Building a Taylor Rule Using FRED

This article discusses how to build and display a graph of a Taylor rule with FRED, the St. Louis Fed's economic database. The article provides additional instructions for saving the graph to a FRED Dashboard and puts forward a series of classroom discussion questions and suggested assignments. We argue that this pedagogical strategy provides an engaging context for the discussion of an otherwise abstract topic in macroeconomics.

Diego Mendez-Carbajo[†,1]   **Keith G. Taylor**[‡,1,2]   **Mark A. Bayles**[‡,1,2]

†Illinois Wesleyan University, ‡Federal Reserve Bank of St. Louis

1. Introduction

As more and more instructors heed the call to engage in high-impact "active-learning" pedagogical strategies, they are likely to find out, as Salemi (2002; p. 730) states, that "it takes time to develop and revise good active learning exercises." That certainly has been our experience when incorporating real data into teaching and learning activities. Aiming to develop the expected proficiency associated with "interpreting and manipulating data" that Hansen (2009; 2012) identifies as a desirable marker in the education of economics majors, we endorse the use of FRED (Federal Reserve Economic Data) Dashboards to save precious instructional time. The works of Patel and Saunoris (2016) and Mendez-Carbajo (2015) convincingly argue for the use of FRED data-visualization resources when testing abstract economic theory concepts against the underlying data that they embody. Our contribution is to employ FRED graphs as building blocks in the type of inquiry-based pedagogy described by Maier, Bangs, & Blunch (2010) as "context-rich problems" as well as key resources to use when employing the case method teaching that Velenchik (1995) and Marks & Rukstad (1996) endorse.

We describe how to use a free and high-quality resource, FRED (Federal Reserve Economic Data) Dashboards, for creating active-learning exercises that combine real data manipulation and discussion of monetary policy. FRED is an online database managed and maintained by the Research Department of the Federal Reserve Bank of St. Louis. As a compiler of 429,000 U.S. and international time series from 80 different sources (as of February 10, 2017), FRED offers easy online access to each and every one of those series through a streamlined and user-oriented website. Moreover, the FRED website allows for the manipulation and visualization of economic data through highly customizable graphs. These graphs – along with data lists, the most recent data points, and custom notes – can be saved and displayed through a FRED Dashboard. These FRED Dashboards are cloud-based individualized FRED web pages that users can create and tailor to their teaching or research needs. Dashboards can be made public to allow them to be shared with students or colleagues. Readers interested in exploring the full range of economic education resources offered by the Federal Reserve Bank of St. Louis will find a clear and concise guide in the work of Suiter and Taylor (2016).

In this paper, we choose to illustrate the pedagogical strategy at hand – in the context of an intermediate macroeconomics or money and banking course – by constructing a Taylor-rule "guided" monetary policy interest rate and then comparing it to the federal funds interest rate, the actual instrument that the Federal Open Market Committee has employed since the mid-1980s to transmit its economic policy decisions to the at-large economy. As the Board of Governors of the Federal Reserve System (BGFRS, 2005; p.16) describes it, the Federal Open Market Committee "sets the federal funds rate at a level it believes will [help achieve] its monetary policy objectives." The "guided" monetary policy interest rate put forward by Taylor (1993) is that the federal funds rate should be set "equal to the rate thought to be consistent in the long run with the achievement of full employment and price stability [...]" (BGFRS, 2005; p.23). This "rule," named after the Stanford University economics professor John Taylor, is expressed (for the purposes of this paper) as the following expression put forward by Rudebusch (2010):

$$\text{Target rate} = 1 + 1.5 \times \text{Inflation} - \text{Unemployment Gap}$$

Because the "guidance" provided by the Taylor rule is a function of both the variables employed to quantify "inflation" and "unemployment gap" and of the parameters that factor their relative weights, plus a constant(s), we are aware of the fact that the choices or assumptions made to operationalize this abstract concept are non-trivial. For example, instead of the unem-

15

ployment gap, Zimmermann (2014) builds on the original work of Taylor (1993) in order to build a rule employing a measure of the Real Gross Domestic Product gap (relative to the Real Potential Gross Domestic Product estimated by the U.S. Congressional Budget Office). Because the focus of this paper is to develop a pedagogical strategy suitable for undergraduate students, we will not attempt to settle the question of which formulation of the rule is optimal. Moreover, we echo Zimmermann (2014) and invite the reader to "play around with the formula" and see how it matches up with the effective federal funds rate.

We believe that the Taylor rule is comprehensible by undergraduate students in intermediate macroeconomics or money and banking courses. Mankiw's Macroeconomics textbook (now in its ninth edition) features the Taylor rule as a "case study" when discussing the interaction between business cycles and monetary policy rules. Stating that "in addition to being simple and reasonable, the Taylor rule for monetary policy also resembles actual Fed behavior in recent years" (Mankiw 2016; pp. 445-446), the author showcases this concept in order to illustrate the aforementioned interplay between monetary policy, employment, and price stability.

The process of illustrating the concept of a Taylor rule using FRED and saving the resulting graph to a dashboard is relatively straightforward. Nonetheless, in order to facilitate access to the materials discussed in this pedagogical strategy we have created a "public FRED dashboard" – hosted by the Federal Reserve Bank of St. Louis – containing several graphs, data points, data lists, and discussion questions presented in this paper. Instructors merely interested in displaying a FRED graph or data point during a lecture can do so through this URL: https://research.stlouisfed.org/useraccount/dashboard/2122 .

In what follows, this paper discusses contexts for the use of the proposed pedagogical strategy and outlines its assessment. We also provide step-by-step instructions to design the active-learning activity and save the instructional materials to a FRED Dashboard. Instructions to create the dashboard itself are available in Appendix A. We also suggest both in-class discussion questions and out-of-class assignments. A handout describing a sample out-of-class assignment, suitable for distribution among students, is available in Appendix B. The last section of the paper offers some reflections and concludes.

2.   Contexts for Use and Assessment

We suggest two different, yet related, contexts for using this pedagogical strategy: in-class discussion prompts and out-of-class research assignments. We recommend that instructors first show students how to use the FRED website in class and then direct them to complete similar tasks outside of class by providing a step-by-step handout (similar to that provided in Appendix B). By providing students with opportunities to familiarize themselves with FRED graphs of increasing complexity (i.e. adding series, changing the units of the series) as the academic term progresses, instructors build students' confidence and promote the "positive attitude toward learning" that Salemi (2002; p.728) describes. Once student mastery of the relatively simple FRED graph interface has been established through several rounds of instructor feedback, we would advocate for the replication of the Taylor rule exercise as the foundation of an out-of-class assignment.

The assessment measures associated with this pedagogical strategy could take a variety of forms. For example, when used as an in-class lecture aid, the instructor may choose to designate a randomly selected student to build the FRED graph following the steps dictated by the instructor. By doing so, the instructor can easily assess familiarity with and competence in data access and manipulation tasks. Once the FRED graph is fully built and is on display in the class-

room, it can be used for either a guided or an open-ended discussion of monetary policy rules. In this case, accuracy in interpreting economic concepts and data or merely class participation can be measured.

Alternatively (or ideally),in addition to the aforementioned assessment strategy, the instructor could put students into groups and assign each group a particular time frame (e.g. 1970s, 1980s, 1990s, early 2000s…) in which to compare the federal funds rate to the guidance provided by the Taylor rule. Each group would be responsible for discussing how, specifically, each particular business cycle(s) impacted the overlap between the monetary policy actually implemented through the federal funds interest rate and the stated "guidance." In this setting, the instructor could direct students to build additional FRED graphs of gasoline prices, housing prices, budget deficits, or other relevant indicators of prevailing economic conditions during the time period under discussion. In this context, the FRED graphs become building blocks in the type of inquiry-based pedagogy described by Maier et al. (2010) as "context-rich problems." Having said that, because this assessment strategy is likely to consume a significant portion of a regular class period, we encourage instructors to consider weaving it into a stand-alone out-of-class assignment.

Finally, a straightforward out-of-class assignment could use a handout with instructions for building the particular FRED graph and a series of modifications in its construction aimed at comparing and contrasting different fundamental assumptions about monetary policy rules. Appendix B includes a sample assignment of the nature we just outlined. The use of FRED graphs as a basis for evidence-based argumentation makes for a valuable asset in case-method teaching in economics (as described by Velenchik, 1995 and Marks & Rukstad, 1996). Student-built FRED graphs would inform either the drafting of a case or guide the students' preparation for the case itself. All in all, none of the proposed assessment measures are mutually exclusive; therefore, we encourage instructors to employ them all.

3. Construction of the Taylor Rule Graph

The building of a FRED graph illustrating a Taylor rule for monetary policy interest rates makes use of the same set of data visualization resources discussed by Mendez-Carbajo (2015). The fact that the FRED website allows every user with access to a web browser to freely explore its rich repository of data and to manipulate these data in terms of units, frequency, and range without the need to download the data makes for a remarkably accessible teaching resource. Moreover, although the building of a FRED graph can be completed by any user, those who register for a FRED account can save their work for future editing with easy access through a FRED Dashboard. Instructions on how to register a FRED account and create a FRED Dashboard are provided in Appendix A. Detailed instructions on the FRED graph functionality described below can be found at https://fredhelp.stlouisfed.org/#fred-graphs-how-can-i-customize-a-fred-graph.

The first step consists of creating a graph of the federal funds rate. Within the FRED website (https://fred.stlouisfed.org/) the instructor will search for "Effective Federal Funds Rate." Alternatively, the instructor can use the series ID "(FEDFUNDS)" to locate that specific data series. Additional options for finding series in FRED can be found at https://fredhelp.stlouisfed.org/#fred-data-how-can-i-find-data-on-fred. The resulting graph is presented below and can be accessed at https://fred.stlouisfed.org/graph/?g=cFVv.

Figure 1 – FRED Graph of Effective Federal Funds Rate (Complete Data Range)
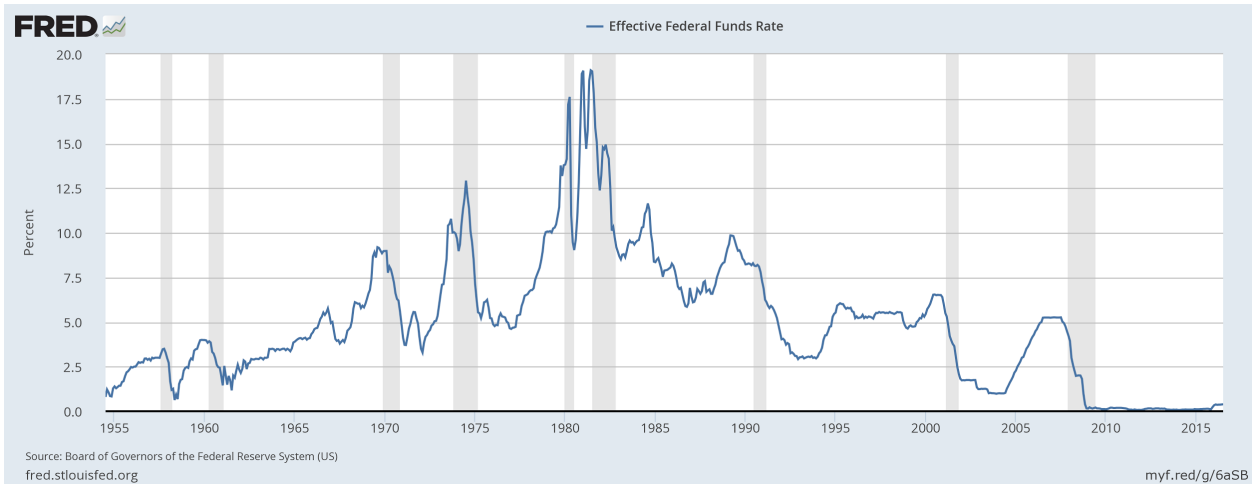
Because the graph includes all of the available data points starting in 1955, the scale of the graph makes the most recent values of the Effective Federal Funds rate (the closest values to the "zero bound") hard to visualize. This can be addressed by changing the range of observations in any of the four following possible ways: (1) by clicking on "10Y" directly above the graph; (2) by entering "2006-07-01" on the left-hand-side (beginning) date box directly above the graph; (3) by clicking on the left-most handle of the scroll bar and dragging it to the right; or (4) by clicking and holding on the portion of the graph above the 2006 year and then dragging the cursor to the right to highlight the last ten years of data points. Additional information related to modifying the graph's date range can be found at https://fredhelp.stlouisfed.org/fred/graphs/customize-a-fred-graph/change-graph-time-range/. The resulting graph is presented below and can be accessed at https://fred.stlouisfed.org/graph/?g=cFVx.

Figure 2 – FRED Graph of Effective Federal Funds Rate (Limited Data Range)
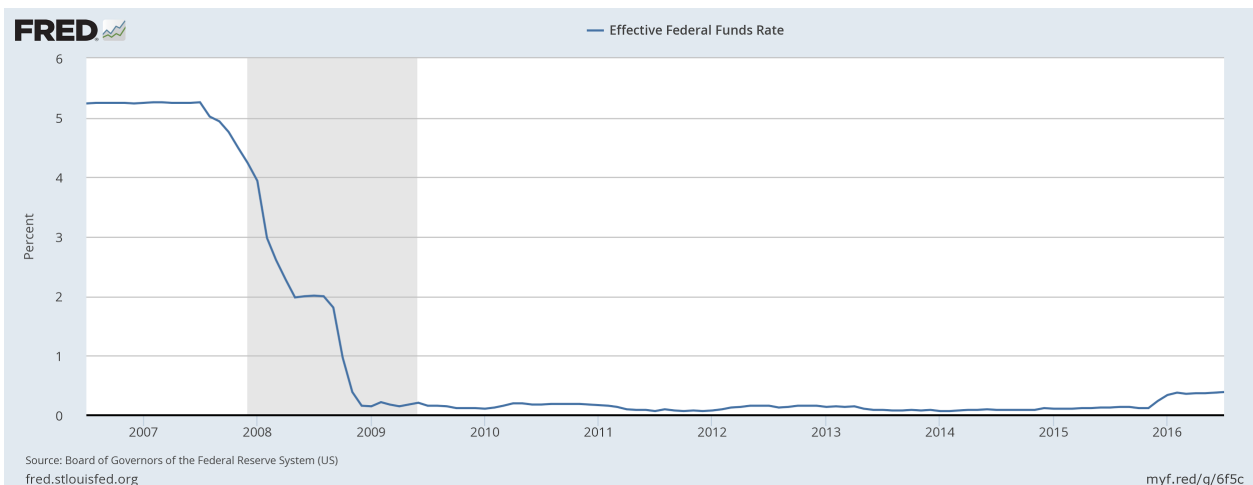
Next, the instructor will edit the graph in order to add a second line to represent the Taylor-rule "guided" monetary policy interest rate. As discussed above, for the purposes of this pedagogical strategy, the Taylor rule will take the following expression put forward by Rudebusch (2010):

$$\text{Target rate} = 1 + 1.5 \times \text{Inflation} - \text{Unemployment Gap}$$

Within the FRED graph displaying the "effective federal funds rate," the instructor will edit the graph by clicking on the orange "EDIT GRAPH" button on the upper right side of the page. A panel will slide from right to left and several editing options will become available: Edit Line 1, Add Line, and Format. The instructor will click on the "ADD LINE" tab and use the search box under the heading "Add data series to graph:" to locate and select the series "Consumer Price Index for All Urban Consumers: All Items, Index 1982-1984=100, Seasonally Adjusted" [series ID (CPIAUCSL)]. Please note that the CPI is an index number and that as such it is reported, by default, in levels. Because the Taylor rule incorporates a measurement of the cost of living expressed as a rate of inflation, the units of the CPI need to be modified accordingly. This is done by selecting "Percent Change" from the drop-down menu displayed directly below the series name under the label "Units:" More detailed instructions on adding a series to a line are available at https://fredhelp.stlouisfed.org/fred/graphs/customize-a-fred-graph/data-transformation-add-series-to-existing-line/. A complete overview of the various units available in FRED, can be found at https://fredhelp.stlouisfed.org/fred/graphs/customize-a-fred-graph/edit-data-series-units/.

Once the CPI series is added as "Line 2" and transformed into the inflation rate, two more series must be added to that line. The process is straightforward. In the search box located under the heading "Customize data," the instructor will first type "Civilian Unemployment Rate, Percent, Seasonally Adjusted" [series ID (UNRATE)], select the series, and click "Add." The same process is repeated in order to add the "Natural Rate of Unemployment (Long-Term), Percent, Not Seasonally Adjusted" [series ID (NROU)] to Line 2. The instructor should notice that each of the three series now listed in the "EDIT LINES" tab and "EDIT LINE 2" sub-tab has been automatically assigned a reference designator in the form of a letter between parentheses. Those letters will be used to combine the series according to the algebraic expression (1) embodying the Taylor rule.

The last step, then, is to simply enter the following formula in the text box right next to the label "Formula:":

$$1 + (1.5 \times a) - (1 \times (b - c))$$

By clicking "Apply," the FRED graph updates its content and displays, simultaneously, the effective federal funds rate (as a blue line) and the "guidance" monetary policy interest rate suggested by the Taylor rule (as a red line). Detailed instructions for creating a custom formula can be found at https://fredhelp.stlouisfed.org/fred/graphs/customize-a-fred-graph/data-transformation-add-series-to-existing-line/. The resulting graph is presented below and can be accessed at https://fred.stlouisfed.org/graph/?g=cFVz .

Figure 3 – FRED Graph of Effective Federal Funds Rate and Taylor Rule
(Limited Data Range)
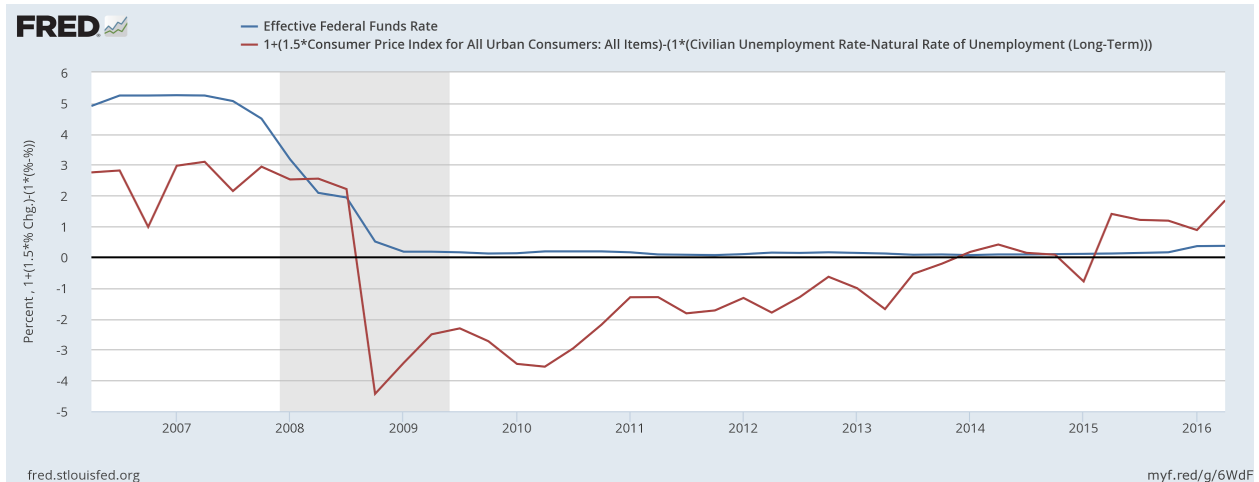
In our experience, novice FRED graph users are likely to forget to change the CPI units from levels to percent change or add to the price level and unemployment series in a different order from the one specified above. Both issues need to be addressed in order for the Taylor rule to display correctly. These are valuable learning opportunities in data literacy for students creating a FRED graph for the first time.

An instructor with a registered FRED account can easily save this FRED graph by clicking on the button labeled "Account Tools" (located below the graph itself) and then selecting "Save graph" from the pop-up menu. A new page will appear presenting the account user with several options for saving the graph. Naming it is the next step. The user must then choose an observation range to display. We suggest the second option, "Always chart from 2006-07-01 to the last value available," which preserves the start date for the time series graph and keeps on updating the end date of the time series as new data becomes available. This ensures an automated update of the graph.

Now listed in the instructor's "Saved Graphs" tab in the FRED account, the Taylor rule graph can be added to a homonymous FRED Dashboard. This task is accomplished by clicking on the hyperlink "Add to Dashboard" located to the right of the graph's name. Detailed instructions for creating a dashboard are available in Appendix A. Instructions for adding a graph to a dashboard can be found at https://fredhelp.stlouisfed.org/fred/account/dashboard-features/add-a-saved-graph-to-a-dashboard/. This Dashboard can be built up to display a custom-made gallery of teaching and learning resources. We will discuss several of those resources in the next section.

## 4. Suggested Discussion Questions and Assignments

The FRED graph illustrating the Taylor rule can be used as a prompt for in-class discussions about monetary policy management and/or as the basis for out-of-class short writing assign-

ments focused on its design. We will discuss these uses next.

Since the data range displayed in the FRED graph includes the 2008-2009 recession (also known as the "Great Recession"), an instructor can use the visual representation of the Taylor rule as an effective prompt for discussing the practical "guidance" provided by such a theoretical concept. For instance, the instructor can ask students to interpret the economic implications of setting a monetary policy interest rate with negative values while at the same time facing a practical "zero boundary." The ongoing prominence of the public debate on this specific aspect of monetary policy makes the connection of economic theory with current events particularly easy and, in our pedagogical experience, very rewarding. Another successful line of discussion we have followed relates to the methodological choices involved in the construction of the Taylor rule itself. Engaging the students in the critical assessment of the coefficient values assigned to the variables "inflation" and "unemployment gap" allows the instructor to highlight the competing monetary policy goals stated in the Federal Reserve Act, commonly referred to as the "dual mandate."

An instructor can redact the aforementioned discussion topics and display them next to the FRED Graph in a previously set up "Taylor rule" FRED Dashboard by making use of a resource called "Notes." These "Notes" are one of several FRED Dashboard "widgets" that can be inserted into an existing dashboard by simply clicking on the "Add Widget" button located at the top left-hand side of the webpage. By displaying customized notes next to a FRED graph, an in

Figure 4 – Screen Capture of Model Taylor Rule FRED Dashboard (Top Section)
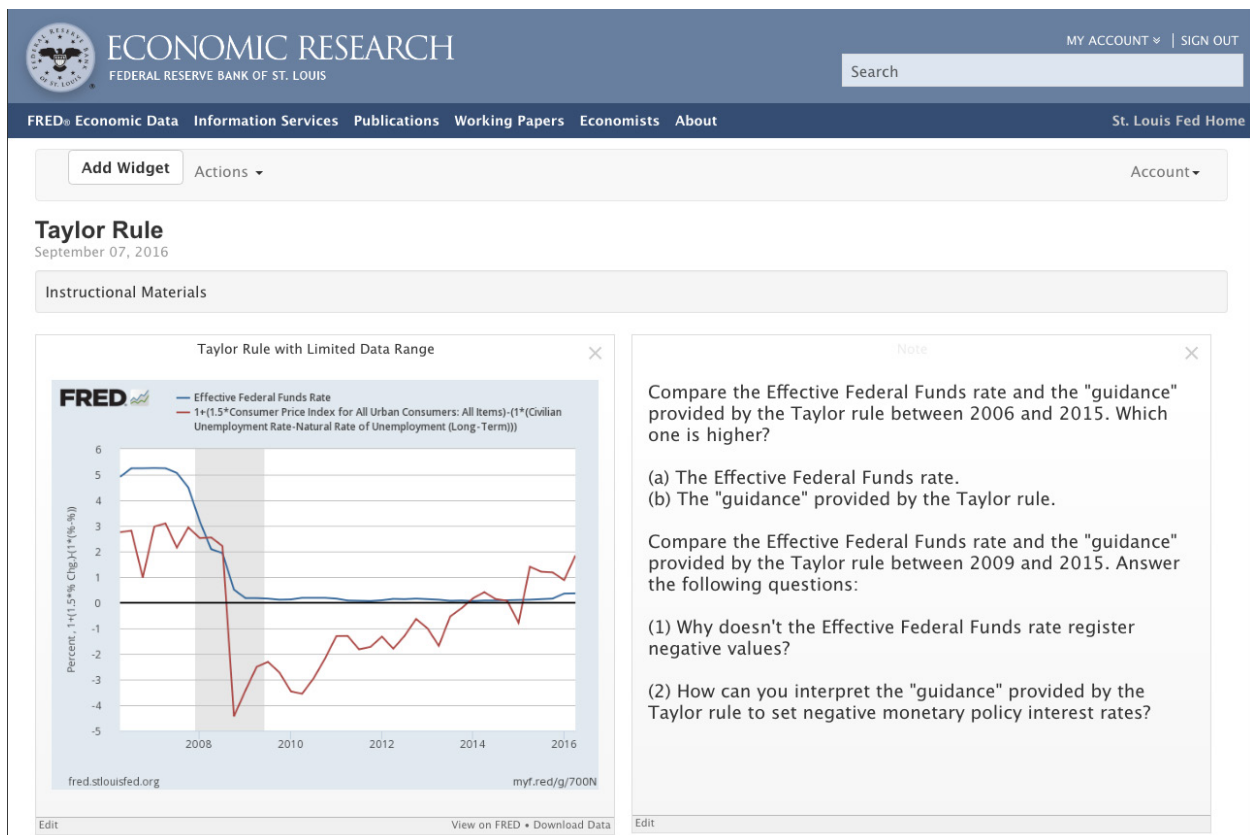
structor will ensure expedient access to teaching and learning materials during an in-class lecture or guided discussion. A FRED Dashboard containing several graphs, data points, data lists, and the discussion questions put forward in this paper is presented below and can be accessed at https://research.stlouisfed.org/dashboard/2122.

Another extension of a guided class discussion of the Taylor rule could be focused on the formulation of the rule itself. The instructor can point students to accessible scholarly materials, such as the ones we cite in the previous section, in order to articulate this conversation. This particular discussion topic could be the kernel of an out-of-class, or perhaps group, assignment. After students become proficient in navigating the FRED website and building FRED graphs, they can be assigned the task of building alternative formulations of the Taylor rule by changing the operational definitions of "inflation" and "unemployment gap." For example, instead of measuring inflation as the percentage change in the CPI, students can compute inflation as the percentage change in the "Personal Consumption Expenditures: Chain-type Price Index" [series ID (PCEPI)]; doing so is common practice in professional-grade publications centered on monetary policy. Similarly, computing the unemployment gap as the difference between the recorded unemployment rate and the "Natural Rate of Unemployment (Short-Term)" [series ID (NROUST)] (as opposed to the "long-term" natural rate of unemployment incorporated in the formulation of the Taylor rule outlined in the previous section) makes for a relatively straightforward assignment. Given the vast amount of price, employment, and output-related statistical series accessible through the FRED database, we will not attempt to produce an exhaustive listing of all the potential variations in this assignment and instead direct the reader to Appendix B for a sample of relevant FRED series. These are also accessible in the form of data lists embedded in the following FRED Dashboard: https://research.stlouisfed.org/dashboard/2122. Any alternative embodiment of the Taylor rule that the instructor or student chooses may serve as the basis for short-form writing assignments discussing the pros and cons of "guiding" monetary policy in this fashion.

Another avenue for expanding the discussion of monetary policy through the Taylor rule would be to connect it with scholarly publications of a sophistication and complexity appropriate to an undergraduate audience. A number of short-form pieces published by the research divisions of Federal Reserve Banks across the country fit that bill. For example, in an Economic Letter published by the Federal Reserve Bank of San Francisco, Nechio (2011) compares the monetary policy followed by the European Central Bank between 2001 and 2010 with the interest rate rule put forward by Taylor and examines how a common monetary policy does not fit all of the countries in the euro area. An instructor could use this Economic Letter as the foundation for a take-home assignment where students create FRED graphs illustrating the Taylor rule for different European countries over the last decade and then re-examine Nechio's (2011) conclusions regarding a "one-size-fits-all" monetary policy.

Lastly, instructors looking to infuse the undergraduate macroeconomic curriculum with more sophisticated topics related to monetary policy "guidance" can refer to the work of Dupor (2015) to introduce the concept of the "natural rate of interest." In this Economic Synopses published by the Federal Reserve Bank of St. Louis, Dupor produces a graph comparing different versions of the Taylor-rule-implied measures of the Federal Funds rate with alternative specifications of the "natural rate of interest." An instructor could use this Economic Synopses as the foundation for a take-home assignment where students reflect on the relationship between monetary policy and macroeconomic fundamentals in contrast to the relationship between monetary policy and the business cycle.

5. Conclusions

The building of a FRED graph illustrating a Taylor rule for monetary policy interest rates makes use of the rich set of data visualization resources available through the FRED website. In our description of the pedagogical strategy, we provided step-by-step instructions on how to build the FRED graph. We also put forward a series of prompts aimed at jump-starting and guiding in-class discussions as well as outlined short take-home assignments that build on the FRED graph itself. Because the design of these instructional resources is time-consuming, we advocate for the use of FRED Dashboards to save and display them. To that end, we have made available the graphs, data points, data lists, and discussion questions discussed in this paper through the following URL: https://research.stlouisfed.org/useraccount/dashboard/2122.

We believe that by connecting course material to current events and articulating abstract theoretical concepts through the use of real data, the curriculum of undergraduate macro-economics becomes more engaging to our students. The hands-on nature of the proposed pedagogical strategy and the opportunities that it presents for deeper discussions of econom-ic theory makes it a valuable addition to the repertoire of "active learning" strategies of any instructor. Moreover, unlike textbook examples or paper-based handouts, as new macroeco-nomic data becomes publicly available, the FRED graphs we built update automatically. Thus, the data visualization exercise at the center of the teaching and learning experience remains fresh and dynamic throughout a quarter or semester term and across academic years.

Finally, we would like to echo Chair of the Board of Governors of the Federal Reserve System Janet Yellen's (2014) words "The suddenness and severity of the global financial crisis forced policymakers to respond rapidly and creatively" in order to encourage fellow economic educa-tors to adopt engaging and creative pedagogical strategies as exciting as the times we live in.

References

Board of Governors of the Federal Reserve System (2005). *The Federal Reserve System: Purposes & functions*. Washington, DC: Board of Governors of the Federal Reserve System.

Dupor, W. (2015). Liftoff and the natural rate of interest. *Economic Synopses* 2015-12. Retrieved from https://research.stlouisfed.org/publications/economic-synopses/2015/06/05/liftoff-and-the-natural-rate-of-interest/

Hansen, W. L. (2009). Reinvigorating liberal education with an expected proficiencies approach to the academic major. In D. Colander & K. M. McGoldrick (Eds.), *Educating economists: The Teagle discussion on re-evaluating the undergraduate economics major* (107-125). Northampton, MA: Edward Elgar Publishing, Inc.

Hansen, W. L. (2012). An expected proficiencies approach to the economics major. In G. Hoyt & K. M. McGoldrick (Eds.) *International handbook of teaching and learning economics* (188-194). Northampton, MA: Edward Elgar Publishing, Inc.

Maier, M., Bangs, J., & Blunch, N. H. (2010). Context-rich problems in economics. In M. K. Salemi & W. B. Walstad (Eds.) *Teaching innovations in economics: strategies and applications for interactive instruction* (170-189). Northampton, MA: Edward Elgar Publishing, Inc.

Mankiw, N. G. (2016). *Macroeconomics, 9e*. New York, NY: Worth Publishers.

Marks, S. G. & Rukstad, M. G. (1996). Teaching macroeconomics by the case method. *Journal of Economic Education 27*(2), 139-147.

Méndez-Carbajo, D. (2015). Data visualization and the online FRED database. *Journal of Economic Education 46*(4), 420–429.

Nechio, F. (2011). Monetary policy when one size does not fit all. *FRBSF Economic Letter 2011-18*. San Francisco, CA: Federal Reserve Bank of San Francisco.

Patel, D. & Saunoris, J. (2016). Using FRED data series to improve learning outcomes in economic courses: From student to practitioner. *Journal of Economics and Finance Education 15*(2), 37-49.

Rudebusch, G. (2010). The Fed's exit strategy for monetary policy. *FRBSF Economic Letter 2010-18*. San Francisco, CA: Federal Reserve Bank of San Francisco.

Salemi, M. K. (2002). An illustrated case for active learning. *Southern Economic Journal 68*(3), 721-731.

Suiter, M. C. & Taylor, K. G. (2016). Resources for economic educators from the Federal Reserve Bank of St. Louis. *Journal of Economic Education 47*(1), 71-75.

Taylor, J. (1993). Discretion versus policy rules in practice. *Carnegie-Rochester Conference Series on Public Policy 39*, 195-214.

Velenchik, A. D. (1995). The case method as a strategy for teaching policy analysis to undergraduates. *Journal of Economic Education 26*(1), 29-38.

Yellen, J. (2014). Remarks at the panel discussion on "Shaping the future of the macroeconomic policy mix." Retrieved from https://www.federalreserve.gov/newsevents/speech/yellen20141107a.htm

Zimmermann, C. (2014). The FRED blog: the Taylor Rule. Retrieved from https://fredblog.stlou-isfed.org/2014/04/the-taylor-rule/

Appendix A

Although any user accessing the FRED website (https://fred.stlouisfed.org/) can follow the instructions provided in this paper and build a Taylor rule for monetary policy interest rates, we advocate for first creating a FRED account. With a registered free FRED account, an instructor can save any FRED graph for future reference – a time-saving resource during an in-class lecture.

Figure 5 – Screen Capture of FRED Home Page (Top Section)
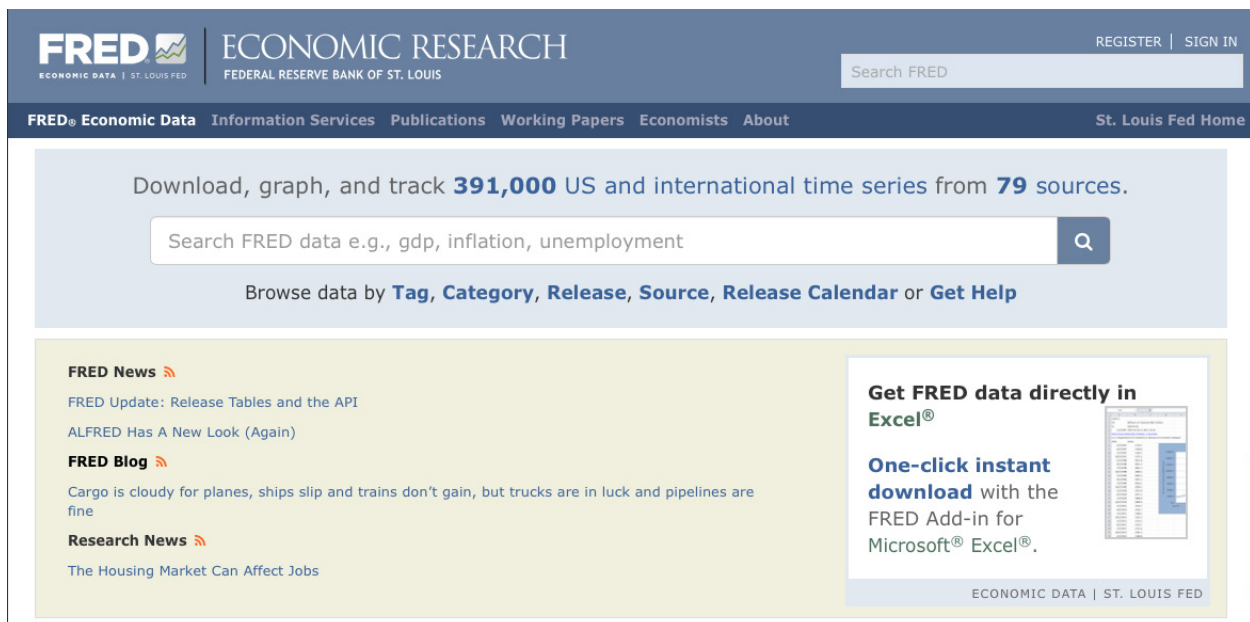
To create a free user account, the instructor will click on "Register" at the top right corner of the home page of the FRED website (see Figure 5). The process only requires the new user to provide first and last names along with a working email address and to create a password. Soon after the new account is requested the instructor will be asked to confirm the registration information via email. More detailed instructions on creating an account are accessible at https://fredhelp.stlouisfed.org/fred/account/fred-account-features/register/. A complete list of FRED-related functionalities associated with the user account, as well as the strict privacy policies of the Federal Reserve Bank of St. Louis, are accessible at https://fredhelp.stlouisfed.org/#fred-account-what-can-i-do-with-a-fred-account.

The registered user of a FRED Account can save any and all FRED graphs through this free cloud-based service by clicking first on the "Account Tools" button (located directly below each and every FRED graph) and then on the "Save Graph" tab that pops us. More detailed instructions for saving a graph can be found at https://fredhelp.stlouisfed.org/fred/account/fred-account-features/save/. Although it is not strictly key to the pedagogical strategy discussed in this paper, we strongly recommend creating a Dashboard for sorting and displaying the FRED-related teaching and learning materials we described.

Figure 6 – Screen Capture of FRED User Account Home Page (Top Section)
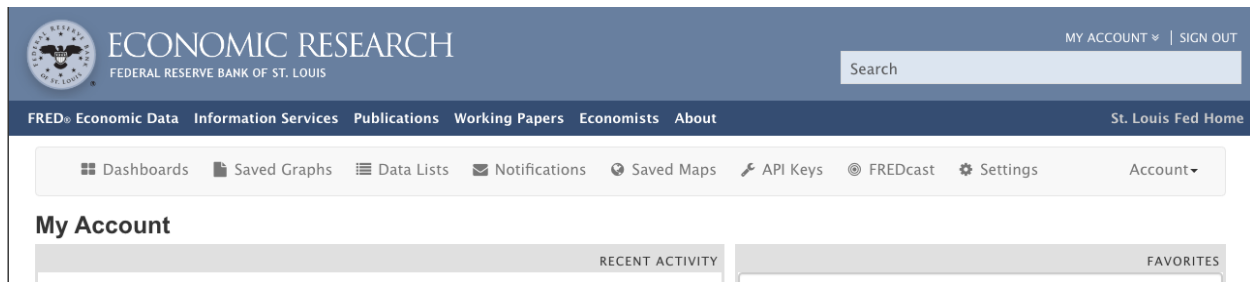
To create a Dashboard the instructor will first click on the "Dashboard" button located near the top left corner of the FRED user account home page (see Figure 6) and then on the "+ Create" button that appears on its place (see Figure 7).

Figure 7 – Screen Capture of FRED User Account Dashboard Page (Top Section)
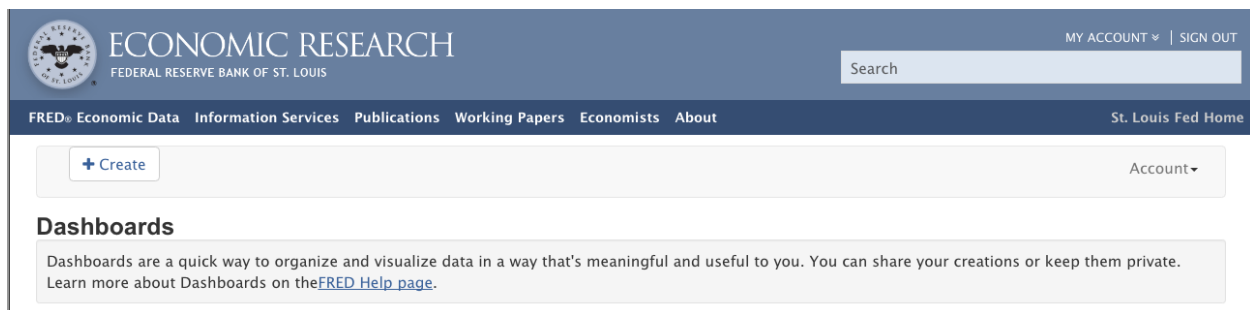
By inputting a name for the Dashboard (we suggest "Taylor rule") and a brief description (we suggest "Instructional materials"), the instructor can keep all of the relevant teaching and learning resources organized for expedient and easy access. The instructor will notice that under the "Description" text box a drop-down menu offers the choice between "Private" and "Public." The FRED account user can choose to keep the contents of a Dashboard private (the default) or searchable and visible to other FRED Account users (i.e. "Public"). Because this distinction is not relevant to the task at hand, we will not discuss it further. A complete list of functionalities associated with Dashboards is accessible at https://fredhelp.stlouisfed.org/#fred-account-what-can-i-do-with-fred-dashboards.

Appendix B

Student Handout for Creating a Taylor Rule in FRED

Purpose. This assignment asks that you:

1. Create a plot of the federal funds interest rate.

2. Create a plot of a Taylor rule for monetary policy guidance.

3. Compare the values of the federal funds interest rate and the Taylor rule.

4. Discuss the macroeconomic implications of following a Taylor rule for monetary policy.

Pedagogical Rationale. This assignment requires that you, first, search for data online, select a particular range of observations, manipulate them, and compute a Taylor rule according to a specific formula. Next, you will interpret the numerical values. Lastly, you will build an argument about the macroeconomic implications of following a Taylor rule when setting monetary policy. These tasks will aim to develop your proficiency in searching for, manipulating, and interpreting data.

Grading. Your grade will be determined by (a) how precisely you complete the search and manipulation data tasks and (b) how accurate your interpretation of the data is.

Steps to Search for and Manipulate the Data. Follow these steps:

1. Access https://fred.stlouisfed.org/ and search for "Effective Federal Funds Rate (FED-FUNDS)."

2. Create a FRED graph by clicking on the series' name.

3. In the FRED graph, limit the data range displayed in the plot by selecting "10Y" to the left of the "EDIT GRAPH" orange button.

4. Click on the "EDIT GRAPH" orange button and select the "ADD LINE" tab.

5. Add the data series "Consumer Price Index for All Urban Consumers: All Items, Index 1982-1984=100, Seasonally Adjusted (CPIAUCSL)" to the graph.

6. Change the units of the LINE 2 series to "Percent Change."

7. Customize the data of the LINE 2 series by adding "Civilian Unemployment Rate, Percent, Seasonally Adjusted (UNRATE)."

8. Further customize the data of the LINE 2 series by adding "Natural Rate of Unemployment (Long-Term), Percent, Not Seasonally Adjusted (NROU)."

9. Complete the customization of the data of the LINE 2 series by entering the formula "1 + (1.5 × a) – (1 × (b - c))" and selecting "Apply."

Writing Prompts. Answer the following questions:

1. Which is higher: the federal funds interest rate or the "guidance" provided by the Taylor rule? Consider the following three periods separately: 2006 to 2008, 2009 to 2014, and 2015 to today.

28

2. Briefly describe the concept of "zero boundary." Use that concept to explain the limitations of using a Taylor rule to "guide" monetary policy between 2009 and 2014. Explain your answer.

3. Consider the relative values of the federal funds interest rate and the "guidance" provided by the Taylor rule since 2015. Describe the impact that following such "guidance" would have on overall economic activity, the unemployment rate, and the inflation rate. Explain your answer.

Instruction Notes. The assignment can be easily modified by asking students to compute and compare different formulations of the Taylor rule. We provide the series' names and IDs below.

Series' names and identifiers

<u>Alternatives to the Consumer Price Index for All Urban Consumers: All Items</u>

-   Personal Consumption Expenditures: Chain-type Price Index (PCEPI)

-   Personal Consumption Expenditures Excluding Food and Energy (Chain-Type Price Index) (PCEPILFE)

-   Trimmed Mean PCE Inflation Rate (PCETRIM12M159SFRBDAL)

-   Median Consumer Price Index (MEDCPIM158SFRBCLE)

-   Sticky Price Consumer Price Index less Food and Energy (CORESTICKM159SFRBATL)

<u>Alternative to the Natural Rate of Unemployment (Long-Term)</u>

-   Natural Rate of Unemployment (Short-Term) (NROUST)

<u>Alternative to the Unemployment Gap: the Output Gap</u>

-   Real Potential Gross Domestic Product, Billions of Chained 2009 Dollars, Not Seasonally Adjusted (GDPPOT)

-   Real Gross Domestic Product, Billions of Chained 2009 Dollars, Seasonally Adjusted Annual Rate (GDPC1)

-   Gross Domestic Product: Implicit Price Deflator, Index 2009=100, Seasonally Adjusted (GDPDEF)