Conditional capital asset pricing model and asset growth rate

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Abstract

Motivated by the recent empirical work of Cooper, Gulen and Schill (2008), I test whether asset growth rates are still a strong predictor for cross sectional stock returns on monthly basis. I apply Avramov and Chordia's (2006) work to test if asset growth rate inherently absorbed other firms' characteristics in the two step regressions, risk unadjusted returns and risk adjusted returns are analysed sperately in the framework of asset growth rate. The findings are consistent with Cooper, Gulen and Schill (2008) that asset growth rate could be used as a predictor for the cross sectional returns, however, the predictability of the asset growth rates in the sample does not outperformed the firm size and book-to-market ratio. The predictability of cross section returns for asset growth rate is similar to the firm size and book-to-market ratio. The ability of asset growth rates to explain risk adjusted returns, which are derived from conditional capital asset pricing models, is less than other firms' characteristics.

1 Introduction

Identifying the determinate of the cross sectional stock returns is viewed as one of the interesting topics in the area of empirical asset pricing in finance. The failure of the benchmark capital asset pricing model (CAPM), introduced by Sharp (1964), Lintner (1965) and Black (1972), to explain the cross sectional stock returns attracks many researchers' attention. Early research, such as Basu (1977, 1983) identifies that CAPM fails to explain the earning yield effect of the cross sectional stock returns, Banz also (1981) finds that the firm size could not be explained by the CAPM. Further more,Bhandari (1988) finds the leverage effects are unexplained by the CAPM, and book equity value to market equity value effects documented by Chan, Hamao, and Lakonishok (1991) the in Japanese market also fail to be explained by the CAPM. A benchmark work by Fama and French (1992) show that the relationship between the cross sectional returns and the market beta is relatively weaker and is not consistent over the periods of 1941 to 1990. On the other hand, they find the firm size and book-to-market ratio do capture some variations of cross sectional stock returns. A following work by Fama and French (1993) shows that their three-factor model do a better job of explaining the cross sectional stock returns than CAPM. All of the above evidence address the question: whether the cross sectional stock returns are determined solely by risk factors such as market beta or the non-risk factors such as size, book-to-market ratio. Even though there are not many theoretical works supporting the non-risk factor models, the empirical evidence makes the argument that cross sectional stock returns should relate to firms' characteristics in some way.

In order to fill in the theoretical blank in the economic interpretations of why firms' characteristics could explain the cross sectional stock returns, Berk, Green and Naik (1999) develop a theoretical work that relates firms' characteristics to the dynamics of the firms' systematic risk. They provide the theoretical grounds to show the relationship between cross sectional stock returns and firms' characteristics. They find that firms' investments take an important role in determining firms' systematic risk. It also makes sense that a valuable investment opportunity indicates a profitable performance for firms in the future, and the systematic risks are going to change as firms explore the investment opportunities. In their model, book-to-market ratio and firm size are used as the proxies for investment opportunities. Following their theoretical work, Gomes, Kogan and Zhang (2003) develop a general equilibrium model where the cross sectional stock returns are directly related to firms' characteristics.

Cooper, Gulen and Schill (2008) show that by sorting asset growth rates, stocks with higher asset growth rate exhibit lower returns and stocks with lower asset growth rate exhibit higher returns. And from their cross section regressions, they find that the asset growth rate works better than the firm size and book-to-market ratio. They also find that asset growth rates subsume some other firms' characteristics, such as sales growth rates and buy-and-hold strategies. These may come from the facts that asset growth rates incorporate comprehensive information compared with other variables. From the perspective of accountants,the growth rate of asset could be viewed as an all-in-one variable that relates to the firms' operation.

However, Cooper, Gulen and Schill (2008) find inconsistent results with some theoretical works from the perspective of risk-based explanation, such as Berk, Green and Naik (1999) and Gomes, Kogan, and Zhang (2003). They argue that Fama and French (1992,1993) should capture the variations on the asset growth rates sorted portfolios. And as in Fama and French (2008) argue that by sorting stocks on some specific variables could cause the cross section regressions results biased. In this paper, I apply a method that avoids sorting stocks to examine asset growth rates from the perspective of risk-based explanations. Then main hypothesis is to test if asset growth rates subsume the ability of other firms' characteristics to explain the expected stock returns, and to test if the risk adjusted returns, which are associated with asset growth rates, is lower than others returns that associated with other firms' characteristics.

By applying Avramov and Chordia's (2006) model, I perform an empirical test that applies to the individual stock excess return without sorting, asset growth rates are tested if they subsume other firms' characteristics in explaining the cross sectional individual returns. I also test whether there is an improvement for the conditional capital asset pricing models by allowing risk factors to be varied with asset growth rates. On one hand, I could test the ability of asset growth rates to explain the cross sectional individual stock return, on the other hand, I could also examine the ability of asset growth rates to explain the risk adjusted returns.

Following the theoretical work by Gomes, Kogan and Zhang (2003), I also show how asset growth rates are related to the market beta. The evidence shows that there is a negative relationship between asset growth rates and firms' risk factors. The result also confirms the empirically identified negative relationship between asset growth rates and returns, such as in Fairfield, Whisenant, and Yohn (2003), Titman, Wei, and Xie (2004), etc. These results also indicate the investments are negatively related to the cross sectional stock returns. Generally speaking, as in Fama and French (2008), the cash outflows are negatively related to the cross sectional stock returns.

The contribution of this paper to the literature could be highlighted in the following ways: first, the evidence shows how asset growth rates are related to capital asset pricing models; second, by examining the asset growth rate from the perspective of risk-based explanation, the ability of all-in-one variable to explain the risk adjusted returns is showed.

The rest of the paper is organized in the following orders. The second section is the methodology, in this section I discuss how to apply time series regression analysis on conditional beta and how to estimate the cross-sectional coefficients, and the relationship between firm beta and the expected stock returns is also showed; the third section is data description, I describe how the variables in the sample are constructed and conditions to selecting criteria; the fourth section is the empirical analysis, in this part I discuss the empirical regression results from time-series and cross sectional regression; the final section is the conclusion.

2 Methodology

2.1 *Asset growth rate and firm beta*

Before estimating the cross sectional regression coefficients, first, I develop how asset growth rates relate to the firms' beta. As in Gomes, Kogan and Zhang (2003), firms' size is negatively related to firms' beta and the book-to-market ratio is positively related to firms' beta. Their theoretical work provides a solid ground to derive the relationship between firms' risk factor beta and asset growth rate. The main idea firms' characteristics relate to the firms' beta is as follows[1],

$$\beta_{ft} = \tilde{\beta}_t^a + \frac{V_{ft}^o}{V_{ft}}\left(\beta_t^o + \tilde{\beta}_t^a\right) + \left(\frac{K_t}{V_t^a}\right)^{-1}\left(\beta_t^a - \tilde{\beta}_t^a\right) \tag{1}$$

where β_{ft} is firms' risk factor, V_{ft}^o is firms' growth option value, and it is the same across the market at time t, V_{ft} is the total value of the firm at time

[1] Where $K_{ft} = \int k_i \mathrm{d}i$. More details about the derivation can be found in Gomes, Kogan and Zhang (2003).

t, and $\frac{K_t}{V_t^a}$ stands for the book-to-market ratio at time t. Therefore, from the above equation I could imply that the firm's beta does not only relate to the firm's total value, but also depends on the book-to-market ratio. Among other research, firms' investment is associated with firms' expected returns. When firms invest more, there is a corresponding decline in firms' growth options relative to firms' asset in place.Finally the expected return of the firm is decreased with the corresponding decline in the market beta, Berk, Green, and Naik (1999), Gomes, Kogan, and Zhang (2003), etc. Here I use asset growth rates as the proxy for the firms' investment. As firms invest more, the corresponding assets will be increased as well, as a result, there will be a positive asset growth rate for the firm. Therefore, together with firm size and book-to-market ratio, as Avramov and Chordia (2006), I apply asset growth rates as additional factors to be conditioned by the market beta and other risk factors to test their role to predict future returns.

On the other hand, I could also easily derive the firm value in the form of asset growth rate. For example, the total value of the firm is positively related to the firms' asset growth rate,

$$V_t = \Big(\frac{P_t}{E_t} * ROE_t\Big) * \Big(A_{t-1} * \Big(1 + g_t\Big) - L_t\Big) \tag{2}$$

where V_t is the total value of the firm at time t, P_t is the price of the firm at time t, E_t is the firms' equity at time t, ROE is the return on equity ratio at time t, A_{t-1} is the firms' asset at time $t-1$, g_t is the firms' asset growth rates at time t and L_t stands for the leverage of the firm at time t.

2.2 *Asset pricing and firms' characteristics*

I follow the previous research by Avramov and Chordia (2006), applying the asset pricing models to the individual stock and testing the validity of the asset pricing models and the role of asset growth in explaining the cross section expected returns from unconditional and conditional perspective. Following Connor and Korajcyk (1988), Brennan, Chordia and Subrahmanyam (1998) and Avramov and Chordia (2006), the stock returns follow a K factor model,

$$R_{jt} = E(R_{jt}) + \sum_{k=1}^{L} \beta_{jk,t-1} * f_{kt} + e_{jt} \tag{3}$$

where R_{jt} is the return for stock j at time t, and E is the expectation operator at time $t-1$, $\beta_{jk,t-1}$ is the conditional beta corresponding to the kth

factor at time $t-1$, is the unanticipated time t return on the kth factor conditional on the information at $t-1$ and the expectation of the factor is zero, is the idiosyncratic returns which is unrelated to the factors , i.e.,$E(e_{jt}|f_{jt}) = 0$.

Under the assumption of the perfect pricing, expected return function could be expressed as,

$$E(R_{jt}) = \tilde{R}_t + \sum_{k=1}^{L} \lambda_{k,t} * \beta_{jk,t-1} \tag{4}$$

where $\tilde{R}_t$ is the zero β return at time t, $\lambda_{k,t}$ is the risk premium for the kth factor at time t. The conditional zero beta return is assumed equal to the risk free rate. Thus the risk adjusted return equation could be derived by substituting equation (4) into equation (3),

$$R_{jt}^{adj} = R_{jt} - R_{ft} - \sum_{k=1}^{L} (\lambda_{jt} + f_{kt}) * \beta_{jk,t-1}{}^{2} \tag{5}$$

The cross-sectional regression analysis takes the adjusted return of individual stocks as dependant variable and firms' characteristics as independent variables on the left hand side,

$$R_{jt}^{adj} = a_{ot} + \sum_{i=1}^{N} a_{it} * Z_{ij,t-1} + e_{jt} \tag{6}$$

the coefficients for the cross sectional regression are a_{it},$Z_{ij,t-1}$ are the firms' characteristics one period lagged to the risk adjusted returns. In the paper, firms' characteristics such as,firm size, the ratio of book equity to market equity, turnover ratio, asset growth rate and lagged returns are tested. All the coefficients are estimated by the Fama and Macbeth (1973) cross section regression.

The null hypothesis is tested by the coefficients from equation (6). If the asset growth rate works better than other firms' characteristics, I expect to find a relatively less R^2 in the risk adjusted cross sectional regression. Under the earlier assumption, the capital asset pricing models in the time series regression explain at least some of the expected returns, therefore if the asset growth rate works better than other firms' characteristics, the risk adjusted returns are less likely to be explained by the firm size, book to market, momentum factors from the cross sectional regressions, i.e., the more actual

[2] More details about this equation could be found in Avramov and Chordia (2006).

the capital asset pricing model to price the individual stocks, the less the explanatory ability of other firms' characteristics in the following cross sectional regression. On the other hand, if the asset pricing models do not work well for individual stocks, whether conditional or unconditional models, all those lagged firms' characteristics used in the cross sectional regression will end up with higher R^2, if those characteristics works well for risk adjusted returns.

The conditional betas take the following forms,

$$\begin{aligned}\beta_{jk,t-1} =&\beta_{jk1} + \beta_{jk2}Z_{t-1} + (\beta_{jk3} + \beta_{jk4}Z_{t-1})Size_{j,t-1} + (\beta_{jkt} + \beta_{jk6}Z_{t-1})BM_{j,t-1} \\ &+ (\beta_{jk7} + \beta_{jk8}Z_{t-1})assetg_{j,t-1}\end{aligned} \quad (7)$$

where $\beta_{jk,t-1}$ is the factor loading of kth factor of firm j at time $t-1$, Z_{t-1} stands for the macroeconomic variable at time $t-$,$BM_{j,t-1}$ is the ratio of book value to market value for firm j at time $t-1$, and $assetg_{j,t-1}$ is the asset growth rate for firm j at time $t-1$. Default spread $(De)$is used as a proxy for the macroeconomic varialbe in the paper, and it is defined as the difference between BAA grade corporate bond yields and AAA grade corporate bond yield. Default spreads could also be defined as the difference of BAA grade corporate bond yields and long term government treasury bills,such as Hahn and Lee(2006). In the regression analysis,I find the results from the above two definitions are similar, therefore the result of the first form definition are reported. The predictability of macroeconomic variables to the future stock returns was identified by Chen, Roll and Ross (1986), and Keim and Stambaugh (1986). Becasue these variables tend to move closely to the macroeconomic conditions, by incorporating these macroeconomic variables into the firm level risk factor analysis, any shocks from the macroeconomic changes could be reflected in the form of innovation risk, and be priced in the stock returns.

Based on the conditional beta equation, the following scenarios are tested: unconditional β is tested by set all other βs that related to firms' characteristics and macroeconmic variable equal to zero.Under this scenario, the only risk that matters to the stock return is from the market, and the factor loadings of risk premiums for firm j will be constant as time passes. In the second scenario, I examine the case that only macroeconomic variables matter. The one period lagged macroeconomic varialbes reflect the innovations on the macroeconomic condtions, the lagged variables could also indicate how risk factors evolve over time, i.e., capture the effects of last period risk factors to the current period risk factor if there exists any effect.In the third scenario, I allow factor loadings vary with firms' characteriscs exclude the macroeconomic variable. This scenario helps us to compare micro and macro changes effects on the factor loadings, and also one period lag in the regression analysis indirectly helps us to examine predictability of firms' characteristics to the future returns. In the fourth scenario, I let firms' factor loadings to vary with both firms' characteristics and macroeconomic variables. I expect this scenario outperforms any other scenarios in terms of explanatory ability of the model. Other scenarios are also tested in the two step regressions, such as the comparision of firm size and book-to-market ratio to the asset growth rates with and without the existence of macroeconomic variables.

For example, in the asset growth rate scenario, all factors in the Fama and French 3-factor model are conditional on the asset growth rate,$Assetg$, then the following factors are analysed in the time series regression,

$$\begin{aligned} r_{jt} = \alpha_j + \beta_{j1,1} MKT_t + \beta_{j2,1} Assetg_{j,t-1} MKT_t + \beta_{j2,1} SMB_t \\ + \beta_{j2,2} Assetg_{j,t-1} SMB_t + \beta_{j3,1} HML_t + \beta_{j3,2} Assetg_{j,t-1} HML_t + \varepsilon_{j,t} \end{aligned} \tag{8}$$

where $r_{j,t}$ is the excess return for firm j at time t,calculated by the return of firm j minus the risk free rate, MKT_t is the market return excess return factor at time t, SMB_t is the small size minus big size factor at time t and HML_t is the high book-to-market ratio minus low book-to-market ratio at time t and $Assetg$ is the asset growth rate for firm j at time t. The factor loadings in equation (8) are estimated by the ordinary linear regression model, and the pricing errors are estimated by the the constant term from the above regression. Theoretically, under the null hypothesis of asset pricing model is correct, then the pricing errors from the pricing model are statistically insignificant different from zero.Compared with the traditinal Fama and French model, the asset growth rates are also incorporated in the model, and because of their predictability of future returns, the pricing errors from the regression are expectd to be less than the traditional three factor model. If asset growth rate works better than the firm size or the ratio of book-to-market value in predicting the future returns, then the pricing errors from the above equation should be less than the traditional model.

In the literature, there are two ways that could be used to estimate the factor loadings of equation (8). The first method is to run the time series regression using the entire sample, as in Avramov and Chordia (2006) and the second is called the rolling method, i.e., all the factor loadings at time t are estimated by the past information with a window constraint. The window constraint here means the fixed period of time used to estimate the factor loadings, and this window keeps updating as sample periods expands. For example, in Fama and Macbeth (1973),they use the second method to estimate the factor loadings in the first time series regessions, and then use the results from the first step to test the market efficiency. Also, in Brennan, Chordia and Subrahmanyam (1998), the second method is used to estimate the factor loadings.

On the other hand, the first method is also prefered by researchers. For example, Fama and French (1992, 1993), forming the portfolios based on firms' characteristics and then allocate stocks to the different groups to form the portfolio, and they allow factor loadings for each stock changes over time, and the reason for this arises from the fact that the composition for each portfolio changes over time. I have to admit that using future data to estimate the factor loading on individual stock may affect the results, especially for the un-scaling case. Because under un-scaling scenario in the model, individual stock will not allocate to any portfolios in the following times, factor loadings will be estimated using time series data over the entire data, therefore, these loadings will be constant over time. However, rolling methodology also exist the above issues on the conditional factor loadings and unconditional factor loadings. But whether the results are significantly affected by those unconditional factor loadings for each stock and how I should compare factor loadings to those calculated from portfolios are left for the future research. For the purpose, i.e., to comapre the asset growth rate factor with other firms' characeristics, either methodologies will work, therefore, I follow Avramov and Chordia (2006)'s methodology by using the first estimation method.

The final step in the analysis is to estimate the risk adjusted returns with respect to some firms' characterics and widely identified anomolies. The reason I include the second step in the analysis is to compare the predictability of asset growth rate to the risk adjusted returns with other micro variables. If the empirical findings from the first step of time series regressions are correct, I want to test whether the asset growth rate captures all the effects of the firm size or the ratio of book-to-market equity to the individual firm, or whether they explain different aspects of the individual future return.

Therefore, the cross section regression for the equation (8) is estimated as follows,

$$(\alpha_{j,t} + \varepsilon_{j,t}) = a_{0,t} + A_{j,t}X_{j,t-1} + \epsilon_{j,t} \tag{9}$$

where $\alpha_{j,t} + \varepsilon_{j,t}$ is the risk adjusted returns for firm j at time t, $A_{j,t}$ is the row vector of cofficients from the cross section regression for firm j at time t, and $A_{j,t}$ is the column vector of firms' characteristics for firm j at time $t-1$. The firms' characteristic vector in the regression analysis includes firm size, the ratio of book-to-market equity, stock turnover ratio and momentum factors. By setting up cross section regression in this way, not only help us to test the null hypothesis about the asset growth rate, but also helps us to test the validity of capital asset pricing model to individual stock. And the ability of firms' characteristics to expain the cross section risk adjusted returns are also tested.Finally, the standard Fama and Macbeth method is used to estimate the coefficients for equation (9): the estimated $\hat{A}_{mt}$ is the time series average of cross section coefficients , and the standard errors are calculated by the time series. The $t-$value is then calculated as dividing estimated $\hat{A}_{mt}$ by its corresponding standard errors.

3 Description of the data

The data sample includes the common stocks listed on AMEX, NYSE and NASDAQ from January 1962 to Decemeber 2001. Because of the unavailable trading volume data for most NASDAQ stocks before January 1983, I divide the sample into two sub-samples: the first sub-sample includes only common stocks listed on AMEX, NYSE over the period from January 1962 to December 2001, and the second sub-sample includes all the common stocks from January 1962 to December 2001. Financial firms usually have higher leverage ratios than non-financial firms, which could potentially bias the results,[3], therefore I exclude the financial firms with Standard Industry Code (SIC) between 6000 and 6999. Monthly stock returns, share prices, share outstandings and trading volumes are obtained from Center for Research in Security Prices (CRSP) and annual accounting data, such as year end book value of common equity, year end market value of common equity and total assets are obtained from the COMPUSTAT Annual Industry Database.I emerge these databases together by using CUSIP[4].

To be considered in the monthly analysis, a common stock has to meet the several criteria, detailed information about these criteria could be found in the APPENDIX1. As explained in Kothari, Shanken and Sloan (1995), COMPUSTAT financial data suffered sever survivorship biases, especially

[3]For more detailed discussion, refers to Fama and French (1992,1993, 1996), Brennan, Chordia, and Subrahmanyam (1998), Avramov and Chordia (2006), etc

[4]Apendix1 includes more detailed explanation on CUSIP.

for those high leverage companies. In line with the previous researches in the literature, Fama and French (1992), Kothari, Shanken and Sloan (1995), Avramov and Chordia (2006), I exclude the first two years of data from COMPUSTAT to minimize the survival bias. After meeting the above criteria, I end up with 1171 stocks per month on average and 3834 total distinct firms over the entire period for the sample of AMEX and NYSE. The AMEX, NYSE and NASDAQ sample includes 1936 stocks per month and 8963 total distinct firms over the entire monthly period.

In order to reduce the skewness of the data, I take logarithms for most variables, except past returns and asset growth rate. The negative book-to-market ratios are excluded from the sample, because on average the negative book-to-market ratios only account for very small part of total firms each year. As in Fama and French (1992), I also trimmed the ratio of book-to-market value among 0.005 fractile and 0.995 fractile to exclude extreme values. All those the ratio of book-to-market value greater than 0.995 fractile are set equal to the 0.995 fractile value and those less than 0.005 fractile are set equal to the 0.005 fractile value. Unlike other firms' characteristic variables, I do not take logarithmic transformation for the asset growth rate, because deleting negative growth from the sample will potentially bias the results, about half of the firms experienced negative asset growth during the period (2919 out of 3834 distinct firms in AMEX and NYSE sample experienced at leaset once negative asset growth during the sample periods), and it is also reasonable for firms to experience negative asset growth periods, especially for the economic recession years, reducing the investments in asset will not hurt the firm in the long run. I also trimmed the asset growth rate between 0.005 and 0.995 fractile to eliminate the extreme values, but trimming out extreme values by 0.005 and 0.995 fractile will not change too much of the results.

Other variables considered in the paper are past returns based on different formation periods, they are last two to three month, four to six month and seven to twelve month returns. $Ret2$, $Ret4$ and $Ret7$ stand for those different periods of returns, the geometric mean returns are calculated seperately. As disscussed before, default spread are calculated by the difference between Moody's Seasoned Aaa grade corporate bond yields[5] and Moody's Seasoned Baa grade corporate bond yields, as in Fama (1990), Jagannathan and Wang (1996), Ferson and Harvey (1999), Avramov and Chordia (2006), for the other calculation of default spread, i.e., the difference between Moody's Sea-

[5]Date are available on the website of FEDERAL RESEARVE BANK OF ST.LOUIS.

Table 1: Statistic Summary

Panel A: AMEX and NYSE				Panel B: AMEX,NYSE and NASDAQ		
Variables	*Mean*	*Median*	*Std*	*Mean*	*Median*	*Std*
Size	1.3931	0.2177	5.1483	0.8351	0.0963	4.0527
BM	0.9335	0.8053	0.6365	0.9283	0.7831	0.6853
Assetg	0.1334	0.0785	0.4013	0.1591	0.0817	0.7902
Turnover	0.0427	0.0297	0.0513	0.0533	0.0320	0.0813
*Ret*2	0.0240	0.0134	0.1482	0.0252	0.0099	0.1786
*Ret*4	0.0365	0.0212	0.1810	0.0384	0.0166	0.2189
*Ret*7	0.0736	0.0452	0.2703	0.0778	0.0320	0.3292

Table1 shows the statistical summary of the firm characteristics. Size is the market price times the share outstanding at time t. BM is the book-to-market ratio at time t, and those values that more than 5 percent of the BM value are set equal to the value at 5 percent and the values above 95 percent are set equal to the value at 95 percent to smooth the sample observations. Assetg is the assets growth rate and is equal to the asset increments between time t-1 and time $t-2$. Turnover is the firm's turnover ratio, calculated by dividing the stock trading volume of firm j by the share outstandings at time t. $Ret2$ are the lagged returns of the last 2nd to the $3rd$ periods prior to the time t. $Ret4$ are the lagged returns of the last $4th$ to the $6th$ periods prior to the time t. $Ret7$ are the lagged returns of the last $7th$ to the 12th periods prior to the time t. Panel A includes the data from AMEX and NYSE and panel B includes the data of AMEX, NYSE and NASDAQ from the periods of 1962 to 2001. The earliest NASDAQ stocks included in the sample are from the year of 1975.

soned Baa grade corporate bonds and the 10-year Treasury constant maturity rates, such as in Hahn and Lee (2006). Fama and French factors are obtained from Fama and French Data Library website, it includes the monthly market excess return from the market portfolio, small firm minus big firm factor from the strategy of long small firms and short big firms, and high book-to-market value minus low book-to-market value factor from the strategy of long high BM ratio and short low BM ratio.

Table1 reports the statistical summaries of the sample. Panel A includes the results of the AMEX and NYSE listed common stocks. The time series average of cross sectional size of the common stocks is about 1.39 billions from the periods of 1963 to 2001, which is higher than the corresponding mean size in the panel B,which shows the facts that the common stocks listed on NASDAQ are the relatively small size stocks. The book-to-market ratio of AMEX and NYSE common stocks is also higher than the book-to-market ratio of AMEX, NYSE and NASDAQ all together. For the firm size and book-to-market ratio in these two samples, the sample without NASDAQ common stocks exhibit relatively smaller standard deviation than the sample that includes NASDAQ common stocks. The 13.34 percent asset growth rate in the AMEX and NYSE sample is lower than the asset growth rate of 15.91 percent in the overall sample, which shows the fact that common stocks listed on NASDAQ have higher cash outflows than the common stocks in the AMEX and NYSE sample. The time series average of cross section turnover ratio of 4.27 percent for the AMEX and NYSE sample also lower than that of 5.33 percent in the overall sample, shows the common stocks from the NASDAQ exchange traded more frequently than those common stocks in the AMEX and NYSE exchanges. Past returns for AMEX and NYSE common stocks are lower than the sample that includes NASDAQ common stocks, I could also concludes from this fact that NASDAQ common stocks may exhibit a little bit strong momentum effects, which cause the overall sample exhibits the stronger past returns. The average standard deviations are about 4 percent higher in the overall sample as well.

4 Regression Analysis

4.1 *Empirical results for CAPM*

Table2 shows the two step regression analysis applied to the CAPM model. The second column of the table2 shows final results from the regression, and the cofficients and adjusted R^2 are reported. Under the unscaled case, the time series average of cross sectional BM is positively related to the risk adjusted returns, and the negative relationship exists between risk adjusted returns and firm size or turnover ratio, all those relationship confirms the empirical results in the literature. All the coefficients from the cross section regression are statistically significant, which shows the facts taht CAPM does not work well for the individual stocks and CAPM does not explain the identified anomalies, such as size, book-to-market, turnover and momentum effects. The firms' characteristics have the ability to explain the risk adjusted returns that left unexplained by the CAPM model. But from the adjusted R^2, I could see that the explanatory ability of the firms' characteristics are limited, only counts about 5.09 percent.

From the third column to the ninth column reports the results that risk factors are scaled by differenct scaling scenarios. All the coefficients confirms the empirical findings in the literature,and they exhibit the proper relation-

Table 2: CAPM model with AMEX and NYSE stocks

	Unscaled	*BM, Size*	*Assetg*	*BM, Size, def*	*Def*	*Assetg, def*	*Assetg, BM*	*Assetg, BM, Def*
Intercept	0.33078	0.32609	0.33398	0.31411	0.31996	0.3222	0.3394	0.32067
$t-value$	2.874	2.9267	2.9367	2.9921	2.8129	2.9114	3.0296	3.0086
BM	0.21301	0.21936	0.21606	0.19084	0.21908	0.2089	0.19997	0.17988
$t-value$	3.5717	3.7442	3.6509	3.3087	3.6623	3.5342	3.391	3.0827
Size	-0.11571	-0.11615	-0.11546	-0.11788	-0.11446	-0.11243	-0.12047	-0.11932
$t-value$	-2.6355	-2.6924	-2.6439	-2.8228	-2.6263	-2.6194	-2.7824	-2.8338
Turnover	-0.14985	-0.14359	-0.14417	-0.12509	-0.13922	-0.13233	-0.13907	-0.12705
$t-value$	-3.338	-3.2883	-3.2454	-2.9473	-3.1357	-3.0423	-3.1567	-2.969
*Ret*2	0.89452	0.98778	0.88124	0.99339	0.87719	0.87811	0.90254	0.84911
$t-value$	3.0353	3.4368	3.0097	3.4889	3.0259	3.0541	3.1154	2.924
*Ret*4	1.141	1.21196	1.1244	1.2534	1.1527	1.1184	1.1208	1.1245
$t-value$	4.3042	4.7563	4.3022	5.0408	4.4155	4.3356	4.3442	4.4072
*Ret*7	1.0264	1.0742	1.0316	1.1068	1.0115	1.0094	1.0445	1.0181
$t-$value	5.9218	6.3657	5.9961	6.6435	5.8492	5.9072	6.2038	6.0781
$\tilde{R}^2$	5.0937	5.0161	5.0536	4.8744	5.039	4.9646	4.9873	4.8944

Table2 shows the results of conditional beta on different firms' characteristics. $t-$value is the $t-$statistic value from Fama and Macbeth cross sectional regression. Variable BM stands for the ratio of book value to market value. Negative ratios are deleted from teh sample. In order to aviod the skewness of the sample, I take the logarithms of the book-to-market ratio of each firm before the regression analysis. All values that are below 5 percent of the total value are set to the value at 5 percent and values that are above 95 percent of the total value are set the value at 95 percent. Size is teh logarithms of the product of the stock price and share outstandings at time t. Turnover is the logarithms of the ratio of the trading volume with share outstandings at time t. $Ret2$ are the lagged stock returns from the last $2nd$ to the $3rd$, and $Ret4$ are the lagged stock returns from the $4th$ to the $6th$, $Ret7$ are the lagged stock returns from the $7th$ to the $12th$. Assetg are the asset growth rates and are calculated via the following equation: $assetg_t = \left(\frac{assetg_{t-1} - assetg_{t-2}}{assetg_{t-2}}\right)$. Def, default spread, is defined as the difference between BAA corporate bond yields and AAA corporate bond yields. The conditional beta is calculated in the following form,

$$\beta_{j,t} = \beta_{j1,t-1} + (\beta_{j2,t-1} + \beta_{j3,t-1} Z_{t-1}) Size_{j,t-1} + (\beta_{j3,t-1} + \beta_{j4,t-1} Z_{t-1}) BM_{j,t-1} + (\beta_{j4,t-1} + \beta_{j5,t-1} Z_{t-1}) assetg_{t-1}$$

where Z_{t-1} is a proxy variable for macroeconomic conditions,in the regression analysis, the default spread is used.

ship with firms' charateristics. Under the scaling case, the adjusted R^2 does not change too much from the case of the unscaling case, but all of the scaling scanorios have a lower adjusted R^2. The pricing errors for all the cases are significant different from zeros, which means the firms' characteristics are not good enough to explain the risk adjusted returns. Inconsistant with the null hypothesis, I did not find scaling by asset growth rate, and other combinations of asset growth rates with other firms' characteristics outperform those scaling with firm size and book-to-market ratios,which means that scaling market risk factor does not help to explain the individual stock returns. Even in the case I include default spread to consider the macroeconomic conditions, the risk adjusted does not include any new informations that could be explained by the following firms' characteristics and anomalies. However, from the above analysis, I could imply the asset growth rate at least do a similar job as firm size and the ratio of book-to-market value.

Table3 shows the results of applying CAPM to the sample of AMEX, NYSE and NASDAQ. By including NASDAQ common stocks into the sample, I could get the similar results as those in the case of cosidering AMEX and NYSE only. book-to-market value ratios are positive related to the risk adjusted returns from the two step regressions, firm sizes are negatively related to the risk adjusted returns, i.e., the small firm earns a higher risk adjused returns than big firms. The lagged values are still statistically significant across all the unscaled and scaled scenarios. But I notice that the adjusted R^2s decrease as compared with the first case, however, this decreases may be casued by including more stocks in the cross sectional regression, there lower the mean of the cross sectional average value. Theorectically speaking, I apply CAPM to the individual stocks not to the portfolios, including more stocks does not change the risk factor components either in the time series regression analysis or in the cross sectional regression analysis. But this will not be the case if I apply capital asset pricing model to the portfolios, becasue in this case the component of the portfolio will be changed by the equal weighted or valued weighted methods.

4.2 *Empirical Results for Fama and French Three Factor Model*

Table4 shows the regression results of applying Fama and French three factor model to the AMEX nad NYSE sample. The second column shows that the coefficients of the firms' characteristics for the regression on risk adjusted

Table 3: CAPM model with AMEX, NYSE and NASDAQ Stocks

	Unscaled	$BM, Size$	Assetg	BM,Size,Def	Def	Assetg,Def	Assetg,BM	Assetg,Size,Def	Assetg,BM,Def	Assetg,Size
Intercept	0.41611	0.4046	0.4242	0.39263	0.40102	0.41423	0.43055	0.39461	0.41681	0.40013
t-value	3.1221	3.1018	3.2092	3.1498	3.0302	3.1977	3.2903	3.1633	3.3069	3.0668
BM	0.20572	0.2008	0.2006	0.16487	0.20858	0.18818	0.18591	0.17265	0.15051	0.19717
t-value	3.4978	3.4557	3.4340	2.8686	3.5341	3.2116	3.2039	2.9947	2.6042	3.3691
Size	-0.19376	-0.1876	-0.1937	-0.18208	-0.189	-0.18935	-0.19708	-0.18018	-0.19486	-0.18543
t-value	-4.0012	-3.9472	-4.0269	-3.9627	-3.9416	-4.0125	-4.1359	-3.9087	-4.2045	-3.8987
Turnover	-0.10982	-0.1018	-0.1040	-0.095235	-0.10376	-0.092446	-0.098812	-0.091754	-0.085103	-0.099593
t-value	-2.1901	-2.0989	-2.1032	-2.0281	-2.1205	-1.9194	-2.0172	-1.9537	-1.7975	-2.0446
Ret2	0.68133	0.7846	0.6714	0.84487	0.6506	0.63623	0.6924	0.82389	0.62042	0.74487
t-value	2.4548	2.8589	2.4345	3.0925	2.3789	2.3141	2.5122	3.0337	2.2182	2.7032
Ret4	0.92675	0.9775	0.9183	1.0441	0.94571	0.91357	0.89013	1.0518	0.89598	0.96631
t-value	3.8792	4.2091	3.8974	4.575	4.0114	3.8869	3.8045	4.6031	3.8237	4.1606
Ret7	0.87275	0.9335	0.8838	0.98683	0.87383	0.89023	0.89958	0.99213	0.91608	0.92617
t-value	5.505	6.0281	5.6057	6.4773	5.5273	5.7047	5.837	6.5728	6.0055	5.9373
$\tilde{R}^2$	4.6186	4.56	4.58	4.4543	4.5705	4.5232	4.521	4.4591	4.4804	4.5857

Table3 shows the results of conditional beta on different firms' characteristics. $t-$value is the $t-$statistic value from Fama and Macbeth cross sectional regression. Variable BM stands for the ratio of book value to market value. Negative ratios are deleted from teh sample. In order to aviod the skewness of the sample, I take the logarithms of the book-to-market ratio of each firm before the regression analysis. All values that are below 5 percent of the total value are set to the value at 5 percent and values that are above 95 percent of the total value are set the value at 95 percent. Size is teh logarithms of the product of the stock price and share outstandings at time t. Turnover is the logarithms of the ratio of the trading volume with share outstandings at time t. $Ret2$ are the lagged stock returns from the last $2nd$ to the $3rd$, and $Ret4$ are the lagged stock returns from the $4th$ to the $6th$, $Ret7$ are the lagged stock returns from the $7th$ to the $12th$. Assetg are the asset growth rates and are calculated via the following equation: $assetg_t = \left(\frac{assetg_{t-1} - assetg_{t-2}}{assetg_{t-2}}\right)$. Def, default spread, is defined as the difference between BAA corporate bond yields and AAA corporate bond yields. The conditional beta is calculated in the following form,

$$\begin{aligned}\beta_{j,t} = \beta_{j1,t-1} + (\beta_{j2,t-1} + \beta_{j3,t-1}Z_{t-1})Size_{j,t-1} + (\beta_{j3,t-1} + \beta_{j4,t-1}Z_{t-1})BM_{j,t-1} \\ + (\beta_{j4,t-1} + \beta_{j5,t-1}Z_{t-1})assetg_{t-1}\end{aligned}$$

where Z_{t-1} is a proxy variable for macroeconomic conditions,in the regression analyis, the default spread is used.

returns are all statistically different from zero, except for the constant term. The adjusted R^2 from the regression is about 2.9 percent, which is much lower than the unscaled case for CAPM case, which is about 5.10 percent. The decreased adjusted R^2 implies that althought Fama and French three factor model does not work perfect in asset pricing, it does a better job than the traditional CAPM model. Table4 also shows that different from CAPM, all the constant coefficients from in the Fama and French model are insignificant different zero, which shows the fact that if there is more information incororates in the risk adjusted returns, the firms' characteristics could help to price those returns exactly. On the other hand, all the adjusted R^2s from the regression are decreased in the Fama and French three factor model, on average there is a 2 percent decrease.

For the case of scaling Fama and French three factors by firms' characteristics, I find the combination of asset growth rate with firm size and default spreads do a better job than other scenarios, which has the lowest adjsuted R^2 of 2.52 percent. However, scaling risk factors by using asset growth rate alone, the subsequent firms' characteristics do not work well in explaining the risk adjusted risk, a higher djusted R^2 of 2.75 percent. As previous case, the ability of macroeconomic variable in explaining the individual stock returns is limited, which has an adjusted R^2 close to the unscaled case.

Unlike the CAPM case, the coefficients for book-to-market ratios becomes insignificants in this case, though some coefficients are on the margin, like scaling by asset growth rate with a $t-$value of 1.5163. The scaled scenarios all exhibits the insignificant effects compared with the unscaled cases, which shows that the conditional Fama and French models subsume the book-to-market effects. And subsequent book-to-market ratio can not explain the risk adjusted returns from the first time series regression, all the factors that related to the book-to-market ratios have been priced at the first step. Except for the case of scaling three factor model by the combination of asset growth rate and book-to-market ratio, and the case of the combination of asset growth rate, book-to-market ratio and default spread, all the coefficient on the book-to-market ratio have the positive signs, which show the existence of positive relationship between returns and book-to-market ratio. The negative signs for the book-to-market ratio could not be explained at this moment and leave for the future research. But, one of the explanation for the negative sign could be arise from the data snooping problems, or the combination of asset growth rate with other firms' characteristics casue the components of the risk adjusted returns different to other cases, and then caused the following lagging book-to-market ratio negatively related to the

Table 4: Fama and French 3-Factor Model with AMEX and NYSE stocks

	$Unscaled$	$BM, Size$	$Assetg$	$BM, Size, Def$	Def	$Assetg, Def$	$Assetg, BM$	$Assetg, BM, Def$	$Assetg, Size, Def$
$Intercept$	-0.01562	0.01393	0.00528	0.01277	-0.02233	0.01531	0.02884	0.049238	0.012993
$t-value$	-0.30373	0.334301	0.11499	0.3461	-0.45972	0.3667	0.69431	1.3188	0.35522
BM	0.09509	0.02616	0.06620	0.00198	0.05866	0.01603	-0.00981	-0.05152	0.00584
$t-value$	2.0602	0.64324	1.5163	0.05213	1.3341	0.38947	-0.23901	-1.3379	0.14954
$Size$	-0.07090	-0.06368	-0.06889	-0.04718	-0.07084	-0.06853	-0.07664	-0.07868	-0.05059
$t-value$	-2.7492	-2.6814	-2.8026	-2.1384	-2.7702	-2.8618	-3.1976	-3.4947	-2.2794
$Turnover$	-0.14052	-0.12516	-0.1268	-0.11653	-0.14138	-0.11736	-0.1295	-0.10691	-0.10008
$t-value$	-3.4532	-3.3293	-3.2409	-3.3334	-3.5187	-3.1118	-3.3563	-2.9903	-2.8693
$Ret2$	0.857	0.94769	0.7738	0.82314	0.7513	0.64362	0.73428	0.58299	0.79778
$t-value$	3.1183	3.7072	2.8821	3.2129	2.788	2.4526	2.7974	2.2071	3.1565
$Ret4$	1.1282	1.2486	1.0867	1.1925	1.1371	1.014	1.0587	0.91811	1.1804
$t-value$	4.61	5.5875	4.592	5.5052	4.8371	4.4554	4.5879	4.0461	5.4878
$Ret7$	0.98044	1.0463	0.98507	1.0254	0.94836	0.91024	0.97181	0.9252	1.0123
$t-$value	5.9495	6.8615	6.1806	7.0262	5.8661	5.8979	6.3117	6.2399	7.0485
$\tilde{R}^2$	2.9137	2.6084	2.7549	2.5823	2.8311	2.649	2.6774	2.6042	2.5231

Table4 shows the results of conditional beta on different firms' characteristics. $t-$value is the $t-$statistic value from Fama and Macbeth cross sectional regression. Variable BM stands for the ratio of book value to market value. Negative ratios are deleted from teh sample. In order to aviod the skewness of the sample, I take the logarithms of the book-to-market ratio of each firm before the regression analysis. All values that are below 5 percent of the total value are set to the value at 5 percent and values that are above 95 percent of the total value are set the value at 95 percent. Size is teh logarithms of the product of the stock price and share outstandings at time t. Turnover is the logarithms of the ratio of the trading volume with share outstandings at time t. $Ret2$ are the lagged stock returns from the last $2nd$ to the $3rd$, and $Ret4$ are the lagged stock returns from the $4th$ to the $6th$, $Ret7$ are the lagged stock returns from the $7th$ to the $12th$. Assetg are the asset growth rates and are calculated via the following equation: $assetg_t = \left(\frac{assetg_{t-1} - assetg_{t-2}}{assetg_{t-2}}\right)$. Def, default spread, is defined as the difference between BAA corporate bond yields and AAA corporate bond yields. The conditional beta is calculated in the following form,

$$\begin{aligned} \beta_{j,t} = \quad & \beta_{j1,t-1} + (\beta_{j2,t-1} + \beta_{j3,t-1} Z_{t-1}) Size_{j,t-1} + (\beta_{j3,t-1} + \beta_{j4,t-1} Z_{t-1}) BM_{j,t-1} \\ & + (\beta_{j4,t-1} + \beta_{j5,t-1} Z_{t-1}) assetg_{t-1} \end{aligned}$$

where Z_{t-1} is a proxy variable for macroeconomic conditions,in the regression analyis, the default spread is used.

Table 5: Fama and French 3-Factor Model with AMEX, NYSE and NASDAQ Stocks

	Unscaled	*BM, Size*	Assetg	BM,Size,Def	Def	Assetg,Def	Assetg,BM	Assetg,Size,Def	Assetg,BM,Def	Assetg,Size
Intercept	0.11902	0.12	0.14796	0.10338	0.11056	0.16002	0.1685	0.19211	0.11345	0.1117
$t-$value	1.8679	2.2899	2.5101	2.2511	1.7948	2.9058	3.027	3.7848	2.4709	2.1225
BM	0.086113	0.028427	0.057857	-0.0021263	0.054014	0.0040582	-0.017403	-0.059325	-0.00388	0.0458
$t-$value	1.9217	0.71283	1.3559	-0.057686	1.2647	0.10067	-0.42637	-1.5534	-0.10244	1.0991
Size	-0.14633	-0.111	-0.13942	-0.081951	-0.13906	-0.13334	-0.13964	-0.13708	-0.087995	-0.1032
$t-$value	-4.5392	-3.8567	-4.4872	-3.1994	-4.4299	-4.5687	-4.6688	-5.1073	-3.4035	-3.5666
Turnover	-0.08788	-0.079691	-0.072083	-0.082931	-0.094689	-0.066991	-0.076702	-0.057581	-0.068472	-0.0671
$t-$value	-2.1828	-2.1699	-1.8503	-2.4799	-2.4049	-1.8098	-2.0012	-1.626	-2.0549	-1.8342
$Ret2$	0.66378	0.84753	0.59364	0.81058	0.57002	0.50071	0.57241	0.45118	0.75592	0.7931
$t-$value	2.5282	3.4022	2.2982	3.2722	2.1928	1.9396	2.2366	1.7193	3.0863	3.1702
$Ret4$	0.89913	1.0767	0.87661	1.1016	0.95274	0.84225	0.85931	0.76748	1.0788	1.0535
$t-$value	4.0737	5.2531	4.1011	5.5201	4.486	4.0608	4.0863	3.6411	5.4644	5.1795
$Ret7$	0.81462	0.92142	0.84259	0.99095	0.82766	0.82893	0.84208	0.85617	0.95716	0.9537
$t-$value	5.4155	6.6093	5.776	7.4723	5.6103	5.8728	6.0091	6.3247	7.296	6.8399
$\tilde{R}^2$	2.6708	2.4595	2.5773	2.4313	2.6322	2.5448	2.5276	2.5152	2.373	2.47

Table5 shows the results of conditional beta on different firms' characteristics. $t-$value is the $t-$statistic value from Fama and Macbeth cross sectional regression. Variable BM stands for the ratio of book value to market value. Negative ratios are deleted from teh sample. In order to aviod the skewness of the sample, I take the logarithms of the book-to-market ratio of each firm before the regression analysis. All values that are below 5 percent of the total value are set to the value at 5 percent and values that are above 95 percent of the total value are set the value at 95 percent. Size is teh logarithms of the product of the stock price and share outstandings at time t. Turnover is the logarithms of the ratio of the trading volume with share outstandings at time t. $Ret2$ are the lagged stock returns from the last $2nd$ to the $3rd$, and $Ret4$ are the lagged stock returns from the $4th$ to the $6th$, $Ret7$ are the lagged stock returns from the $7th$ to the $12th$. Assetg are the asset growth rates and are calculated via the following equation: $assetg_t = \left(\frac{assetg_{t-1} - assetg_{t-2}}{assetg_{t-2}}\right)$. Def, default spread, is defined as the difference between BAA corporate bond yields and AAA corporate bond yields. The conditional beta is calculated in the following form,

$$\beta_{j,t} = \beta_{j1,t-1} + (\beta_{j2,t-1} + \beta_{j3,t-1} Z_{t-1}) Size_{j,t-1} + (\beta_{j3,t-1} + \beta_{j4,t-1} Z_{t-1}) BM_{j,t-1} + (\beta_{j4,t-1} + \beta_{j5,t-1} Z_{t-1}) assetg_{t-1}$$

where Z_{t-1} is a proxy variable for macroeconomic conditions,in the regression analyis, the default spread is used.

Table 6: Adjusted R^2 of Cross Section Regression of Risk Adjusted Return and Asset Growth Rate

	$Unscaled$	$BM, Size$	$Assetg$	$BM, Size, Def$	Def	$Assetg, Def$	$Assetg, BM$	$Assetg, Size, Def$	$Assetg, BM, Def$	$Assetg, Size$
$CAPMR^2$	2.2893	2.2863	2.2608	2.2709	2.2633	2.2665	2.2521	2.2595	2.3048	2.2833
FFR^2	1.6019	1.56	1.5604	1.57	1.5744	1.57	1.5932	1.50	1.67	1.5222

Variable BM stands for the ratio of book value to market value. Negative ratios are deleted from teh sample. In order to aviod the skewness of the sample, I take the logarithms of the book-to-market ratio of each firm before the regression analysis. All values that are below 5 percent of the total value are set to the value at 5 percent and values that are above 95 percent of the total value are set the value at 95 percent. Size is teh logarithms of the product of the stock price and share outstandings at time t. Turnover is the logarithms of the ratio of the trading volume with share outstandings at time t. $Ret2$ are the lagged stock returns from the last $2nd$ to the $3rd$, and $Ret4$ are the lagged stock returns from the $4th$ to the $6th$, $Ret7$ are the lagged stock returns from the $7th$ to the $12th$. Assetg are the asset growth rates and are calculated via the following equation: $assetg_t = \left(\frac{assetg_{t-1} - assetg_{t-2}}{assetg_{t-2}}\right)$. Def, default spread, is defined as the difference between BAA corporate bond yields and AAA corporate bond yields. $CAPMR^2$ stands for the adjusted R^2 based on the CAPM model. The dependent variable of the regression is the risk adjusted returns from the first time series regression, and the independent variables in the regression are asset growth rates for firm j at time $t-1$, and lagged returns. FFR^2 is based on the Fama and French three factor model, with all else the same as in the CAPM case. The sample covers only AMEX and NYSE common stocks.

adjusted returns. For example, Billings and Morton (2002) also documents the negative relationship between the lagged component book-to-market ratios to the future stock returns.

The coefficients for the firm size are consistent with the relationship documented in the literature, small firm earns higher returns than big firms, i.e., the negative relationship exists. But unlike the book-to-market ratio, all the coefficients are significant different from zero. Scaling Fama and French three factor model by different firms' characteristics and macroeconomic variable, default spread, do not help to explain the size effects. THe coefficients for the lagged returns are also statistically different from zero in the sample, shows the momentum anomaly is the most persistent phenomenon on the market, Unconditional or conditional CAPM, Fama and French three factor models lose their pricing ability in the case of momentum anomaly.

Table5 shows the results of applying Fama and French three factor model to the common stocks listed on the AMEX, NYSE and NASDAQ exchanges. The results are much similar to the resutls in the table4. Firm size exhibits negative relationship with risk adjusted returns, and the coefficients from the regression are significant different zero. book-to-market value exhibits a positive relationship with risk adjusted returns, excepts for some cases which related to the related to the asset growth rate. Under this scenario, scaled Fama and French three factor model by asset growth, book-to-market value and default spread do a better job than other scenarios, which has the loweste adjusted R^2 of 2.37 percent on average. All the conditional models work better than the unscaled model, which has the highest adjusted R^2 of 2.67 percent. The coefficients of the pricing error are significantly different from zeros, which may indicates the conditional or unconditional pricing models do not work well for the NASDAQ common stocks.

To illustrate the effects of asset growth rate and complete the hypothesis test, table6 includes the adjusted R^2 for both CAPM and Fama and French three factor models. From the table6 I could say that the asset growth rate does not outperform firm size and book-to-market ratio. Both R^2 decrease to the half of the corresponding firm size and book-to-market ratio cases. The predictability of asset growth rate to the risk adjusted returns is limited, at least in the sample.

5 Discussion and Conclusion

From the above analysis, I could conclude that the asset growth rate in the sample does not significantly outperform the firm size and book-to-market ratios in predicting the future returns. The risk adjusted returns from the condtional capital asset pricing model, failed to be explained by the asset growth rate, or the asset growth rate does not do a better work to predict future risk adjusted returns in the sample. Therefore, I could conclude that even though asset growth rate stands for the all in one varialbe in the financial statement, when I use the asset growth rate in terms of pricing or predicting individual stock returns, most of the information about the firms' characteristics are already reflected by the size and book-to-market ratio effects. Two steps regression analysis supports the conclusions. From the time series regression, conditional pricing model based on the asset growth rate does not produce a relatively less risk returns, the pricing factors have the similar effects as the firm size and the book-to-market ratio. In the cross section regressions, the adjusted R^2 for the asset growth rate is relatively lower than those for firm size and book-to-market ratio.

Two possible reasons for the falure of asset growth rate to outperform the firm size and book-to-market ratio are as followings: first, the annaul asset growth rate is a bad proxy for the following short term monthly asset growth rate. Because of the unavailability of the monthly total asset returns, assuming constant asset growth rates for the firm over the next 12 months does not proxy for the actual monthly asset growth rate, and any variations for the dependant variables can not be explained by the constant asset growth rate over time. Second, asset growth rate does not predict the short term future returns. The documented the empirical findings in the literature shows the long term predictability up to 5 years, the effects of asset growth are priced by the investor in pricing the short term returns, or the market reacts slow to the asset growth rate.

The following researches should be considered in the future: first, the monthly asset growth rate should be substituted by the annual asset growth rate, and the long term stock excess returns should be considered; second, the time varying asset growth rate should be used to the corresponding constant asset growth rate if I apply monthly returns in the analysis; third, the asset growth rate factor should be formed by the similar methods of SMB and HML factors from Fama and French three factor model; fourth, the rolling methodology of fixed window estimating factor loadings should be tested; fifth, the individual stocks should be grouped into size or value portfolios in order to minimize the firm size and book-to-market effects.

Even though the short term predictability of asset growth rate to the future return does not outperform the widely identified firm size and book-to-market ratio effects, asset growth rate at least does a similar job as firm size and book-to-market ratio in the short term, the long term effects of asset growth rate may be outperformed than other firms' characteristics. The analysis confirms the empirical effects of the asset growth rate to predict the future returns, and uses the methodology that could test the hypothesis from the perspective of excess returns and risk adjusted returns. More theoretical work should be done to show the relationship between the relationship between risk factors and asset growth rate, the simply accounting transformation needs a solid proof to rule out the effects of other accounting factors.

Appendix Data

DATA from CSRP and COMPUSTAT:

PERMNO,CRSP permanent number, is used as unique index for identifying the stocks;

CUSIP,CUSIP Identifier, is used as identifier to merge data from CRSP and COMPUSTAT;

SHRCD, Share Code, common stocks with code 10 and 11 are included in the sample;

EXCHCD, Exchange Code, common stocks with code 1, 2 and 3 are included in the sample, which stands for AMEX, NYSE and NASDAQ seperately;

SICCD, Standard Industrial Classification Code, sample excludes codes between 6000 and 6999, missing value, and code with value zero;

PRC, Price or Bid/Ask Average, sample includes all the values that absolute value does not equal to zero;

VOL, Trading Volume, units in hundreds of shares;

SHROUT, Shares Outstanding, units in thousands;

RET, Returns, monthly common stock returns;

Data6, total asset;

Data24, Calendar year price;

Data25, Calendar year common stock outstanding;

Data35, Deferred tax and invest tax credits;

Data60, Total Common Equity;

Turnover, turnover ratio, calculated as $\left(\frac{VOL}{SHROUT}\right)$;

Size, firm capitalization, calculated as $|PRC|*SHROUT$;

BV, book value of equity, calculated as $data60 + data35$;

MV, market value of equity, calculated as $data24 * data25$;

BM, ratio of book value to market value, calculated as $\left(\frac{BV}{MV}\right)$;

Assetg, asset growth rate, calculated as $assetg_t = \left(\frac{asset_{t-1}}{asset_{t-2}}\right)$;

RET2, calculated as $\left(\left[\prod_{i=2}^{3}(1 + RET_{t-i})\right]^{1/2} - 1\right)$;

RET4, calculated as $\left(\left[\prod_{i=4}^{6}(1 + RET_{t-i})\right]^{1/3} - 1\right)$;

RET7, calculated as $\left(\left[\prod_{i=7}^{12}(1 + RET_{t-i})\right]^{1/6} - 1\right)$;

DATA SCREENING CRITERIA

First, current month return and its previous 36 months return must be available from the CRSP. Available from CRSP means in the past 36 months, no missing values are allowed; second, the firm should have non-missing values for the price and share outstanding from CRSP in previous month to calculate firm size; third, its trading volumes and share outstandings need to be available for previous second month to calculate the turnover ratio, which is calculated as dividing trading volume by the share outstanding; fourth, last month's book-to-market ratio (BM) should be available, the BM ratio is measured as the ratio of the end of previous year book value of common equity to the end of previous year market value of equity. Following the work of Fama and French (1992), 6 moth lag rule is applied, i.e., the BM ratio at end of year $t - 1$ is used as monthly value for July of year t to June of year $t + 1$; fifth, the asset growth (ASSETG) also needs to be available for the previous month, following the same logic as BM ratio, the monthly asset growth rate ($Assetg$) was calculated by using the data from end of previous year.

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