Predoctoral Research Assistant Coding Challenge

Finance Group, MIT Sloan School of Management

Time Limit: 24 Hours

Important Information

- You may use any resources, including AI tools, Stack Overflow, textbooks, and academic papers.
- **If you use AI assistance, include either the full printed conversation log as a PDF or a link to it.**
- **What matters is your judgment, interpretation, and documentation of choices—not just working code.**
- We are as interested in *how* you approach problems as in your final answers.
- Please submit: (1) all code, (2) a writeup (3–5 pages), and (3) output tables/figures.

1 Background

Understanding how financial markets respond to monetary policy is central to macro-finance research. A key empirical challenge is isolating the *surprise* component of Federal Reserve announcements, since efficient markets should only respond to unexpected policy changes.

The Federal Reserve Bank of San Francisco maintains the **U.S. Monetary Policy Event-Study Database (USMPD)**, which provides high-frequency changes in interest rates and asset prices around FOMC announcements.

You will use this database to analyze how asset prices respond to monetary policy surprises, with a particular focus on cross-country heterogeneity in exchange rate responses.

2 Data

2.1 Monetary Policy Surprises

Download the USMPD from the SF Fed website:

https://www.frbsf.org/research-and-insights/data-and-indicators/us-monetary-policy-event-study-database/

The database includes multiple surprise measures (MP1, MP2, ED1–ED4, and pre-constructed principal component surprises). You will need to select an appropriate measure for your analysis.

2.2 Asset Prices

You will need to obtain daily data for the following assets from sources of your choosing (e.g., FRED, Yahoo Finance, Bloomberg):

Exchange rates (all versus USD):

- Euro (EUR), British Pound (GBP), Japanese Yen (JPY)
- Swiss Franc (CHF), Australian Dollar (AUD), Canadian Dollar (CAD)
- At least two additional currencies of your choice

U.S. Treasury yields:

- 2-year, 5-year, and 10-year nominal yields

U.S. breakeven inflation rates:

- 5-year and 10-year breakeven inflation (TIPS spreads)

2.3 External Positions

Download the **External Wealth of Nations** database from Brookings:

https://www.brookings.edu/articles/the-external-wealth-of-nations-database/

You will use the Net Foreign Asset position as a share of GDP (NFA/GDP) for each country whose currency you analyze.

3 Tasks

3.1 Part 1: Data Preparation and Surprise Measure Selection (20 points)

(a) Explore the available surprise measures in the USMPD

(b) **Choose one primary surprise measure** for your analysis and justify your choice

(c) Merge the surprise data with daily asset price data

(d) Provide summary statistics

In your writeup, discuss any methodological choices, data issues, or tradeoffs that you think are important.

3.2 Part 2: Asset Price Responses to Monetary Policy (25 points)

Estimate the response of each asset to monetary policy surprises:

$$\Delta y_{i,t} = \alpha_i + \beta_i \cdot \text{Surprise}_t + \varepsilon_{i,t} \tag{1}$$

Run this regression separately for:

- Each exchange rate (8+ currencies)
- Each Treasury yield (2Y, 5Y, 10Y)
- Each breakeven inflation rate (5Y, 10Y)

Deliverables:

(a) A well-organized regression table summarizing all results

(b) Appropriate visualizations

In your writeup, interpret your findings and discuss any patterns, puzzles, or limitations you identify.

3.3 Part 3: The Role of External Positions (25 points)

Recent research suggests that countries' external financial positions affect how their currencies respond to U.S. monetary policy shocks (see Antolín-Díaz, Cenedese, Han, and Sarno, 2023).

Your task: Test whether the NFA/GDP ratio moderates exchange rate responses to U.S. monetary policy surprises.

Estimate a panel regression of the form:

$$\Delta e_{i,t} = \alpha_i + \beta_1 \cdot \text{Surprise}_t + \beta_2 \cdot (\text{Surprise}_t \times \text{NFA}_{i,t-1}) + \gamma \cdot \text{NFA}_{i,t-1} + \varepsilon_{i,t} \tag{2}$$

where $\Delta e_{i,t}$ is the change in exchange rate i on FOMC day t, and $\text{NFA}_{i,t-1}$ is the lagged NFA/GDP ratio for country i.

Deliverables:

(a) Panel regression results with appropriate standard errors (discuss your choice: clustered by country, by time, or two-way)

(b) A visualization showing how the estimated exchange rate response varies with NFA/GDP

In your writeup, explain your methodology, interpret the results economically, and discuss any issues you think are important or challenging.

3.4 Part 4: Extension (30 points)

Propose and implement **one** extension that deepens or improves the analysis. This is deliberately open-ended.

We evaluate:

- The quality of your idea (does it address something interesting or important?)
- The quality of execution
- Your interpretation of the results

4 Submission Requirements

1. **Code**: Well-documented Python, R, or Stata code that reproduces all results. Code should run from start to finish without manual intervention (except for initial data downloads).
2. **Writeup**: A 3–5 page document (excluding tables/figures) addressing all questions above. *This is the most important part of your submission.*
3. **Tables and Figures**: Clear, publication-quality output.

Key References

Acosta, M., Ajello, A., Bauer, M., Loria, F., & Miranda-Agrippino, S. (2025). Financial Market Effects of FOMC Communication: Evidence from a New Event-Study Database. *FRB San Francisco Working Paper 2025-30*.

Antolín-Díaz, J., Cenedese, G., Han, S., & Sarno, L. (2023). U.S. Interest Rate Surprises and Currency Returns. *SSRN Working Paper*.

Lane, P. R., & Milesi-Ferretti, G. M. (2018). The External Wealth of Nations Revisited: International Financial Integration in the Aftermath of the Global Financial Crisis. *IMF Economic Review*, 66, 189–222.

Good luck! We look forward to reviewing your work.