Mini-Project 4
Buy and Hold
Group 5
Dobelman
STAT 486 - Market Models

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March 21, 2013

1 Introduction to the Strategy

In this project, we take advice from Chapter 14 of Benjamin Graham's The Intelligent Investor. In this chapter, Graham suggests seven criteria for the defensive investor to use when selecting a quantitatively-tested portfolio "to make sure that he obtains 1.) a minimum of quality in the past performance and current financial position of the company, and also 2.) a minimum of quantity in terms of earnings and assets per dollar price" (Graham). The seven criteria are as follows:

1. Adequate Size of the Enterprise: By choosing larger companies you limit the risk of holding a smaller company that easily can be affected by outside forces in a negative way. A way to implement this for industrial securities is to check that annual revenue is greater than 100 million dollars. Since we are testing Dow stocks, we disregarded this criterion because all Dow stocks will be sufficiently large.

2. A Sufficient Financial Condition: You want to invest in a company that will be able to pay off its current liabilities (has a strong current ratio) and has a low risk of defaulting on its debt in the future. The two ways we implemented this criterion was to check that the ratio of current assets to current liabilities was greater than 2, and long-term debt is less than net current assets

3. Earning Stability: Over the years you want to see that the company has strong earnings per share to show that the company has been profitable over a period of time. We implemented this by checking to make sure that earnings were positive for the last 10 years.

4. Dividend Record: You want to see that the company has paid dividends over the last 20 years. This shows value being returned to shareholders and that the firm is still in good financial standing and certain about their future. Graham suggests checking to make sure that the company has paid some dividend for the past 20 years, however he also notes that in 1970 all Dow stocks had paid a dividend. So to implement this we just checked to make sure that the company's previous year dividend was greater than 0.

5. Earnings Growth: Growth in earnings shows the investor that the company is still a good option to buy and has value in the future. If a company shows signs of reduced growth then an investor should be concerned about investing too late in the company. To implement this, we checked to make sure that the past-three-year-average-of-per-share-earnings today divided by past-three-year-average-of-per-share-earnings ten years ago was greater than one-third, as suggested by Graham.

6. Moderate Price to Earnings Ratio: You want to make sure that the price to earnings ratio is not too high. If it is inflated then you should wait to invest because you would be buying the stock at a premium. A benchmark is current price should not be more than 15 times the average earnings over the last three years. We implemented this by checking to make sure that the current price divided by past-three-year-average-of-per-share-earnings was less than 15.

7. Moderate Ratio of Price to Assets: The ratios of price to assets should be relatively moderate to make sure they are not over valuing the assets. For this, we required the current price divided by last-reported-book-value-per-share to be less than 1.5.

2 Data

We pulled our data from the CRSP/Compustat Merged data set, starting in 1950 and ending in 2011. We pulled only the stocks that were a part of our DJIA constituent list. The variables we downloaded included ACT (current assets), BKVLPS (book value per share), DLTT (long-term debt), EPSPI (earnings per share), LCT (current liabilities), dvpsp_c (dividends per share, calendar), and prcc_c (closing price per share, calendar). Immediately we noticed that the data was incomplete: for most companies, we see neither earnings data until 1963 nor dividends data until 1971. Because of this, we had to modify our criteria for including a stock to make sure that the data we were checking existed.

3 Commentary and Concerns

Looking at a graph of the value of our 100,000 portfolio (1), we can see that the SP500 dividends-included takes off above everything else. While the buy and hold portfolio value is considerably lower, it seems to be less risky and almost always gives positive. Another thing to note is that whenever our algorithm failed to find any stocks matching our criteria in the data set, we assumed a return of 1 (no money was invested in the buy and hold Graham portfolio). Due to this, we see a large period of stagnation during the mid 1990s to early 2000s in growth of the portfolio. Even with this, the Graham portfolio has higher annualized and total returns than the Dow and SP500 dividends-excluded. However, if we were to slightly alter the algorithm to be less restrictive in choosing the portfolio when no stocks are selected, we could likely see growth during that period as the Graham portfolio usually performs well when a stock is selected. We feel that being slightly less restrictive would only improve the annualized and total returns of the buy and hold portfolio.

4 Growth of our Portfolio

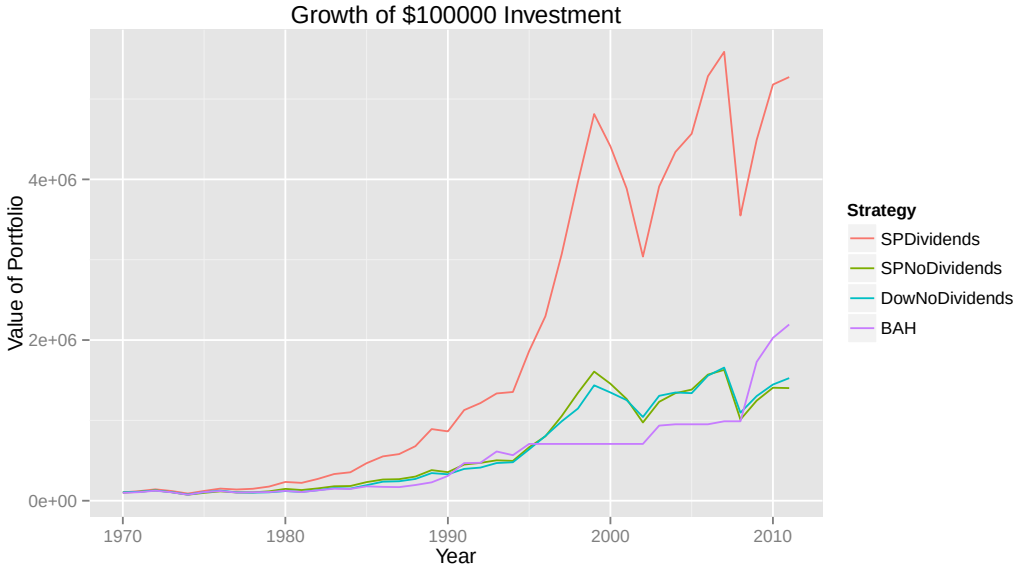

Figure 1: Above: Growth of an initial investment of several different strategies.

5 Performance Tables

	Type	BAH	SPDiv	SP500	Dow
1	Total Return	21.937	52.736	14.021	15.261
2	CAGR	1.076	1.099	1.065	1.067

	Year	SPDiv	SP500	Dow	BAH
1	1970	1.04	1.00	1.05	0.98
2	1971	1.14	1.11	1.06	1.09
3	1972	1.19	1.16	1.15	1.17
4	1973	0.85	0.83	0.83	0.84
5	1974	0.74	0.70	0.72	0.71
6	1975	1.37	1.31	1.38	1.44
7	1976	1.24	1.19	1.18	1.12
8	1977	0.93	0.88	0.83	0.84
9	1978	1.06	1.01	0.97	1.03
10	1979	1.19	1.12	1.04	1.02
11	1980	1.33	1.26	1.15	1.14
12	1981	0.95	0.90	0.91	0.88
13	1982	1.22	1.15	1.20	1.20
14	1983	1.22	1.17	1.20	1.15
15	1984	1.07	1.02	0.96	0.98
16	1985	1.32	1.27	1.28	1.22
17	1986	1.18	1.14	1.23	0.96
18	1987	1.05	1.02	1.02	0.98
19	1988	1.17	1.12	1.12	1.15
20	1989	1.31	1.27	1.27	1.17
21	1990	0.97	0.93	0.96	1.35
22	1991	1.31	1.27	1.20	1.52
23	1992	1.08	1.05	1.04	1.01
24	1993	1.10	1.07	1.14	1.30
25	1994	1.01	0.99	1.02	0.92
26	1995	1.38	1.34	1.33	1.25
27	1996	1.23	1.21	1.26	1.00
28	1997	1.34	1.31	1.23	1.00
29	1998	1.29	1.27	1.16	1.00
30	1999	1.21	1.20	1.25	1.00
31	2000	0.92	0.91	0.94	1.00
32	2001	0.88	0.87	0.93	1.00
33	2002	0.78	0.77	0.83	1.00
34	2003	1.29	1.26	1.25	1.32
35	2004	1.11	1.09	1.03	1.02
36	2005	1.05	1.03	0.99	1.00
37	2006	1.16	1.14	1.16	1.00
38	2007	1.06	1.04	1.06	1.04
39	2008	0.64	0.62	0.66	1.00
40	2009	1.26	1.23	1.19	1.75
41	2010	1.15	1.13	1.11	1.17
42	2011	1.02	1.00	1.06	1.08

6 Code

```
#######################################################
##        Mini Project 4 - Buy and Hold              ##
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#######################################################


## Load Libraries
library(ggplot2)
library(plyr)
library(lubridate)
library(xtable)

## Load the .csv data from WRDS/COMPUSTAT
bah.data <- read.delim("data.csv", stringsAsFactors = F, sep = ";")

## Load constituent list
constituents <- read.csv2("dogsdates.csv", stringsAsFactors = F)

## Add returns
bah.data$returns <- NA

for (i in 2:length(bah.data$returns)) {

  bah.data$returns[i] <- (bah.data$prcc_c[i] / bah.data$prcc_c[i - 1])

}

## Remove stocks that weren't in the DOW for specific years
## If a stock joined during a year, don't include it for that year
## If a stock left during a year, include it for that year

bah.data$marker <- FALSE
bah.data$marker2 <- FALSE

for(i in 1:length(constituents$Start)) {

  x <- constituents$PERMNO[i]
  y <- constituents$Start[i]

  w <- which(bah.data$fyear == y & bah.data$lpermno == x)
  z <- which(bah.data$fyear < y & bah.data$lpermno == x)
  bah.data$marker[w] <- TRUE
  bah.data$marker2[z] <- TRUE

}


bah <- function(year) {

  rows <- which(bah.data$fyear == (year - 1))
```

```
## Make our rules
ruleone <- bah.data$A[rows] >= .9
ruletwo <- bah.data$DLTT[rows] < bah.data$B[rows]
x <- subset(bah.data, fyear < (year - 1) & fyear >= (year - 11))
z <- x$lpermno[which(x$EPSPI < -1)]
z <- unique(z)
x <- x[-which(x$lpermno %in% z), ]

rulethree <- !(bah.data$lpermno[rows] %in% z)
rulefour <- bah.data$dvpsp_c[rows] != 0

e <- subset(bah.data, fyear >= (year - 3) & fyear < year &
              !(is.na(bah.data$EPSPI)))

count_three <- ddply(e, "lpermno", summarise, avg3 = mean(EPSPI))

f <- subset(bah.data, fyear >= (year - 13) & fyear < (year - 10) &
              !(is.na(bah.data$EPSPI)))

count_thirteen <- ddply(f, "lpermno", summarise, avg13 = mean(EPSPI))


q <- merge(count13, count3, by = "lpermno")
q <- mutate(q, fivecrit = avg3 / avg13)
failfive <- q$lpermno[which(q$fivecrit < 1/5)]


rulefive <- !(bah.data$lpermno[rows] %in% failfive)

critsix <- merge(count_three, bah.data[rows, ], by = "lpermno")
failsix <- critsix$lpermno[which(critsix$prcc_c/critsix$EPSPI > 18)]

rulesix <- !(bah.data$lpermno[rows] %in% failsix)
ruleseven<- bah.data$prcc_c[rows] / bah.data$BKVLPS[rows] <= 2.5

candidates <- ruleone & ruletwo & rulethree & rulefour & rulefive & rulesix &
              ruleseven

candidates73 <- ruleone & ruletwo & ruleseven

if (year < 1973) {

  perms <- bah.data$lpermno[candidates73]
  returns <- mean(bah.data$returns[which(bah.data$lpermno %in% perms &
                                         bah.data$fyear == year)])

  if (all(candidates73 == FALSE)) {

    returns <- 1
```

```
    }

  }

 else {

   perms <- bah.data$lpermno[candidates]
   returns <- mean(bah.data$returns[which(bah.data$lpermno %in% perms &
                                          bah.data$fyear == year)])

   if (all(candidates == FALSE)) {

     returns <- 1

    }

  }

  returns

}

years <- 1970:2011
bah.returns <- c()

for(i in 1970:2011) {
  bah.returns[i - 1969] <- bah(i)
}


bah.table <- read.csv("benchmarkdecimal.csv")
bah.table$BAH <- bah.returns
bah.table[,2:4] <- bah.table[,2:4] + 1
bah.table.invest <- bah.table
bah.table.invest[,2] <- cumprod(bah.table.invest[,2])
bah.table.invest[,3] <- cumprod(bah.table.invest[,3])
bah.table.invest[,4] <- cumprod(bah.table.invest[,4])
bah.table.invest[,5] <- cumprod(bah.table.invest[,5])
bah.table.invest[,2:5] <- bah.table.invest[,2:5] * 100000

bah.table2 <- melt(bah.table, id.vars = "Year")
bah.table3 <- melt(bah.table.invest, id.vars = "Year")

qplot(Year, value, color = variable, geom = "line",
      data = bah.table3) + ylab("Value of Portfolio") +
      ggtitle("Growth of $100000 Investment") +
      scale_colour_discrete(name = "Strategy")

ggsave("invest.pdf")

xtable(bah.table)
```

```
### Calculate total return over 32 years and CAGR
total <- prod(bah.table$BAH)
cagr <- total^(1/42)
total.spd <- prod(bah.table$SPDividends)
cagr.spd <- total.spd^(1/42)
total.sp <- prod(bah.table$SPNoDividends)
cagr.sp <- total.sp^(1/42)
total.dow <- prod(bah.table$DowNoDividends)
cagr.dow <- total.dow^(1/42)

tm <- matrix(nrow = 2, ncol = 5)
tm[1, 1] <- "Total Return"
tm[1, 2] <- round(total, 3)
tm[2, 1] <- "CAGR"
tm[2, 2] <- round(cagr, 3)
tm[1, 3] <- round(total.spd, 3)
tm[1, 4] <- round(total.sp, 3)
tm[2, 3] <- round(cagr.spd, 3)
tm[2, 4] <- round(cagr.sp, 3)
tm[1, 5] <- round(total.dow, 3)
tm[2, 5] <- round(cagr.dow, 3)

tm <- as.data.frame(tm)
colnames(tm) <- c("Type", "BAH", "SPDividends", "SPNoDividends", "DOW")
xtable(tm)
```