PE_Valuation

Arpit Gupta

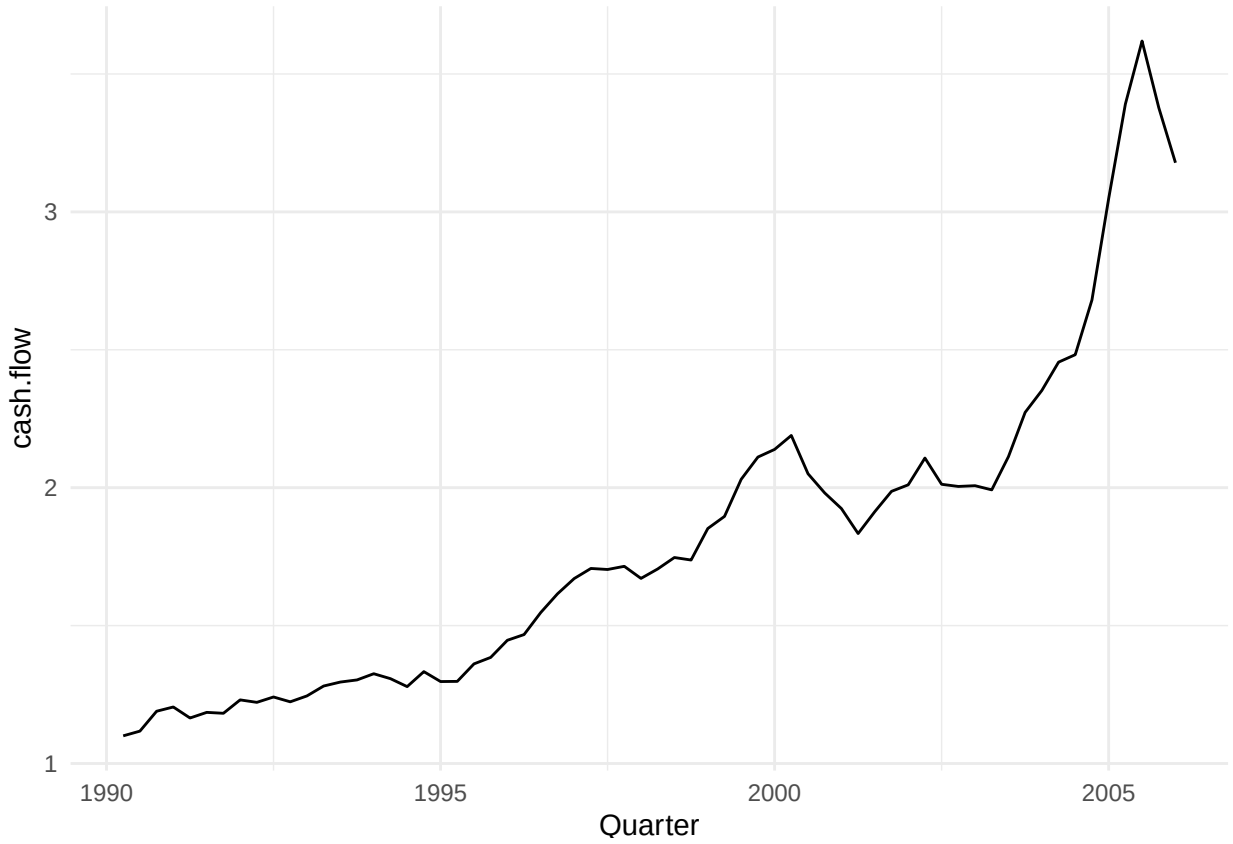
3/7/2021

Dividend and Capital Gains Strip Exploration

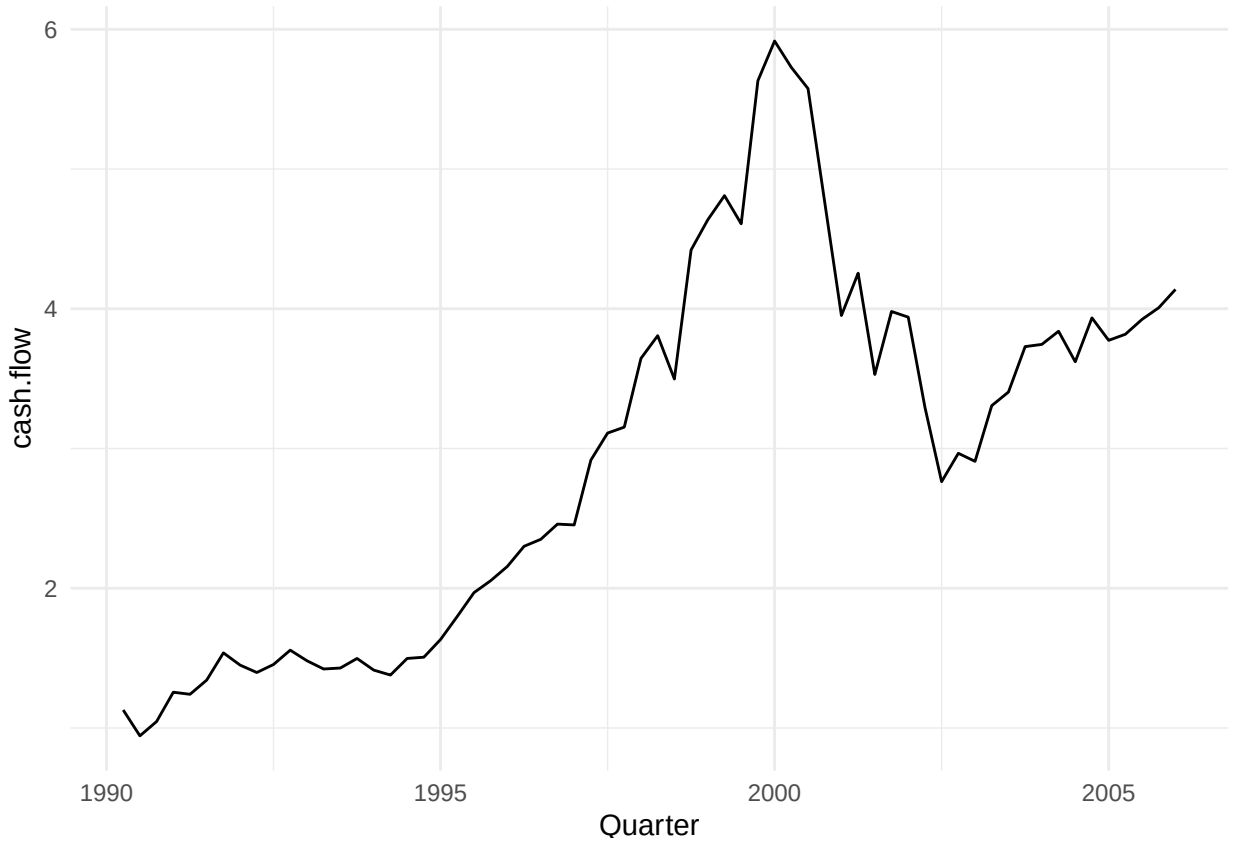
```
div.strip.data <- readMat("/Users/agupta011/Dropbox/Research/Infrastructure/JFfinal/Code/APmodel/197420

growth.strip = div.strip.data$Div.cohort.growth %>%
  as.data.frame() %>%
  mutate(vintage = row_number()) %>%
  gather(growth, cash.flow, 1:64) %>%
  mutate(vintage.quarter = (vintage - 1)/4 + 1974) %>%
  mutate(Age = as.numeric(gsub("V", "", growth)),
         Quarter = vintage.quarter + Age * 0.25)

sample = growth.strip %>% filter(vintage.quarter == 1990) %>%
  mutate(type = "dividend")

head(sample)
```

```
##   vintage growth cash.flow vintage.quarter Age Quarter     type
## 1      65     V1  1.100243            1990   1 1990.25 dividend
## 2      65     V2  1.117398            1990   2 1990.50 dividend
## 3      65     V3  1.189454            1990   3 1990.75 dividend
## 4      65     V4  1.204828            1990   4 1991.00 dividend
## 5      65     V5  1.164961            1990   5 1991.25 dividend
## 6      65     V6  1.185348            1990   6 1991.50 dividend
```

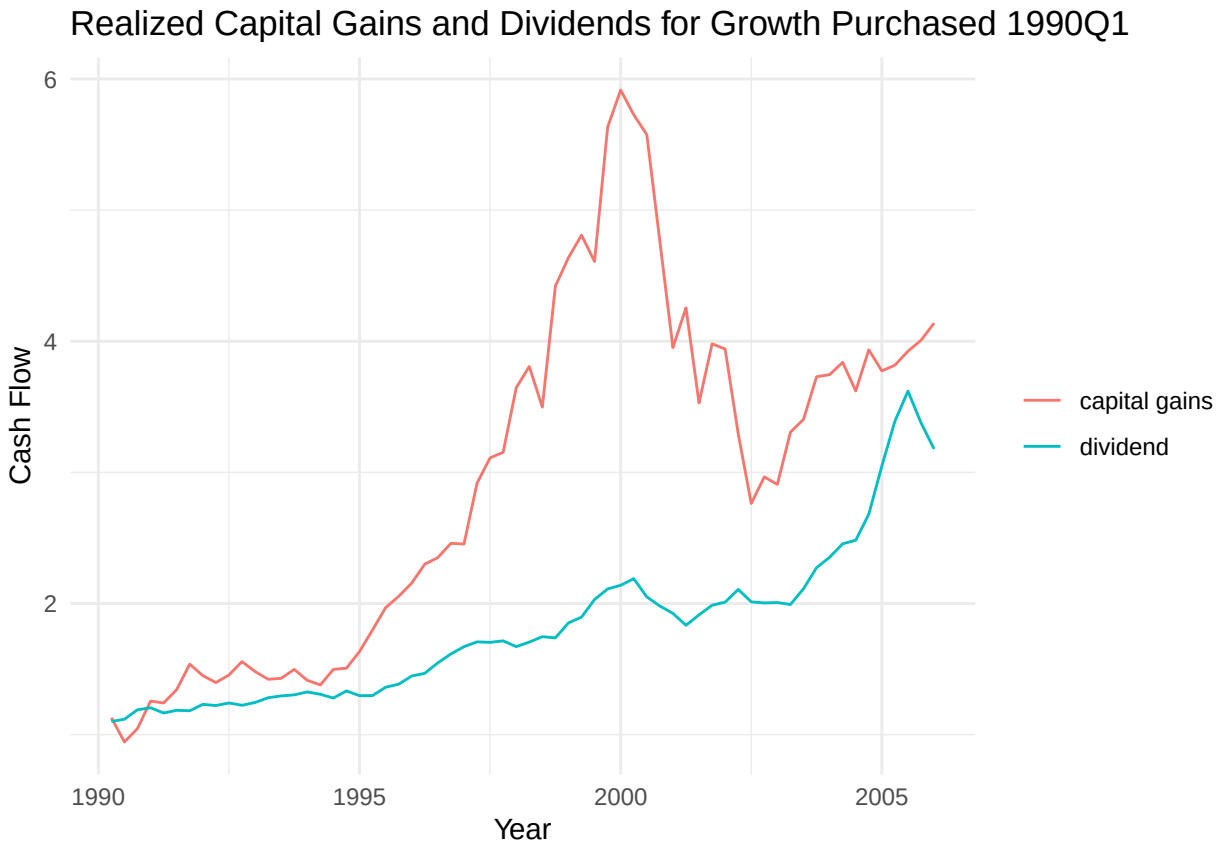
```
g <- ggplot(sample, aes(x = Quarter, y = cash.flow)) +
  geom_line()
g
```




```
growth.gains.strip = div.strip.data$Div.Pricestrip.cohort.growth %>%
  as.data.frame() %>%
  mutate(vintage = row_number()) %>%
  gather(growth, cash.flow, 1:64) %>%
  mutate(vintage.quarter = (vintage - 1)/4 + 1974) %>%
  mutate(Age = as.numeric(gsub("V", "", growth)),
         Quarter = vintage.quarter + Age * 0.25)

sample.gains = growth.gains.strip %>% filter(vintage.quarter == 1990) %>%
  mutate(type = "capital gains")

g <- ggplot(sample.gains, aes(x = Quarter, y = cash.flow)) +
  geom_line()
g
```




```
combined.sample = rbind(sample, sample.gains)

g <- ggplot(combined.sample, aes(x = Quarter, y = cash.flow, color = factor(type))) + theme(legend.titl
  labs(title = "Realized Capital Gains and Dividends for Growth Purchased 1990Q1",
       y = "Cash Flow", x = "Year") +
  geom_line()
g
```



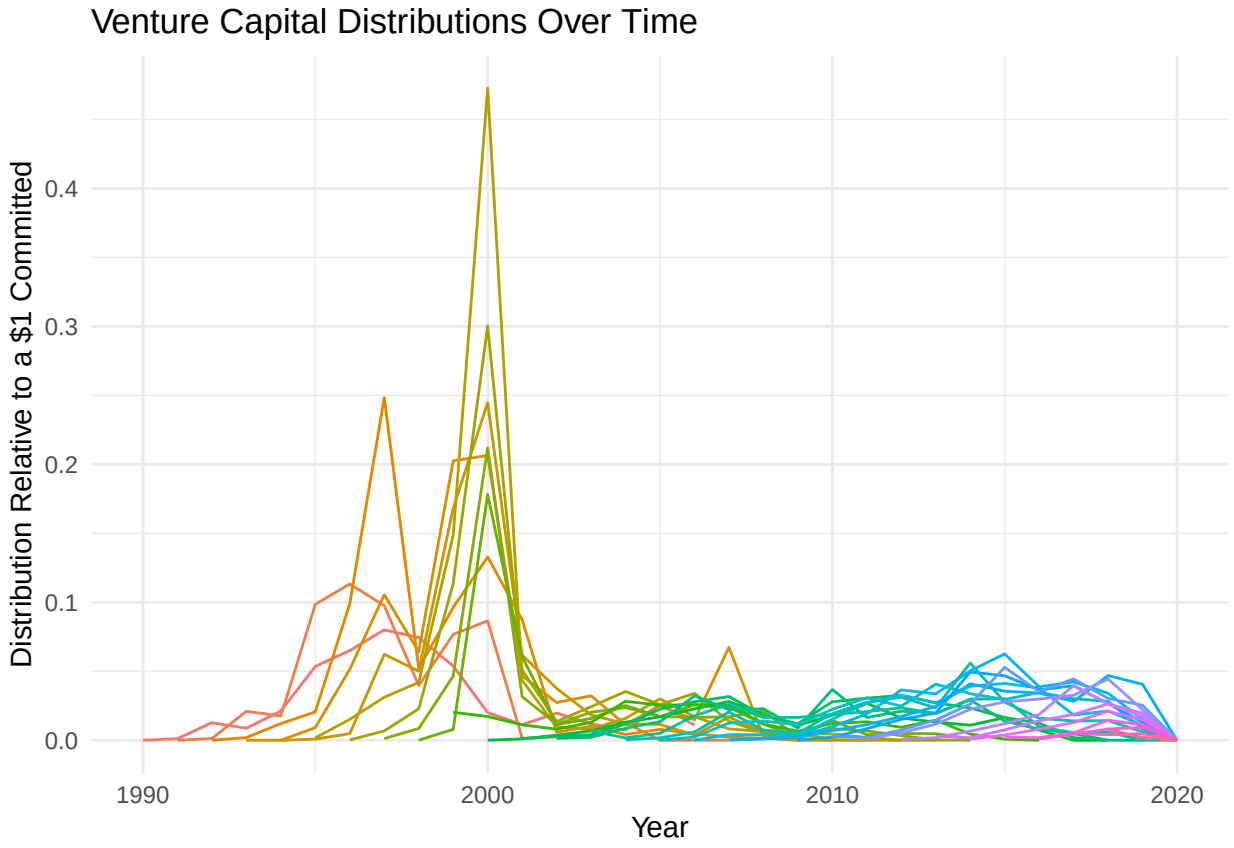
Venture Capital Data

```
load(file = "/Users/agupta011/Dropbox/Research/Infrastructure/JFfinal/Data/YearlyCashFlowOct20.Rda")

venture.capital = fund.quarterly %>% filter(fund.category == "Venture Capital")


venture.capital.plot = venture.capital %>%
  group_by(Vintage, year) %>%
  mutate(yearly.cash = mean(net.cf.distribution.rescale, na.rm = TRUE)) %>%
  select(Vintage, year, yearly.cash) %>%
  unique %>% as.data.frame() %>%
  filter(Vintage >= 1990)

head(venture.capital.plot)
```

```
##   Vintage year yearly.cash
## 1    2001 2002 0.002984519
## 2    2001 2003 0.003872314
## 3    2001 2004 0.011834765
## 4    2001 2005 0.022480854
## 5    2001 2006 0.027915613
## 6    2001 2007 0.031668624
```

```
p <- ggplot(venture.capital.plot, aes(x = year, y = yearly.cash, color = factor(Vintage))) +
  geom_line() + theme(legend.position = "none") +
  labs(title = "Venture Capital Distributions Over Time",
```

```
       y = "Distribution Relative to a $1 Committed",
       x = "Year")
p
```

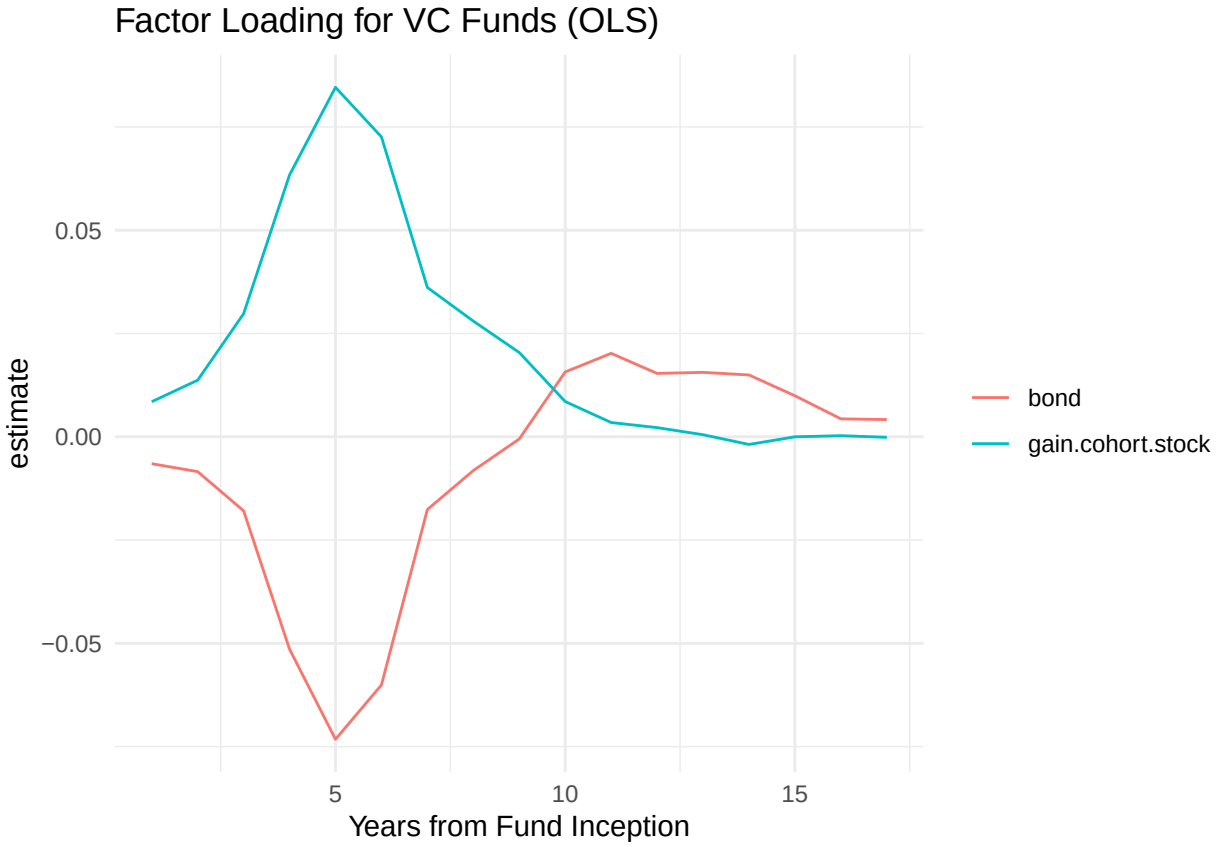


Estimate Factor Exposure of VC

OLS

```
load(file = "/Users/agupta011/Dropbox/Research/Infrastructure/JFfinal/Data/MergedCashFlowOct20.Rda")

venture.capital.df = fund.quarterly.div %>%
  filter(fund.category == "Venture Capital")

#head(venture.capital.df)

venture.capital.df = venture.capital.df %>%
  mutate(bond = 1) %>%
         filter(!is.na(gain.cohort.growth) & !is.na(cohort.value))


# OLS Regression (2 factor)
ols.2 = lm(net.cf.distribution.rescale ~ 0 + AgeFactor +
             AgeFactor:gain.cohort.stock, data = venture.capital.df)

tidy.ols.2 = tidy(ols.2)
```

```
    ols.broom = tidy.ols.2 %>% mutate(AgeFactor = as.numeric(stringr::str_extract(term,"\\d+\\.*\\d*")))

  ols.broom = ols.broom %>%
      mutate(Type =   ifelse(grepl("gain.cohort.stock", term) & grepl("AgeFactor", term), "gain.cohort.s
 # ols.broom

q <- ggplot(ols.broom, aes(x = AgeFactor, y = estimate, group = Type, color = factor(Type))) +
  geom_line() + theme(legend.title = element_blank()) +
  labs(title = "Factor Loading for VC Funds (OLS)",
       x = "Years from Fund Inception")
q
```

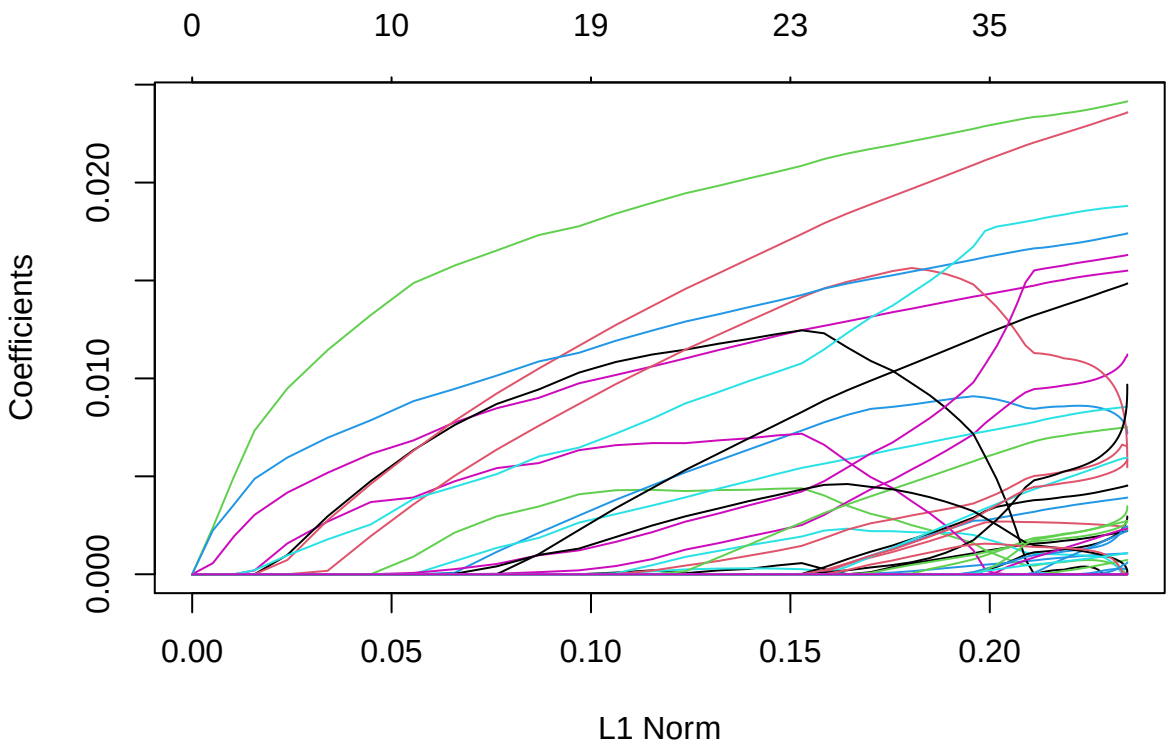


Elastic Net

```
# Y
fund.subset.y = venture.capital.df %>%
  select(net.cf.distribution.rescale) %>%
  as.matrix()

# X
# Age Dummies
AgeFactor = venture.capital.df

#dummies = dummy(AgeFactor$AgeFactor, sep = "_", verbose = false)
```

```
dummies <- dummy_cols(AgeFactor$AgeFactor)


#dummies = dummies::dummy(AgeFactor$AgeFactor, sep = "_")
fund.subset.age <- cbind(venture.capital.df, dummies)

# Cross dummies with all div vars to generate exposures
model.list = c("bond",
               "cohort.stock",
               "cohort.small",
               "cohort.growth",
               "cohort.reit",
               "cohort.infra",
               "cohort.nr",
               "cohort.value",
               "gain.cohort.stock",
               "gain.cohort.small",
               "gain.cohort.growth",
               "gain.cohort.reit",
               "gain.cohort.infra",
               "gain.cohort.nr",
               "gain.cohort.value")


for (number in 1:length(model.list)) {

        for(year in 1:16) {
          div = model.list[number]
          new.name = paste0(div, "_", year)
          age.name = paste0(".data_", year)

          # Standard
          fund.subset.age$temp = as.numeric(unlist(fund.subset.age[div])) * as.numeric(unlist(fund.subs
          fund.subset.age = mutate(fund.subset.age, !!new.name := temp)


        }
}

# Age Subset
fund.subset.x.age = fund.subset.age %>%
  select(starts_with("bond_"),
         starts_with("cohort.small_"),
         starts_with("cohort.stock_"),
         starts_with("cohort.growth_"),
         starts_with("cohort.reit_"),
         starts_with("cohort.infra_"),
         starts_with("cohort.nr_"),
         starts_with("cohort.value_"),
         contains("gain.cohort.stock_"),
         contains("gain.cohort.small_"),
         contains("gain.cohort.growth_"),
         contains("gain.cohort.reit_"),
```

```
         contains("gain.cohort.infra_"),
         contains("gain.cohort.nr_"),
         contains("gain.cohort.value_")) %>% as.matrix()

#head(fund.subset.x.age)


# run the ML Model
penalized = cva.glmnet(x = fund.subset.x.age, y = fund.subset.y, alpha = seq(0, 1, len = 11)^3, nfolds =


number.of.alphas.tested <- length(penalized$alpha)

cv.glmnet.dt <- data.table()

for (j in 1:number.of.alphas.tested){
        glmnet.model <- penalized$modlist[[j]]
        min.mse <-  min(glmnet.model$cvm)
        min.lambda <- glmnet.model$lambda.min
        alpha.value <- penalized$alpha[j]
        new.cv.glmnet.dt <- data.table(alpha=alpha.value,min_mse=min.mse,min_lambda=min.lambda)
        cv.glmnet.dt <- rbind(cv.glmnet.dt,new.cv.glmnet.dt)
}

      best.params <- cv.glmnet.dt[which.min(cv.glmnet.dt$min_mse)]

# Best Fit Elastic Net Model
penalized.model = glmnet(x = fund.subset.x.age,
                         y = fund.subset.y,
                          lower.limits = 0,
                         alpha = best.params$alpha,
                         lambda =best.params$lambda,
                         intercept = FALSE)

      penalized.model <- glmnet(x = fund.subset.x.age , y = fund.subset.y,
                                lower.limits = 0,
                                lambda = best.params$min_lambda,
                                alpha = best.params$alpha, intercept = FALSE)

# Visualization
penalized.model.truncated = glmnet(x = fund.subset.x.age,
                         y = fund.subset.y,
                          lower.limits = 0,
                         alpha = best.params$alpha,
                         intercept = FALSE)

plot(penalized.model.truncated)
```



Visualize Factor Exposure for VC

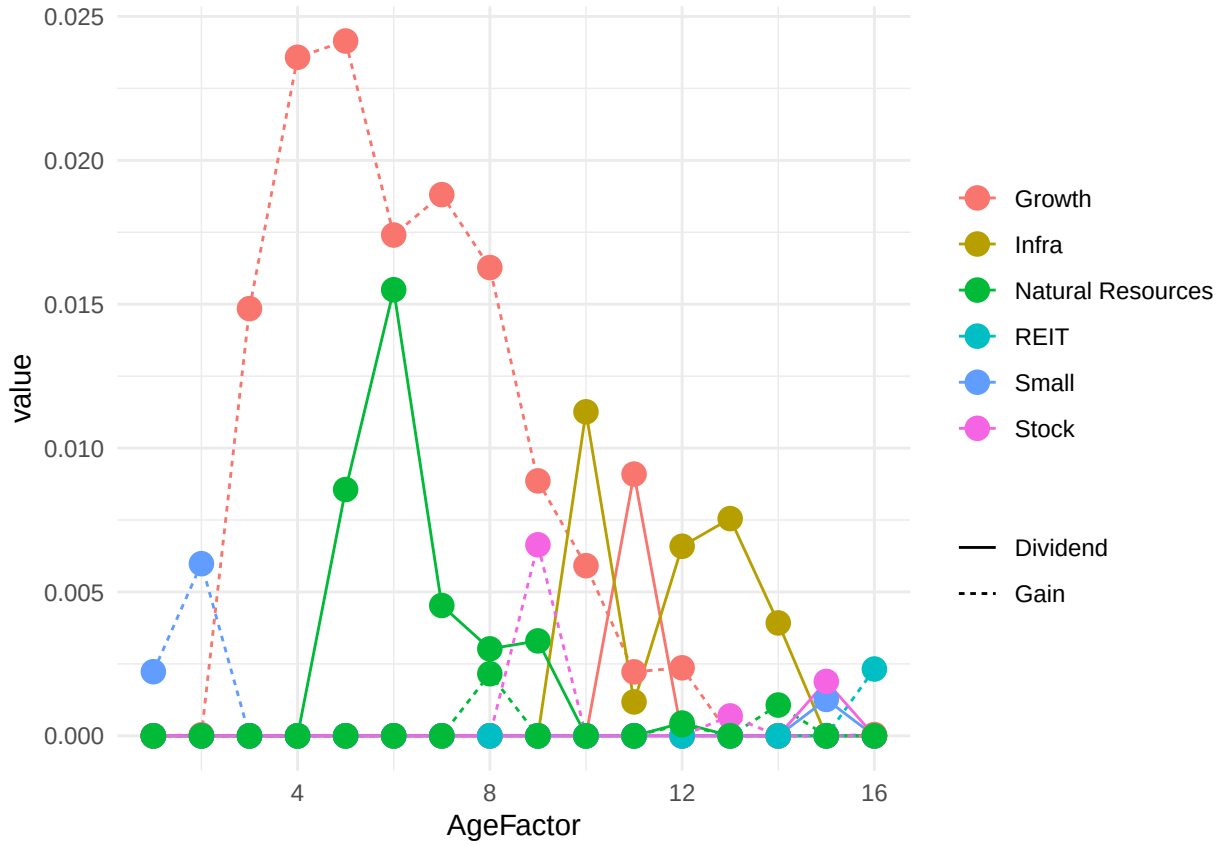
```
temp = LassoCoefs(penalized.model, model.list)
```

```
## Warning: Expected 2 pieces. Missing pieces filled with `NA` in 241 rows [1, 2,
## 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, ...].
```

```
## Warning: Expected 2 pieces. Missing pieces filled with `NA` in 241 rows [1, 2,
## 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, ...].
```

```
## Warning: Expected 2 pieces. Missing pieces filled with `NA` in 1 rows [1].
```

```
penalized.wide.age = temp[[1]]
  age.coef.pen = temp[[3]]

#head(age.coef.pen)
#penalized.wide.age


g <- ggplot(data = age.coef.pen, aes(x = AgeFactor, y = value, group= factor(Type), color = factor(facto
  geom_point(shape = 16, fill = "white", size = 0.5, stroke = 6) + theme(legend.title = element_blank())
g
```


0.025
0.020
0.015
0.010
0.005
0.000
value
4
8
12
16
AgeFactor
Growth
Infra
Natural Resources
REIT
Small
Stock
Dividend
Gain