

This code is to create the target cash holdings as of 2019 to use in model 3. The final code exports the dataframe with cash holdings to an excel sheet. The dataframe is merged with data from Betasuite (Fama-French factors and returns) in excel. All the data is in the attached excel sheet "Data_model_3"

```
##Prep
```

```
rm(list=ls())
```

```
library("rmarkdown")
```

```
library("tinytex")
```

```
library("readxl")
```

```
library("zoo")
```

```
library("ExcelFunctionsR")
```

```
library("runner")
```

```
library("car")
```

```
library("magrittr")
```

```
library("tidyverse")
```

```
library("DescTools")
```

```
library("dplyr")
```

```
library("formatR")
```

```
library("censReg")
```

```
library("survival")
```

```
library("VGAM")
```

```
library("lmtest")
```

```
library("sandwich")
```

```
library("Metrics")
```

```
data <- read_excel("C:/Users/marki/OneDrive/Skole/Master Thesis/After Preliminary/Portfolio/Covid-19 dividends/Optimal_Cash/Data 22.04.2023_Final.xlsx",
```

```
sheet = "Data_Compustat")
```

```
data$fiscal_date <-
```

```
  as.Date(paste0(data$`Data Year - Fiscal`, "-01-01"),  
          format = "%Y-%m-%d")
```

```
data <- data %>% mutate(year = year(fiscal_date))
```

```
FF_data <- FF_monthly <- read_excel("C:/Users/marki/OneDrive/Skole/Master Thesis/After  
Preliminary/Portfolio/Covid-19 dividends/returns_covid/FF_monthly.xlsx",  
                                   sheet = "FF_monthly_regression_estimates")
```

```
ESG_Scores_2019 <- read_excel("C:/Users/marki/OneDrive/Skole/Master Thesis/After  
Preliminary/Portfolio/Covid-19 dividends/returns_covid/ESG-Scores-SP1500-2018-2022.xlsx",  
                              sheet = "2019")
```

```
Monthly_returns <- read_excel("C:/Users/marki/OneDrive/Skole/Master Thesis/After  
Preliminary/Portfolio/Covid-19 dividends/returns_covid/Monthly returns.xlsx",  
                              sheet = "2014_2020")
```

```
gvt_support_data <- read.csv("C:/Users/marki/OneDrive/Skole/Master Thesis/After  
Preliminary/Portfolio/Covid-19 dividends/returns_covid/GitHub_oxford.csv")
```

```
gvt_support_data <- select(gvt_support_data, EconomicSupportIndex, RegionName, RegionCode,  
Date)
```

```
gvt_support_data <- na.omit(gvt_support_data)
```

```
gvt_support_data$state <- substr(gvt_support_data$RegionCode,  
nchar(gvt_support_data$RegionCode)-1,  
nchar(gvt_support_data$RegionCode))
```

```
gvt_support_data <- gvt_support_data %>% group_by(state) %>%
```

```
mutate(avg_support_idx = mean(EconomicSupportIndex))
```

```
gvt_support_data <- select(gvt_support_data, state, avg_support_idx)
```

```
gvt_support_data <- distinct(gvt_support_data)
```

```
data <- merge(data, gvt_support_data[c("state", "avg_support_idx")],  
             by = "state", all.x = TRUE)
```

```
##Optimal Cash##
```

```
data$`2-Digit SIC` <- LEFT(data$`Standard Industry Classification Code`, 2)
```

```
data <- data %>% filter(!`2-Digit SIC`=="60")
```

```
data <- data %>% filter(!`2-Digit SIC`=="61")
```

```
data <- data %>% filter(!`2-Digit SIC`=="62")
```

```
data <- data %>% filter(!`2-Digit SIC`=="63")
```

```
data <- data %>% filter(!`2-Digit SIC`=="64")
```

```
data$industry_CF <- (data$`Operating Income Before Depreciation`-
```

```
data$`Interest and Related Expense - Total`
```

```
- data$`Income Taxes - Total` -
```

```
data$`Dividends Common/Ordinary`)/
```

```
(data$`Assets - Total`-
```

```
data$`Cash and Short-Term Investments`)
```

```
data <- data %>%
```

```

arrange(`2-Digit SIC`, year) %>%
group_by(`2-Digit SIC`) %>%
mutate(industry_sigma = rollapply(industry_CF, width = 10, FUN = sd, fill = NA,
                                align = "right")) %>%
mutate(industry_sigma = na.locf(industry_sigma, na.rm = FALSE))

```

```

data$year_Dummy <- factor(data$`Data Year - Fiscal`)

```

```

data$IPO_Date <- as.Date(data$IPO_Date, origin = "1899-12-30")

```

```

data$assets_less_cash <- data$`Assets - Total`-data$`Cash and Short-Term Investments`

```

```

data$cash <- data$`Cash and Short-Term Investments`/data$assets_less_cash

```

```

data$firm_size <- log(data$`Assets - Total`)

```

```

data$working_capital <- (data$`Working Capital (Balance Sheet)` -
                        data$`Cash and Short-Term Investments`)/data$assets_less_cash

```

```

data$capex <- data$Acquisitions / data$assets_less_cash

```

```

data$RD <- data$`Research and Development Expense`/
data$`Assets - Total`

```

```

data["RD"][is.na(data["RD"])] <- 0

```

```

data <- data %>% arrange(year)

```

```

data <- data %>% group_by(`Ticker Symbol`) %>%

```

```
mutate(sales_growth = (`Sales/Turnover (Net)`-lag(`Sales/Turnover (Net)`[`Ticker Symbol`==`Ticker Symbol` & year==year]))/
```

```
lag(`Sales/Turnover (Net)`[`Ticker Symbol`==`Ticker Symbol` & year==year]))
```

```
data$CF_from_Operations <- data$`Operating Activities - Net Cash Flow`/
```

```
data$assets_less_cash
```

```
data <- data %>% mutate(firm_age = year - year(IPO_Date))
```

```
data$log_age <- log(data$firm_age)
```

```
data$US_corp_tax_t <- ifelse(data$year < 2018, 0.35, 0.21)
```

```
data$Foreign_Tax <- (data$`Pretax Income - Foreign` * data$US_corp_tax_t -  
data$`Income Taxes - Foreign`)/data$assets_less_cash
```

```
data["Foreign_Tax"][is.na(data["Foreign_Tax"])] <- 0
```

```
data$dividend_dummy <- ifelse(data$`Dividends Common/Ordinary`>0, 1, 0)
```

```
data["dividend_dummy"][is.na(data["dividend_dummy"])] <- 0
```

```
data$dividends_over_Assets_lessCash <- data$`Dividends Common/Ordinary`/  
(data$`Assets - Total` - data$`Cash and Short-Term Investments`)
```

```
data <- data %>% mutate(industry = as.factor(`2-Digit SIC`))
```

```
data[sapply(data, is.infinite)] <- NA
```

```
data <- data %>% group_by(year) %>%
```

```
  mutate(cash_win = Winsorize(cash, probs = c(0.01,0.99), na.rm = TRUE)) %>%
```

```
  ungroup()
```

```
data <- data %>% group_by(year) %>%
```

```
  mutate(capex_win = Winsorize(capex, probs = c(0.05,0.95), na.rm = TRUE)) %>%
```

```
  ungroup()
```

```
data <- data %>% group_by(year) %>%
```

```
  mutate(CF_from_Operations_win = Winsorize(CF_from_Operations, probs = c(0.01,0.99), na.rm = TRUE)) %>%
```

```
  ungroup()
```

```
data <- data %>% group_by(year) %>%
```

```
  mutate(Foreign_Tax_win = Winsorize(Foreign_Tax, probs = c(0.01,0.99), na.rm = TRUE)) %>%
```

```
  ungroup()
```

```
data <- data %>% group_by(year) %>%
```

```
  mutate(RD_win = Winsorize(RD, probs = c(0.01,0.99), na.rm = TRUE)) %>%
```

```
  ungroup()
```

```
data <- data %>% group_by(year) %>%
```

```
  mutate(sales_growth_win = Winsorize(sales_growth, probs = c(0.05,0.95), na.rm = TRUE)) %>%
```

```
  ungroup()
```

```
data <- data %>% group_by(year) %>%
```

```
  mutate(working_capital_win = Winsorize(working_capital, probs = c(0.01,0.99), na.rm = TRUE)) %>%
```

```
  ungroup()
```

```
data <- data %>% group_by(year) %>%
```

```
  mutate(firm_size_win = Winsorize(firm_size, probs = c(0.01,0.99), na.rm = TRUE)) %>%
```

```
ungroup()
```

```
data <- data %>% group_by(year) %>%
```

```
  mutate(industry_sigma_win = Winsorize(industry_sigma, probs = c(0.01,0.99), na.rm = TRUE)) %>%
```

```
  ungroup()
```

```
data <- data %>% group_by(year) %>%
```

```
  mutate(log_age_win = Winsorize(log_age, probs = c(0.01,0.99), na.rm = TRUE)) %>%
```

```
  ungroup()
```

```
##OPTimal Cash regression from 2014 to 2019##
```

```
optimal_cash_2006 <- lm(cash ~ capex_win +
```

```
  CF_from_Operations_win +
```

```
  Foreign_Tax_win +
```

```
  log_age_win +
```

```
  RD_win +
```

```
  sales_growth_win +
```

```
  working_capital_win +
```

```
  firm_size_win + industry_sigma_win + dividend_dummy +
```

```
  year_Dummy + industry,
```

```
  subset = year > "2013" & year < "2020",
```

```
  data = data)
```

```
summary(optimal_cash_2006)
```

```
bptest(optimal_cash_2006)
```

```
coeftest(optimal_cash_2006, vcov = vcovHC(optimal_cash_2006, type = "HC1"))
```

```
cash_intercept <- coef(optimal_cash_2006)[1]
cash_capex <- coef(optimal_cash_2006)[2]
cash_CF_from_operations <- coef(optimal_cash_2006)[3]
cash_foreign_tax <- coef(optimal_cash_2006)[4]
cash_log_age <- coef(optimal_cash_2006)[5]
cash_RD <- coef(optimal_cash_2006)[6]
cash_sales_growth <- coef(optimal_cash_2006)[7]
cash_working_capital <- coef(optimal_cash_2006)[8]
cash_firm_size <- coef(optimal_cash_2006)[9]
cash_industry_sigma <- coef(optimal_cash_2006)[10]
cash_dividend_dummy <- coef(optimal_cash_2006)[11]
```

```
cash_2015 <- coef(optimal_cash_2006)[12]
cash_2016 <- coef(optimal_cash_2006)[13]
cash_2017 <- coef(optimal_cash_2006)[14]
cash_2018 <- coef(optimal_cash_2006)[15]
cash_2019 <- coef(optimal_cash_2006)[16]
```

```
cash_ind_02 <- coef(optimal_cash_2006)[17]
cash_ind_10 <- coef(optimal_cash_2006)[18]
cash_ind_13 <- coef(optimal_cash_2006)[19]
cash_ind_14 <- coef(optimal_cash_2006)[20]
cash_ind_15 <- coef(optimal_cash_2006)[21]
cash_ind_16 <- coef(optimal_cash_2006)[22]
cash_ind_17 <- coef(optimal_cash_2006)[23]
cash_ind_20 <- coef(optimal_cash_2006)[24]
cash_ind_21 <- coef(optimal_cash_2006)[25]
cash_ind_22 <- coef(optimal_cash_2006)[26]
cash_ind_23 <- coef(optimal_cash_2006)[27]
```



```
cash_ind_24 <- coef(optimal_cash_2006)[28]
cash_ind_25 <- coef(optimal_cash_2006)[29]
cash_ind_26 <- coef(optimal_cash_2006)[30]
cash_ind_27 <- coef(optimal_cash_2006)[31]
cash_ind_28 <- coef(optimal_cash_2006)[32]
cash_ind_29 <- coef(optimal_cash_2006)[33]
cash_ind_30 <- coef(optimal_cash_2006)[34]
cash_ind_31 <- coef(optimal_cash_2006)[35]
cash_ind_32 <- coef(optimal_cash_2006)[36]
cash_ind_33 <- coef(optimal_cash_2006)[37]
cash_ind_34 <- coef(optimal_cash_2006)[38]
cash_ind_35 <- coef(optimal_cash_2006)[39]
cash_ind_36 <- coef(optimal_cash_2006)[40]
cash_ind_37 <- coef(optimal_cash_2006)[41]
cash_ind_38 <- coef(optimal_cash_2006)[42]
cash_ind_39 <- coef(optimal_cash_2006)[43]
cash_ind_40 <- coef(optimal_cash_2006)[44]
cash_ind_41 <- coef(optimal_cash_2006)[45]
cash_ind_42 <- coef(optimal_cash_2006)[46]
cash_ind_44 <- coef(optimal_cash_2006)[47]
cash_ind_45 <- coef(optimal_cash_2006)[48]
cash_ind_47 <- coef(optimal_cash_2006)[49]
cash_ind_48 <- coef(optimal_cash_2006)[50]
cash_ind_49 <- coef(optimal_cash_2006)[51]
cash_ind_50 <- coef(optimal_cash_2006)[52]
cash_ind_51 <- coef(optimal_cash_2006)[53]
cash_ind_52 <- coef(optimal_cash_2006)[54]
cash_ind_53 <- coef(optimal_cash_2006)[55]
cash_ind_54 <- coef(optimal_cash_2006)[56]
cash_ind_55 <- coef(optimal_cash_2006)[57]
cash_ind_56 <- coef(optimal_cash_2006)[58]
```

```
cash_ind_57 <- coef(optimal_cash_2006)[59]
cash_ind_58 <- coef(optimal_cash_2006)[60]
cash_ind_59 <- coef(optimal_cash_2006)[61]
cash_ind_65 <- coef(optimal_cash_2006)[62]
cash_ind_70 <- coef(optimal_cash_2006)[63]
cash_ind_72 <- coef(optimal_cash_2006)[64]
cash_ind_73 <- coef(optimal_cash_2006)[65]
cash_ind_75 <- coef(optimal_cash_2006)[66]
cash_ind_78 <- coef(optimal_cash_2006)[67]
cash_ind_79 <- coef(optimal_cash_2006)[68]
cash_ind_80 <- coef(optimal_cash_2006)[69]
cash_ind_82 <- coef(optimal_cash_2006)[70]
cash_ind_87 <- coef(optimal_cash_2006)[71]
```

```
data$cash_ind_02 <- ifelse(data$industry == "02", 1, 0)
data$cash_ind_10 <- ifelse(data$industry == "10", 1, 0)
data$cash_ind_13 <- ifelse(data$industry == "13", 1, 0)
data$cash_ind_14 <- ifelse(data$industry == "14", 1, 0)
data$cash_ind_15 <- ifelse(data$industry == "15", 1, 0)
data$cash_ind_16 <- ifelse(data$industry == "16", 1, 0)
data$cash_ind_17 <- ifelse(data$industry == "17", 1, 0)
data$cash_ind_20 <- ifelse(data$industry == "20", 1, 0)
data$cash_ind_21 <- ifelse(data$industry == "21", 1, 0)
data$cash_ind_22 <- ifelse(data$industry == "22", 1, 0)
data$cash_ind_23 <- ifelse(data$industry == "23", 1, 0)
data$cash_ind_24 <- ifelse(data$industry == "24", 1, 0)
data$cash_ind_25 <- ifelse(data$industry == "25", 1, 0)
data$cash_ind_26 <- ifelse(data$industry == "26", 1, 0)
data$cash_ind_27 <- ifelse(data$industry == "27", 1, 0)
data$cash_ind_28 <- ifelse(data$industry == "28", 1, 0)
data$cash_ind_29 <- ifelse(data$industry == "29", 1, 0)
```

```
data$cash_ind_30 <- ifelse(data$industry == "30", 1, 0)
data$cash_ind_31 <- ifelse(data$industry == "31", 1, 0)
data$cash_ind_32 <- ifelse(data$industry == "32", 1, 0)
data$cash_ind_33 <- ifelse(data$industry == "33", 1, 0)
data$cash_ind_34 <- ifelse(data$industry == "34", 1, 0)
data$cash_ind_35 <- ifelse(data$industry == "35", 1, 0)
data$cash_ind_36 <- ifelse(data$industry == "36", 1, 0)
data$cash_ind_37 <- ifelse(data$industry == "37", 1, 0)
data$cash_ind_38 <- ifelse(data$industry == "38", 1, 0)
data$cash_ind_39 <- ifelse(data$industry == "39", 1, 0)
data$cash_ind_40 <- ifelse(data$industry == "40", 1, 0)
data$cash_ind_40 <- ifelse(data$industry == "41", 1, 0)
data$cash_ind_42 <- ifelse(data$industry == "42", 1, 0)
data$cash_ind_44 <- ifelse(data$industry == "44", 1, 0)
data$cash_ind_45 <- ifelse(data$industry == "45", 1, 0)
data$cash_ind_47 <- ifelse(data$industry == "47", 1, 0)
data$cash_ind_48 <- ifelse(data$industry == "48", 1, 0)
data$cash_ind_49 <- ifelse(data$industry == "49", 1, 0)
data$cash_ind_50 <- ifelse(data$industry == "50", 1, 0)
data$cash_ind_51 <- ifelse(data$industry == "51", 1, 0)
data$cash_ind_52 <- ifelse(data$industry == "52", 1, 0)
data$cash_ind_53 <- ifelse(data$industry == "53", 1, 0)
data$cash_ind_54 <- ifelse(data$industry == "54", 1, 0)
data$cash_ind_55 <- ifelse(data$industry == "55", 1, 0)
data$cash_ind_56 <- ifelse(data$industry == "56", 1, 0)
data$cash_ind_57 <- ifelse(data$industry == "57", 1, 0)
data$cash_ind_58 <- ifelse(data$industry == "58", 1, 0)
data$cash_ind_59 <- ifelse(data$industry == "59", 1, 0)
data$cash_ind_65 <- ifelse(data$industry == "65", 1, 0)
data$cash_ind_70 <- ifelse(data$industry == "70", 1, 0)
data$cash_ind_72 <- ifelse(data$industry == "72", 1, 0)
```

```

data$cash_ind_73 <- ifelse(data$industry == "73", 1, 0)
data$cash_ind_75 <- ifelse(data$industry == "75", 1, 0)
data$cash_ind_78 <- ifelse(data$industry == "78", 1, 0)
data$cash_ind_79 <- ifelse(data$industry == "79", 1, 0)
data$cash_ind_80 <- ifelse(data$industry == "80", 1, 0)
data$cash_ind_82 <- ifelse(data$industry == "82", 1, 0)
data$cash_ind_87 <- ifelse(data$industry == "87", 1, 0)

```

```

data$year2015 <- ifelse(data$year == "2015", 1, 0)
data$year2016 <- ifelse(data$year == "2016", 1, 0)
data$year2017 <- ifelse(data$year == "2017", 1, 0)
data$year2018 <- ifelse(data$year == "2018", 1, 0)
data$year2019 <- ifelse(data$year == "2019", 1, 0)

```

```

data$optimal_cash <- (data$industry_sigma*cash_industry_sigma +
  data$firm_size*cash_firm_size + data$working_capital*cash_working_capital +
  data$sales_growth*cash_sales_growth + data$RD*cash_RD +
  data$Foreign_Tax*cash_foreign_tax +
data$CF_from_Operations*cash_CF_from_operations +
  data$capex*cash_capex + cash_intercept +
data$dividend_dummy*cash_dividend_dummy
  +data$cash_ind_02*cash_ind_02
  +data$cash_ind_10*cash_ind_10
  +data$cash_ind_13*cash_ind_13
  +data$cash_ind_14*cash_ind_14
  +data$cash_ind_15*cash_ind_15
  +data$cash_ind_16*cash_ind_16
  +data$cash_ind_17*cash_ind_17
  +data$cash_ind_20*cash_ind_20

```

+data\$cash_ind_21*cash_ind_21
+data\$cash_ind_22*cash_ind_22
+data\$cash_ind_23*cash_ind_23
+data\$cash_ind_24*cash_ind_24
+data\$cash_ind_25*cash_ind_25
+data\$cash_ind_26*cash_ind_26
+data\$cash_ind_27*cash_ind_27
+data\$cash_ind_28*cash_ind_28
+data\$cash_ind_29*cash_ind_29
+data\$cash_ind_30*cash_ind_30
+data\$cash_ind_31*cash_ind_31
+data\$cash_ind_32*cash_ind_32
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+data\$cash_ind_39*cash_ind_39
+data\$cash_ind_40*cash_ind_40
+data\$cash_ind_42*cash_ind_42
+data\$cash_ind_44*cash_ind_44
+data\$cash_ind_45*cash_ind_45
+data\$cash_ind_47*cash_ind_47
+data\$cash_ind_48*cash_ind_48
+data\$cash_ind_49*cash_ind_49
+data\$cash_ind_50*cash_ind_50
+data\$cash_ind_51*cash_ind_51
+data\$cash_ind_52*cash_ind_52
+data\$cash_ind_53*cash_ind_53
+data\$cash_ind_54*cash_ind_54

```

+data$cash_ind_55*cash_ind_55
+data$cash_ind_56*cash_ind_56
+data$cash_ind_57*cash_ind_57
+data$cash_ind_58*cash_ind_58
+data$cash_ind_59*cash_ind_59
+data$cash_ind_65*cash_ind_65
+data$cash_ind_70*cash_ind_70
+data$cash_ind_72*cash_ind_72
+data$cash_ind_73*cash_ind_73
+data$cash_ind_75*cash_ind_75
+data$cash_ind_78*cash_ind_78
+data$cash_ind_79*cash_ind_79
+data$cash_ind_80*cash_ind_80
+data$cash_ind_82*cash_ind_82
+data$cash_ind_87*cash_ind_87

```

```

+data$year2015*cash_2015
+data$year2016*cash_2016
+data$year2017*cash_2017
+data$year2018*cash_2018
+data$year2019*cash_2019)

```

```
data$abnormal_cash <- data$cash - data$optimal_cash
```

```
data$excess_cash <- ifelse(data$abnormal_cash>0, data$abnormal_cash, NA)
```

```
data$insufficient_cash <- ifelse(data$abnormal_cash<0, data$abnormal_cash, NA)
```

```
data$insufficient_cash_abs <- ifelse(data$abnormal_cash<0, data$abnormal_cash*(-1), NA)
```

```
data$excess_cash_scaled <- (data$excess_cash*data$assets_less_cash)/data$`Assets - Total`
```

```
data <- data %>% group_by(year) %>%
```

```
mutate(abnormal_cash_win = Winsorize(abnormal_cash, probs = c(0.01,0.99), na.rm = TRUE)) %>%
ungroup()
```

```
data <- data %>% group_by(year) %>%
mutate(excess_cash_win = Winsorize(excess_cash, probs = c(0.01,0.99), na.rm = TRUE)) %>%
ungroup()
```

```
data <- data %>% group_by(year) %>%
mutate(excess_cash_scaled_win = Winsorize(excess_cash, probs = c(0.01,0.99), na.rm = TRUE)) %>%
ungroup()
```

```
data <- data %>% group_by(year) %>%
mutate(insufficient_cash_win = Winsorize(insufficient_cash, probs = c(0.01,0.99), na.rm = TRUE))
%>%
ungroup()
```

```
data <- data %>% group_by(year) %>%
mutate(insufficient_cash_abs_win = Winsorize(insufficient_cash_abs, probs = c(0.01,0.99), na.rm =
TRUE)) %>%
ungroup()
```

```
data$ticker <- data$`Ticker Symbol`
```

```
abnormal_cash_2019_data <- select(data, excess_cash, insufficient_cash, abnormal_cash, ticker,
`Cash and Short-Term Investments`, `Assets - Total`, `Debt in Current Liabilities -
Total`,
`Long-Term Debt - Total`, `Operating Income Before Depreciation`,
`Closing price`, `Shares outstanding`, `Book/Market`,
year)
```

```
library(openxlsx)
```

```
setwd("C:/Users/marki/OneDrive/Skole/Master Thesis/After Preliminary/Portfolio/Covid-19  
dividends/returns_covid")
```

```
write.xlsx(abnormal_cash_2019_data, file = "Lins_data_abnormal_cash")
```