Visualizing Data and the Online FRED Database[§]

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Abstract:

I discuss a pedagogical strategy based on data visualization and analysis in the teaching of intermediate macroeconomics and financial economics. In these short projects students collect and manipulate economic data from the online Federal Reserve Economic Data (FRED) database in order to illustrate theoretical relationships discussed in class. All the data collection and manipulation tasks are conducted through the FRED website. I argue that as students locate and use effectively the quantitative information that they need to evaluate abstract concepts they are in effect developing the connection between theories and empirical evidence that underpins the discipline of economics.

Keywords: Intermediate Macroeconomics; Financial Economics; Data Manipulation; Data Analysis.

JEL codes: A22, C82, G12, G14, G15.

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As Simkins and Maier convincingly argue in their description of pedagogical strategies to improve student learning in the economics major, Bloom's higher-order cognitive processes (Bloom 1956) and Siegfried *et al.* "thinking like an economist" learning goals (Siegfried *et al.* 1991) are best achieved through learning that encourages students to "analyze trends and correlations in economic data, apply economic theory to real-world problems, and evaluate economic policies" (Simkins and Maier 2009, 85) [1]. The challenge, then, lies in designing course assignments that help students develop the intellectual proficiencies involved in "doing economics". In what follows I will argue that the web-based interface of the FRED database is an excellent resource for relating economic concepts and theories to data. The data-visualization and manipulation capabilities of the FRED website are significant pedagogical resources since, as Tufte puts it, "at their best, graphics are instruments for reasoning about quantitative information" (Tufte 2001, 9).

Identifying with Velenchik's description of the "limitations of theory teaching" through classroom examples I too find them "often abstracted from context" (Velenchik 1995, 31). When introducing students to the discipline of economics we, as instructors, undertake considerable efforts to make the material relevant and engaging through the use of examples and illustrations close to the students' "micro" reality. For example, discussing opportunity cost in terms of hours of sleep versus hours of study. Because students are familiar with these kinds of information they are likely to find *thinking in microeconomic terms* relatively easy and –to an extent, intuitive. At the same time, I would argue, there is a large information deficit when it comes to the "macro" reality that the students live in[2]. In my own experience, beginning-of-the-semester student surveys on current inflation or GDP growth rates reveal great gaps in students' familiarity with macroeconomic information. I would argue that this type of information deficiency makes the task of *thinking in macroeconomic terms* marginally more difficult. For example, the discussion

[1] For an in-depth discussion of the expected proficiencies of the Economic academic major I direct the reader to the seminal work of Hansen (Hansen 1986). His influence in shaping the contemporary effort to "educate economists" is explicitly stated in the collected works edited by Colander and McGoldrick (Colander and McGoldrick 2009), (Part 3: Changing the Way We Teach Economics).

[2] The work of Goffe offers quantitative evidence of student factual misconceptions related to principles of macroeconomics. See (Goffe 2013)

of historical shifts of the Phillips Curve requires referencing a historical context (e.g. the 1970's oil shocks) usually external to the course content and potentially controversial in and of itself[3]. In addition, students face the need to develop a new vocabulary, that of quantitative information. Continuing with the example of the Phillips Curve, students learn about how U.S. inflation increased three-fold in the 1970s and are expected to compare that figure with a doubling of the unemployment rate during the same period. In other words, students need to learn to evaluate issues of magnitude and proportion.

The pedagogical approach that I propose employs data-visualization techniques in an intermediate macroeconomic theory or financial economics course. Visualization of economic models through diagrams enjoys a long tradition in the discipline. As Wilkins argues for the use of graphical models as a means to visualize algebraic models (Wilkins 1992), Maclachlan *et al.* endorse the use of the software package Mathematica to demonstrate and visualize through diagrams sophisticated economics models (Maclachlan *et al.* 2010). Simultaneously, teaching with data has been endorsed in a variety of course settings and using different data-manipulation tools. For example, (Adams and Kroch 1989), (Peterson 2000), (Whiting 2006), and (Elmslie and Tebaldi 2010) effectively highlight the connection between abstract model-building and empirical testing methods central to our discipline. Yet, whereas the aforementioned authors make data search and retrieval tasks marginal to the course assignments that they describe the pedagogical strategy that I propose makes the tasks of finding and accessing data central to the students' work. The use of the Federal Reserve Economic Database (FRED), an online compiler of "240,000 US and international time series from 76 sources" (as of January 9, 2015), vastly reduces data searching costs in terms of time and energy. Moreover, its web interface (https://research.stlouisfed.org/fred2/) allows for the immediate visualization of any and all the data series in the FRED repository. In the pedagogical strategy that I put forward I make use of the Data Tool "Create Your Own Graphs" as well as the "Create Your Own Data Transformations" feature in the "Edit Data Series" tab of any FRED online graph[4].

[3] See (Fuhrer *et al.* 2009)

[4] For a discussion of the Data Tool "Create Your Own Maps" I direct the reader to the work of Suiter and Stierholz. See (Suiter and Stierholz 2009)

The activities that I describe could also be used in conjunction with the case method teaching in economics that Velenchik and (Marks and Rukstad 1996) endorse in order to "'understand the real world' […] while mastering basic economic theory" (Velenchik 1995, 29). In the context of this particular pedagogical strategy, the proposed data visualizations can be valuable assets in either drafting a *case* or in guiding the students' *preparation* for the case itself. In the course activity that I describe in the following sections students manipulate data series through the FRED website to quantify a series of macroeconomic concepts in the contemporary context of the United States economy.

THE COURSE

The course where I make the most extensive use of this pedagogical strategy is an elective financial economics course open to any student who has completed the introduction to economics course. There are no other pre-requisites to this elective course. The class meets twice a week during a 14-week semester in a classroom equipped with a computer and a video projector. The content is organized around four units: (a) Stock Prices (4 class periods), (b) Bond Prices (4 class periods), (c) Interest Rates (4 class periods), and (d) Exchange Rates (4 class periods). At the end of the semester we also devote 3 class periods to Financial Derivatives, although the students are not currently tested on this topic. For each thematic unit there is a text-based case study based on an *Economic Letter* published by a Federal Reserve Bank and an on line quiz. Course grades are also determined by two in-class partial exams, on week 5 and week 11, as well as a comprehensive final exam, on week 14.

During the first class period of the semester the students meet the academic librarian who serves as the liaison with the Economics Department for a research instruction session at the library's computer lab. There, the students are introduced to the databases that they will use to gather the data for the graphing and analysis exercises. This research instruction session also serves to introduce the academic librarian to the students in order to encourage them to seek her/his assistance with database needs throughout the semester.

The library subscribes to a number of specialized databases and although we use one of them, Standard and Poor's *NetAdvantage*, for the first course unit I have found the public-access

Federal Reserve Bank of Saint Louis' FRED database ideally suited for the purposes of this course. During the research instruction session at the library the students become familiarized with FRED's website and with the processes of plotting specific data series and "creating your own data transformations". This particular function allows the website user to algebraically manipulate the data on her/his browser, eliminating the need to download the data series into a spreadsheet in order to compute ratios, differences, and so on. Also during this class period, the students become familiar with the on line teaching platform Moodle, locating the discussion questions for the data graphing and analysis exercises. All the course materials are available through the Moodle course page and students submit their work through this medium too. I personally find this particular feature of the course design very convenient and although student evaluations endorse it is not indispensable for the application of the pedagogical strategy that I describe here.

Currently, I have incorporated FRED-based graphing and analysis activities into the discussion of seven separate topics or concepts in my financial economics course[5]. Table 1 lists the concepts, the data series & codes, and the data transformations that I employ. Each concept and topic is first presented through a lecture and immediately compared against its historical record in the United States. In order to do so students are split into small groups and assigned either different time periods or different variables to analyze. For example, on a topic like the term spread different groups are tasked with comparing different decades and on a topic like the sovereign risk premium different groups compare different countries. In what follows I will describe a step-by-step implementation of this pedagogical strategy in order to highlight its enduring, significant and replicable qualities.

[INSERT TABLE 1 ABOUT HERE]

[5] A free-access collection of peer-edited classroom teaching activities using FRED is available at *Starting Point: Teaching and Learning Economics* portal (http://serc.carleton.edu/econ/fred) (Last accessed January 18, 2015)

THE ACTIVITY

This activity quantifies market-based inflation expectations, as reflected in Treasury security yields, over time. The activity can be used as either (a) an instructor-led illustration in which the instructor shows –either on paper or on a screen– the data and students analyze them, or (b) as a student activity in which students find the specified data. Instructors with less time could use option (a) and instructors interested in their students learning about the FRED database could use option (b). In order to highlight the replicability of this activity I will describe it as an instructor-led in-class demonstration.

This activity plots the yield of a non-inflation-adjusted Treasury bond (e.g. the 30-Year Treasury Constant Maturity Rate), the yield of an inflation-adjusted Treasury bond (e.g. the 30-Year Treasury Inflation-Indexed Bond), and computes the difference between the two of them. This difference is an approximation of inflation expectations developed by financial markets. Within a lecture discussing real and nominal interest rates, for example, an instructor could use this activity to help students understand the concept of inflation expectations and to guide a discussion of their quantification.

Within the FRED website (https://research.stlouisfed.org/fred2/) the instructor will select the tab “Data Tools” and within that tab the “Create Your Own Graph” tool. Once the “FRED Graph” window opens, the instructor will present a graph of the 30-Year Treasury’s Inflation-Indexed Bonds (WTP30A28) (Category: Money, Banking & Finance > Interest Rates > Treasury Inflation-Indexed Securities). This can be accomplished by typing either the first few words of the name of the series or their database label in the search box labeled “Add Data Series > Type keywords to search for data”. Once the data is plotted the instructor can ask students to review the relationship between bond yield and bond price, discussing how it is possible that a bond offers a negative yield. Questions of volatility can also be brought up by pointing out sudden and large changes in the value of the series.

The instructor will then “Add a Data Series > Add New Series”, graphing the 30-Year Treasury’s Constant Maturity Bond Rate (DGS30) (Category: Money, Banking & Finance > Interest Rates > Treasury Constant Maturity). Once both series are plotted, see Figure 1, the

instructor could point out that although there is frequent co-movement between the series the yield of the inflation-indexed Treasury securities rarely exceeds the yield of the non-inflation-indexed Treasury securities. The instructor can ask students to put forward an argument for why that is the case. Thus having introduced the concept of inflationary expectations, or – alternatively– that of an "inflation premium" the instructor will proceed to quantify this concept.

[INSERT FIGURE 1 ABOUT HERE]

In order to do so, the instructor will first "Edit Data Series 2" (30-Year Treasury's Constant Maturity Bond Rate (DGS30)) by deleting it [clicking on the trash can icon to the right of the series' name] and then "Add a Data Series > Modify Existing Series > Data Series 1", graphing 30-Year Treasury's Constant Maturity Bond Rate (DGS30). These steps are needed in order to have both series as part of the same database object and allow for their manipulation[6]. This manipulation is accomplished by selecting "Create Your Own Data Transformation > Formula > b – a > Apply".

The graph, see Figure 2, now plots the difference between non-inflation-indexed and inflation-indexed Treasuries, a computation of inflation expectations, and can be used to organize in-class discussions around questions such as these: What average value did inflation expectations have before the 2008-2009 recession? What are the implications of such stable inflation expectations for bond prices? Consider both the magnitude and the volatility of inflation expectations after the 2008-2009 recession: What are the implications of such volatile inflation expectations for bond prices? Finally, as part of a monetary policy evaluation exercise the evidence of increased volatility of inflation expectations after 2009 can be brought to bear on a discussion of unconventional monetary policy during and after the Great Recession.

[INSERT FIGURE 2 ABOUT HERE]

[6] For more information on FRED features please see: http://fredqa.stlouisfed.org/ (Last accessed, January 19, 2015)

Between the presentation of the data and the ensuing discussion, instructors should allocate 20-30 minutes of classroom time. All FRED data plots can be saved into a "dashboard" in a "user account"[7] and thus prepped ahead of class to save time. The recommended method for assessment of this course activity would be to have students write up a short memo where they discuss the historical evolution of inflation expectations computed as the difference between non-inflation-indexed and inflation-indexed Treasury bonds. This should be a take-home assignment. Finally, the richness of the FRED online data repository allows for further sophistications of this activity. For example, by plotting the difference between the 10-Year Treasury's Constant Maturity Bond Rate (DGS10) and the 10-Year Treasury's Inflation-Indexed Bonds (WTP10J14) students can discuss how and why 10-Year and 30-Year inflation expectations are different.

CONCLUSIONS

I have employed graphing and analysis exercises like the one described above in intermediate macroeconomics and financial economics courses over the last five years. Not having conducted a systematic evaluation of their pedagogical effectiveness my overall assessment is derived from a comparison of old and new in-class practices and observed student behavior. In a forthcoming publication I present some evidence of improved test scores across time as the diagrammatic representation of a theoretical concept is complemented with the plotting of the actual data series[8]. A summary of this assessment is presented in the Appendix.

Agreeing with (Simkins and Maier 2009) in that "doing economics" is an effective pedagogical strategy to improve student learning I believe that bringing data into the classroom through the FRED database is a highly significant strategy. The ease of access to thousands of data series and the ability to manipulate them online –thus circumventing the need to download data series and manipulate them through spreadsheets- makes this resource unique. Although data repositories from the International Monetary Fund and the World Bank also include means

[7] For more information on this particular feature please see: http://fredqa.stlouisfed.org/2014/03/17/new-on-fred-user-dashboards/ (Last accessed, January 19, 2015)

[8] See (Mendez-Carbajo 2016) Quantitative Reasoning and Information Literacy in Economics. In *Information Literacy –Not Just for Librarians: Issues in Assessment, Teaching, and Application*, WAC Clearinghouse (in digital format) and Parlor Press (in print). Forthcoming.

to visualize their data series online their ease of access and sophistication are far less than those from the FRED website. The instructional strategy that I have described is enduring because it is solidly grounded in economic theory and eminently replicable because it is based on a free resource open to the public. Moreover, it can take multiple forms. To sketch another example: an instructor can make the concept of real interest rates operational through the FRED website by computing the difference between any nominal interest rate series and the growth rate of the Consumer Price Index.

I would also like to point out that the online visualization and manipulation of data series through the FRED website is not, and does not pretend to be, a substitute for the formal analysis of data. As the online menu of available data transformations does not include options such as computing correlation coefficients or fitting a regression line instructors interested in incorporating those computations into their lecture or assignment design will have to separately show students how to download data series and use spreadsheets or statistical packages. Having said that, even for those more advanced consumers of data the FRED website provides easy access to preliminary visual data analysis and frequency/unit manipulation.

Incorporating this type of data graphing and analysis exercises into an existing intermediate-level course may present some initial challenges to some instructors and/or students. As with any and all changes in pedagogy there is a period of adaptation during which instructor's and students' expectations are re-aligned. For example, replacing some lecture time with topic-specific, in-class, data-graphing demonstrations and discussions requires that students take on a more active role. Also, as Velenchik point out, in an open-ended discussion the instructor "has to guide the class through the process of distinguishing between good and bad ideas" (Velenchik 1995, 37). This is a departure from the lecturer being a "sage on stage" but also an opportunity to empower students in their own learning. As for the opportunity cost of using data in the classroom in an intermediate theory course I have personally chosen to replace made-up exercises aimed at rote memorization (e.g. deriving the purchasing power parity theory of exchange rates from the *law of one price* between two currencies) with real-life applications of those concepts. A potential challenge of using the FRED online database for in-class instructional purposes derives from the very fact that it is online and thus outside of the

omnipotent control of a course instructor. Besides unpredictable power outages, computer malfunctions and the like, the use of the FRED website ties its users to a continually growing and evolving data repository and visual interface. Although in a world of consumer electronics and professional software where new versions of operating systems and programs supersede old familiar ones we are exposed to the same need to adapt unexpected changes in the FRED website may be jarring to some. In my experience newer versions of the website have not taken any critical functionality away and effectively added valuable new features. Instructors considering using FRED for instructional purposes should keep in mind that FRED is key to the research functions of the Federal Reserve Bank of St. Louis and so it shares the professional prestige of the whole institution[9].

Student reflections on the use of data graphing and analysis exercises in my courses have been consistently positive. Quoting from the university's standard anonymous course evaluations and the in-class exit interviews, students state that: "It was great to use the FRED database in class" , "I really liked how we went from lecture to application to case study, it was a good progression", and "I can now better connect financial theories with data". Also important when considering the impact of this pedagogical strategy is to ascertain its reflection on students' work in other courses. As I have stated earlier, lacking a systematic evaluation tool all that I can offer at this time is anecdotal evidence. Yet it is compelling: out of the 16 research projects that students undertook over the last two years in the section of Senior Project (i.e. the capstone course in the major) that I have taught six were devoted to financial economics topics discussed through quantitative case studies in lower-level courses. Employing a variety of econometric techniques, mastered in a separate methods course, the students broached topics ranging from the determinants of the sovereign risk premium in Europe to the relationship between the corporate bond risk premium and U.S. monetary policy. In my opinion, the articulation of a course-specific discussion question into a fully-fledged, semester-long, research project speaks strongly of the value of connecting theory and data in our courses.

[9] For a history of FRED please see:
http://www.stlouisfed.org/publications/ar/2013/pages/fred_history.cfm (Last accessed, January 19, 2015)

APPENDIX

The Activity

The Intermediate Macroeconomics course where I implemented this data-based pedagogy is organized around four units of content: (a) Introduction (4 class periods), (b) Long-Run Economic Performance (6 class periods), (c) Business Cycles and Macroeconomic Policy (8 class periods), and (d) Macroeconomic Policy (6 class periods). There are bi-weekly on line quizzes and two in-class partial exams, on week 6 and week 12, as well as a comprehensive final exam, on week 16. As a voluntary activity, for extra credit, during the last week of classes students can deliver a group presentation on the macroeconomic conditions of the country that they are assigned to at the beginning of the semester.

During the first class period of the semester the students meet the academic librarian who serves as the liaison with the Economics Department for a research instruction session at the library's computer lab. There, the students are introduced to the database that they will use to gather the data for the visualization exercises and are assigned to one of four different work groups. This research instruction session also serves to introduce the academic librarian to the students in order to encourage them to seek her/his assistance with database needs throughout the semester.

The library subscribes to the International Financial Statistics (IFS) on-line database maintained by the International Monetary Fund (IMF) and I have found this resource very convenient for the purposes of my course. In order to keep the data analysis and the size of the work groups manageable each semester I identify four or five different countries for the students to study. During the research instruction session at the library all students work on gathering data on the GDP components for the U.S., also becoming familiar with the on line teaching platform Moodle, locating the discussion questions for the quantitative case studies, and importing their data into Microsoft Excel for purposes of analysis.

Currently, I have incorporated a data-visualization exercise to each of the following seven topics in a standard intermediate macroeconomics course: (1) GDP components, (2) Uses

of Saving, (3) Productivity, (4) Growth, (5) Inflation, (6) Interest Rates, and (7) the Phillips Curve. Each of these concepts and topics are first presented from a conventional theoretical perspective and immediately compared against their historical record in the United States. I then direct students to compile, after class, the relevant data from the IFS data base and to plot those data into Microsoft Excel spreadsheets. Depending on the topic, students are asked to compute ratios between variables (topic 1), rates of growth (topics 2, 3, and 5), sums or subtractions (topics 2, 4 and 6), or to generate a scatter plot (topic 7). The use of spreadsheets for data manipulation and plotting is common practice in the discipline and this element of the activity contributes to the development of research literacy skills. Also, it is usually at this stage when students begin to be aware of matters germane to social-structural information literacy. For example, changes in the methodology of data collection, or even a change in the definition of the object of study (e.g. Germany pre-and-post 1990), result in discontinuities in the series –or even gaps. Also, time periods when the variables are very large in magnitude (e.g. Brazil's hyper-inflation in the 1990s) dwarf the rest of the data, making their visual interpretation much more difficult. Although these data-related issues are sometimes frustrating to some students they are excellent educational opportunities to develop a historical context to the study of macroeconomics.

After the data is plotted students use the graphs they have generated to answer a series of discussion questions highlighting how quantitative evidence validates –and sometimes challenges--the theoretical relationships focus of the course. These questions are posted on an on line discussion forum hosted on the Moodle teaching platform. Only students registered in the course have access to these questions and the forum is set up in a "Q&A" format, which prevents individual students from seeing their peers' answers to the common set of questions until they have posted their own work. Students have no less than 48 hours to complete the data collection, plotting and analysis before the submission of their answers is blocked. In other words, their work must be completed and uploaded to Moodle by the time the class convenes the following day. The discussion questions associated with each data-visualization exercise cover a range of issues. Some questions ask the students to describe visual aspects of the data (e.g. "which GDP component is the largest?") and aim to be prompts for discussion of economic structures when different countries' data are compared. Some questions (e.g. "Is the country a net lender or a net

borrower?") require the application of theoretical concepts discussed in class to the changing reality of different economies. Finally, some other questions (e.g. "Do the growth rate of labor productivity and the unemployment rate move in the same direction? Why not?") aim to bring to the fore the theoretical relationships object of the course.

During the class period when the data-visualization exercises are discussed the students' work –both their data plots and their answer to the discussion questions--are projected on video screens. Over the last three years I have made use of a technology-intensive classroom setup with multiple video projectors and a digital whiteboard. Those are not essential components of this activity but they facilitate the visualization of trends, cycles and degrees of association between variables. Moreover, I believe that the fact that students see their work projected for everybody else to see serves to produce a certain degree of peer pressure that marginally improves the average quality of their work. It is during the in-class discussion period when the aspects of quantitative literacy, or numeracy, becomes central to the course. As the students work through their individual discussion questions they gain confidence in reading and interpreting the data associated with the assignment. Also, as the same discussion question is addressed across different countries students are able to observe different orders of magnitude, proportion and sign of macroeconomic magnitudes under study, effectively developing a true context for their theoretical study of economics.

Assessment

For the purpose of this paper I will focus on the challenges associated with the discussion of a standard production function, the derivation of the concept of labor productivity, its connection to the demand for labor, and –finally, to the concept of the unemployment rate.

One of the data-visualization exercises completed in this course covers the topic of labor productivity and its relationship to the unemployment rate. Over the years, most of my in-class exams have included questions on these concepts. The phrasing of the questions has evolved but the focus remains on the same issue: economic theory teaches us that as productivity increases, other things being equal, the unemployment rate decreases. In my experience, students tend to struggle with the notion that as workers become more productive the demand for their labor

increases. Their “micro” thinking, discussed earlier in this paper, leads them to conclude that employers demand fewer workers once these workers become more productive.

In the fall semesters of 2008 and 2009, prior to the inclusion of data-visualization exercises in the course, I asked students to identify in a diagram the impact of an increase in total factor productivity on output and on the marginal productivity of labor. Although, in general terms, the students displayed their knowledge of the concepts at stake through a proficient replication of the graphs discussed in class, they struggled when confronted with the task of evaluating a reporter’s statement contradicting intermediate macroeconomic theory. In fact, as the students were asked to analyze information, rather than to replicate material covered in lectures, the average scores on these specific questions dropped from 75% to 34% and their standard deviations increased from 0.15 to 0.25. Due to the small size of the populations under study I will not attempt to draw conclusions about the statistical robustness of these figures. Nevertheless, one could argue that as students were pushed up the skill pyramid representing Bloom’s (1956) taxonomy of learning objectives they faltered at the more demanding task.

In the fall semesters of 2011 and 2012, after the inclusion of data-visualization exercises in the course, I asked students to identify in the same sets of diagrams the impact of decreases in either capital expenditure or in total factor productivity on output, the marginal productivity of labor, and the unemployment rate. The phrasing of the questions was more specific than in previous tests but it also demanded that students relate changes in production and in labor productivity to changes in the unemployment rate. The average scores on these questions were 57% in 2011 and 62% in 2012, with standard deviations of 0.41 and 0.29, respectively. Notice that although the standard deviations of the post quantitative case study test scores have increased relative to the pre quantitative case study test scores the 2009 and 2012 values are very similar.

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Concept	Data Series and Codes	Data Transformation
Purchasing Power Parity	(a) Japan / U.S. Foreign Exchange Rate (DEXJPUS) (b) Consumer Price Index for All Urban Consumers: All Items (CPIAUCSL) (c) Consumer Price Index of All Items in Japan© (JPNCPIALLMINMEI)	c/b
Corporate Risk Premium	(a) Moody's Seasoned Baa Corporate Bond Yield (BAA) (b) Moody's Seasoned Aaa Corporate Bond Yield (AAA)	a-b
Inflation Expectations	(a) 30-Year Treasury's Constant Maturity Bond Rate (DGS30) (b) 30-Year Treasury's Inflation-Indexed Bonds (WTP30A28)	a-b
Sovereign Debt Risk Premium	(a) Interest Rates, Government Securities, Government Bonds for Spain (INTGSBESM193N) (b) Interest Rates, Government Securities, Government Bonds for Germany (INTGSBDEM193N)	a-b
The Interest Swap Spread	(a) 10-Year Swap Rate (MSWP10) (b) 10-Year Treasury's Constant Maturity Rate (WGS10YR)	a-b
Nominal and Real Interest Rates	(a) 30-Year Conventional Mortgage Rate (MORTG) (b) Consumer Price Index for All Urban Consumers (CPIAUCSL) (Unit: Percent Change)	a-b
Taylor Rule	(a) Effective Federal Funds Rate (FEDFUNDS) (b) Consumer Price Index for All Urban Consumers (CPIAUCSL) (Unit: Percent Change) (c) Civilian Unemployment Rate (UNRATE) (d) Natural Rate of Unemployment (Long-Term) (NROU)	1+(1.5*b) -(1*(c-d))

Table 1: Economic Concepts and Data Visualization through FRED

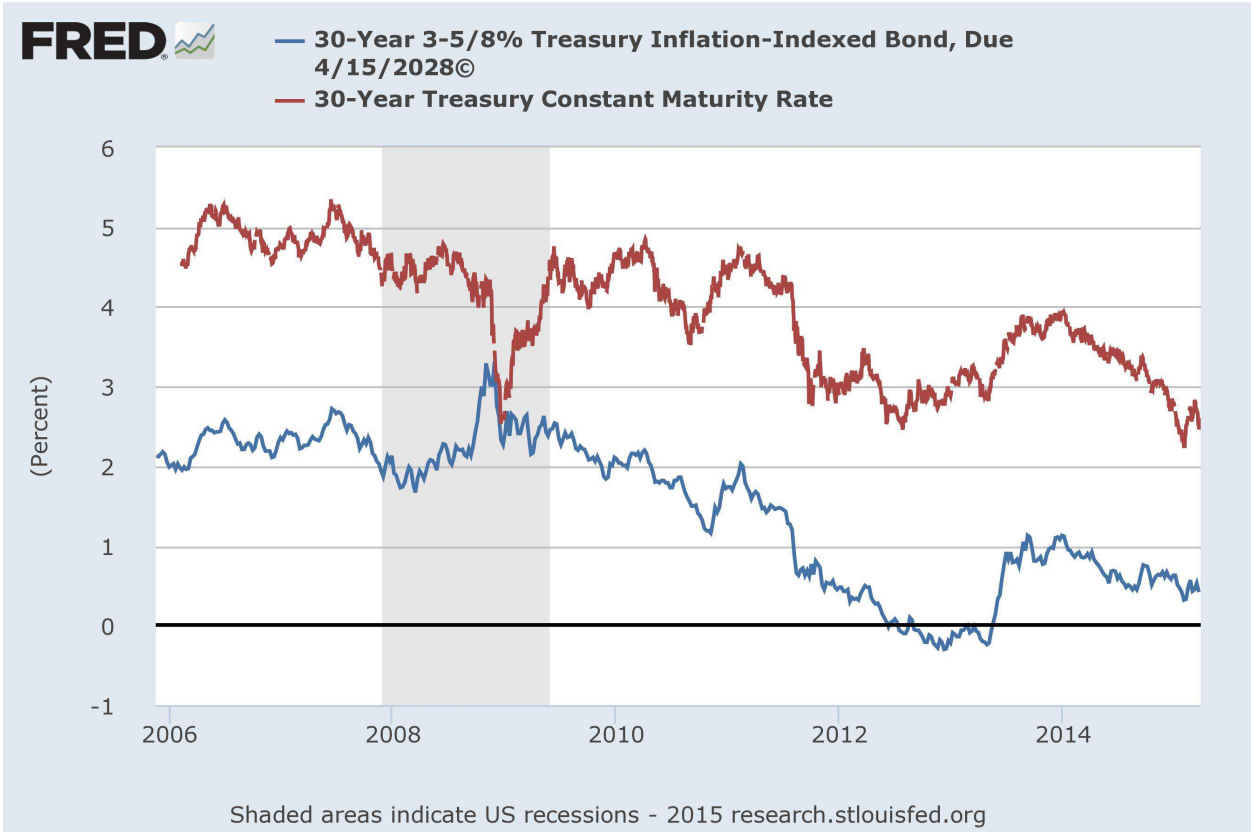

Figure 1: Yield on 30-Year Treasury's Inflation-Indexed Bonds (WTP30A28) and Yield on the 30-Year Treasury's Constant Maturity Bond Rate (DGS30)

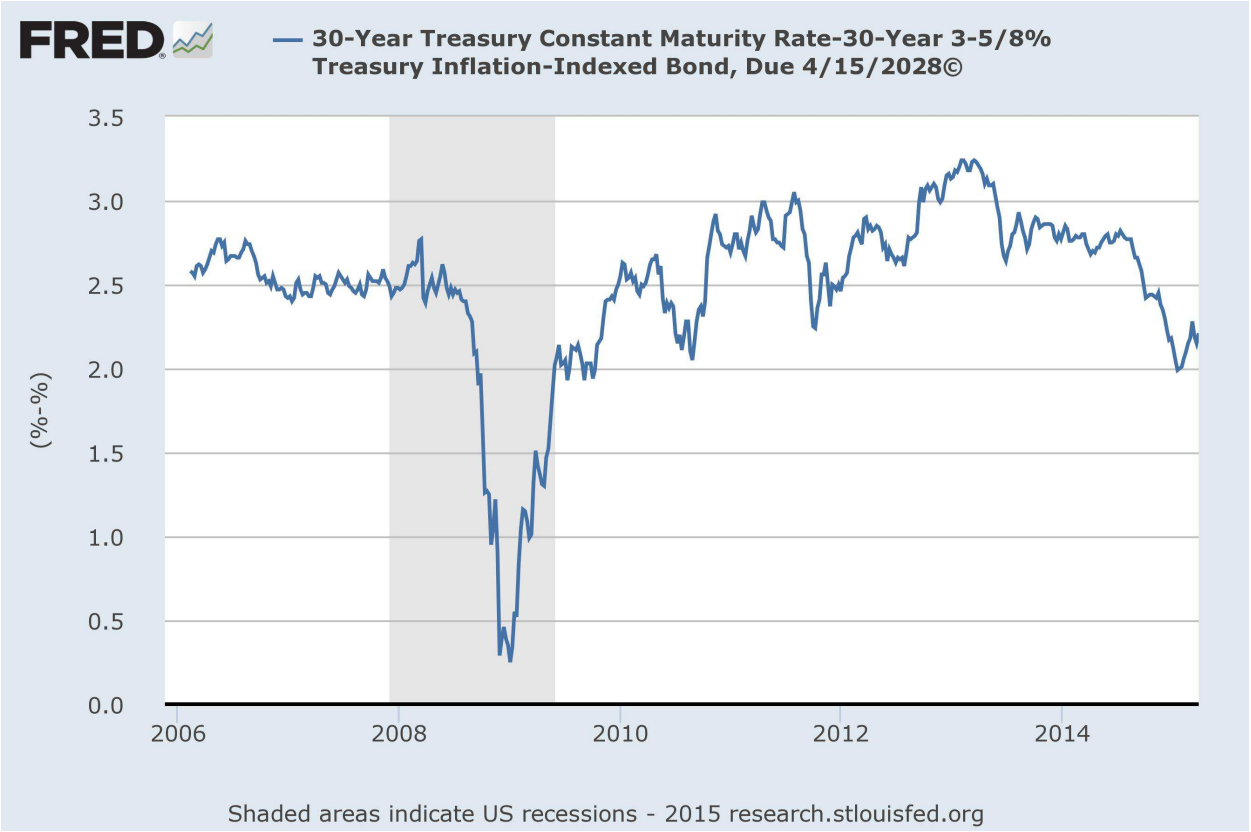

Figure 2: Spread between the 30-Year Treasury's Constant Maturity Bond Rate (DGS30) and the 30-Year Treasury's Inflation-Indexed Bonds (WTP30A28).