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Term Structure of Equity: Analysis for the Case of European Stocks

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Acknowledgement. My professors at Levy Economics Institute, thank you for inspiring my love of Economics. To my amazing brother Abdoul Kadir Jaiteh in Arizona I am grateful to have you in my life, without your support and inspiration which I doubt any of this would have been possible. Special appreciation to my Mum and late Dad who has been a strong pillar in my life, a massive thanks for making the experience a memorable one and for your continued unconditional love.

PLAGIARISM STATEMENT

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Sulayman Jaiteh

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Abstract

This paper studies the equity term structure and its relevance in pricing European stocks, using a duration concept. In explaining the cross-sectional variation in the duration premium, we made use of cash flow duration in understanding the value premium. Empirically, we measure cash flow duration using balance sheet data and to show if difference in return is a manifestation of value premium. Also relating the time series return to the factor model of Fama and French model which was able to explain the 40% of the cross-sectional variation in return. The term structure of equity shows a downward slope with the measure of cash flow duration created at firms level.

Keywords: Cash flow duration, term premium, equity return, factor model.

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1 Introduction.

There is evidence in a wide range of literature that examined the return on equity and its term structure, the relationship that exists between cash flow duration and returns on equity (Donaldson et al., 1990; Campbell, 1991; Ammer & Mei, 1995 ; Dechow et al., 2004 and Lettau & Wachter, 2011) . The main objective of this study is to ascertain if duration can explain the value premium, also if it can be useful in pricing European stocks. This can be a useful tool for forecasting and evaluation by analyst . A crucial question that this paper raised was about the term structure of equity and its accuracy. Analyzing stocks based on duration has been a recent topic in finance that attracts wide interest from practitioners. Duration measures the changes in the valuation of a portfolio for a given change in the market rate defined by Macaulay. In essence, Macaulay calculates duration as the weighted average of time to maturity of investment cash flow. This idea has been used extensively and considered to be accepted to equities as well, with some extensions to the usual Macaulay duration simply because equities have an infinite maturity which are not known in advance unlike bond.

Researchers are able to explore the nature of the term structure thereby coming up with very interesting arguments. In general, the term structure can depict either an upward-sloping, flat and downward-sloping trend depending on the rate of interest in the market according to the literature (see for instance Yan, 2001). Low interest-rate brings about an upward-sloping term structure while a flat structure is happening when the interest rate is at medium and downward-sloping as a result of a high interest rate, since higher interest reduces borrowing thus making borrowing expensive. At very long maturities we noticed a flattened yield curve. As interest rates goes up, borrowing becomes costly, thus leading to high yield debt issues. While a decrease in interest rate is more attractive to the equity market leading to a rise in equity markets. For instance, we have noticed with the recent Covid-19 crisis bringing about low yield, as bond yields fall with shocks in the

economy. This has made equity investment more attractive in the long run than bonds. The present yield gap on the S&P 500 is one of the highest since the great financial crisis, said (Mueller-Glissmann) of Goldman Sachs research on "equity duration puzzle".

The purpose of this research is to ascertain the Euro Stoxx 50 equity market using duration analysis and further comparing the results with the outstanding work of M.Weber (2018) on duration and term structure of equity returns in the US stock market. Duration is a concept often used to capture the average maturity (in years) of cash flows associated with a given investment.

2 Structure of the Paper

The paper studied equity portfolios sorted on cash flow duration, which effectively ranks stocks based on whether firm value is concentrated in short or long-term cash flows. I find a strong premium for short duration stocks and show that several of its properties are consistent with this premium existing in equilibrium because earning requires exposure to reinvestment risk, which is undesirable from the perspective of long-term investors.

3 Methodology

I used the widely available evaluation tool used in the world of finance, for example Capital Asset pricing model (CAPM) and Fama and French factor model in addition to the duration strategy in assessing and comparing returns. The approach here considers a period of four years and checks for the return characteristics in a cross section of stocks considered on the basis of duration, book- to-market, size and beta.

The sample includes all firms with available monthly stocks data from the European stock market (EURO STOXX 50) from 2017 through 2020. I utilized fifty monthly stocks from the European stock market (EURO STOXX 50). The case of Europe, we followed Michael Weber's analysis on cash flow duration and term structure of equity return on the U.S stock market. Balance sheet data of the stocks was obtained from yahoo finance, computed book value of equity (BE) as the total assets minus total liabilities. Equity value (EQ) was reported already on the balance, hence requires no further computations. I used the U.S three-month Treasury bill rate as a proxy for the risk-free rate of return in the scope of this paper.

Duration is the implied cash flow measure which looks at the weighted average of time until cash flows are received. To determine the weights, we computed the ratio of discounted cash flows to price, with the help of the model below that has been widely used in literature of equity duration analysis.

Cash flow duration is computed using the Macaulay duration equation for bond. Our empirical analysis is similar to Weber, (2018) in modeling the timing of the cash flows to investigate the risk premium of claims to cash flows with different maturities. In his paper he confirmed that stocks with higher duration earn lower returns as compared to the low duration stocks. Duration is the implied cash flow measure which looks at the weighted average of time until cash flows are received. To determine the weights, we computed the ratio of discounted cash flows to price, with the help of the model below that has been widely used in literature of equity duration analysis.

$$Dur_{i,t} = \frac{\sum_{s=1}^{T} ss \times CFi, t+s/(1+r)^s}{P_{i,t}} \tag{1}$$

$CF_{i,t+s}$ denotes the cash flow at time t + s, $P_{i,t}$ is the current price, r is the expected return on equity, P denotes the market capitalization of equity (stock price multiplied by shares out- standing), CF denotes the net cash distributions to equity holders and r denotes the expected return on equity.

The expected return on equity is constant across both stocks and time. However, extending the duration concept to equities introduces two key problems normally: Firstly, as for bonds, they usually make a finite number of cash payments, while the sequence of payments on equity securities is infinite. Secondly the amount and timing of the cash payments on a bond are normally specified, known or specified in advance and are subject to little uncertainty, however, the payments on equity securities are unspecified in advance and can be subject to great uncertainty.
Therefore, the duration formula in (1) can further be partitioned into two parts i.e., final detail forecasting period with length T and infinite terminal expression. This helps to deal with the problems while assuming the latter is paid as a level of perpetuity.

With this assumption; the equation can be written in this form:

$$Dur_{i,t} = \frac{\sum_{s=1}^{T} s \times CF_{i,+s}/(1+r)^s}{P_{i,t}}(T + \frac{1+r}{r}) \times P_{i,t} - \sum_{s=1}^{T} \frac{CF_{i,t+s}/(1+r)^s}{P_{i,t}} \tag{2}$$

Without loss of generality, I make use of the assumption that the cash flow stream for an equity security can be partitioned into a finite forecasting period and an infinite terminal expression, since it is standard in the equity valuation literature of recent. Moreover, the second problem in implementing equation (3) is the forecasting of the finite period cash distributions, $CF_{i,t}; 0 < t \leq T$.

The forecasting model is based on recent research indicating that accounting-based performance measures provide effective information variables for forecasting future cash flows Nissim and Penman, (2001). Using M.Weber's (2018) strategy to mitigate the second complication by starting with the accounting identity that expresses net cash distributions to equity in terms of earnings and book value of equity to forecast cash flow through forecasting return on equity (ROE), $\frac{E_{i,t+s}}{B_{i,t=S-1}}$ and growth in book equity , ($\frac{BV_{i,t+s}-BV_{i,t+s-1}}{BV_{i,t+s-1}}$).

$$CF_{i,t+s} = E_t - (BV -_t BV_{t-1}). \tag{3}$$

where: E_t represents accounting earnings at the end of period t, and BV_t represents the book value of equity at the end of period t.

Rearranging the right-hand side of the equation leads to the equation below.

$$CF_{i,t+s} = BV_{t,t+S-1} \times \left[\frac{E_{i,t+s}}{BV_{i,t+s-1}} - \frac{BV_{i,t+s} - BV_{i,t+s-1}}{BV_{i,t+s-1}}\right] \tag{4}$$

Equation (4) indicates that to forecast net cash distributions to equity, one needs to first forecast return on equity (ROE) denoted by $\frac{E_{i,t+s}}{BV_{i,t+s-1}}$; and Growth in equity, denoted $\frac{BV_{i,t+s}-BV_{i,t+s-1}}{BV_{i,t+s-1}}$. Moreover, computing duration for all the fifty stocks for a period of four years, ie from 2017 to 2020 and obtained results in table 2 and 3. Then, created two portfolios with the top twenty-five and bottom twenty-five stocks based on the duration measures. We rank our portfolios based on their book-to-market values and also base on their betas values, later computing their returns to see if there exist any significant relationship between our portfolios. We show the duration created, beta and book-to-market stocks and categorizing them into two portfolios.

Further went on to create an equally weighted portfolio of the top twenty-five and bottom twenty-five stocks and computing their returns. In order to get the values of the beta of

our stocks, we extracted the beta for the period of five years provided in yahoo finance, then created a portfolio using the low and high beta stocks into two equally weighted portfolios thus computing their return accordingly. Also, formed two equally weighted portfolios using the book-to-market values of the stocks. The market value of equity was obtained by multiplying the number of shares outstanding with the current share price for every stock. In this way, we are able to compare duration to the three main common risk factors i.e., Beta, size and book-to-market. Traditionally, book-to-market cannot not be ignored since it is the most important factor to consider in portfolio analysis and asset management. This can give good information about the status of any investment.

A regression was conducted on the time series return using Fama and French three factor data for the European stocks. This was done purposely to check for the value premium of the duration stocks and to see if the model can give an explanation to the difference in returns even after controlling for the other risk factors.

$$(LonDurRet(R_{i,t}) - ShtDurRetur(R_{i,t})) = \alpha + \beta_{1,s}\chi_{2,s,t} + \beta_{2,s}\chi_{2,s,t} + \beta_3\chi_{3,s,t} + \varepsilon_{i,s,t} \quad (5)$$

where $R_{i,t}$ is excess return of portfolio i at time t, α_i is a model-specific pricing error, and $\beta_{i,s}$ is the time-series loading of returns on risk factors, $\chi_{i,s,t}$ such as Market, HML and SMB.

The above model was used to relate the time series return to the different factors of the Fama and French factors to see how much duration premium is explained by the well known other risk factors in research. We check to see if the difference in return is not just a manifestation of the value premium. This model shows what factors of the duration premium are explained by the control factors.

4 Findings and results

The question of whether equity duration is crucial for asset analysis in finance has been a heated topic over the years and no consensus has been reached on its validity. However, empirical evidence has shown significant global correlations between returns on equities. The empirical evidence shows the shortcomings of depending on equity duration as a measure and as well as managing risk. Considering the wide attraction of the concept of duration, I discussed in this paper why I considered it viable to explore the concept that has been popular for more than 20 years.

In this section, the outcome of the empirical analysis is discussed and the interest rate sensitivity of value stocks over growth stocks has been explored equally. We noticed that lower duration stocks performed better than higher duration stocks, this was consistent with empirical evidence Weber, (2018). As one might expect growth stocks having larger portions of cash flow expected to happen in the future to have a higher duration than value stocks, since growth stocks can easily be adjusted to inflation but the reverse is not true. In this case, we tested whether the excess performance of value stocks, which is the low duration stocks relative to growth stocks (higher duration stock) might be as a result to some extent, the difference in the interest rate exposure risk. Meanwhile, this test has not rejected the hypothesis even though the power of the predicted coefficients were not very significant i.e low explanatory power.

We have seen from table 2, most firm's duration is below 24 months, which is the duration of which no cash distributions are made in the finite forecast horizon under consideration. Therefore, we forecast that most firms will distribute some proportion of the value represented by their stock price during the 4-year finite forecast period. In the same vein, the

minimum value of duration from table 1 is -291.51 months, this is an exceptional case.The negative duration indicating a negative number for duration means that the present value of the cash flows through the forecasted horizon is more than the market value of equity. One reason could be the stock is underpriced or is that our forecasting model has been incorrectly specified to forecast that past profitability will continue into the future. At the extreme end , the maximum value of duration is 23.98 months as depicted in table 2. For duration to be so much greater than 24 months, the negative present value of the finite forecast period, cash flows must be larger relative to the market capitalization. The economics intuition here is that average cash flow maturity is considered a price risk factor. Our analysis suggests that the value premium serves as a compensation for the low duration stock's exposure to cash flow risk.

The correlation was also checked and there exists a positive significant correlation between our portfolios created based on duration (see table 4). The Outliers in the graph could be the Covid-19 pandemic effect as shown in figure 1.7. The correlation shows a positive significant linear relationship in our portfolios, this high correlations, we suspected it might be due to outlier. Looking at the benchmark, it has a mean return of -0.001 and a standard deviation of 0.059, this result is shown in table 1.2. The beta of the higher duration stock is 0.99 while the beta of the lower duration stocks is 1.3. The higher beta can serve as a justification as to the reason why low duration stocks perform better than higher duration stocks. From the analysis, the higher duration stocks have a mean return of 0.008, standard deviation of 0.06, while the lower duration stocks have also have a negative mean of -0.004, standard deviation of 0.08. The returns of lower duration stocks (0.6) are higher compared to the return of higher duration stocks (0.2).

A regression test was conducted on the Fama and french three risk factors and the difference in the returns of the portfolios to see if this can explain the cross-sectional return differential, and this result can be found in table 3. The factors explained 40% of the return differential which is not substantial enough to make a conclusion about our model.

Moreover, we went long on the higher duration stocks and short on lower duration stocks to check the spread on returns, this strategy was a good move, since higher duration stocks are considered growth stocks which values are expected to elevate in the future. Also, we download the benchmark and compute the returns, further comparing it with our portfolios. This can be found in table 5.

Generally, long duration equities are more sensitive to interest rate movements relative to short duration equities. i.e., if interest rates decline, share prices of long duration equities are expected to rise more than those of short duration equities.We notice that our returns monotonically decrease with cash flow duration for all the stocks, again this has confirmed the downward sloping of equity term structure. The higher the duration leads to a lower return. We notice from the table that low duration stocks show higher risk in the form of both higher market beta and higher stock return volatility over the four-year consideration period. Not surprising to see low duration stocks indicate that our portfolio is more volatile than the market by 30%. The low duration stocks have less average length of time to receive its cash flow. This finding has corroborated Weber's conjecture about the return of the two classes of stocks based on their duration measures.

As depicted in plot 1.5 and 1.6, surprisingly, this justification was further proven by the use of beta created portfolios and portfolio created on book-to-market, beta and market value. The results obtained in the returns shows that higher beta portfolios produce return more than lower beta portfolios, this logically, makes sense to any rational investor since higher betas signifies greater risk which is normally compensated in terms of return. Furthermore, in comparing their returns based on the categories of portfolios created, again the result corroborated our findings. Showing higher returns for higher book-to-market portfolios.Finally, we realized the cross-sectional differences in the temporal companies cash flow pattern serves crucial role in understanding the value premium in Europe. There is evidence that companies that pay a large portion of their cash flow in the very near future not only likely show high book-to-market ratio but are more sensi-

tive to aggregate cash flow shock (Lattau and Wachter, 2007, Campbell et al, 2004).Value premium is eventually a cash flow risk premium and this view was confirmed and held firmly in our empirical work.

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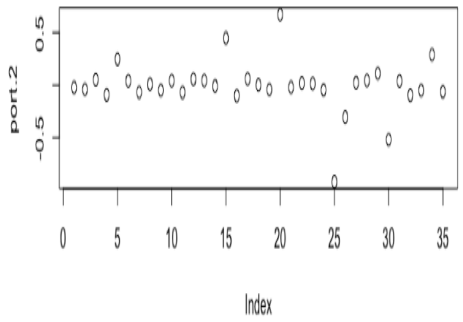
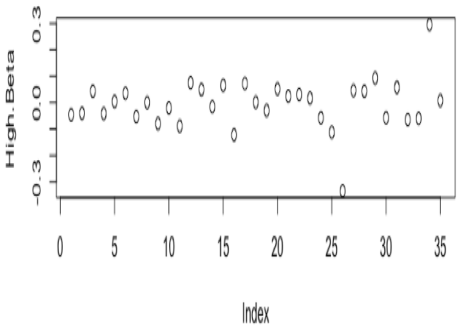
Stocks	Ticker	Mean.Dur	Std.Dur
Food & beverage	ABI.BR	-2.35	5.23
Automotive industry	DAI.DE	-5.34	6.8
Petroleum	ENI.MI	-50.52	25.16
Electric utility	IBE.MC	-90.26	40.03
Petroleum	FP.PA	-32.46	18.02
Telecommunication	DTE.DE	-30.82	17.86
Banking	BBVA.MC	-106.84	56.10
Banking	BNP.PA	-19.81	13.90
Banking	ISP.MI	-198.96	90.70
Banking	GLE.PA	-16.87	12.22
Telecommunication	TEF.MC	-27.23	15.93
Banking	INGA.AS	-50.46	28.66
Insurance	CS.PA	-44.	27.45
Banking	SAN.MC	-291.51	139.28
Technology	NOKIA.HE	-45.34	19.12
Media	VIV.PA	-1.74	5.33
Software—Infrastructure	ADYEN.AS	-16.53	12.68
Retail	AD.AS	-24.54	4.77
Construction and materials	CRG.IR	0.39	4.60
Automotive industry	BMW.DE	0.64	4.77
Clothing	ITX.MC	2.21	3.95
Construction & materials	SGO.PA	4.01	2.99
Goods and Services	SIE.DE	4.02	3.14
Chemistry	BAYN.DE	1.71	4.58
Chemistry	BAS.DE	2.96	3.77

Table 1: Low Cash Flow Duration Stocks



plot 1.1



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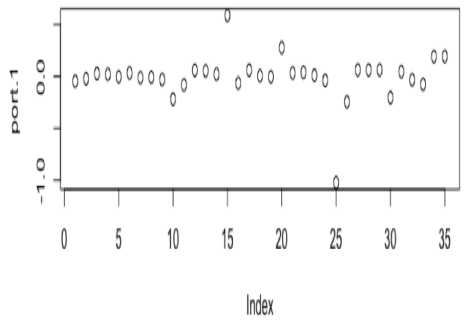

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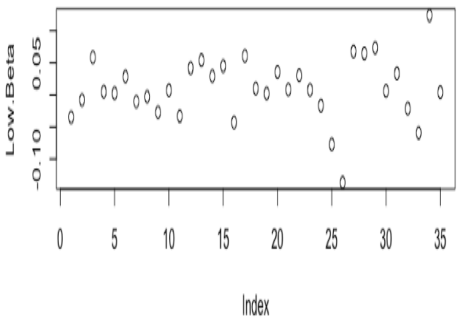

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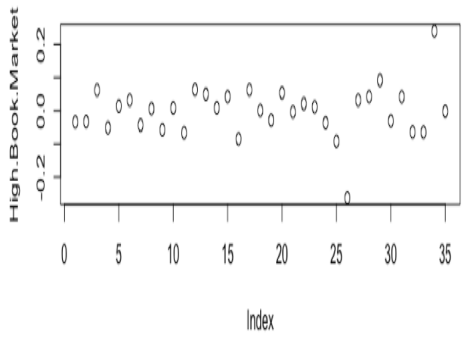

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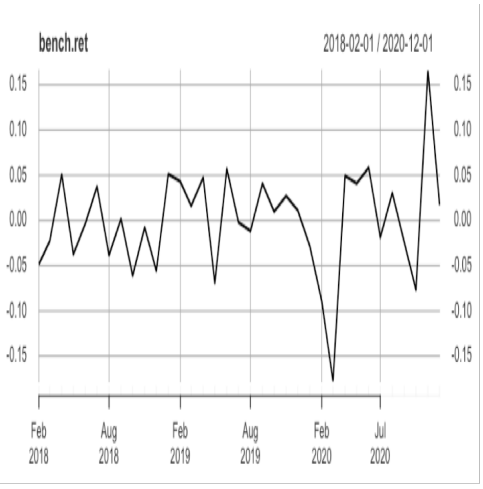

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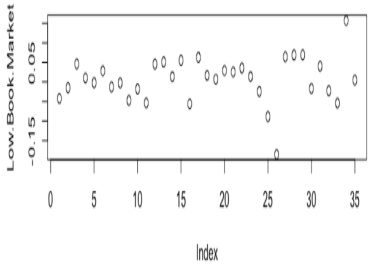

Plot 1.4

Figure 1: Visual Plots

Stocks	Ticker	Mean.Dur	Std.Dur
AEROSPACE	AIR.PA	8.64	0.64
Real estate	URW.AS	8.05	1.52
Chemistry	AI.PA	23.98	26.03
Chemicals	LIN.DE	5.53	4.21
Optical industry	EL.PA	8.22	1.87
Health care equipment	FRE.DE	7.14	1.75
Logistics	DPW.DE	4.52	2.81
Technology	ASML.AS	9.80	0.46
Technology	ASM.MC	9.94	0.35
Construction and materials	DG.PA	6.99	1.69
Technology	SAP.DE	5.78	2.27
Insurance	MUV2.DE	8.12	1.03
Finance	DB1.DE	9.96	0.28
Bookmaking	FLTR.IR	9.72	0.69
Semiconductors	IFX.DE	9.35	0.78
Luxury	KER.PA	10.18	0.18
Engineering and service	KNEBV.HE	9.54	0.51
Personal and household goods	OR.PA	8.43	0.96
Personal and household goods	MC.PA	8.03	1.17
Alcohol	RI.PA	9.44	0.52
Health care equipment	PHIA.AS	9.65	0.38
Aerospace	SAF.PA	7.74	1.41
Goods and Services	SU.PA	9.00	0.70
Automotive industry	VOW.DE	7.79	1.18
Real estate	VNA.DE	9.17	0.67

Table 2: High Cash Flow Duration Stocks

Reg.Result	MKT.Rf	SMB	HML
Coefficients	$3.0309e^{-12}$	$2.22516e^{-12}$	$4.37738e^{-12}$
R-square	0.352	0.036	0.40
Adjusted R-square	0.0280	-0.44	0.01
Residual	$-4.52642e^{-20}$	$-7.42932e^{-11}$	$3.55778e^{-11}$
Standard Error	$2.90825e^{-12}$	$8.12347e^{-12}$	$9.52065e^{-11}$

Table 3: Summary Regression Results

Corr	H.Dur	L.Dur	H.Beta	L.Beta	H-B-M	L-B-M
H.Dur	1					
L.Dur	0.95	1				
H.Beta	0.97	0.93	1			
L.Beta	0.96	0.95	0.93	1		
H-B-M	0.95	0.99	0.99	0.94	1	
L-B-M	0.99	0.96	0.96	0.98	0.95	1

Table 4: Correlations between stocks

	H.Dur	L.Dur	BM.Ret
MEAN	0.0078	−0.042	−0.0001
SD	0.0600	0.0787	0.0590
Avg.Volatility	0.0024	0.0031	0.0022
Mean Shp.R	36.3764	−28.4515	−26.1522
Beta	0.9913	1.3029	1

Table 5: Summary Statistics on duration socks

LOW B-TO_M	HIGH B-TO-M	LOW BETAS	HIGH BETAS	LOW MARKEY VALUE(M€)	HIGH MARKET VALUE(B€
0.000	0.002	0.790	1.870	309,09.60	1,15.236
0.000	0.000	0.460	1.400	12,8811.43	86,729.136
0.000	0.007	0.890	1.390	24,9697.75	35.379
0.000	0.007	0.710	1.640	24972.22	78.303
0.000	0.004	0.990	1.260	23,584.72	86.147
0.000	0.002	0.940	2.430	21,055.66	62.710
0.000	0.001	0.570	1.220	32,096.91	114.312
0.000	0.004	0.970	1.270	49,641.68	83,746.542
0.000	0.004	0.680	1.130	52,542.56	86.363
0.000	0.004	0.990	1.1520	50,805.06	72.218
0.000	0.002	0.990	1.930	3,243.30	34.632
0.000	0.002	0.890	1.760	26,399.35	63.400
0.000	0.005	0.600	1.870	24,879.33	43.821
0.000	0.001	0.750	2.140	30,691.80	27.474
0.000	0.390	0.540	1.630	20,9466.31	147.972
0.000	0.002	0.480	1.750	33,4106.90	20.516
0.000	0.002	0.960	1.300	47,785.67	30.705
0.000	0.003	0.530	1.440	35,684.05	41.691
0.000	0.002	0.670	1.340	48,150.33	52.030
0.000	0.001	0.860	1.300	48,150.33	54.007
0.000	0.003	1.000	1.510	33,261.53	610,136
0.000	0.001	1.080	1.470	50,805.06	83,746.542
0.010	0.011	1.060	1.440	66,365.78	86,942.550
0.007	0.005	0.180	2.020	67,863.86	9,753.964
0.010	0.005	0.530	1.080	70,650.00	92,290.050

Table 6: Stock categorized on B/M,Beta & Market value