

Author / Eingereicht von
Felix Reichel
Matriculation number
K12008176

Submission / Angefertigt am
Department of
Economics

Thesis Supervisor / First
Supervisor / BeurteilerIn /
ErstbeurteilerIn /
ErstbetreuerIn
Dr. Jochen Güntner

1st January 2024

Stock Returns over the FOMC Cycle Revisited



Bachelor Thesis

to obtain the academic degree of

Bachelor of Science

in the Bachelor's Program

Economics and Business

To myself, respectively.

Contents

1. Motivation	1
2. What is the "FED Put" and how can it be explained?	2
2.1. The FED Put	2
2.2. Stock Returns over the FOMC Cycle	3
2.3. The Economics of the FED Put	6
3. Stock returns over the FOMC Cycle Revisited	8
3.1. The FOMC Cycle	8
3.2. Institutional Setting	9
3.3. FOMC Data	9
3.4. Statistical Analysis	9
3.4.1. MLR model	9
3.4.2. FOMC dummies	10
3.4.3. Data Preprocessing	10
3.4.4. Calculation of stock excess returns	11
3.4.5. Regression Results	11
4. Conclusion	15
A. Appendix	17
A.1. R Code: FOMC Dummy Generation	17
A.1.1. CSV File: Example structure of generated FOMC dummy variables	20
A.2. R Code: Tests	21
A.3. R Code: Fama-French Daily Factors Data Extraction	22
A.4. STATA Code: Statistical Analysis	23

List of Figures

2.1. Average 5-day stock excess returns over FOMC cycle time (pct) (Cieslak et al.)	3
2.2. “The long arm of the Fed”	4
2.3. Probability of Federal Funds Rate (FFR) target changes within FOMC cycle time (Cieslak et al.)	5
2.4. Negative and positive phrases of the stock market count (Cieslak and Vissing-Jorgensen)	7
3.1. Frequency of FOMC meetings during the year from 1994 to 2016 (Cieslak et al.)	8

List of Tables

3.1. Replication results of Table 1 Panel A as in (Cieslak et al.)	12
3.2. European Stock Returns over the FOMC cycle	12
3.3. US Stock Returns over the FOMC Cycle from 2016 onwards	13
3.4. European Stock Returns over the FOMC Cycle from 2016 onwards	13
3.5. Comparison of Dummy Coefficients between US and European Stock Returns	14

1. Motivation

The starting point of this thesis is recently conducted research that studies the link and possible causal effects between monetary policy decisions by the FED and the stock market in the U.S., not only in an ex-post but also in an ex-ante sense.

The paper "Stock Returns over the FOMC Cycle" (Cieslak et al.) finds a pattern in financial markets around the world that suggests that stock market excess returns in the last 23 were entirely earned in even weeks (0, 2, 4 and 6) starting from the last FOMC meeting. The authors tie their findings to a known phenomenon called "Fed Put", by which they mean accommodating monetary policy.

In a follow-up paper, "The Economics of the FED Put" (Cieslak and Vissing-Jorgensen) the authors use textual analysis of FOMC (Federal Open Market Committee) scripts to identify and measure the causal effect that policymakers indeed pay attention to the stock market, especially since the mid-1990s and stock market performance is linked with updates of the FED's internal growth projections. The authors further claim that even if the policymakers seem to be aware that a dynamic like the FED put could cause overly risky investing behavior leading to moral-hazard implications, it does not particularly change their decision-making in an ex-ante sense.

In my thesis, I aim to find out whether the financial pattern regarding stock excess returns in FOMC even weeks is still relevant from 2016 (which should not be the case, especially once the information has reached the market) onwards (probably complicated by the COVID-19 crisis) since the paper published in 2019 only investigates this pattern before 2016. Additionally, the authors prove the relevance of their financial pattern worldwide using exchange-traded funds (ETFs) containing European stocks. I want to include further results with a specific focus on European stock returns.

2. What is the "FED Put" and how can it be explained?

2.1. The FED Put

The FED Put in general refers to (or, moreover, to the belief of) a strong accommodating monetary policy by the Federal Reserve (FED), by which, in case of a sharp decline in asset prices, the FED is expected by the market (its investors) to intervene. The term is coined from the concept of a "Put option" in asset markets, which gives the buyer the option to sell at a predetermined price. Thus, the FED would protect an investor from the decline in the value of an asset.¹

Central banks have gained credibility ever since the mid-1980s by keeping inflation low. (Hall) The related term "Greenspan Put" is often used to describe the monetary policy of the under former Federal Reserve Chairman Alan Greenspan to intervene in financial markets in order to prevent significant declines or disruptions.

While some argue that market interventions are necessary to prevent financial crises (like the Dot-com bubble burst in 2001 or Lehman Brothers in 2008), others believe that these interventions distort the market and create unnecessary moral hazards (Cieslak and Vissing-Jorgensen), meaning that investors are willing to take on excessive risks because they believe that the FED will always come to rescue them arguing that such "too big to fail" beliefs or mentality can lead to financial crises in the long run.

¹<https://corporatefinanceinstitute.com/resources/economics/FED-Put/>

2. What is the "FED Put" and how can it be explained?

2.2. Stock Returns over the FOMC Cycle

Diving further into dynamics like the FED Put, the paper “Stock Returns over the FOMC cycle” focusses on a FOMC cycle specific pattern of the equity premium since 1994. The stock returns exhibit a distinct, statistically significant patterns over the FOMC cycle. Notably, it primarily accrues in even weeks of FOMC cycle time (for a graphical explanation of the FOMC cycle, see figure 3.1 on page 8). For calculation of stock excess returns they authors use research portfolio data provided by Kenneth R. French for convenience².

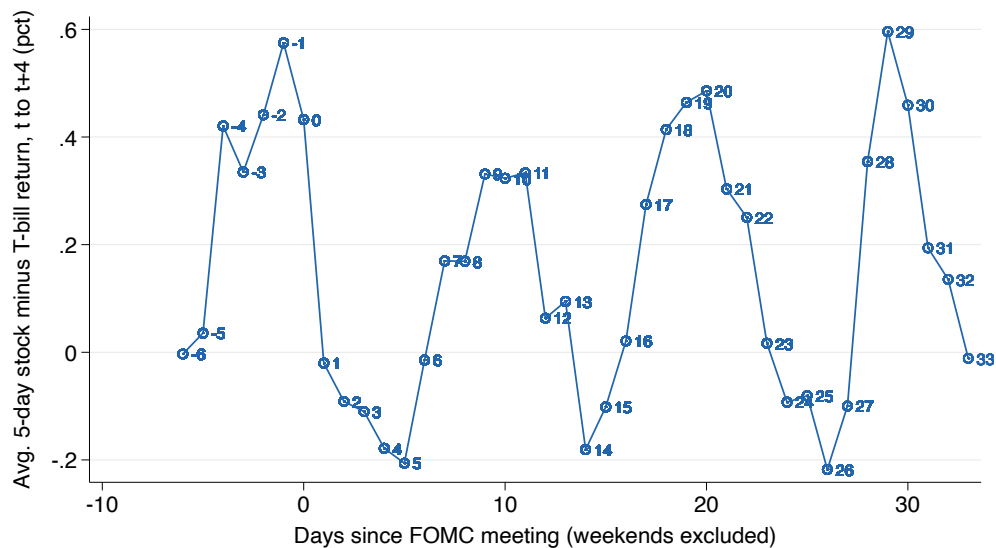


Figure 2.1.: Average 5-day stock excess returns over FOMC cycle time (pct) (Cieslak et al.)

The authors present three different trading strategies (A, B, and C) that demonstrate on the influence of the FOMC cycle on stock market returns. Of particular note is Strategy A, which involves exclusively holding stocks during even FOMC cycle weeks. This strategy demonstrates that the average annual returns more than double compared to holding for example an ETF throughout the entire FOMC cycle. Conversely, the authors find that holding an ETF during uneven FOMC weeks resultet in financial losses over the examined period from 1994 to 2016. This results have also been covered in the media.³

²https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html#research

³<https://www.economist.com/finance-and-economics/2016/09/03/the-long-arm-of-the-FED>

2. What is the "FED Put" and how can it be explained?

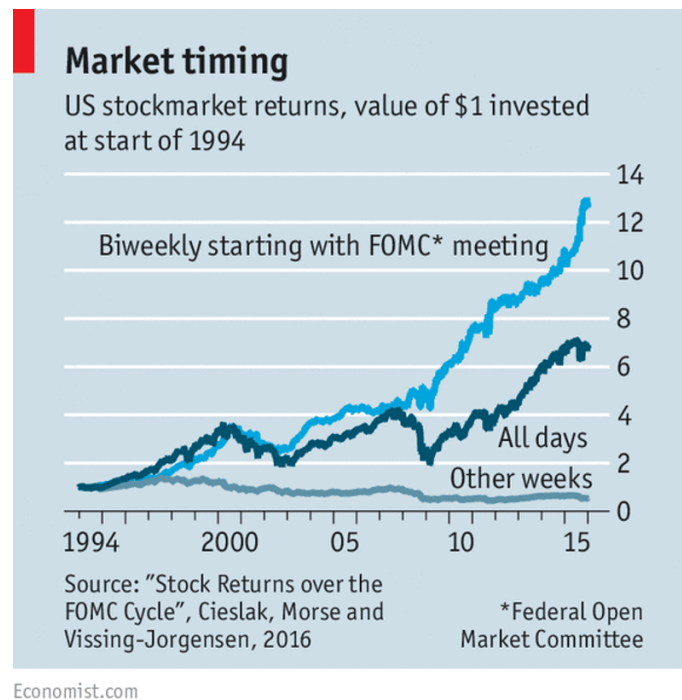


Figure 2.2.: "The long arm of the Fed"

The authors extend their analysis to explore whether the FOMC cycle return pattern extends beyond the United States, potentially influenced by movements of the dollar currency. To investigate this, they use ETFs containing globally diversified stocks. To establish causality, the authors compare FOMC cycles with other macroeconomic news calendars (e.g., Bloomberg macroeconomic news), dispelling the notion that macroeconomic news significantly correlates with FOMC cycle calendars. They also provide evidence that the release of quarterly firm profits does not substantially account for the observed equity premium patterns over the FOMC cycle.

The authors examine a causal link between the FED's policy actions and the behavior of the stock market by analyzing changes in the Federal Fund target changes between meetings, FED funds futures and internal meetings of the Board of Governors. They propose that the FED's accommodating policies have a substantial impact on the stock market, resulting in a decrease of the overall equity premium. Additionally, they contend that there is evidence of informal communication channels between FED officials, the

2. What is the "FED Put" and how can it be explained?

media, and the financial sector, which serve as a means for disseminating information about monetary policy to the market.

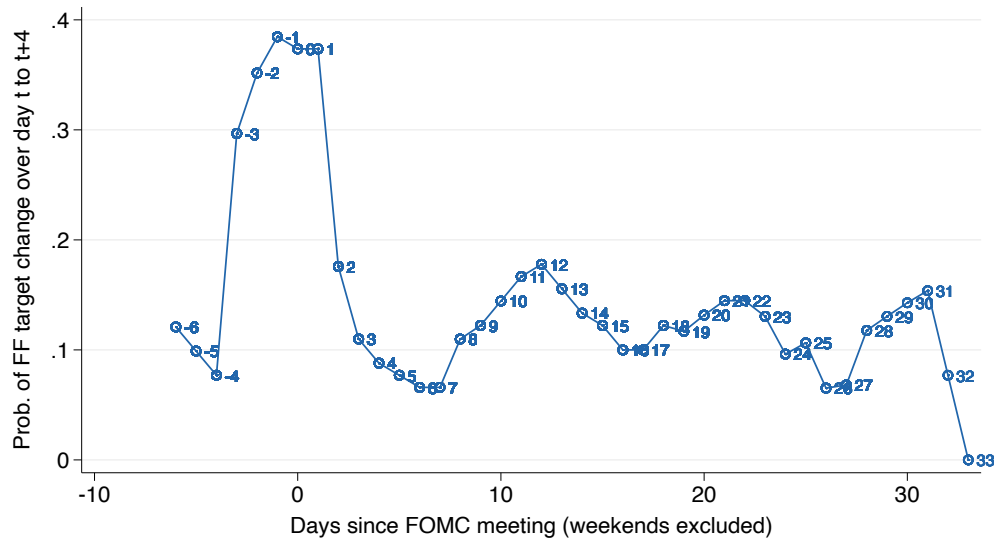


Figure 2.3.: Probability of Federal Funds Rate (FFR) target changes within FOMC cycle time (Cieslak et al.)

2. What is the "FED Put" and how can it be explained?

2.3. The Economics of the FED Put

"The Economics of FED Put" (Cieslak and Vissing-Jorgensen) further attempts to study the economics of the relationship between FED policy and the stock market. The authors compare the stock market's predictive power to other economic indicators to forecast changes in the Federal Funds Rate (FFR) using textual analysis from former Federal Open Market Committee (FOMC) meeting transcripts.⁴ Their findings affirm that the FED indeed pays a lot of attention to the stock market during market downturns.

They argue that the FED Put is fueled by the Federal Reserve's concerns about the consumption wealth effect. Conversely, strong stock market performance corresponds to updates of the FED's internal growth projections. Empirical evidence substantiates their claims, as multiple regressions on changes in the Federal Funds Rate (FFR) demonstrate that the stock market captures a higher proportion of the variance (R-squared) compared to other macroeconomic indicators. Significantly, this relationship appears to be less pronounced before the 1990s period.

During the third European Central Bank (ECB) research conference⁵, valuable comments on the econometric approach used by the authors were made by the discussant, Emmanuel Moench, the former head of research at Deutsche Bank. Moench suggests that the correlation between negative stock excess returns and the Federal Funds Rate is heavily influenced by two specific FOMC meetings (during financial crises like the dot-com bubble burst in 2001 and the 2008 financial crisis). Furthermore, he recommended incorporating additional covariates, including consumer confidence news and credit spreads, into the regression models to enhance their explanatory power. Moench sees the stock market as one of several co-factors influencing Federal Reserve policy (presumably over the updates of the FED's growth projections as stated by the authors), rather than a dominant driver of the FED's policy.

⁴https://www.federalreserve.gov/monetarypolicy/fomc_historical.htm

⁵European Central Bank.

2. What is the "FED Put" and how can it be explained?

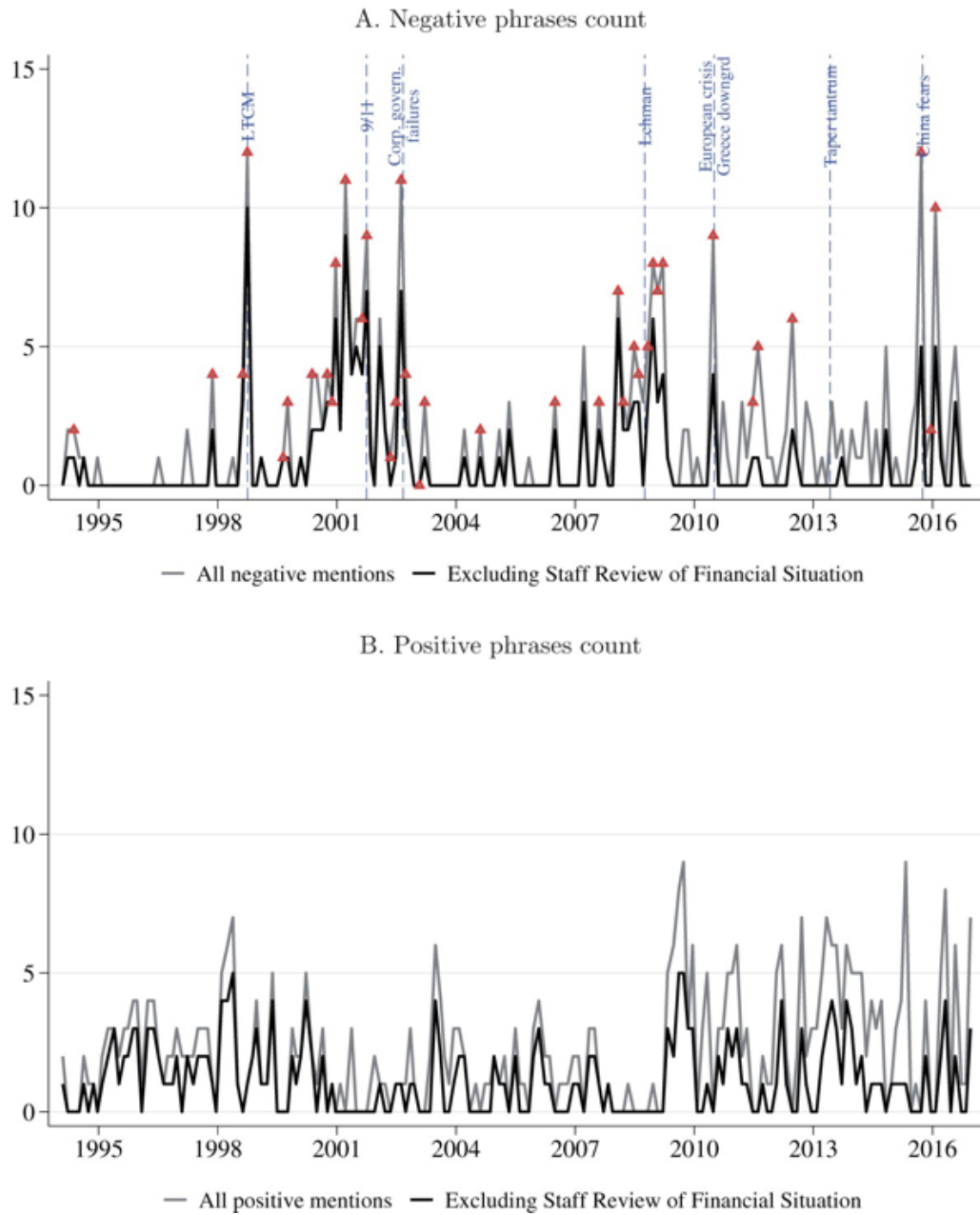


Figure 2.4.: Negative and positive phrases of the stock market count (Cieslak and Vissing-Jorgensen)

3. Stock Returns over the FOMC Cycle Revisited

3.1. The FOMC Cycle

The FOMC meets approximately every eight weeks during the year, resulting in an FOMC cycle time of approximately 7 weeks (excluding weekends) most of the time since a year has 52 weeks. The authors, therefore, define FOMC cycle time week dummy variables for week 0 as days -1 to 3, week 1 as days 4 to 8, and week 6 as days 29 to 33. Worth mentioning is that the authors drop 3 days, which would be in FOMC cycle week 7 from their investigation, and that the number of available data points decreases for FOMC dummies (meaning 920 days in week 0, 924 days in week 2, 831 days in week 4, 120 days in week 6 for the relevant timespan from 1994 to 2016).

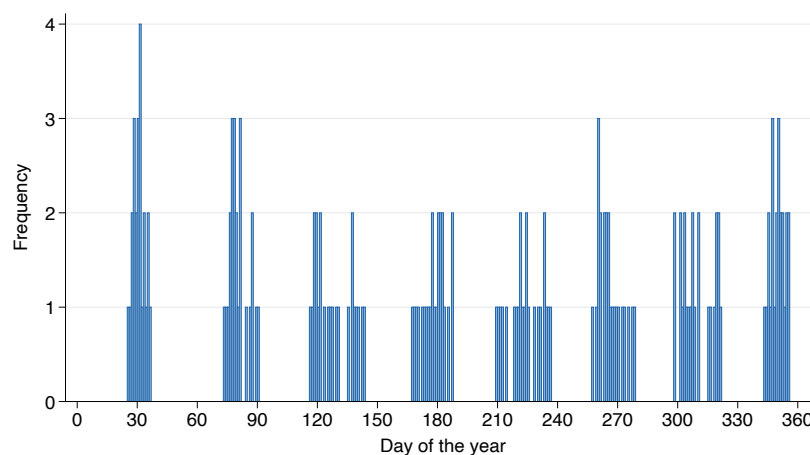


Figure 3.1.: Frequency of FOMC meetings during the year from 1994 to 2016 (Cieslak et al.)

3.2. Institutional Setting

The Federal Reserve System is comprised of the Board of Governors, 12 Federal Reserve Banks, and the FOMC. The FOMC's 12 members are responsible for implementing monetary policy to achieve macroeconomic goals, such as adjusting Federal fund rates and conducting large-scale purchases of treasury securities and Federal agency-issued or guaranteed securities since the 2008 financial crisis as policy tools to lower long-term interest rates, ensuring the functioning of the U.S. economy.¹

3.3. FOMC Data

The FOMC publishes detailed records of its meeting proceedings on the Federal Reserve's webpage². The transcripts have been produced by the FOMC Secretariat shortly after every meeting since the year 1994. The meeting participants have the opportunity to review the transcripts for accuracy within the subsequent weeks. These transcripts are available on the Federal Reserves webpage and contain a very small amount of confidential information that may be deleted. The FOMC also issues a policy statement after each meeting, summarizing the economic outlook and their policy decisions. The Chairman holds press briefings to discuss policy decisions and economic projections. The minutes of the meetings are released three weeks after every regular meeting, and the meeting transcripts are accessible for up to five years after the meeting.

3.4. Statistical Analysis

3.4.1. MLR model

One relevant multiple linear regression (MLR) model with dummy variables for even FOMC cycle weeks as in (Cieslak et al.) can be defined as:

$$ex1_i = \beta_0 + D_0 * \gamma_1 + D_1 * \gamma_2 + \epsilon_i \quad (3.1)$$

¹<https://www.federalreserve.gov/aboutthefed.htm>

²<https://www.federalreserve.gov/monetarypolicy/fomccalendars.htm>

3. Stock Returns over the FOMC Cycle Revisited

where

$$D_0 = \begin{cases} 1, & \text{If in week 0 of FOMC cycle time} \\ 0, & \text{Otherwise} \end{cases} \quad (3.2)$$

is a function equal to 1 if the FOMC cycle dummy is in week 0,

$$D_1 = \begin{cases} 1, & \text{If in week 2,4 or 6 of FOMC cycle time.} \\ 0, & \text{Otherwise} \end{cases} \quad (3.3)$$

is a function equal to 1 if the FOMC cycle dummy is in week 2, 4 or 6, $ex1_i$ are the 1-day risk-free excess returns on stocks, $\hat{\beta}_0$ is the OLS-estimated intercept, $\hat{\gamma}_1, \hat{\gamma}_2$ are OLS-estimated coefficients and $\epsilon_i \sim i.i.d. \mathcal{N}(0, \sigma^2)$ are independent identically distributed OLS-estimated standard errors. The OLS-estimated coefficient $\hat{\gamma}_1$ is of more importance with subject to the probability of target changes between meetings. (see figure 2.3)

3.4.2. FOMC dummies

The R Code in `generate_fomc_dummies_cycle_dummies.R` (see Appendix) generates FOMC week dummy variables by using the "FOMC_Cycle_dates_1994_nov2023.xlsx" file containing FOMC meeting dates for later estimation of the influence of the FOMC cycle on excess stock returns.

3.4.3. Data Preprocessing

The analysis commences with the importation and organization of two datasets. The first dataset, identified as `fomc_data`, is loaded from the file `fomc_week_dummies_1994_nov2023.csv`. This dataset includes information related to FOMC week dummies spanning from November 1994 to November 2023. The data is sorted by date, and the sorted dataset is then saved as `d:fomc_data`, thereby replacing any pre-existing file.

Following this, the second dataset, labeled as `us_returns_data`, is imported from the file `us_returns_df_1994_oct2023.csv`. This dataset contains information regarding Fama-French factors for the U.S. market, covering the period from October 1994 to October 2023.

3. Stock Returns over the FOMC Cycle Revisited

Similar to the first dataset, it undergoes sorting by date, and the sorted dataset is saved as `d:us_returns_data`, replacing any existing file.

To consolidate the information, a merge operation is executed using the "date" variable as the key. This operation combines the `fomc_data` and `us_returns_data` datasets into a new dataset named `FED_Put_datamerged_data`. The merged dataset is saved as `d:FED_Put_datamerged_data`, effectively replacing any prior file.

Finally, a new variable named `date2` is generated by transforming the existing "date" variable using the `date()` function with the "YMD" (year-month-day) format. The resulting dataset is now then used for further analysis, incorporating information from both the FOMC week dummies and U.S. market returns datasets.

3.4.4. Calculation of stock excess returns

Excess stock returns are calculated using the Fama-French 3-factor model developed by Kenneth R. French and Eugene Fama. Data for US market returns for this model and also for various other markets (e.g., European, Asia) get published regularly on Kenneth R. French's webpage³.

If m represents $1 + \text{stock return}$ and r denote $1 + \text{bill return}$, the 1-day excess return (ex1) is calculated by subtracting r from m and multiplying the result by 100, which can be expressed as $\text{ex1} = 100 \times (m - r)$. The 5-day excess return (ex5) is computed over a rolling 5-day window, involving the product of five consecutive values of m and r . The formula is given by $\text{ex5} = 100 \times (m \times m_{t+1} \times m_{t+2} \times m_{t+3} \times m_{t+4} - r \times r_{t+1} \times r_{t+2} \times r_{t+3} \times r_{t+4})$. Furthermore, t represents the observation number in the dataset.

Overall, the calculation for evaluating stock excess returns provides insight into their performance relative to the risk-free rate.

3.4.5. Regression Results

The regression coefficients in Table 3.1, 3.2, 3.3 and 3.4 are reported with t-Statistics robust to heteroskedasticity in parentheses. The coefficients for dummy variables in Table 3.5

³https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

3. Stock Returns over the FOMC Cycle Revisited

	(1) 2014-2016	(2) 1994-2014	(3) 1994-2016
Dummy = 1 in Week 0	0.174* (1.92)	0.138*** (2.80)	0.143*** (3.21)
Dummy = 1 in Week 2, 4, 6	0.166** (2.55)	0.0890** (2.38)	0.0990*** (2.95)
Intercept	-0.0486 (-1.14)	-0.0164 (-0.76)	-0.0206 (-1.05)
Observations	782	5224	6006
significant at 1%-level (***), 5% level (**), 10% level (*)			

Table 3.1.: Replication results of Table 1 Panel A as in (Cieslak et al.)

	(1) 2014-2016	(2) 1994-2014	(3) 1994-2016
Dummy = 1 in Week 0	0.191* (1.83)	0.131*** (2.65)	0.138*** (3.08)
Dummy = 1 in Week 2, 4, 6	0.146* (1.89)	0.0420 (1.12)	0.0555 (1.63)
Intercept	-0.0819 (-1.61)	-0.00213 (-0.09)	-0.0124 (-0.60)
Observations	782	5223	6005
significant at 1%-level (***), 5% level (**), 10% level (*)			

Table 3.2.: European Stock Returns over the FOMC cycle

show distinct patterns between US and European stock 1-day excess returns over the FOMC cycle time. In the pre-covid sample period 2016-2019 (1), the coefficient for Dummy = 1 in Week 0 is -0.211 (statistically significant at the 5%-level) for US stocks compared to -0.106 (statistically insignificant) for European stock returns. For Dummy = 1 in Week 2, 4, 6, the US coefficient is -0.0487 compared to 0.00678 (both statistically insignificant) for European stock excess returns. Similar contrasting patterns in coefficients persist in the subsequent periods 2019-2022 (2), 2016-2023 (3), and 1994-2023 (4), emphasizing the slightly nuanced responses of US and European stock markets with respect to FOMC cycle-related events.

3. Stock Returns over the FOMC Cycle Revisited

	(1)	(2)	(3)	(4)
	2016-2019	2019-2022	2016-2023	1994-2023
Dummy = 1 in Week 0	-0.211** (-2.29)	-0.0952 (-0.57)	-0.125 (-1.40)	0.0800** (2.01)
Dummy = 1 in Week 2, 4, 6	-0.0487 (-0.74)	0.0578 (0.48)	0.0256 (0.41)	0.0828*** (2.81)
Intercept	0.0960** (2.48)	0.0108 (0.12)	0.0434 (0.94)	-0.00622 (-0.34)
Observations	762	779	1752	7772

significant at 1%-level (***), 5% level (**), 10% level (*)

Table 3.3.: US Stock Returns over the FOMC Cycle from 2016 onwards

	(1)	(2)	(3)	(4)
	2016-2019	2019-2022	2016-2023	1994-2023
Dummy = 1 in Week 0	-0.106 (-1.35)	-0.0641 (-0.43)	-0.0612 (-0.78)	0.0911** (2.34)
Dummy = 1 in Week 2, 4, 6	0.00678 (0.12)	0.111 (1.03)	0.0759 (1.36)	0.0599** (2.05)
Intercept	0.0596* (1.79)	-0.0165 (-0.21)	0.00995 (0.25)	-0.00743 (-0.41)
Observations	762	779	1753	7772

significant at 1%-level (***), 5% level (**), 10% level (*)

Table 3.4.: European Stock Returns over the FOMC Cycle from 2016 onwards

In the first sample from 2016 onwards (1), where the coefficient for the term for FOMC cycle week 0 is statistically significant on the 5%-level, the sign of the coefficient turned negative, which is in a consonant with a market dynamic labeled by the media as a so-called "FED Call".⁴ Looking at the whole period from 1994 to 2023 (4), the regression coefficient of the FOMC cycle pattern turns out to be significantly smaller. All samples from COVID-19 onwards seem to be statistically insignificant so far, suggesting that the FOMC cycle pattern has probably decreased or vanished.

⁴<https://www.economist.com/finance-and-economics/2022/07/21/the-fed-put-morphs-into-a-fed-call>.

3. Stock Returns over the FOMC Cycle Revisited

Table 3.5.: Comparison of Dummy Coefficients between US and European Stock Returns

	Dummy = 1 in Week 0	Dummy = 1 in Week 2, 4, 6
(1) Pre Covid-19		
2016-2019 (US)	-0.211**	-0.0487
2016-2019 (Europe)	-0.106	0.00678
(2) Post/During Covid-19		
2019-2022 (US)	-0.0952	0.0578
2019-2022 (Europe)	-0.0641	0.111
(3) Full sample from 2016		
2016-2023 (US)	-0.125	0.0256
2016-2023 (Europe)	-0.0612	0.0759
(4) Full sample revisited		
1994-2023 (US)	0.0800**	0.0828***
1994-2023 (Europe)	0.0911**	0.0599**

4. Conclusion

In conclusion, the examination of stock excess returns during Federal Open Market Committee (FOMC) even weeks (0, 2, 4, 6) from 2016 onwards shows distinct patterns, also when comparing US and European stock markets. The comparison of coefficients for dummy variables in Table 3.5 display the slight differences in the responses of the two markets during the FOMC cycle.

In the pre-covid period (2016-2019), US stocks exhibited a negative "Fed Call" with a coefficient of -0.211, statistically significant at the 5%-level in FOMC week 0, while European stocks showed a less pronounced negative response with a statistically insignificant (indifferent from 0 for all significance-levels) coefficient of -0.106. Similarly, during FOMC week 2, 4, 6, US stocks displayed a coefficient of -0.0487 (statistically insignificant), contrasting with the positive coefficient of 0.00678 (statistically insignificant) for European stocks.

Focussing on the entire revisited sample period (1994-2023) results in statistically significantly smaller regression coefficients for the FOMC cycle pattern. Overall, samples from the COVID-19 onwards exhibit statistical insignificance, suggesting a potential decrease or disappearance of the FOMC cycle pattern.

Bibliography

Cieslak, Anna, Adair Morse, and Annette Vissing-Jorgensen. "Stock Returns over the FOMC Cycle". Eprint: <https://onlinelibrary.wiley.com/doi/pdf/10.1111/jofi.12818>, *The Journal of Finance* 74, no. 5 (2019): 2201–2248. <https://doi.org/https://doi.org/10.1111/jofi.12818>. <https://onlinelibrary.wiley.com/doi/abs/10.1111/jofi.12818>. (Cit. on pp. 1, 3, 5, 8, 9, 12).

Cieslak, Anna, and Annette Vissing-Jorgensen. "The Economics of the Fed Put". *The Review of Financial Studies* 34, no. 9 (Sept. 1, 2021): 4045–4089. ISSN: 0893-9454, visited on 11/06/2023. <https://doi.org/10.1093/rfs/hhaa116>. <https://doi.org/10.1093/rfs/hhaa116>. (Cit. on pp. 1, 2, 6, 7).

European Central Bank. *Third ECB Annual Research Conference: Session 2: The economics of the Fed put*. Sept. 26, 2018. Visited on 11/05/2023. <https://www.youtube.com/watch?v=jeQXGSsk5Ac>. (Cit. on p. 6).

"Fed Put". Corporate Finance Institute. Visited on 11/17/2023. <https://corporatefinanceinstitute.com/resources/economics/fed-put/>.

French, Kenneth R. "Kenneth R. French - Data Library". Visited on 11/05/2023. https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html#Research.

Hall, Pamela. "Is there any evidence of a Greenspan put?" Number: 2011-06 Publisher: Swiss National Bank, *Working Papers* (2011). Visited on 11/17/2023. <https://ideas.repec.org/p/snb/snbwpa/2011-06.html>. (Cit. on p. 2).

"The Fed put morphs into a Fed call". *The Economist*, visited on 11/17/2023. <https://www.economist.com/finance-and-economics/2022/07/21/the-fed-put-morphs-into-a-fed-call>.

"The long arm of the Fed". *The Economist* (Sept. 3, 2016). ISSN: 0013-0613, visited on 11/19/2023. <https://www.economist.com/finance-and-economics/2016/09/03/the-long-arm-of-the-fed>. (Cit. on p. 4).

A. Appendix

A.1. R Code: FOMC Dummy Generation

The R code in this section, provided in listing A.1, generates FOMC week dummy variables based on the defined week pattern over the FOMC cycle. The resulting data frame is then saved to a CSV file.

```
1 # Load required libraries
2 library(readxl)
3 library(lubridate)
4
5 current_path = rstudioapi::getActiveDocumentContext()$path
6 setwd(dirname(current_path))
7
8 # Define constants
9 monday <- 1
10 saturday <- 6
11 sunday <- 7
12 weekend_duration <- 2
13
14 # Define FOMC cycle patterns
15 fomc_wm1 <- c(-6:-2)
16 fomc_w0 <- c(-1:3)
17 fomc_w1 <- c(4:8)
18 fomc_w2 <- c(9:13)
19 fomc_w3 <- c(14:18)
20 fomc_w4 <- c(19:23)
21 fomc_w5 <- c(24:28)
22 fomc_w6 <- c(29:33)
23
24 # Combine FOMC patterns into a cycle
25 fomc_cycle <- c(fomc_wm1, fomc_w0, fomc_w1, fomc_w2, fomc_w3, fomc_w4, fomc_w5, fomc_w6)
26
27 # Function to calculate time difference in weeks
28 get_difftime_weeks <- function(fomc_meeting_date, date) {
29   weekday_of_fomc_meeting_date <- wday(fomc_meeting_date, week_start = monday)
```

A. Appendix

```
30 adjusted_fomc_meeting_date <- fomc_meeting_date - days(weekday_of_fomc_meeting_date)
31 return(floor(difftime(date, adjusted_fomc_meeting_date, units = "weeks")))
32 }
33
34 # Function to get FOMC day within the cycle
35 get_fomc_day_within_fomc_cycle <- function(fomc_meeting_date, date) {
36   weekday_of_date <- wday(date, week_start = monday)
37   if (weekday_of_date %in% c(saturday, sunday)) return(NULL)
38   weekday_of_fomc_meeting_date <- wday(fomc_meeting_date, week_start = monday)
39   difftime_days <- as.integer(difftime(date, fomc_meeting_date, units = "days"))
40   occurred_weekends <- get_difftime_weeks(fomc_meeting_date, date)
41   as.integer(difftime_days - (weekend_duration * occurred_weekends))
42 }
43
44 # Function to get next dummy value
45 get_next_dummy_value <- function(fomc_cycle_day, fomc_w) as.integer(fomc_cycle_day %in%
46   fomc_w)
47
48 # Set working directory
49 current_path <- rstudioapi::getActiveDocumentContext()$path
50 setwd(dirname(current_path))
51
52 # Read FOMC data
53 fomc_data <- read_excel(
54   'FOMC_Cycle_dates_1994_nov2023.xlsx',
55   sheet = 1,
56   col_names = c("Startdate", "Enddate", "start_less_end_bool"),
57   col_types = c("date", "date", "logical"),
58   skip = 10
59 )
60
61 # Initialize vectors for FOMC cycle week dummies
62 dates <- w_t0 <- w_t1 <- w_t2 <- w_t3 <- w_t4 <- w_t5 <- w_t6 <- w_tm1 <- w_cluster <-
63   fomc_d <- w_even <- w_t2t4t6 <- c()
64
65 # Process FOMC start dates
66 fomc_start_dates <- rev(fomc_data$Enddate)
67 first_fomc_start_date <- as.Date(fomc_start_dates[1])
68 adj_first_fomc_start_date <- ymd(first_fomc_start_date) -
69   days(as.integer(wday(first_fomc_start_date, week_start = monday))) - days(7)
70 prev_fomc_start_date <- first_fomc_start_date
71 length <- length(fomc_start_dates)
72 remaining_fomc_start_dates <- as.Date(fomc_start_dates[2:length])
73
74 # Loop through FOMC start dates
75 for (next_fomc_start_date in remaining_fomc_start_dates) {
76   next_fomc_start_date <- as.Date(next_fomc_start_date, origin = lubridate::origin)
77   prev_fomc_start_date <- as.Date(prev_fomc_start_date, origin = lubridate::origin)
```

A. Appendix

```
75 adj_prev_fomc_start_date <- ymd(prev_fomc_start_date) -  
    days(as.integer(wday(prev_fomc_start_date, week_start = monday))) - days(7)  
76 adj_next_fomc_start_date <- ymd(next_fomc_start_date) -  
    days(as.integer(wday(next_fomc_start_date, week_start = monday))) - days(7)  
77  
78 # Generate sequence of days between FOMC meetings  
79 days_between_fomc_meetings_seq <- seq(adj_prev_fomc_start_date + days(1),  
    adj_next_fomc_start_date + days(1), "day")  
80  
81 # Loop through days between FOMC meetings  
82 for (date in days_between_fomc_meetings_seq) {  
83   date <- as.Date(date, origin = lubridate::origin)  
84   fomc_cycle_day <- get_fomc_day_within_fomc_cycle(prev_fomc_start_date, date)  
85  
86   # Check conditions for dummy values  
87   if (!is.null(fomc_cycle_day) && fomc_cycle_day %in% fomc_cycle) {  
88     dates <- c(dates, date)  
89     fomc_d <- c(fomc_d, fomc_cycle_day)  
90     w_cluster <- c(w_cluster, get_difftime_weeks(first_fomc_start_date, date) + 1)  
91     w_even <- c(w_even, get_next_dummy_value(fomc_cycle_day, c(fomc_w0, fomc_w2,  
        fomc_w4, fomc_w6)))  
92     w_t2t4t6 <- c(w_t2t4t6, get_next_dummy_value(fomc_cycle_day, c(fomc_w2, fomc_w4,  
        fomc_w6)))  
93     w_t0 <- c(w_t0, get_next_dummy_value(fomc_cycle_day, fomc_w0))  
94     w_t1 <- c(w_t1, get_next_dummy_value(fomc_cycle_day, fomc_w1))  
95     w_t2 <- c(w_t2, get_next_dummy_value(fomc_cycle_day, fomc_w2))  
96     w_t3 <- c(w_t3, get_next_dummy_value(fomc_cycle_day, fomc_w3))  
97     w_t4 <- c(w_t4, get_next_dummy_value(fomc_cycle_day, fomc_w4))  
98     w_t5 <- c(w_t5, get_next_dummy_value(fomc_cycle_day, fomc_w5))  
99     w_t6 <- c(w_t6, get_next_dummy_value(fomc_cycle_day, fomc_w6))  
100    w_tm1 <- c(w_tm1, get_next_dummy_value(fomc_cycle_day, fomc_wm1))  
101  }  
102 }  
103 prev_fomc_start_date <- next_fomc_start_date  
104 }  
105  
106 # Create a data frame with the results  
107 df <- data.frame(  
108   date = as.Date(dates, origin = lubridate::origin),  
109   w_t0 = w_t0,  
110   w_t1 = w_t1,  
111   w_t2 = w_t2,  
112   w_t3 = w_t3,  
113   w_t4 = w_t4,  
114   w_t5 = w_t5,  
115   w_t6 = w_t6,  
116   w_cluster = w_cluster,  
117   w_tm1 = w_tm1,  
118   fomc_d = fomc_d,
```


A. Appendix

```
119   w_even = w_even,
120   w_t2t4t6 = w_t2t4t6
121 )
122
123 # Write the results to a CSV file
124 write.csv(df, 'fomc_week_dummies_1994_nov2023.csv', row.names = FALSE)
125
126 # Run tests
127 testthat::test_dir('tests')
```

Listing A.1: R code for FOMC Week Dummy Generation

A.1.1. CSV File: Example structure of generated FOMC dummy variables

The listing A.2 displays the first 35 examples of the generated FOMC dummies in the CSV file, containing approximately one FOMC cycle consisting of 7 work-weeks:

```
1 1993-12-13,0,0,0,0,0,0,0,0,0,1,-6,0,0
2 1993-12-14,0,0,0,0,0,0,0,0,0,1,-5,0,0
3 1993-12-15,0,0,0,0,0,0,0,0,0,1,-4,0,0
4 1993-12-16,0,0,0,0,0,0,0,0,0,1,-3,0,0
5 1993-12-17,0,0,0,0,0,0,0,0,0,1,-2,0,0
6 1993-12-20,1,0,0,0,0,0,0,0,1,0,-1,1,0
7 1993-12-21,1,0,0,0,0,0,0,0,1,0,0,1,0
8 1993-12-22,1,0,0,0,0,0,0,0,1,0,1,1,0
9 1993-12-23,1,0,0,0,0,0,0,0,1,0,2,1,0
10 1993-12-24,1,0,0,0,0,0,0,0,1,0,3,1,0
11 1993-12-27,0,1,0,0,0,0,0,0,2,0,4,0,0
12 1993-12-28,0,1,0,0,0,0,0,0,2,0,5,0,0
13 1993-12-29,0,1,0,0,0,0,0,0,2,0,6,0,0
14 1993-12-30,0,1,0,0,0,0,0,0,2,0,7,0,0
15 1993-12-31,0,1,0,0,0,0,0,0,2,0,8,0,0
16 1994-01-03,0,0,1,0,0,0,0,0,3,0,9,1,1
17 1994-01-04,0,0,1,0,0,0,0,0,3,0,10,1,1
18 1994-01-05,0,0,1,0,0,0,0,0,3,0,11,1,1
19 1994-01-06,0,0,1,0,0,0,0,0,3,0,12,1,1
20 1994-01-07,0,0,1,0,0,0,0,0,3,0,13,1,1
21 1994-01-10,0,0,0,1,0,0,0,0,4,0,14,0,0
22 1994-01-11,0,0,0,1,0,0,0,0,4,0,15,0,0
23 1994-01-12,0,0,0,1,0,0,0,0,4,0,16,0,0
24 1994-01-13,0,0,0,1,0,0,0,0,4,0,17,0,0
25 1994-01-14,0,0,0,1,0,0,0,0,4,0,18,0,0
26 1994-01-17,0,0,0,0,1,0,0,0,5,0,19,1,1
27 1994-01-18,0,0,0,0,1,0,0,0,5,0,20,1,1
28 1994-01-19,0,0,0,0,1,0,0,0,5,0,21,1,1
```

A. Appendix

```
29 1994-01-20,0,0,0,0,1,0,0,5,0,22,1,1
30 1994-01-21,0,0,0,0,1,0,0,5,0,23,1,1
31 1994-01-24,0,0,0,0,0,1,0,6,0,24,0,0
32 1994-01-27,0,0,0,0,0,0,0,6,1,-6,0,0
33 1994-01-28,0,0,0,0,0,0,0,6,1,-5,0,0
34 1994-01-31,0,0,0,0,0,0,0,7,1,-4,0,0
35 1994-02-01,0,0,0,0,0,0,0,7,1,-3,0,0
```

Listing A.2: First 35 examples of the generated FOMC dummies

A.2. R Code: Tests

The provided test (see listing A.3), implemented with the `testthat` package in R, is designed to assess the accuracy of the `get_fomc_day_within_fomc_cycle` function. In this test scenario, a reference FOMC meeting date, set to "2014-01-28" (`fomc_test_date`), serves as the basis for evaluating the function's output for various input dates. The expectations are explicitly defined for different scenarios, encompassing dates preceding, matching, and succeeding the FOMC meeting date. The function is expected to return negative values for dates before the meeting, indicating the number of days prior, 0 for the meeting date itself, and positive values for dates afterward, denoting the days post-meeting. Importantly, the test accounts for weekends, with the function expected to return `NULL` for input dates falling on Saturdays or Sundays. By assessing the function's behavior across this range of conditions, the test aims to ensure the accurate functioning of `get_fomc_day_within_fomc_cycle` in relation to FOMC meeting dates and weekends, contributing to the overall verification of its correctness and robustness.

```
1 library(testthat)
2
3 test_that("get_fomc_day_within_fomc_cycle returns expected values", {
4
5   fomc_test_date <- as.Date("2014-01-28")
6
7   expected_values <- c(
8     -5, -4, -3, -2, NULL, NULL, -1, 0, 1, 2, 3,
9     NULL, NULL, 4, 5, 6, 7, 8, NULL, NULL, 9, 10)
10
11   dates <- as.Date(
12     c("2014-01-21", "2014-01-22", "2014-01-23", "2014-01-24",
13       "2014-01-25", "2014-01-26", "2014-01-27", "2014-01-28",
14       "2014-01-29", "2014-01-30", "2014-01-31", "2014-02-01",
```

A. Appendix

```
15     "2014-02-02", "2014-02-03", "2014-02-04", "2014-02-05",
16     "2014-02-06", "2014-02-07", "2014-02-08", "2014-02-09",
17     "2014-02-10", "2014-02-11"))
18
19   for (i in dates) {
20     expect_equal(get_fomc_day_within_fomc_cycle(fomc_test_date, dates[i]),
21                 expected_values[i])
22   }
```

Listing A.3: R code for FOMC Cycle Dummy Generation Tests

A.3. R Code: Fama-French Daily Factors Data Extraction

The following R Code in listing A.4 reads the Fama-French daily factors data from a CSV file, extracts data within a specified date range, and writes the subsetting data to a new CSV file named `us_returns_df_1994_oct2023.csv`.

```
1 library(readxl)
2
3 current_path <- rstudioapi::getActiveDocumentContext()$path
4 setwd(dirname(current_path))
5
6 # Read the Fama-French daily factors data from CSV file
7 us_returns <- read.csv('F-F_Research_Data_Factors_daily_nov2023.CSV', col.names =
8   c("DATE", "Mkt-RF", "SMB", "HML", "RF"), skip = 4)
9
10 # Extract relevant date range
11 date_format <- "%Y%m%d"
12 us_returns$DATE <- as.Date(as.character(us_returns$DATE), format = date_format)
13 start_date <- as.Date("1993-12-31", format = "%Y-%m-%d")
14 end_date <- as.Date("2023-10-31", format = "%Y-%m-%d")
15 us_returns_df <- subset(
16   us_returns,
17   DATE >= start_date & DATE <= end_date
18 )
19
20 # Change the date format to yyyy-mm-dd
21 new_date_format <- "%Y-%m-%d"
22 us_returns_df$DATE <- format(us_returns_df$DATE, format = new_date_format)
23
24 # Write the subsetting data frame to a new CSV file
25 write.csv(
26   us_returns_df,
27   'us_returns_df_1994_oct2023.csv',
28   row.names = FALSE
29 )
```

Listing A.4: R Code for Fama-French Daily Factors Data Extraction

A.4. STATA Code: Statistical Analysis

This STATA code provided in listing A.5 conducts an analysis of stock returns in relation to FOMC meetings. The focus extends to both U.S. and European stock returns, with the code structured into following sections:

Setup

- Clears existing data and configures preferences.
- Initializes a log file for documentation.

Data Import and Preprocessing

- Imports FOMC meeting dates and U.S. stock return data.
- Merges datasets based on the date variable.
- Converts the date variable to a standardized format.

Calculation of Excess Stock Returns

- Computes excess stock returns using the methodology from Cieslak et al. (2019).

Statistical Analysis

- Performs regression analyses on excess stock returns for various time periods.
- Utilizes the `eststo` command to store regression results.

Output Generation

- Outputs regression results in LaTeX format, generating tables for different analysis periods.
- Replicates the statistical analysis for European stock returns.

A. Appendix

```
1 // U.S. Stock Returns over the FOMC Cycle - Statistical Analysis
2 clear
3 set more off
4 set cformat %5.3f
5 capture log close
6 cd "<insert-working-directory-here>"
7 cap mkdir stata_log
8 log using "stata_log/stata_log", replace
9
10 import delimited "FOMC_dummy_generation/fomc_week_dummies_1994_nov2023.csv", clear
11 sort date
12 save d:fomc_data, replace
13
14 import delimited "F-F_Factors_daily_US/us_returns_df_1994_oct2023.csv", clear
15 sort date
16 save d:us_returns_data, replace
17
18 merge date using d:fomc_data d:us_returns_data
19 save d:fed_put_datamerged_data, replace
20 gen date2 = date(date, "YMD")
21
22 gen m = (mktrf + rf) / 100 + 1
23 gen r = rf / 100 + 1
24 replace m = 1 if m ==.
25 replace r = 1 if r ==.
26 label var m "1+stock return"
27 label var r "1+bill return"
28 gen ex1 = 100 * (m - r)
29 label var ex1 "1-day excess return, day t, pct"
30 gen t = _n
31 label var t "Observation number"
32
33 eststo mlr1: reg ex1 w_t0 w_t2t4t6 if t >= 5307 & t <= 6089, robust
34 eststo mlr2: reg ex1 w_t0 w_t2t4t6 if t >= 16 & t < 5307, robust
35 eststo mlr3: reg ex1 w_t0 w_t2t4t6 if t >= 16 & t <= 6089, robust
36 esttab mlr1 mlr2 mlr3 using "stata_out/Stock Returns over the FOMC cycle.tex", ///
37   r2(%9.4g) ar2(%9.4g) stats(N) starlevel(* 0.1 ** 0.05 *** 0.01) noobs ///
38   mlabels("2014-2016" "1994-2014" "1994-2016") ///
39   postfoot("significant at 1%-level (***), 5% level (**), 10% level (*)")
40
41 eststo mlr1: reg ex1 w_t0 w_t2t4t6 if t >= 6089 & t < 6872, robust
42 eststo mlr2: reg ex1 w_t0 w_t2t4t6 if t >= 6872 & t < 7658, robust
43 eststo mlr3: reg ex1 w_t0 w_t2t4t6 if t >= 6089, robust
44 eststo mlr4: reg ex1 w_t0 w_t2t4t6, robust // 1994-2023
45 esttab mlr1 mlr2 mlr3 mlr4 using "stata_out/Stock Returns over the FOMC cycle
    Revisited.tex", ///
46   r2(%9.4g) ar2(%9.4g) stats(N) starlevel(* 0.1 ** 0.05 *** 0.01) noobs ///
47   mlabels("2016-2019" "2019-2022" "2016-2023" "1994-2023") ///
```

A. Appendix

```
48 postfoot("significant at 1%-level (***), 5% level (**), 10% level (*)")
49
50 // European Stock Returns over the FOMC Cycle - Statistical Analysis
51 clear
52 import delimited "FOMC_dummy_generation/fomc_week_dummies_1994_nov2023.csv", clear
53 sort date
54 save d:fomc_data, replace
55
56 import delimited "F-F_Factors_daily_European/european_returns_df_1994_sept2023.csv",
    clear
57 sort date
58 save d:eur_returns_data, replace
59
60 merge date using d:fomc_data d:eur_returns_data
61 save d:fomc_eur_ret_datamerged_data, replace
62 gen date2 = date(date, "YMD")
63
64 gen m = (mktrf + rf) / 100 + 1
65 gen r = rf / 100 + 1
66 replace m = 1 if m ==.
67 replace r = 1 if r ==.
68 label var m "1+stock return"
69 label var r "1+bill return"
70 gen ex1 = 100 * (m - r)
71 label var ex1 "1-day excess return, day t, pct"
72 gen t = _n
73 label var t "Observation number"
74
75 eststo mlr1: reg ex1 w_t0 w_t2t4t6 if t >= 5307 & t <= 6089, robust
76 eststo mlr2: reg ex1 w_t0 w_t2t4t6 if t >= 16 & t < 5307, robust
77 eststo mlr3: reg ex1 w_t0 w_t2t4t6 if t >= 16 & t <= 6089, robust
78 esttab mlr1 mlr2 mlr3 using "stata_out/European Returns over the FOMC cycle.tex", ///
79 r2(%9.4g) ar2(%9.4g) stats(N) starlevel(* 0.1 ** 0.05 *** 0.01) noobs ///
80 mlabels("2014-2016" "1994-2014" "1994-2016") ///
81 postfoot("significant at 1%-level (***), 5% level (**), 10% level (*)")
82
83 eststo mlr1: reg ex1 w_t0 w_t2t4t6 if t >= 6089 & t < 6872, robust
84 eststo mlr2: reg ex1 w_t0 w_t2t4t6 if t >= 6872 & t < 7658, robust
85 eststo mlr3: reg ex1 w_t0 w_t2t4t6 if t >= 6089, robust
86 eststo mlr4: reg ex1 w_t0 w_t2t4t6, robust // 1994-2023
87 esttab mlr1 mlr2 mlr3 mlr4 using "stata_out/European Stock Returns over the FOMC cycle
    Revisited.tex", ///
88 r2(%9.4g) ar2(%9.4g) stats(N) starlevel(* 0.1 ** 0.05 *** 0.01) noobs ///
89 mlabels("2016-2019" "2019-2022" "2016-2023" "1994-2023") ///
90 postfoot("significant at 1%-level (***), 5% level (**), 10% level (*)")
```

Listing A.5: STATA code for Statistical Analysis