can be mimicked by certain attributes of a firm, we also analyse several macroeconomic factors to see to what extent they contribute to the explanatory power of book-to-market and size attributes. The methodology we use also allows us to determine the factors that are priced in the context of a multifactor linear asset pricing model.[3]

More specifically, we first analyse whether book-to-market and size attributes are proxies for loadings on a set of candidate macroeconomic risk factors, then examine whether they relate to firm characteristics that effectively causes them to be perceived as riskier, such as high default probability, high beta, low fixed assets ratio, etc. The idea for the latter is that if, for instance, small firms have in general low fixed assets ratios (that is, fixed assets constitute a smaller portion of their total assets, or most of their assets are intangible) and this is a cause for concern, then such firms will, in equilibrium, have to compensate investors for this added risk, irrespective of their loading on economy-wide risk factors. The reason is that conditional on default, firms with less fixed assets will have low recovery ratios. This is especially true for growth firms operating in rapidly growing industries. In a rational market this will imply higher costs of borrowing for these firms, hindering their ability to exploit future growth opportunities. We also analyse whether book-to-market (bm from now on) and size subsume other attributes by constructing mimicking portfolios for those attributes within bm-size sorted portfolios. Both the time series (over recessionary and expansionary periods, and as a whole) and cross-sectional return properties of such portfolios are examined to check whether they are priced, and to uncover, if any, their relationships with the aggregate economy. Moreover, conducting some of our analysis both with capital gains and with total returns we obtain valuable insights regarding dividend policy of firms with regard to their standing in the bm-size spectrum. Most importantly, we discover that especially small growth firms (which are in the very low end of the bm spectrum) provide higher mean returns than the corresponding firms which are in the middle of the bm spectrum if one calculates returns as only capital gains. But once returns are calculated with dividends then the observed recovery risk effect is less pronounced. This finding suggests the existence of an attribute, namely fixed assets, that did not get much attention before. We find that small growth firms have low fixed assets (high intangible assets) ratio, and are usually high technology or service firms. Although their probability of bankruptcy is smaller compared to firms situated in the higher end of the bm spectrum, their recovery rates in the event of default are lower. If investors, for some reason, view such firms as riskier, then higher mean returns for these firms are justified. Indeed, the mimicking portfolios for assuming recovery risk, that is, the portfolios formed by going long with the shares of firms having low fixed assets ratio (high intangible assets ratio) and by going short those of firms with high fixed assets ratio (low intangible assets ratio) are rewarded over several investment horizons, suggesting that investors view such portfolios as being risky. Similar results are obtained for other attribute-sorted mimicking portfolios, the attributes being the volatility, the beta of a stock, and the Ohlson bankruptcy score of a firm, although the results remain tentative for the latter due to data availability problems. We later show that mimicking portfolios for the above attributes provide sizable average returns over several investment horizons. Moreover, these average returns are in general negative or relatively lower in recessionary periods suggesting that the rewards provided by holding these portfolios represents a risk premium. We find that the cross-sectional explanatory power of these attributes are subsumed successfully by bm and size. Hence, we have been able to clear up some of the ambiguity concerning the explanatory power of bm and size by relating them to more fundamental attributes. To conclude, these and other results obtained in the study favor a risk-based explanation for the bm and size effects and suggests that most of the explanatory power of size comes from the fact that it proxies well the so-called recovery risk.

In the remainder of the paper we proceed as follows : In Part I., we describe the data used in the study and in Part II., explain in detail the way the mimicking portfolios are constructed, and how the testing is carried out. In Part III., results are presented, and main findings are summarized in the concluding Part IV. Finally, all the exhibits referred to in the study are displayed in the Appendix.

I. DATA

The sample consists of nonfinancial firms whose stock is traded, or was traded in any of the three US stock markets ; namely NYSE, AMEX, and NASDAQ. Firms that have been delisted are specifically included in the data set to alleviate the well-known survival bias. These firms constitute one-fourth of the sample. The time period covered is from 1974 to 1998. The number of firms changes depending on the year, (around 1700 in 1974, and over 3700 in 1997). The basic inclusion criteria is that both bm and size of the firm should be known by May of the corresponding year, though for market portfolio this constraint is relaxed. Also a firm has to be in operation at least for one year in order to be included in the database but in most cases this is not binding since the data provider already imposes more stringent criteria to select representative firms. All return and accounting data are obtained from DATASTREAM. Financial firms are excluded on the ground that their accounting ratios do not reflect distress as well as those of industrial firms do. Moreover, only firms with ordinary common equity is included in the data set. Prices are closing prices and they are adjusted for subsequent capital actions. The average of closing bid and ask quotations is used when a stock does not trade. If price data is not available for a firm in one specific month, that firm is excluded from the data set only for that month. Monthly returns are simple returns expressed as percentage changes. In return calculations gross dividends are used and the tax and re-investment charges ignored.

Regarding the macroeconomic variables used in the study, 3-month treasury bill rate, long term (over 10 years of maturity) government bond index, long term industrial bond index, long term treasury bond index, and industrial production rate are all obtained from DATASTREAM. Several alternative series (particularly long term AAA, and BAA bond indices, and others) obtained from the website of Chicago Federal Reserve Bank have also been utilised to verify whether there is any difference. The results are robust to such changes. Finally, business cycle information for the American economy is obtained from NBER (National Bureau of Economic Research) website.

Here we also define the two main attributes, book-to-market (bm) and market value (size). Definitions for the other attributes, and accounting ratios can be found in the Appendix. Bm is the inverse of the market value of a company as a percentage of its total equity capital plus reserves less total intangibles. Equivalently, bm = (NTA / MV) * 100 where NTA is net tangible assets defined as fixed assets less depreciation, plus longer-term investments and current assets, less current and deferred liabilities and prior charge capital and minority interest. Market value (size from now on) is the share price multiplied by the number of ordinary shares in issue. The amount in issue is updated whenever new tranches of stock are issued or after a capital change. For companies with more than one class of equity capital , the market value is expressed according to the individual value.

II. METHODOLOGY AND TESTING

A. Construction of the base assets :

The stocks are assigned into 25 portfolios in the following manner : In May of each year from 1974 to 1997, all stocks are ranked based on their book-to-market ratio, and for each year 5 portfolios of bm-sorted stocks are constructed. If a firm has a negative bm then it is excluded from these portfolios only for that year. Rankings are carried out based on the percentile scores, so bm-sorted portfolios do not necessarily contain the same number of firms, though these numbers are close to each other. Moreover, firms in the top %2.5 and the bottom %2.5 percentiles are cut out to avoid outlier effects from some firms having abnormal bm values.

After the first sort and ranking based on bm values, the second sort is based on size, and stocks are finally allocated into 25 portfolios each year. The reason for using May as the sort date each year is to make sure that the values for bm and size are known at the time stock returns are calculated. Hence effectively a five-month reporting lag is recognized. This lag is conservative even for distressed companies who tend to report relatively later. For this purpose, returns for the 25 portfolios (or base assets) are calculated from June to the end of the May of next year, and portfolios are reformed at that time. Both value-weighted and equally-weighted returns are calculated to better distinguish the effects of firm size. Value-weighted portfolio returns also help to diminish the bias caused by bid-ask bounce. Given that we use monthly returns the relative magnitude of this bias should be negligible even for equally-weighted returns. Moreover, if a firm does not trade in some month it is excluded from the calculation of the return of the portfolio it belongs for that month. This procedure also helps to reduce the effects of nonsynchronous trading, and illiquidity. We call these bm-size sorted portfolios as base assets, because they are going to be used as dependent variables in time series regressions in trying to explain their return variability by means of candidate risk factors.

B. Construction of the mimicking portfolios :

To test whether bm and size are related to priced state variables we construct mimicking portfolios for these attributes. To this end, the data is sorted twice the same way as before, but this time at each sort 3 percentile-ranked portfolios are constructed to yield 9 bm-size sorted portfolios. Returns are again calculated in both ways, namely value-weigthed and equally-weighted, but only %0.5 of the top and the bottom firms are eliminated this time. The hope is to increase variability in mimicking portfolio returns. This correction is quite important because in calculating mimicking portfolio returns one takes averages twice (which reduces their variability), first in constructing the 9 representative portfolios, and second in the final step, which is in a sense a cross-sectional average as seen in the following : If we classify our portfolios by high, medium, and low depending on their rankings, the bm mimicking portfolio is computed as follows :

bm = (highBMlowSIZE + highBMmediumSIZE + highBMhighSIZE – lowBMlowSIZE – lowBMmediumSIZE – lowBMhighSIZE) / 3,

and the size mimicking portfolio is computed as,

size = (lowSIZElowBM + lowSIZEmediumBM + lowSIZEhighBM – highSIZElowBM – highSIZEmediumBM – highSIZEhighBM) / 3.

As can be seen from these formulas the mimicking portfolio for one factor is quite independent of the other factor. Thus bm mimicking portfolio returns, for instance, shows how the additional risk of high bm firms are rewarded relative to low bm firms, while keeping the effects of the size factor largely fixed. The very low correlation coefficient, which is 0.042, between bm and size mimicking portfolios shows that this procedure is successful in isolating different influences of bm and size factors.

The market portfolio is constructed from all stocks in the data set with detailed return information. The set used to calculate value-weighted market returns is smaller, however, since this requires market value information as well. The macroeconomic explanatory variables used in regressions are growth rate in real industrial production, default spread, and term spread. Industrial production growth is led 9 months into future in order to take into account the forward – looking nature of stock prices. Default spread variable is the difference of monthly returns between a long-term industrial bond index and a long-term government bond index. First-order correlation coefficient for this series is small, -0.04, hence we may think of it as representing unexpected changes in default risk. Similarly term spread is the difference of monthly returns between a long-term treasury bond index and 3-month treasury bill rate. Different specifications of these variables are tested, but the results are similar. With the exception of the market factor all the other explanatory variables are less variable, as measured by their standard deviation, then base assets. Base assets on average and the market factor has a monthly standard deviation about 0.06. See also Table I-c for some statistics of excess returns on base assets.

Since default spread and term spread factors are already in terms of excess returns they are readily used in time-series regressions. For industrial production growth, however, a mimicking portfolio is constructed from the 9 bm-size sorted portfolios. In trying to identify factors that best capture systematic return covariation in stocks, Chan et al. (1998) find that industrial production growth is no more useful in explaining the return comovement in stocks than an arbitrary series. They run individual regressions on the industrial production growth for each stock to determine their loadings. They rank stocks into five quintiles based on their loadings, and define the difference of returns in the top quintile and the bottom quintile as the mimicking portfolio returns for the industrial production growth. This mimicking portfolio has an insignificant risk premium in their regressions. The reason for this is due to their methodology which accumulates a great deal of measurement error from individual regressions. To avoid this we choose to adapt the procedure in Breeden et al. (1989) where the mimicking portfolio is defined as an appropriate linear combination of some base assets which yields the maximum possible correlation with the state variable it is intended to mimic. According to this definition the weights on such a portfolio are the scaled versions of regression coefficients obtained from regressing the state variable on the base assets returns. T-statistics are not affected by this transformation, hence one can use the above regression instead of solving the quadratic programming problem they pose. As base assets here we use the same 9 bm-size sorted portfolios which were used to obtain bm and size mimicking portfolios.

In the regressions other factor mimicking portfolios are used as well. Some risk factors can be mimicked by sorting firms with respect to certain firm-related attributes rather than by macroeconomic variables. The attributes used in constructing these factor-mimicking portfolios are fixed assets ratio, intangible assets ratio, volatility, beta, and Ohlson score. They are constructed in a way that the resulting portfolio has maximum exposure (assuming, of course, that this exposure is monotonic with respect to the ordering of stocks depending on the relevant attribute) to the risk factor it is intended to mimic, and miminal exposure to the other risk factors. That is, stocks are sorted with regard to one attribute, grouped into tranches, and the return difference of the two tranches lying in both ends of the spectrum is found. Although this concept of forming factor mimicking portfolios is attractive, in practice one ends up at best with imperfect portfolios. The reason is that in some cases an ordering done with respect to one attribute is not independent of the one done with regard to another attribute. Moreover, an ordering may not necessarily represent well all its subgroups of stocks. In the case of the ordering with respect to Ohlson score, for instance, small firms are underrepresented because to calculate this score one needs simultaneous availability of several accounting information, and such a condition is more binding for small firms rather than big firms. Hence, following a mechanic strategy of finding return differences between the two extremes of an ordering will not necessarily yield the best mimicking portfolio. One should pay attention to the number of subgroups (or tranches) of stocks constructed, and to the number of stocks in each subgroup relative to the other subgroups. To be consistent, however, we construct all our mimicking portfolios related to firm-specific attributes by forming three tranches of stocks with the exception of the Ohlson score and intangible assets mimicking portfolios for which five tranches are formed to improve precision, taking into account the fact that measurement errors are more serious with these attributes. Moreover, for these two attributes less weight is given to tranches with small number of stocks where the weights are directly proportional to the number of stocks in each tranch. The reason for this adjustment is the underrepresentation of small firms for Ohlson score; and low cross-sectional dispersion in the intangible assets ratio.

C. The testing procedures :

The time series regressions approach outlined below follows closely the theoretical exposition advanced by Fama (1998).

i) Time-series regressions :

Since we now have all the explanatory variables in terms of returns or excess returns we can readily use them in regressions and exploit the statistical restriction they impose on the intercept terms. In the next section the results of the time series regressions of base assets' excess returns on the excess returns of factor mimicking portfolios are presented. The aim of this regressions, as explained in introduction, is to determine whether the proposed state variables are able to explain stock returns, that is whether they are priced in equilibrium. More specifically, we want to be able to compare the performance of bm and size mimicking portfolios in the presence of other state variable mimicking portfolios in order to shed light on the still unresolved issue of which systematic risk factors bm and size relate to. Unfortunately financial economic theory is silent in this regard. One way to solve this problem is to introduce candidate state variables into the regressions along with bm, size, and market factors. Whether a state variable is of hedging concern to investors mainly depends on two conditions : First, it must be able to explain the expected returns of the assets in the economy, and second it must withstand the exclusion tests, that is, we should not be able to explain the variability in this state variable using other priced state variables as explanatory factors. These two conditions easily translate into empirically testable restrictions in the standard time series based regression tests of capital asset pricing model. Assuming that we have S state variables that are priced, the general form of the tests performed are as follows :

$$R_b - r = \alpha_b + \beta_{bM} * (R_M - r) + \sum_{s=1}^{S} \beta_{bs} * (R_s - r) + \varepsilon_b$$

where R_s denotes the return on the mimicking portfolio for state variable s, R_M denotes the return on the market portfolio, and R_b the return on any asset b, which in our context will be one of the 25 base assets. In the above regression , the intercept term should be zero for any asset b we choose, that is apart from the S state variables of hedging concern, there should be no other variable that offers a risk premium. Moreover, if p is a priced state variable, then α_p in

$$R_p - r = \alpha_p + \beta_{pM} * (R_M - r) + \sum_{s=1}^{S-1} \beta_{bs} * (R_s - r) + \varepsilon_p$$

should be different than zero. That is, a priced state variable, in accounting for the total risk premium of an asset, introduces a stand-alone dimension which cannot be replicated by a linear combination of the risk premiums of the other state variable mimicking portfolios. The role of these intercepts in determining whether a state variable is priced is prominent. The statistical significance of excess returns on factor mimicking portfolios are not that much powerful in this respect. The reason is that by taking a linear combination of factors we obtain a new factor which has the same ability to explain expected stock returns whereas the significance of the intercept term is unchanged by such a transformation.

ii) Other tests:

In these tests we try to ascertain whether the factor-mimicking portfolios constructed by sorting on firm-related attributes provide nonnegligible rewards in the form of returns for holding them over different investment horizons. The performance of these portfolios is analysed across the business cycle, as well as, within each bm-size sorted portfolio to check whether they provide differential returns not explained by bm and size. The procedure can be illustrated as follows: Take, for instance, the fixed assets ratio attribute. We hypothesize (and show later through regressions) that the dispersion of this attribute among firms provides information on the cross-section of expected return premiums pertaining to the recovery risk factor. Subsequently, we test whether the mimicking portfolio formed by sorting on this attribute can be viewed as a risk factor, that is, whether it has enough overall variability, yields low or negative returns during recessionary periods, and provides sizable overall returns for several holding periods. We also construct mimicking portfolios by sorting stocks with respect to fixed assets attribute within each bm-size sorted portfolio, and see whether those portfolio returns exhibit additional variability, and return premiums.

III. EMPIRICAL RESULTS

A. Preliminary results and the concept of recovery risk:

Preliminary results displayed in Table I. show that size and bm effects are very much alive. High bm firms have larger mean excess returns compared to the low bm firms for both value-weighted and equally-weighted returns. The relationship is not monotonic, however. It rather has a U-like shape, low (rather than very low) bm and medium bm firms having the smallest mean excess returns.[4] This is quite striking, and suggests that bm may actually be reflecting several risk factors, the effects of which also depend on size. In particular, small size-very low bm firms have higher mean excess returns compared to their medium bm counterparts. This implies that for small growth firms investors may demand an extra premium given that (see Table II.) such firms have low fixed assets causing them to have low recovery rates in the event of default. This idea is supported by our other findings which we present later in this section. These findings almost suggest that there are some 'optimal' levels of bm and size for firms from investors' perspective. At below or above these levels investors demand higher expected returns, because they view the maverick firm as somewhat more risky. As one goes up in bm spectrum default risk increases (as evidenced by increasing Ohlson scores and debt ratios; see Table II.) thus higher returns follow, as one goes down the spectrum, especially for small firms, recovery risk increases, and this explains the higher average returns for such firms. Moreover, if one calculates only capital gains the observation is somewhat more pronounced. We find that returns on small growth firms consists essentially of capital gains. Investors may view this stream more risky than dividends if the conditions for the Modigliani-Miller theorem to hold are not satisfied.[5] More specifically, if we assume that the dividend stream is more or less smooth, the total variability of returns of a firm, for which capital gains constitutes a large portion of the total return, will be higher. It is plausible to assume also that the duration of the earnings of growth firms is higher than that of value firms which may explain the variability in their returns, and thus their high sensitivity to temporary shocks. As a case in point, one can note that (for the empirical results interpreted so far see Table I-a., I-b., and I-c.) very low bm firms have a higher return variability, as measured by the standard deviation, than low or medium bm firms. One can detect the notorious U-shape in standard deviations as well. This finding once again suggests that different risk factors may be at play in different stages of the bm spectrum of firms. That is, default risk at the high end, and recovery risk at the low end. Growth firms in general operate in industries marked by a fast pace of change, which renders equipment and technology quickly obsolete, thus lowering recovery rate in the event of default. Since large growth firms have a lower probability of default, and a higher ratio of fixed assets compared to small growth firms (see Table II.) they are subject to uncertainty emanating from rapid technological change and other factors only to some degree. This may explain why the observed “recovery effect” is not monotone. It may very well be the case that default risk and recovery risk are priced risk factors along with the market factor, and bm and size attributes determine (or successfully proxy) the loadings of a firm on these factors. If so, omitting these factors will cause bm and size mimicking portfolios to have explanatory power for stock returns.[6]

In Table I-a. and Table I-b. we also display mean excess returns for January to compare our results with the previous literature. Indeed, there is a strong January effect especially for very small, and very high bm firms. We do not dwell on January effect more since the literature on this is voluminous, but we do check later whether bm and size factor mimicking portfolios are still priced in the presence of a January dummy since Loughran (1997) argues that a January seasonal may be driving the bm effect.

B. Results of the time-series regressions tests:

In the first set of regressions we test whether the market factor alone is capable of pricing the base assets. Only 10 out of 25 intercept terms in Table III. are significant, suggesting that the market factor alone does not do a good job of explaining expected returns. In other words, CAPM fails. We have done our regressions both for value-weighted and equally weighted returns but present only the results for value-weighted ones unless there is an interesting insight to be obtained.

In the second set of regressions we introduce bm and size mimicking portfolios as well. Pricing performance considerably improves since most of the t-statistics for intercept terms are insignificant or at the border of being insignificant.[7] T-statistics for bm mimicking portfolios are negative for low bm firms and positive for high bm firms. That is, a very high bm base asset loads positively on the bm factor (or the risk factor represented by bm).[8] For the size factor t-statistics are mostly positive, and adjusted R^2's are all around %70-%80 level, with the exception of very small size–very low bm, and very small size–very high bm base assets. The reason for this is, of course, the high variability of this series which cannot be explained well enough by the modest variation in the explanatory factors.(For other details see Table IV-a.)

In Table IV-b. we show the results of the exclusion tests performed on size and bm factors. It turns out that intercepts are significant in both cases and we have to keep size and bm as the best candidates for priced risk factors. Along with the market factor, size and bm are able to explain returns on base assets quite well, and they somewhat represent different risk factors or factor combinations (which is also evident from the low correlation between them, see Table XIII.) since we are not able to account for one of them by using the other along with the market factor. Another interesting insight in this context is the relative explanatory powers of the factors with value-weighted and equally-weighted returns. We see that for equally-weighted returns size gains more explanatory power driving down the significance of the intercept in the test for bm. Similarly, with equally-weighted returns size gains power and it becomes more difficult to exclude it from the set of priced state variables or factors. This implies that small firm returns have a stronger comovement with the state variables that are of hedging concern to investors.[9]

Having established the significance of bm and size factors we now check whether this significance comes from the well-known January effect. To check for this we use a dummy variable for january in the regressions. The pricing performance is virtually unaltered, and t-statistics for bm and size factors exhibit the same patterns mentioned before. We conclude that the January effect does not have a major role in the explanatory power of bm and size factors.

Liquidity does not appear to be a problem either. To see whether the stocks of small growth firms suffer from liquidity problems we compute a liquidity statistic for each firm as follows: The average daily volume turnover over tha last year is divided by the average market value of the firm, again over the same period. Then equally and value-weighted average liquidity statistic of each bm-size sorted portfolio is calculated for every year between 1974 and 1998. The time series mean of these statistics become the final liquidity measure of a specific base asset. Results shown in Table II. imply that lack of liquidity cannot explain the high returns of small growth firms. Actually some notion of illiquidity (in a nontrading sense) may still be a problem for these firms. But this is illiquidity of assets of the firm conditional on default, which may pose a problem for firms operating in industries marked by rapid change, and lead to lower recovery rates.

i) Macroeconomic Factors:

In Table VI-a. we show the results of the experimentation with the candidate factors; the default spread, and the term spread. As can be seen from the intercepts the pricing performance of these factors is poor, especially for high bm firms. Moreover, default spread and term spread coefficients themselves are not significant, with a few exceptions. This shows that the market factor is a good proxy to track economywide changes, and additional macroeconomic factors do not bring extra explanatory power.[10] Another reason for the insignificance of these factors is the fact that they are only imperfect proxies of what they aim to mimic. If the returns of the bond indices used to construct these mimicking portfolios are contaminated with other information than pure default risk and term structure risk, which is most likely the case, then their poor performance can be justified. Default spread and term spread mimicking portfolios are even less significant in the presence of size and bm factors in the regressions (not shown here), and correlations among these variables are quite low, hence no multicollinearity problem is present. (See Table XIII. for the correlations among all the explanatory factors used in the regressions.)

In our attempt to find another priced state variable we then introduce the 9-months led real industrial production growth (denoted lindpr) into the regressions. Although the number of significant intercept terms is about the same as before where we used only bm and size factors, their significance is somewhat higher. Lindpr is correlated with the market factor which takes away some of its significance. In any case, especially for lindpr, errors-in-variables problem is real due to measurement problems in this seasonally adjusted variable. This is a major problem which causes it to have a lower significance than it deserves. As explained before though, the arguments on the individual significance of a factor should not be overdone in this context. For a state variable or a factor to be of hedging concern, it must be able to (along with the other priced state variables) price non-priced state variables, and we should not be able to exclude it from the set of priced state variables. For both value-weighted and equally-weighted return regressions, the intercept in the exclusion tests is statistically significant. Although this is encouraging for lindpr, its pricing performance with bm and size factors is worse (indeed, multivariate tests find this pricing performance unsatisfactory in that the test statistic is 1.7161 whereas $F_{0.95, 25, 259} = 1.5487$, and $F_{0.99, 25, 259} = 1.8460$) than the one with only bm and size factors included. Such a dilemma supports the hypothesis that size, bm, and even industrial production growth are proxies for possibly overlapping combinations of state variables some (but not all) of which are of hedging concern to investors, and therefore priced.

ii) Factors related to financial ratios and other attributes of firms:

In Table XIII-a., results of the regressions involving the mimicking portfolio for recovery risk (mimicking portfolio for fixed assets) are given. As explained before this portfolio is constructed by sorting firms with respect to their fixed assets ratios and taking the monthly return difference of portfolios consisting of high fixed assets ratio firms and low fixed assets ratio firms. The results are encouraging in that the market factor, bm, and the aforementioned mimicking portfolio named as fixed in the regressions, are able to explain the variation in base assets very well. This prompts us to test whether these three factors together can drive out size. They almost do so, as it is evident from the poor significance level of the intercept term shown in Table XIII-b). However, bm, size, and market factors together are able to drive out fixed. Overall, these results indicate that size mimicking portfolio subsumes the variation in fixed mimicking portfolio. However, this should not be interpreted as the risk represented by fixed assets mimicking portfolio (recovery risk) is not being priced, rather that size factor mimicking portfolio already subsumes this information and this may be one of the reasons why we have a size premium. Moreover, note that recovery risk and default risk are in fact, hard to separate from each other. In addition, size provides information on the default probability of a firm, and on the recovery ratio (which depends on many factors other than fixed assets ratio), informativeness of fixed assets ratio is limited. In that sense, we have shown that one component of the size attribute can be replaced by the fixed assets attribute, and the latter is driving most of the explanatory power of size. Some evidence on whether fixed assets mimicking portfolio represents priced risk is given in Table X. There one can see that the mimicking portfolio has negative returns over recessionary periods, but yields a nonnegligible positive return overall. Note that the recovery risk factor can also be mimicked by forming a portfolio based on the intangible assets attribute of a firm. If growth firms have a higher proportion of their total assets in the form of intangible assets (Table II. shows that they indeed do) and if the investors somehow think that this is risky then the portfolio constructed by buying the stocks of firms with high intangible assets and selling the stocks of firms with low intangible assets should provide them with some reward for holding it. This portfolio has a similar variation to that of the fixed assets mimicking portfolio, and provides negative returns over recessionary periods, and more than compensates for this over expansionary periods, thereby yielding a nonnegligible positive overall return over different horizons.[11] (See Table XII.) Regression tests for this mimicking portfolio yield very similar results to those of the fixed assets mimicking portfolio. (See Table XIII.) Once again size is on the brink of being excluded by the market, bm, and intangible assets factors, while the latter is flatly excluded by market, bm, and size factors combined. This supports our earlier hypothesis that recovery risk is one of the important risk factors that the size attribute loads on.

Table XI. presents information on the mimicking portfolios for volatility, and beta coefficient attributes. (Their precise definitions are given in Table XI.) All of these portfolios provide rewards for holding them over different periods. It is also interesting to see the way these portfolio returns react to business cycles. Results shown supports the view that those attributes reflect risk sensitivity quite well. However, they do not perform as well as the recovery risk mimicking portfolios in regressions tests.[12] (Results are not shown here to conserve space) Hence, it seems that these attributes are somewhat more noisy, due to perhaps measurement problems. Moreover, the fact that we retain the market factor in all our regressions may shed some light on the relative impotence of the beta mimicking portfolio.

We also test whether these mimicking portfolios provide differential returns once bm and size attributes are accounted for. To this end, within each base asset, stocks are ordered with regard to a specific attribute and mimicking portfolio returns are calculated in the usual way. The cross-sectional average of these portfolio returns are close to zero suggesting that other attributes do not represent additional sensitivity to risk factors, assuming that those factors are priced and rewarded. (See TableXII.)

IV. CONCLUSION

In this paper, we have been able to show that the market factor itself is not capable of explaining expected returns on the base assets formed on book-to-market value and size sorted stock portfolios. With the addition of book-to-market and size mimicking portfolios the pricing performance has greatly increased which suggests that a multifactor asset pricing model like APT, or ICAPM, is more likely to hold. The usual size and book-to-market effects have been observed, but with a slight twist that these effects are not monotonic in neither size nor book-to-market quintiles which probably indicates that book-to-market and size factors are related to several state variables posing hedging concern in different size-bm segments. Moreover, the pricing ability of bm and size factors are quite independent of the January effect, though size clearly has a stronger explanatory power for small firms. Liquidity does not appear to pose a problem either. Furthermore, by comparing the results of value-weighted and equally-weighted return regressions we have come to the conclusion that the return generating process for small firms has considerable comovement with the priced state variables. It turned out that among macroeconomic candidate state variables, 9-month led real industrial production growth is most likely to be priced. Default spread and term spread factors largely performed poorly, both in the absence and in the presence of bm and size factors. We have proposed a previously unexplored risk factor, namely recovery risk, manifesting itself more pronouncedly for small growth firms. We have shown that the mimicking portfolios (portfolios constructed by means of fixed assets and intangible assets ratios) for this factor fares well in explaining base asset returns, and provide nonnegligible returns over several investment horizons, and their effects are largely subsumed by size and bm factors. This is evident from the regressions involving those factors, and also from the fact that the cross-sectional average of the fixed assets and intangible assets mimicking portfolio are not different from zero if their returns are calculated within each bm-size portfolio. That is, once bm and size taken into account recovery risk factor does not provide additional risk that requires to be rewarded. This is true for other attributes such as volatility, beta, and Ohlson scores as well. As a conclusion, we may suggest that bm and size attributes of a firm successfully proxy for their loadings on several risk factors, two of which are recovery and default risks.

REFERENCES

Baker L.N., and R.A.Haugen (1996). Commonality in the determinants of expected stock returns. *Journal of Financial Economics* 41, 401-439.

Banz, Rolf W. (1981). The relationship between return and market value of common stocks. *Journal of Financial Economics* 9, 3-18.

Breeden, D.T., M.R.Gibbons, and R.H.Litzenberger (1989). Empirical tests of the consumption-oriented CAPM. *Journal of Finance* 44, 231-262

Brown, S.J., W.N.Goetzmann, and S.A.Ross (1995). Survival. *Journal of Finance* 50, 853-873.

Capaul, C., I. Rowley, and W.F.Sharpe (1993). International value and growth stock returns. *Financial Analysts Journal*. January-February, 27-36.

Chan, K.C., and N.Chen. (1991). Structural and return characteristics of small and large firms. *Journal of Finance* 46, 1467-1484.

Chan, L.K.C, Y. Hamao, and J.Lakonishok. (1991). Fundamentals and stock returns in Japan. *Journal of Finance* 46, 1739-1789.

Chan, L.K.C., Karceski J., and J.Lakonishok (1998). The risk and return from factors. *Journal of Financial and Quantitative Analysis*. Vol. 33, No. 2, 159-188.

Davis, James (1994). The cross-section of realized stock returns: The pre-Compustat evidence. *Journal of Finance* 49, 1579-1593.

Daniel K., and S.Titman (1997). Evidence on the characteristics of cross sectional variation in stock returns. *Journal of Finance* 52, 1-33.

Fama, E.F., and K.R.French (1993). Common risk factors in the returns on stocks and bonds. *Journal of Financial Economics* 33, 3-56.

E.F.Fama (1996). Multifactor portfolio efficiency and multifactor asset pricing. *Journal of Financial and Quantitative Analysis*. 31 (1996), 441-465.

E.F.Fama (1998). Determining the number of priced state variables in the ICAPM. *Journal of Financial and Quantitative Analysis*. Vol. 33, No. 2, 217-231.

Gibbons, M., S.A.Ross, J.Shanken. (1989). A test of the efficiency of a given portfolio. *Econometrica* Vol.57, No. 5, 1121-1152.

Heston, S., K.G.Rouwenhorst, and R.E.Wessels. (1995). The structure of international stock returns and the integration of capital markets. *Journal of Empirical Finance* 2, 173-197.

Jaffe, J., D.B.Keim, and R.Westerfield. (1989). Earnings yields, market values, and stock returns. *Journal of Finance* 44, 135-148.

Kothari, S.P., J.Shanken, and R.G.Sloan (1995). Another look at the cross-section of expected stock returns. *Journal of Finance* 50, 185-224.

Lakonishok, J., A.Shleifer, and R.W.Vishny (1994). Contrarian investment, extrapolation, and risk. *Journal of Finance* 49, 1541-1578.

Merton, R.C. (1973). An intertemporal capital asset pricing model. *Econometrica* 41, 867-887.

Ohlson, J.S., (1980). Financial ratios and the probabilistic prediction of bankruptcy. *Journal of Accounting Research* 19, 109-131.

Warga, A. (1989). *Experimental design in tests of linear factor models. Journal of Business Economics and Statistics*, 7, 191-198.

FOOTNOTES

1. This observation, and the existence of a value premium in stock returns has been confirmed by, among others, Lakonishok, Shleifer, and Vishny (1994), Davis (1994), and Capaul, Rowley, and Sharpe (1993) . The existence of a size premium (stocks of smaller firms have higher average returns) has also been extensively documented. (Banz (1983), Chan, Hamao, and Lakonishok (1991), and Heston, Rouwenhorst, and Wessels (1995)). Since some of these papers find the same effects in different time periods, and for different countries ; arguments of some authors (notably Kothari, Shanken, and Sloan (1995), Brown, Goetzmann, and Ross (1995), and MacKinlay (1995)) stating that such findings are artifacts of data related biases are not shared by the majority of researchers. See also Fama and French (1998), and Davis, Fama, and French (1998).

2. For definitions of all the attributes used in the study see Table II

3. Building on Merton (1973), Fama (1996) laid the theoretical foundations for this empirical work.

4. Fama and French (1993) find a monotonic relationship. Apart from the differences in data sets, and methodologies this may be due to our deliberate inclusion of delisted stocks into the database. Actually, a non-monotonic relationship of mean returns with respect to bm is not very surprising. Jaffe et al. (1989) document a similar U-shape for the relation between mean returns and earnings-price ratio. Fama & French (1992) reports that negative bm firms have high mean returns. Given that negative earnings lead to a low, or even negative bm, very low bm firms should also yield high mean returns unless the return generating process is highly irregular with respect to bm-proxied factor.

5. We only suggest this as a possibility. Dividend policy issues are still far from resolved and out of the context of this paper.

6. Fama & French (1992) find that the post-ranking market betas are U-shaped, being high for low and high bm portfolios. They also report that beta declines as size increases. This observation can be reconciled with our framework as follows: Imagine that high and low bm firms load positively on some factors that are priced but not included in their regressions. Then betas for such firms (or portfolios) will be overestimated relative to the betas of medium bm firms. Moreover, given that the sensitivitiy of big firms to the excluded factors (default and recovery risk for instance) is lower, the upward estimation bias for such firms will be less serious, resulting in a decline in the estimated betas.

7. Multivariate tests along the lines of Gibbons, Ross, and Shanken (1989) yield a test statistic of 1.5996, while $F_{0.95,\ 25,\ 260} = 1.5485$, and $F_{0.99,\ 25,\ 260} = 1.8457$. (See also Fama & French (1993).) Given that our base asset returns and explanatory variables are nearly normally distributed these multivariate tests support the idea that bm and size factors explain the variation in base assets quite well. Moreover, as Fama & French (1993) point out one should not expect wonders from these factors. Indeed, one may even question the linear framework we are in.

8. These findings are in line with the results of Fama&French (1993) which actually shows that differences in the data set, sorting procedure (They first sort for size and then for bm, which supposedly favors bm over size), and data manipulation have little effect on the final results.

9. Higher sensitivity of small firm returns to aggregate market conditions have been verified before. See, for instance, Chan & Chen (1991).

10. Warga (1989) argues that sorting stocks first with respect to size and then with respect to bm decreases the significance of market factor, and increases that of default factor. It is interesting to note that we have an opposite result holding here, with our sorting procedure being done in the opposite way.

11. Lakonishok et al. (1994) argue that if the value premium is due to the pricing of distress risk then high bm firms should underperform low bm firms in some periods, most likely in recessionary periods. They find the converse and argue that investors are not rational. Such a conclusion rests on many implicit assumptions though. Firstly, we can observe only one price path out of many possible. Secondly, bm may have sensitivities (with differing signs) to several factors. Indeed we believe that bm and size attributes are related to several factors, and for robust inferences one should find a ‘fundamental’ attribute (which is related to only one factor and doesn’t have much noise) and analyse the returns of its mimicking portfolio. The attributes we propose for the recovery risk factor seems to be doing a good job in this sense.

12. Results on the second default risk mimicking portfolio, namely Ohlson score mimicking portfolio, show that this portfolio doesn’t perform well either in explaining the variation in base assets, and it is driven out by bm, size, and the market factors taken together as explanatory variables. This may be due to the fact that the very firms who are in financial distress are the ones about which we do not have quality accounting data. This may be especially true for small firms. If high Ohlson score firms are not represented well enough in the data set then this may explain the mediocre performance of this mimicking portfolio.

APPENDIX

TABLE I.

Table I-a. (Value-weighted monthly mean excess capital gains)

all months	verylowBM	lowBM	mediumBM	highBM	veryhighBM
verylowMV	0.0277	0.0203	0.0184	0.0162	0.0325
lowMV	0.0100	0.0130	0.0106	0.0131	0.0246
mediumMV	0.0085	0.0080	0.0086	0.0089	0.0195
highMV	0.0061	0.0076	0.0083	0.0090	0.0159
veryhighMV	0.0125	0.0082	0.0081	0.0096	0.0144

January	verylowBM	lowBM	mediumBM	highBM	veryhighBM
verylowMV	0.0733	0.0942	0.0757	0.0756	0.0803
lowMV	0.0492	0.0739	0.0488	0.0515	0.0871
mediumMV	0.0358	0.0334	0.0464	0.0570	0.0894
highMV	0.0335	0.0492	0.0399	0.0516	0.0823
veryhighMV	0.0455	0.0346	0.0412	0.0489	0.0586

Table I-b. (Value-weighted monthly mean excess returns)

all months	verylowBM	lowBM	mediumBM	highBM	veryhighBM
verylowMV	0.0303	0.0228	0.0221	0.0205	0.0402
lowMV	0.0113	0.0146	0.0127	0.0163	0.0315
mediumMV	0.0091	0.0096	0.0112	0.0125	0.0234
highMV	0.0073	0.0088	0.0104	0.0124	0.0199
veryhighMV	0.0146	0.0101	0.0100	0.0129	0.0175

january	verylowBM	lowBM	mediumBM	highBM	veryhighBM
verylowMV	0.0764	0.1010	0.0869	0.0905	0.0938
lowMV	0.0530	0.0794	0.0559	0.0607	0.1053
mediumMV	0.0364	0.0385	0.0580	0.0763	0.1011
highMV	0.0383	0.0543	0.0482	0.0673	0.0971
veryhighMV	0.0507	0.0407	0.0489	0.0621	0.0670

Table I-c. (Standard deviation of value-weighted monthly excess returns)

stdev	verylowBM	lowBM	mediumBM	highBM	veryhighBM
verylowMV	0.1250	0.1071	0.0528	0.0662	0.2051
lowMV	0.0690	0.0686	0.0506	0.0614	0.0515
mediumMV	0.0655	0.0600	0.0458	0.0505	0.0547
highMV	0.0637	0.0602	0.0646	0.0694	0.0617
veryhighMV	0.0661	0.0537	0.0586	0.0538	0.0803

TABLE II.

Table II. displays certain characteristics of bm-size sorted portfolios. The relevant ratios are averages over the whole sample period 1974-1997, with the exception of Ohlson score which is available for the period 1976-1997. They are calculated for each firm before they are sorted into portfolios. Equally weighted portfolio averages are taken next. Finally, the overall time-series average of these is calculated. This is repeated for each bm-size sorted portfolio whose titles are shown in an abbreviated fashion. For instance, '*vhsizevlbm*' denotes the portfolio of firms with very high market values, and very low book-to-market ratios. The others should be self-explanatory. The abbreviations shown in the table correspond to the following :

Liq : It is the average number of shares traded over the previous 12 months divided by the average market value in that period. Trading volume for a particular stock is consolidated across exchanges on which it is listed.

Fixasset : It denotes the ratio of a firm's fixed assets to its total assets.

Intangible : The ratio of the intangible assets of the firm to its total assets is denoted by this item.

Roe, Roc : They stand for return on equity, and return on capital respectively.

Liab : Liab denotes the debt ratio of the firm, that is total liabilities divided by total assets.

Ohlson : It is the Ohlson score, higher levels of which indicate a higher probability of bankruptcy as explained before. Ohlson (1980)'s bankruptcy score is calculated as follows :
Ohlson = -1.32 – 0.407 log (total assets / GNP price level index) + 6.03 (total liabilities / total assets) – 1.43 (working capital / total assets) + 0.076 (current liabilities / current assets) – 1.72 (1 if total liabilities > total assets, else 0) – 2.37 (net income / total assets) – 1.83 (funds from operations / total liabilities) + 0.285 (1 if net loss for last two years, else 0) – 0.521 (net income(t) – net income(t-1)) / (abs (net income(t)) + abs (net income(t-1))).

Beta : It stands for the beta of a stock calculated by Datastream using the price data for the previous 60 months.

Dy : It denotes the dividend yield and is based on gross dividens (including tax credits).

Vol : This measures the volatility of a stock based on the last 52 weekly sampled prices.

Date : It is the time when Datastream began keeping record of a firm.

TABLE II. cont'd.

Characteristics of bm-size sorted portfolios.

Portfolio	bm	size	liq	fixasset	intangible	roe	roc	liab	ohlson	beta	dy	vol	date
Vhsizevlbm	0.2008	2790.6882	2.9356	0.3248	0.0612	19.3091	23.0419	0.4130	-2.4797	1.0030	1.5661	16.5398	75.0211
Hsizevlbm	0.2023	711.6384	3.0409	0.3582	0.0640	20.7380	24.7667	0.3953	-2.6965	0.9509	1.6039	17.3550	74.1410
Msizevlbm	0.1947	303.6654	3.3564	0.3153	0.0606	20.3652	24.3779	0.3809	-2.4109	0.9631	1.4121	17.4380	76.3211
Lsizevlbm	0.1961	151.0197	3.6577	0.2971	0.0577	19.0434	23.3502	0.3864	-2.3384	0.9838	1.0817	17.0872	76.6521
Vlsizevlbm	0.1950	57.9224	3.5494	0.2899	0.0465	16.9830	19.8419	0.4126	-1.5745	0.9848	1.0828	16.0821	77.3988
Vhsizelbm	0.4159	2906.7537	3.1075	0.4080	0.0335	15.3197	19.9062	0.4193	-2.2593	0.9516	2.4118	17.6552	74.2248
Hsizelbm	0.4156	618.5750	3.3799	0.3559	0.0389	15.9709	20.8994	0.4019	-2.3418	0.9445	2.0386	16.7510	73.9887
Msizelbm	0.4152	276.3689	3.0608	0.3734	0.0337	14.4951	19.8532	0.3929	-2.4987	0.8944	2.1125	17.0431	75.5011
Lsizelbm	0.4224	134.8951	3.6789	0.3694	0.0350	14.6738	19.2333	0.3998	-2.1768	0.9460	1.9283	17.6843	76.8725
Vlsizelbm	0.4205	52.8266	3.4683	0.2903	0.0291	12.4852	15.1457	0.4491	-1.3218	0.9875	1.4959	16.4008	76.7560
Vhsizembm	0.6253	2769.9487	2.7208	0.4527	0.0218	11.9079	15.6548	0.4455	-1.8934	0.8821	3.6618	16.6261	73.1939
Hsizembm	0.6262	608.6712	2.8437	0.4089	0.0247	12.1556	15.3083	0.4521	-1.8704	0.8974	3.4636	15.9474	74.1637
Msizembm	0.6235	250.3541	2.7185	0.4528	0.0207	12.0707	15.9393	0.4217	-2.0060	0.8777	3.1392	15.7143	74.0861
Lsizembm	0.6276	125.1735	2.7664	0.4412	0.0214	11.5027	15.2531	0.4277	-1.7828	0.8827	3.2394	15.9429	75.6541
Vlsizembm	0.6321	51.2294	3.2082	0.3923	0.0268	10.8925	14.8090	0.4367	-1.3806	0.8972	2.6994	15.7511	76.8449
Vhsizehbm	0.8734	2820.8451	2.1683	0.5456	0.0150	9.4910	12.3075	0.4629	-1.6613	0.7664	5.0644	14.5055	72.2660
Hsizehbm	0.8681	566.1908	2.5018	0.4612	0.0194	9.3338	12.7858	0.4529	-1.6545	0.8349	4.4282	14.5795	73.1772
Msizehbm	0.8613	228.5682	2.5969	0.4401	0.0151	9.7501	13.4664	0.4221	-1.9960	0.8478	3.7271	14.4701	74.4472
Lsizehbm	0.8671	110.1155	2.4337	0.4478	0.0118	9.9289	13.5627	0.4428	-1.6653	0.8354	3.7612	15.3695	74.2425
Vlsizehbm	0.8783	44.0967	2.9337	0.4254	0.0224	9.8079	12.7341	0.4623	-1.1942	0.8671	3.2172	14.4675	76.1883
Vhsizevhbm	1.2817	2474.7224	2.3463	0.5007	0.0145	7.3179	10.6511	0.4503	-1.6522	0.8124	4.6320	15.9011	72.6777
Hsizevhbm	1.2726	480.7803	2.5030	0.4351	0.0147	8.2531	11.7043	0.4357	-1.5427	0.8724	4.0112	14.7557	74.0397
Msizevhbm	1.2763	174.1300	2.4643	0.4392	0.0127	8.2296	11.1625	0.4315	-1.6639	0.8572	4.1413	14.0155	73.6858
Lsizevhbm	1.3334	73.6868	2.7544	0.4082	0.0136	6.8387	10.5967	0.4513	-1.2411	0.8689	3.3446	14.0903	74.4156
Vlsizevhbm	1.4191	22.8594	3.1820	0.3639	0.0396	7.5150	10.9242	0.4767	-0.6306	0.8682	3.2028	12.6861	77.5447

NOTE :Financial ratios shown in the above table are explained in the previous page.

TABLE III.

$R_t - r_t = \beta_0 + \beta_1 * [market_t - r_t] + \varepsilon_t$

Dependent variable : Excess returns on 25 BM-SIZE sorted portfolios.
Below, *t* denotes the t-ratios obtained from regressions, and *market* stands for the market portfolio. *MV* is the market value (or size) of a firm, and *adjRsq* is the R^2 adjusted for degrees of freedom. *BM* denotes book-to-market ratio, *bm* is the mimicking portfolio formed by sorting on the book-to-market attribute. Regressions cover the period June 1974-June 1998.

Table III. (Value-weighted monthly returns)

intercept(t)	verylowBM	lowBM	mediumBM	highBM	veryhighBM
verylowMV	1.8744	0.6864	2.6922	1.3382	1.6336
lowMV	-2.0113	-0.5701	-1.3278	1.3356	3.2782
mediumMV	-2.5293	-2.6175	-2.2589	-0.8966	2.9606
highMV	-3.4503	-2.7106	-1.7758	-0.7173	1.9515
veryhighMV	-0.2375	-2.1377	-1.7338	0.3205	2.6860

market(t)	verylowBM	lowBM	mediumBM	highBM	veryhighBM
verylowMV	10.8332	15.9175	25.2118	21.2347	4.7846
lowMV	30.5621	32.1119	37.7243	30.8595	18.1363
mediumMV	30.7197	32.2015	36.3486	27.0555	23.6266
highMV	28.9808	31.4964	33.8216	27.9959	23.1798
veryhighMV	26.3972	34.5646	28.7539	27.2417	26.0086

adjRsq(t)	verylowBM	lowBM	mediumBM	highBM	veryhighBM
verylowMV	0.2885	0.4679	0.6886	0.6105	0.0709
lowMV	0.7648	0.7821	0.8321	0.7682	0.5333
mediumMV	0.7666	0.7831	0.8214	0.7181	0.6600
highMV	0.7451	0.7754	0.7993	0.7317	0.6514
veryhighMV	0.7080	0.8062	0.7421	0.7208	0.7018

TABLE IV.

$R_t - r_t = \beta_0 + \beta_1 * [market_t - r_t] + \beta_2 * bm_t + \beta_3 * size_t + \varepsilon_t$

Dependent variable : Excess returns on 25 BM-SIZE sorted portfolios.
Below, *t* denotes t-ratios obtained from regressions, and *market* stands for the market portfolio. *MV* is the market value (or size) of a firm, and *adjRsq* is the R^2 adjusted for degrees of freedom. *BM* denotes book-to-market ratio, *bm* is the mimicking portfolio formed by sorting with respect to book-to-market attribute. Regression period is June 1974-June 1998.

Table IV-a. (Value-weighted monthly returns)

intercept(t)	verylowBM	lowBM	mediumBM	highBM	veryhighBM
verylowMV	2.1718	0.3765	2.1498	-1.7028	0.0962
lowMV	-1.0952	-0.3585	-1.7670	-0.3858	0.7478
mediumMV	-0.9451	-2.2870	-2.0870	-2.1754	1.2124
highMV	-2.2180	-1.8218	-1.4124	-1.3809	-0.1106
veryhighMV	1.5059	-0.5792	-1.0721	-0.6729	1.7359

bm(t)	verylowBM	lowBM	mediumBM	highBM	veryhighBM
verylowMV	-4.4989	-3.0506	-2.0290	5.0318	2.9621
lowMV	-8.4459	-6.3263	-1.1724	2.1876	5.0135
mediumMV	-7.8792	-5.0568	-0.7884	2.8873	3.9860
highMV	-6.9791	-3.6603	-2.1898	2.1461	6.7102
veryhighMV	-6.9416	-4.5883	-0.8550	3.8462	5.2172

size(t)	verylowBM	lowBM	mediumBM	highBM	veryhighBM
verylowMV	5.2676	6.0739	5.6049	8.2962	3.0056
lowMV	7.0763	8.1268	4.0952	5.2618	6.0778
mediumMV	3.3432	5.6472	0.9395	2.1414	2.5100
highMV	3.8101	1.5196	1.8652	0.2523	0.3814
veryhighMV	1.7008	-0.6659	-1.5527	-0.8726	-3.1543

market(t)	verylowBM	lowBM	mediumBM	highBM	veryhighBM
verylowMV	5.9194	10.4224	18.7774	18.4524	3.5694
lowMV	23.6875	24.7935	29.7037	25.2847	15.5225
mediumMV	24.2668	24.6265	29.2320	22.6653	20.2923
highMV	22.3237	24.7688	26.6322	23.6379	22.2462
veryhighMV	20.7446	28.5389	24.1822	24.3499	25.2959

adjRsq(t)	verylowBM	lowBM	mediumBM	highBM	veryhighBM
verylowMV	0.3709	0.5303	0.7182	0.7232	0.1340
lowMV	0.8247	0.8323	0.8404	0.7951	0.6327
mediumMV	0.8086	0.8126	0.8210	0.7316	0.6883
highMV	0.7844	0.7844	0.8026	0.7346	0.7003
veryhighMV	0.7486	0.8200	0.7438	0.7328	0.7296

Table IV-b. (Exclusion tests for bm and size)

$$bm_t = \beta_0 + \beta_1 * [market_t - r_t] + \beta_2 * size_t + \varepsilon_t$$

(4.48) (-6.77) (3.82)

(3.59)*

$$size_t = \beta_0 + \beta_1 * [market_t - r_t] + \beta_2 * bm_t + \varepsilon_t$$

(2.33) (9.78) (3.83)

(3.41)*

Note : The numbers in parentheses are t-ratios obtained by using value-weighted mimicking portfolio returns. The ones indicated with stars are those of equally-weighted return regressions.*bm* and *size* denote the mimicking portfolios constructed by sorting on book-to-market and size attributes respectively. *market* stands for the market portfolio. Regressions cover the period June1974-June 1998.

TABLE V.

$$R_t - r_t = \beta_0 + \beta_1 * [market_t - r_t] + \beta_2 * bm_t + \beta_3 * size_t + \beta_4 * dummy_t + \varepsilon_t$$

Dependent variable : Excess returns on 25 BM-SIZE sorted portfolios
Below, *t* denotes t-ratios obtained from regressions, and *market* stands for the market portfolio. *MV* is the market value (or size) of a firm, and *adjRsq* is the R^2 adjusted for degrees of freedom. *BM* denotes book-to-market ratio, *bm* and *size* are the mimicking portfolios formed by sorting with respect to book-to-market and size attributes. *dummy* is the January dummy variable. Regression period is June 1974-June 1998.

Table V. (Value-weighted monthly returns)

intercept(t)	verylowBM	lowBM	mediumBM	highBM	veryhighBM
verylowMV	2.1016	0.1085	1.6418	-1.8554	0.2320
lowMV	-1.2154	-1.0767	-1.8276	-0.4489	0.6451
mediumMV	-0.8504	-2.0075	-2.2728	-2.6376	0.5896
highMV	-2.1138	-2.1575	-1.5087	-1.7950	-0.7770
veryhighMV	1.3407	-0.5954	-1.2376	-1.0955	1.2605

bm(t)	verylowBM	lowBM	mediumBM	highBM	veryhighBM
verylowMV	-4.4598	-3.2768	-2.5322	4.7804	3.0541
lowMV	-8.4532	-7.1255	-1.2426	2.0826	4.8423
mediumMV	-7.6725	-4.7414	-0.9924	2.4068	3.3811
highMV	-6.7974	-3.9797	-2.2740	1.7102	6.1073
veryhighMV	-6.9780	-4.5385	-1.0240	3.3968	4.7287

size(t)	verylowBM	lowBM	mediumBM	highBM	veryhighBM
verylowMV	5.1982	5.8648	5.2933	8.1174	3.0774
lowMV	6.9283	7.8090	4.0003	5.1698	5.9654
mediumMV	3.3701	5.7917	0.7862	1.8274	2.1125
highMV	3.8251	1.2750	1.7690	-0.0382	-0.0704
veryhighMV	1.5900	-0.6779	-1.6670	-1.1683	-3.4917

market(t)	verylowBM	lowBM	mediumBM	highBM	veryhighBM
verylowMV	5.8137	10.1026	18.3811	18.0959	3.6469
lowMV	23.2908	24.5974	29.2591	24.9070	15.2520
mediumMV	24.0335	24.6200	28.7504	22.2625	19.9603
highMV	22.1027	24.3274	26.2096	23.2177	21.9627
veryhighMV	20.3796	28.1512	23.7616	23.9295	24.8938

dummy(t)	verylowBM	lowBM	mediumBM	highBM	veryhighBM
verylowMV	0.2030	1.5414	2.9557	1.0385	-0.8033
lowMV	0.8017	4.1749	0.5196	0.4057	0.5310
mediumMV	-0.4653	-1.4651	1.2545	2.7479	3.6943
highMV	-0.4002	2.0615	0.6923	2.4713	3.8938
veryhighMV	0.8327	0.1504	1.0600	2.4958	2.7474

Table V. cont'd.

adjRsq(t)	verylowBM	lowBM	mediumBM	highBM	veryhighBM
verylowMV	0.3687	0.5325	0.7257	0.7232	0.1329
lowMV	0.8245	0.8415	0.8400	0.7945	0.6317
mediumMV	0.8081	0.8134	0.8213	0.7377	0.7016
highMV	0.7837	0.7869	0.8022	0.7393	0.7145
veryhighMV	0.7483	0.8194	0.7439	0.7376	0.7357

TABLE VI.

$$R_t - r_t = \beta_0 + \beta_1 * [market_t - r_t] + \beta_2 * dspread_t + \beta_3 * tspread_t + \varepsilon_t$$

Dependent variable : Excess returns on 25 BM-SIZE sorted portfolios
Below, *t* denotes t-ratios obtained from regressions, and *market* stands for the market portfolio. *MV* is the market value (or size) of a firm, and *adjRsq* is the R^2 adjusted for degrees of freedom. *BM* denotes book-to-market ratio. *dspread* is obtained by taking the monthly return differences of a long-term industrial bond index and a long-term government bond index. *tspread* is constructed by taking monthly return differences of a long-term treasury bond index and the three-month treasury bill rate. Regression period is June 1974-June 1998.

Table VI. (Value-weighted monthly returns)

Intercept(t)	verylowBM	lowBM	mediumBM	highBM	veryhighBM
verylowMV	1.8425	0.5652	2.5232	1.3908	1.8016
lowMV	-2.1524	-0.8976	-1.2681	1.3454	3.3145
mediumMV	-3.0889	-2.6027	-2.0889	-0.7456	2.7511
highMV	-3.4401	-2.4666	-2.0172	-0.8244	1.8390
veryhighMV	-0.0074	-2.3399	-1.9682	0.4109	2.7686

dspread(t)	verylowBM	lowBM	mediumBM	highBM	veryhighBM
verylowMV	0.9613	-0.1632	-0.7588	1.8656	1.2063
lowMV	-0.6033	-0.7069	-0.5373	-0.8829	-0.4724
mediumMV	-2.6313	-0.2206	-0.0211	-0.6666	-1.4286
highMV	0.4070	-0.5320	-1.1739	-0.2311	-1.6490
veryhighMV	3.2445	-0.9682	-1.4773	-1.4229	0.4559

tspread(t)	verylowBM	lowBM	mediumBM	highBM	veryhighBM
verylowMV	-0.0859	-0.4794	-0.3398	0.0691	0.8361
lowMV	-0.8689	-1.5761	0.2113	0.3714	0.6855
mediumMV	-2.5034	-0.2570	0.5381	0.7596	-0.4293
highMV	-0.4837	0.9863	-1.2205	-0.5922	-0.0575
veryhighMV	0.5689	-1.1148	-1.1202	0.7308	0.7009

market(t)	verylowBM	lowBM	mediumBM	highBM	veryhighBM
verylowMV	10.4422	15.4908	24.5028	20.5439	4.3832
lowMV	29.7806	31.5231	36.4839	29.9000	17.4661
mediumMV	30.7993	31.1798	35.0377	26.1409	23.1014
highMV	28.1094	30.4140	33.1051	27.1974	22.6718
veryhighMV	25.7282	33.7647	28.2178	26.5245	24.9770

adjRsq(t)	verylowBM	lowBM	mediumBM	highBM	veryhighBM
verylowMV	0.2872	0.4646	0.6870	0.6144	0.0692
lowMV	0.7637	0.7825	0.8313	0.7681	0.5325
mediumMV	0.7718	0.7816	0.8205	0.7184	0.6603
highMV	0.7441	0.7760	0.7992	0.7302	0.6536
veryhighMV	0.7186	0.8058	0.7424	0.7242	0.7002

TABLE VII.

$$R_t - r_t = \beta_0 + \beta_1 * [market_t - r_t] + \beta_2 * bm_t + \beta_3 * size_t + \beta_4 * lindpr_t + \varepsilon_t$$

Dependent variable : Excess returns on 25 BM-SIZE sorted portfolios
Below, *t* denotes t-ratios obtained from regressions, and *market* stands for the market portfolio. *MV* is the market value (or size) of a firm, and *adjRsq* is the R^2 adjusted for degrees of freedom. *BM* denotes book-to-market ratio, *bm* and *size* are the mimicking portfolios formed by sorting with respect to book-to-market and size attributes. *lindpr* is the real industrial production growth led by 9 months. Regression period is June 1974-June 1998.

Table VII-a. (Value-weighted monthly returns)

intercept(t)	verylowBM	lowBM	mediumBM	highBM	veryhighBM
verylowMV	3.5158	-1.1536	1.4263	-0.6381	0.2564
lowMV	-0.8458	-0.2939	0.9109	1.2732	0.9096
mediumMV	-4.1844	-0.6711	-0.0422	0.2134	3.1831
highMV	-1.2042	0.1860	0.0180	0.7194	1.3146
veryhighMV	3.0191	2.8228	-2.2594	-0.5768	2.4549

bm(t)	verylowBM	lowBM	mediumBM	highBM	veryhighBM
verylowMV	-5.1168	-2.4684	-2.1093	4.6603	2.7736
lowMV	-7.8906	-5.9688	-1.6290	1.7483	4.6183
mediumMV	-6.6161	-4.8576	-0.9772	2.4137	3.0291
highMV	-6.5254	-3.7335	-2.3303	1.6455	6.0479
veryhighMV	-7.4419	-5.3369	-0.3024	3.7610	4.4211

size(t)	verylowBM	lowBM	mediumBM	highBM	veryhighBM
verylowMV	4.5162	6.2047	5.2853	7.9181	2.8304
lowMV	6.8797	7.8253	3.5447	4.7462	5.6281
mediumMV	4.2571	5.3798	0.6374	1.8787	1.9031
highMV	3.7063	1.2611	1.6980	-0.0704	0.0099
veryhighMV	1.1877	-1.4932	-1.0410	-0.6929	-3.3575

market(t)	verylowBM	lowBM	mediumBM	highBM	veryhighBM
verylowMV	4.4522	10.1501	16.9754	16.8124	3.2089
lowMV	21.8207	22.7897	26.7164	22.8521	14.0066
mediumMV	24.2652	22.6288	26.5405	20.3212	17.8430
highMV	20.5259	22.3771	24.0165	21.1526	20.0080
veryhighMV	18.2051	25.4792	23.0707	22.3717	22.5782

lindpr(t)	verylowBM	lowBM	mediumBM	highBM	veryhighBM
verylowMV	2.8446	-1.4342	0.5703	0.1410	0.2357
lowMV	-0.3729	-0.1732	1.9004	1.6482	0.6284
mediumMV	-4.1459	0.4320	1.0474	1.4052	3.0025
highMV	-0.1974	1.1623	0.7695	1.4719	1.5437
veryhighMV	2.6484	3.4106	-1.9591	-0.2111	1.9149

adjRsq(t)	verylowBM	lowBM	mediumBM	highBM	veryhighBM
verylowMV	0.3838	0.5327	0.7161	0.7196	0.1307
lowMV	0.8232	0.8311	0.8411	0.7972	0.6286
mediumMV	0.8177	0.8137	0.8208	0.7320	0.6974
highMV	0.7827	0.7845	0.8004	0.7336	0.7021
veryhighMV	0.7529	0.8257	0.7469	0.7311	0.7308

Table VII-b. (Exclusion tests for industrial production growth)

$$\text{lindpr}_t = \underset{\substack{(-32.6)\\(-30.6)^*}}{\beta_0} + \underset{(6.50)}{\beta_1} * [\text{market}_t - r_t] + \underset{(4.76)}{\beta_2} * \text{bm}_t + \underset{(3.50)}{\beta_3} * \text{size}_t + \varepsilon_t$$

Note : The numbers in parentheses are t-ratios obtained by using value-weighted mimicking portfolio returns. The ones indicated with stars are those of equally-weighted return regressions.*bm* and *size* denote the mimicking portfolios constructed by sorting on book-to-market and size attributes respectively. *market* stands for the market portfolio. *lindpr* is the real industrial production growth led by 9 months. Regression period is June 1974-June 1998.

TABLE VIII.

$$R_t - r_t = \beta_0 + \beta_1 * [market_t - r_t] + \beta_2 * bm_t + \beta_3 * fixed_t + \varepsilon_t$$

Dependent variable : Excess returns on 25 BM-SIZE sorted portfolio
Below, *t* denotes t-ratios obtained from regressions, and *market* stands for the market portfolio. *MV* is the market value (or size) of a firm, and *adjRsq* is the R^2 adjusted for degrees of freedom. *BM* denotes book-to-market ratio, *bm* and *fixed* are the mimicking portfolios formed by sorting with respect to book-to-market and fixed assets ratio attri-, butes respectively. Regression period is June 1974-June 1998.

Table VIII-a. (Value-weighted monthly returns)

intercept(t)	verylowBM	lowBM	mediumBM	highBM	veryhighBM
verylowMV	2.7937	1.0736	2.7138	-0.7837	0.4116
lowMV	-0.2928	0.5046	-1.2518	0.2003	1.4400
mediumMV	-0.6825	-1.6340	-2.0635	-1.9375	1.4253
highMV	-1.9131	-1.7406	-1.2287	-1.3309	-0.1496
veryhighMV	1.6509	-0.8153	-1.2903	-0.7523	1.2706

bm(t)	verylowBM	lowBM	mediumBM	highBM	veryhighBM
verylowMV	-3.1389	-0.8887	0.2312	8.2773	4.2779
lowMV	-4.8351	-2.3264	0.2865	4.1844	6.3068
mediumMV	-5.4069	-2.2707	0.1038	3.6238	5.9161
highMV	-4.3821	-2.3519	-1.1675	1.8797	7.3406
veryhighMV	-5.3616	-3.5347	-1.1420	3.1109	4.4702

fixed(t)	verylowBM	lowBM	mediumBM	highBM	veryhighBM
verylowMV	-0.2296	1.9027	2.7493	5.7846	2.3343
lowMV	4.1129	5.0465	1.5370	3.0410	1.5459
mediumMV	4.4238	3.6564	1.8983	1.1843	4.2030
highMV	4.4778	2.4632	1.5336	-0.6753	2.1784
veryhighMV	2.8652	3.1026	0.01	-1.1469	0.5709

market(t)	verylowBM	lowBM	mediumBM	highBM	veryhighBM
verylowMV	8.4632	12.1544	19.9481	19.2444	4.0733
lowMV	24.5228	25.4125	30.9780	26.2861	17.2212
mediumMV	24.8503	25.5459	29.6422	23.5948	20.5136
highMV	22.9311	25.1377	27.4271	24.6378	22.1209
veryhighMV	20.9604	27.8673	23.8328	25.0159	23.5906

adjRsq(t)	verylowBM	lowBM	mediumBM	highBM	veryhighBM
verylowMV	0.3095	0.4759	0.6952	0.6923	0.1233
lowMV	0.8054	0.8103	0.8323	0.7822	0.5884
mediumMV	0.8139	0.8010	0.8226	0.7286	0.7001
highMV	0.7883	0.7872	0.8018	0.7350	0.7051
veryhighMV	0.7532	0.8257	0.7416	0.7333	0.7205

Table VIII-b. (Exclusion tests for size and fixed assets mimicking portfolios)

$$\underset{}{size_t} = \underset{(2.216)}{\beta_0} + \underset{(6.55)}{\beta_1} * [market_t - r_t] + \underset{(5.647)}{\beta_2} * bm_t + \underset{(5.412)}{\beta_3} * fixed_t + \varepsilon_t$$

$$fixed_t = \underset{(-0.013)}{\beta_0} + \underset{(5.34)}{\beta_1} * [market_t - r_t] + \underset{(-7.645)}{\beta_2} * bm_t + \underset{(5.412)}{\beta_3} * size_t + \varepsilon_t$$

Note : The numbers in parentheses are t-ratios obtained by using value-weighted mimicking portfolio returns. *bm* and *size* denote the mimicking portfolios constructed by sorting on book-to-market and size attributes respectively. *market* stands for the market portfolio. *fixed* stands for the mimicking portfolio obtained by sorting with respect to fixed assets ratio attribute. Regression period is June 1974-June 1998.

TABLE IX.

$$R_t - r_t = \beta_0 + \beta_1 * [market_t - r_t] + \beta_2 * bm_t + \beta_3 * intangible_t + \varepsilon_t$$

Dependent variable : Excess returns on 25 BM-SIZE sorted portfolio
Below, *t* denotes t-ratios obtained from regressions, and *market* stands for the market portfolio. *MV* is the market value (or size) of a firm, and *adjRsq* is the R^2 adjusted for degrees of freedom. *BM* denotes book-to-market ratio, *bm* and *intangible* are the mimicking portfolios formed by sorting with respect to book-to-market and intangible assets ratio attributes, respectively. Regression period is June 1974-June 1998.

Table IX-a. (Value-weighted monthly returns)

intercept(t)	verylowBM	lowBM	mediumBM	highBM	veryhighBM
verylowMV	2.7882	1.1185	2.8074	-0.5860	0.4950
lowMV	-0.1556	0.6506	-1.2290	0.2671	1.4624
mediumMV	-0.5279	-1.5592	-2.0156	-1.9452	1.5197
highMV	-1.7330	-1.7356	-1.2503	-1.4266	-0.1056
veryhighMV	1.7201	-0.7099	-1.3107	-0.8680	1.2748

bm(t)	verylowBM	lowBM	mediumBM	highBM	veryhighBM
verylowMV	-3.2605	-1.5015	-0.8272	6.6694	3.6842
lowMV	-6.3428	-4.0174	-0.0914	3.5727	6.3996
mediumMV	-7.0034	-3.4159	-0.4406	3.6362	4.8260
highMV	-5.9427	-3.1016	-1.5206	2.5154	7.1997
veryhighMV	-6.5429	-4.7015	-1.1343	4.0435	4.6429

intangible(t)	verylowBM	lowBM	mediumBM	highBM	veryhighBM
verylowMV	-0.1170	1.4872	-0.6110	2.9576	0.4193
lowMV	1.6834	1.7288	1.7932	2.7298	2.4162
mediumMV	1.9437	3.5936	1.5651	2.1205	2.1181
highMV	2.2312	3.5901	3.2039	2.4902	2.1600
veryhighMV	1.5284	1.4716	0.8566	2.7578	1.0220

market(t)	verylowBM	lowBM	mediumBM	highBM	veryhighBM
verylowMV	8.9802	13.4450	22.6323	21.5971	5.3370
lowMV	27.0842	28.0574	33.3952	28.6814	18.5420
mediumMV	27.4171	27.9877	32.1026	25.3023	22.8379
highMV	25.3850	27.3088	29.5043	25.4959	24.0641
veryhighMV	23.1288	30.4972	25.2702	25.6056	25.2367

adjrsq(t)	verylowBM	lowBM	mediumBM	highBM	veryhighBM
verylowMV	0.3094	0.4733	0.6875	0.6663	0.1070
lowMV	0.7959	0.7955	0.8328	0.7809	0.5933
mediumMV	0.8037	0.8007	0.8219	0.7316	0.6864
highMV	0.7773	0.7921	0.8072	0.7403	0.7050
veryhighMV	0.7481	0.8211	0.7423	0.7391	0.7212

Table IX-b. (Exclusion tests for size and intangible assets mimicking portfolios)

$$\underset{}{size_t} = \underset{(2.325)}{\beta_0} + \underset{(9.248)}{\beta_1} * [market_t - r_t] + \underset{(3.794)}{\beta_2} * bm_t + \underset{(-0.012)}{\beta_3} * intangible_t + \varepsilon_t$$

$$intangible_t = \underset{(0.358)}{\beta_0} + \underset{(4.937)}{\beta_1} * [market_t - r_t] + \underset{(-1.621)}{\beta_2} * bm_t + \underset{(-0.012)}{\beta_3} * size_t + \varepsilon_t$$

Note : The numbers in parentheses are t-ratios obtained by using value-weighted mimicking portfolio returns. *bm* and *size* denote the mimicking portfolios constructed by sorting on book-to-market and size attributes respectively. *market* stands for the market portfolio. *intangible* stands for the mimicking portfolio obtained by sorting with respect to intangible assets ratio attribute. Regression period is June 1974-June 1998.

TABLE X.

This table displays information on the mimicking portfolio formed to mimic fixed-assets attribute and its constitutients. The mimicking portfolio is denoted by *LowF-HighF. HighF, MediumF*, and *LowF* denotes returns on portfolios constructed by sorting firms each year depending on their fixed assets ratio. *dummy* is an indicator variable, taking the value of 1 for a month in a recessionary period and zero otherwise. *Mean* is the time series average of the monthly returns on attribute-sorted portfolios, *stdev* denotes standard deviation of portfolio returns over the whole period. *Recession* indicates the mean over the recessionary periods, and *boom* over the expansionary periods. Business cycle data is from NBER. In display c) *valret* stands for value-weighted returns, *eqret* denotes equally-weighted returns. *valretd* and *eqretd* are the corresponding returns with dividends included. Finally, display d) shows gross returns obtained from investing $1 on the mimicking portfolio for different time horizons. In calculating these returns it is assumed that proceeds are reinvested each month. All returns in Table 10. are equally weighted unless indicated otherwise.

a)Correlation matrix for the returns of the portfolios formed on Fixed-assets ratio

	HighF	*MediumF*	*LowF*	*LowF-HighF*	*Dummy*
HighF	1.0000				
MediumF	0.9173	1.0000			
LowF	0.8934	0.9616	1.0000		
LowF-HighF	0.3674	0.6313	0.7460	1.0000	
Dummy	-0.1305	-0.1340	-0.1164	-0.0479	1.0000

b)Return characteristics of the fixed-assets portfolios

	HighF	*MediumF*	*LowF*	*LowF-HighF*
Mean	0.0129	0.0149	0.0145	0.0016
Stdev	0.0374	0.0480	0.0522	0.0252
Recession	0.0004	-0.0018	-0.0011	-0.0015
Boom	0.0147	0.0173	0.0168	0.0021

c)Return characteristics of the fixed-assets portfolios

	HighF	*MediumF*	*LowF*	*LowF-HighF*
Valret	0.0107	0.0144	0.0144	0.0037
Eqret	0.0093	0.0128	0.0131	0.0038
Valretd	0.0147	0.0167	0.0160	0.0013
Eqretd	0.0129	0.0149	0.0145	0.0016

d)Fixed-assets mimicking portfolio returns over differing horizons

1 year	*2 years*	*3 years*
0.8869	0.8288	0.7928
0.9344	1.1497	1.2600
0.9566	1.0484	1.3199
1.2019	1.0603	0.8789
1.0403	1.0639	0.8734
1.0078	1.0284	1.0929
1.1903	0.9036	1.1369
0.8907	0.9289	1.1630
1.2449	1.1374	1.4627
0.8546	1.0080	
0.9705	1.3403	
1.0596	0.9787	
0.9373	1.4627	
0.9640		
0.9667		
0.9609		
1.1012		
1.0328		
0.9238		
1.0911		
1.1279		
1.1883		
0.9552		
1.0246		
1.4627		

NOTE: Fixed assets ratio is defined as the fixed assets of a firm divided by its total assets. Fixed assets are the net total of land and buildings, plant and machinery, construction in progress and any other fixed assets with leased-out assets excluded.

TABLE XI.

This table displays information on portfolios constructed by sorting stocks on volatility, and beta coefficient attributes. The portfolios are constructed by taking differences of the returns of high and low attribute portfolios. *valret* stands for value-weighted mean capital gains, *valretd* denotes value-weighted returns with dividends included. *recession* denotes mean over recessionary periods, and *boom* that of expansionary periods. Volatility of a stock is calculated from its previous 52 weekly price series. Beta coefficient is calculated from previous 60 months price history. Details of the calculation can be found in Datastream manuals. In sections c) and d) the last number in each column gives the gross return from investing $1 over the whole period.

a)Return characteristics of volatility portfolios

	HighV	*MedV*	*LowV*	*DiffV*
valretd	0.0163	0.0165	0.0152	0.0011
valret	0.0146	0.0142	0.0109	0.0037
recession	0.0000	-0.0010	0.0036	-0.0035
boom	0.0186	0.0190	0.0168	0.0018

b)Return characteristics of beta portfolios

	HighB	*MedB*	*LowB*	*DiffB*
valretd	0.0171	0.0157	0.0146	0.0025
valret	0.0154	0.0136	0.0098	0.0056
recession	-0.0008	0.0001	0.0036	-0.0044
boom	0.0196	0.0180	0.0162	0.0035

c)Volatility mimicking portfolio returns over different horizons

1 year	*2years*	*3 years*
1.0228	0.9839	0.9219
0.9619	0.9603	1.0962
0.9370	1.0697	1.0956
1.0248	0.9272	0.7959
1.1785	1.0604	0.8428
0.9076	0.8869	0.9996
1.2177	0.9073	1.3789
0.7615	0.9453	1.1077
1.1816	0.9823	1.1341
0.8974	1.1272	
0.8235	1.4966	
1.0770	0.9055	
0.9849	1.1341	
0.9213		
0.9289		
1.0177		
1.0822		
0.9077		
1.0590		
1.0644		
1.2233		
1.2234		
0.9664		
0.9369		
1.1341		

d)Beta coefficient mimicking portfolio returns over different horizons

1 year	*2 years*	*3 years*
0.9588	1.0792	1.0054
1.1255	1.0739	1.2678
0.9316	1.0999	1.1518
1.1527	0.9109	0.6343
1.0707	1.0397	0.9162
1.0273	0.7715	1.0186
1.1975	0.8765	1.5222
0.7606	1.0532	1.2677
1.2645	1.0109	1.6772
0.8222	1.2814	
0.8638	1.6319	
0.8932	0.9228	
0.9389	1.6772	
0.9336		
1.0453		
1.0076		
1.0463		
0.9661		
1.0427		
1.2290		
1.1879		
1.3737		
0.9125		
1.0114		
1.6772		

TABLE XII.

In this table (a&b), results pertinent to intangible assets mimicking portfolio and its components are displayed. Mimicking portfolio returns are defined as the difference between the returns of firms with high intangible assets and low intangible assets. Stocks are sorted into five tranches, *HighI* below denotes the average of the highest two tranches, and *LowI* stands for the average of the lowest two tranches where the average is weighted depending on the number of firms in each tranch. *DiffI* denotes the mimicking portfolio returns. *Valretd* and *valret* are value-weighted mean returns calculated with and without dividends, respectively. *Recession* and *boom* shows the mean value-weighted returns (including dividends) over the business cycle. Finally, in c) the average and standard deviation of the returns of mimicking portfolios for several attributes are shown. These return series are calculated by sorting stocks with respect to an attribute within each of the 25 bm-size sorted portfolios. The numbers displayed correspond to this cross-section of 25 portfolios.

a)Return characteristics of intangible assets portfolios

	HighI	*LowI*	*DiffI*
valretd	0.0160	0.0143	0.0017
valret	0.0134	0.0125	0.0009
recession	-0.0020	0.0012	-0.0032
boom	0.0185	0.0162	0.0023

b)Intangible assets mimicking portfolio returns over different horizons

1 year	*2 years*	*3 years*
1.1272	1.1045	1.1462
0.9798	1.1280	1.0273
1.0378	0.9451	1.2001
1.0870	1.1195	1.0474
0.9268	1.0351	1.1788
1.0197	1.0848	0.9847
1.1208	1.1619	0.7876
0.9988	0.9743	1.1114
1.0720	1.0254	1.5037
0.9656	0.8765	
1.1325	0.8707	
0.9579	1.1470	
1.1037	1.5037	
1.0527		
1.0145		
0.9603		
0.9933		
1.0323		
0.8531		
1.0274		
0.8986		
0.9689		
1.0578		
1.0843		
1.5037		

c)Cross-sectional properties of mimicking portfolio returns when bm and size is accounted for

Beta	
average	0.0019
stdev	0.0034
Fixedasset	
average	-0.0039
stdev	0.0043
Intangible	
average	0.0010
stdev	0.0030
Volatility	
average	0.0031
stdev	0.0042
Ohlson	
average	-0.0038
stdev	0.0093

TABLE XIII.

Correlation matrix of mimicking portfolios

CORR	*bm*	*size*	*market*	*indgrowth*	*dspread*	*tspread*	*fixed*	*intangible*	*beta*
bm	1.0000								
size	0.0424	1.0000							
market	-0.3103	0.4628	1.0000						
indgrowth	0.0819	-0.2935	-0.5896	1.0000					
dspread	-0.0789	0.0949	0.0604	0.0168	1.0000				
tspread	0.0240	0.0450	0.1871	-0.0872	-0.3782	1.0000			
fixed	-0.4471	0.3987	0.5344	-0.3381	0.0482	0.0442	1.0000		
intangible	-0.1863	0.1501	0.3528	-0.3215	0.0550	0.0033	0.2501	1.0000	
beta	-0.3589	0.2948	0.5802	-0.3825	-0.0101	0.0882	0.6963	0.1919	1.0000
volatility	-0.2642	0.2710	0.5178	-0.2658	0.0295	0.0480	0.5820	0.0096	0.7030

Explanations : In the table monthly return correlations of mimicking portfolios and candidate factors are shown. All returns are value-weighted. For bm, size, intangible, volatility, fixed assets, and beta attributes, stocks are sorted each year at May with respect to these attributes. Then return differences of stocks with the highest attributes and the stocks with the lowest attributes are found. (For size and fixed assets ratio the reverse is done.) These constitute the mimicking portfolio returns. Returns are calculated beginning from June until the next June to make sure that all accounting information is available by the time returns are calculated.