present

UD/ISCTE-IUL Trading and Bloomberg Program

Fixed Income Securities

U.S. Treasury Securities Market

Summer 2022

Prof. Matt Fleckenstein

University of Delaware, Lerner College of Business and Economics

Table of Contents

Overview

Our goals for today

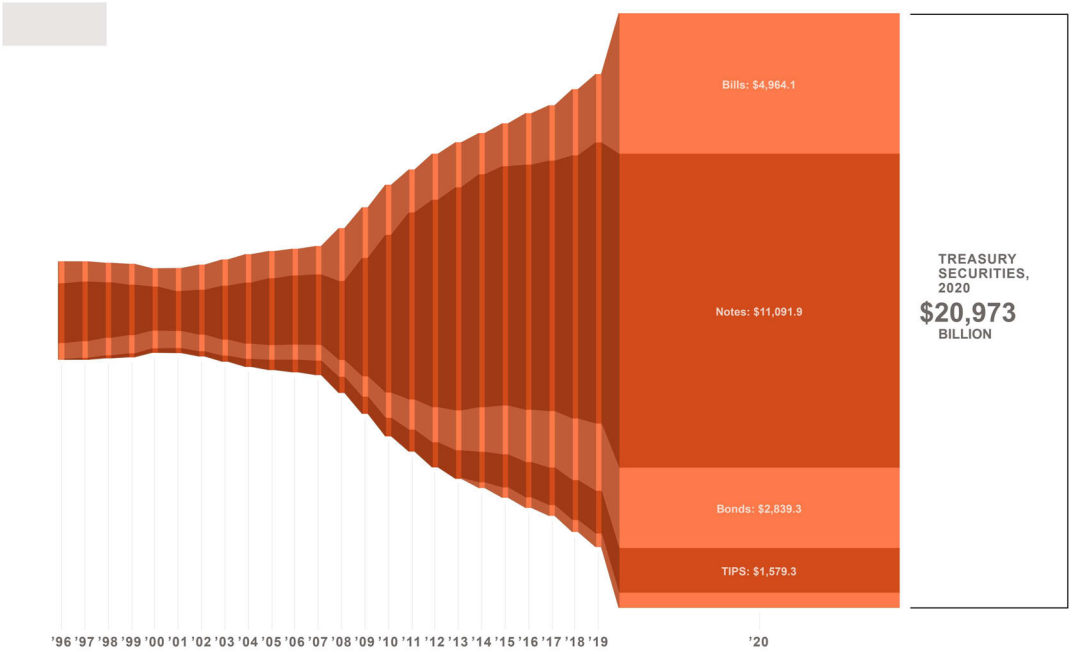
- [ ] Introduction to the U.S. Treasury Securities Market
- [ ] Treasury Bills
- [ ] Treasury Notes and Bonds
- [ ] Treasury STRIPS
- [ ] Treasury TIPS
- [ ] Inflation Swaps

The U.S. Treasury Market

- The Department of the Treasury is the largest single issuer of debt in the world.
- The large volume of total debt and the large size of any single issue have contributed to making the Treasury market the most active and hence the most liquid market in the world

SIFMA Fixed Income Statistics

U.S. Treasury Debt Amount Outstanding



Link to SIFMA

Types of Treasury Securities

- Where to get information about U.S. Treasury securities?
- Go to webpage of the U.S. Treasury.
- In the middle panel, click on `Treasury securities Overview`.

TreasuryDirect®

Home | About | News | Glossary | Forms | Mailing Lists | FAQs | How Do I? | Contact Us | Help | Site Map

Search GO

Home | Individuals | Financial Institutions | Government

Account Login

- TreasuryDirect
- FedInvest®
- SLGSafe®

Open an Account

Learn about opening a TreasuryDirect account.

GUIDED TOUR

Watch our videos.

See below for shortcuts to popular pages

Individuals

- Tax FAQs
- TreasuryDirect: Log in
- Learn about TreasuryDirect
- Find the value of your savings bonds (Calculator)
- Search for Matured Bonds (Treasury Hunt)
- Securities we sell
- Cash paper savings bond
- Interest rates for Series EE
- Interest rates for Series I
- How to buy Series EE
- How to buy Series I
- Gift savings bonds
- More ...

Financial Institutions

- Treasury securities Overview
- How Treasury auctions work
- Treasury Securities Auctions Calendar
- Auction Announcements and Results
- Record-setting auction data
- Auction Query
- Data and resources for economic research
- Resources for employers
- Resources for financial institutions
- Statutes, regulations & guidelines
- More ...

Government

- Public Debt Reports
- Monthly Statement of the Public Debt
- Federal Investments program
- State/local government series (SLGS) securities
- Agency borrowings
- Liquidate your agency's securities
- Interest Rate Data
- FAQs on the Debt
- How to Make a Contribution to Reduce the Debt
- More ...

Try Treasury Hunt to search for matured bonds and held interest payments. Also, see the Matured Unredeemed Debt (MUD) Report.

FiscalData.treasury.gov is our brand-new site featuring federal financial data in machine-readable formats. Explore and download the data today!

Currently, callers to 844-284-2676 may experience longer than normal wait times. You may elect to submit your question or inquiry by e-mail to Treasury.Direct@fiscal.treasury.gov or you can visit our website at https://fiscal.treasury.gov/public/ for more information and resources.

We can do this. Find COVID-19 vaccines near you. Visit Vaccines.gov

Special Announcements

Treasury Resumes Sales of State and Local Government Series Securities

Auction Resources | **Resources & Tools**

Auction Results | Upcoming Auctions | Research Data | Savings Bond Calculator | Debt to the Penny | Savings Bond Rates | for KIDS | Informational Videos | Help Center

TreasuryDirect®

Home | About | News | Glossary | Forms | Mailing Lists | FAQs | How Do I? | Contact Us | Help | Site Map

Search GO

Home | Individuals | Financial Institutions | Government

Home › Institutional › Treasury Marketable Securities

- Financial Institutions
- Treasury Marketable Securities
  - Treasury Bills
  - Treasury Notes
  - Treasury Bonds
  - FRNs
  - TIPS
  - STRIPS
  - BECCS & CUBES
- Announcements, Data & Results
- Auction Fundamentals
- Statutes, Regulations & Guidelines
- Research Center
- Savings Bonds
- Forms for Institutions

Treasury Marketable Securities

U.S. Treasury marketable securities are debt instruments issued to raise money needed to operate the federal government and pay off maturing obligations. These liquid securities can be sold for cash in the secondary market.

U.S. Treasury marketable securities can be stripped into interest and principal components within the secondary market or can be converted from bearer securities into those that can be held in commercial book-entry accounts.

Find out more by selecting from the left navigation.

Account Login

- TreasuryDirect
- FedInvest®
- SLGSafe®

Open an Account

Resources & Tools

- Auction Results
- Upcoming
- Research Data
- Debt to the Penny
- RSS Feeds

Treasury Bill (T-bill)

- Short-term securities with maturities of 4, 13, 26, and 52 weeks.
- Treasury bills do not pay interest before maturity.
    - This is often referred to as a *discount security* or *zero-coupon security*.
- Instead, Treasury bills are issued at a price less than their par value and at maturity, Treasury bills pay back their par value.
    - Intuitively, the "interest" to the investor is the difference between par value and the purchase price.
    - Example: a 52-week T-bill with par value of $100 has a price of $98.

Example of 52-week Treasury Bill

- How to get there on the Bloomberg terminal?
- Open a terminal and on the keyboard type `T Bill`.
- In the popup window, select `B Govt - United States Treasury Bill (Multiple Matches)`.
- Next, click on one of the different Treasury bills in the list.
- Then, click on `DES` on the top-right, or type `DES` on the keyboard and press enter.

Treasury Note (T-Note)

- Medium-term securities with maturities of 2, 3, 5, 7, and 10 years.
- Treasury notes pay interest every six months up to and including the maturity date.
    - Example: A 2-year T-note has its last interest payment in two years, and it pays interest after 6 months, 12 months, and 18 months.
- At maturity, Treasury notes pay back their par value.

Example of 10-year Treasury Note

- How to get there on the Bloomberg terminal?
- Open a terminal and on the keyboard type `T Note`.
- In the popup window, select `T Govt - United States Treasury Note/Bond (Multiple Matches)`.
- Next, click on one of the different Treasury notes in the list.
- Then, click on `DES` on the top-right, or type `DES` on the keyboard and press enter.

- Let's look at price quotes for this Treasury note.
- If you were to purchase this Treasury note, would you pay $95.02?
- The answer is *no*. Prices for Treasury notes are quoted in a specific way, which we will discuss in the next lecture.

- How to get there on the Bloomberg terminal?
- From the `Description` page where you are currently at, type `GP` and press enter.

Treasury Bond (T-Bond)

- Long-term securities with maturities of 20 and 30 years.
    - Currently, the Treasury does not issue 15-year Treasury bonds.
- Treasury bonds notes pay interest every six months up to and including the maturity date. At maturity, Treasury notes pay back their par value.
    - Similar to Treasury notes.

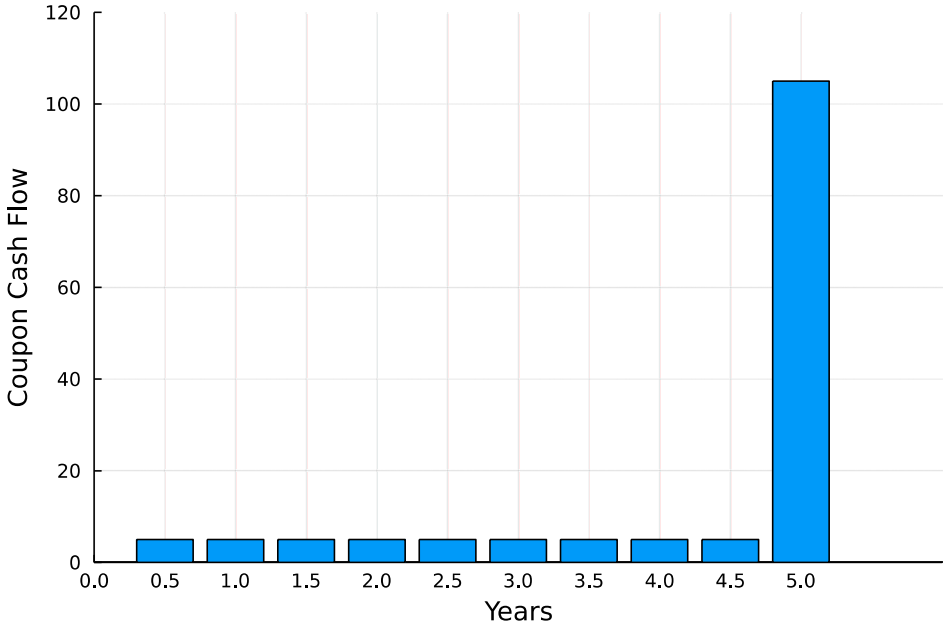
Treasury Marketable Securities

Coupon bonds

- Treasury notes and bonds are referred to as **coupon** securities.
- Why?

Example of Treasury Note Cash Flows

- Par Value F = \$100.
- Coupon Rate c [% p.a.]: 10.0
- Time to maturity T [years]: 5.0



Treasury Floating Rate Note (FRN)

- First issued in 2014 by the U.S. Treasury.
- Maturity of 2 years.
- Pay interest every three months up to and including the maturity date.
    - At maturity, FRNs pay back their par value.
- The interest on an FRN varies with interest rate on 13-week Treasury bills.

Treasury STRIPS

- The Treasury does not issue zero-coupon notes or bonds.
- However, because of the demand for zero-coupon instruments with no credit risk, the private sector has created such securities.
- The process of separating the interest on a bond from the underlying principal is called coupon stripping
- Zero-coupon Treasury securities were first created in August 1982 by large Wall-Street firms.
    - The problem with these securities was that they were identified with particular dealers and therefore reduced liquidity.
    - Moreover, the process involved legal and insurance costs.
    - Today, all Treasury notes and bonds (fixed-principal and inflation-indexed) are eligible for stripping.
- The zero-coupon Treasury securities created under the STRIPS program are direct obligations of the U.S. government

Treasury STRIPS in Bloomberg

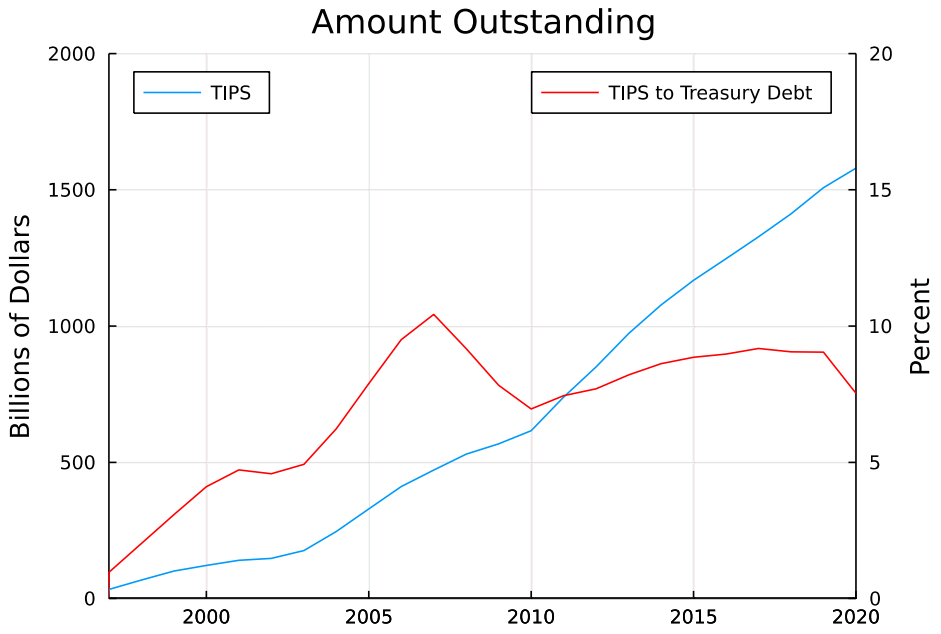
Name	Tic...	Coupon	Maturity	Mty Type	Ctry/Reg	Curr	Identifier
STRIP*	S				US	USD	
United States Treasury Strip Coupon	S	0.000	08/15/2051	NORMAL	US	USD	912834XG8
United States Treasury Strip Coupon	S	0.000	05/15/2051	NORMAL	US	USD	912834WZ7
United States Treasury Strip Coupon	S	0.000	02/15/2051	NORMAL	US	USD	912834WR5
United States Treasury Strip Coupon	S	0.000	11/15/2050	NORMAL	US	USD	912834WJ3
United States Treasury Strip Coupon	S	0.000	08/15/2050	NORMAL	US	USD	912834WC8
United States Treasury Strip Coupon	S	0.000	05/15/2050	NORMAL	US	USD	912834VV7
United States Treasury Strip Coupon	S	0.000	02/15/2050	NORMAL	US	USD	912834VM7
United States Treasury Strip Coupon	S	0.000	11/15/2049	NORMAL	US	USD	912834VE5
United States Treasury Strip Coupon	S	0.000	08/15/2049	NORMAL	US	USD	912834UY2
United States Treasury Strip Coupon	S	0.000	05/15/2049	NORMAL	US	USD	912834UR7
United States Treasury Strip Coupon	S	0.000	02/15/2049	NORMAL	US	USD	912834UH9
United States Treasury Strip Coupon	S	0.000	11/15/2048	NORMAL	US	USD	912834UB2
United States Treasury Strip Coupon	S	0.000	08/15/2048	NORMAL	US	USD	912834TV0
United States Treasury Strip Coupon	S	0.000	05/15/2048	NORMAL	US	USD	912834TP3
United States Treasury Strip Coupon	S	0.000	02/15/2048	NORMAL	US	USD	912834TF5
United States Treasury Strip Coupon	S	0.000	11/15/2047	NORMAL	US	USD	912834SZ2
United States Treasury Strip Coupon	S	0.000	08/15/2047	NORMAL	US	USD	912834RR1
United States Treasury Strip Coupon	S	0.000	05/15/2047	NORMAL	US	USD	912834RK6
United States Treasury Strip Coupon	S	0.000	02/15/2047	NORMAL	US	USD	912834RB6
United States Treasury Strip Coupon	S	0.000	11/15/2046	NORMAL	US	USD	912834QV3

- How to get there on the Bloomberg terminal?
- Open a terminal and on the keyboard type `Treasury STRIP`.
- In the popup window, select `S Govt - United States Treasury Strip Coupon (Multiple Matches)`.
- Next, click on one of the different Treasury bills in the list.
- Then, click on `DES` on the top-right, or type `DES` on the keyboard and press enter.

Treasury Inflation Protected Securities (TIPS)

- First issued in 1997 by the U.S. Treasury.
- Maturities of 5, 10, and 30 years.
- TIPS pay interest every six months up to and including the maturity date. At maturity, Treasury notes pay back their par value.
    - Similar to Treasury notes and bonds.
- Key difference is that both par value and interest go up with the rate of inflation.

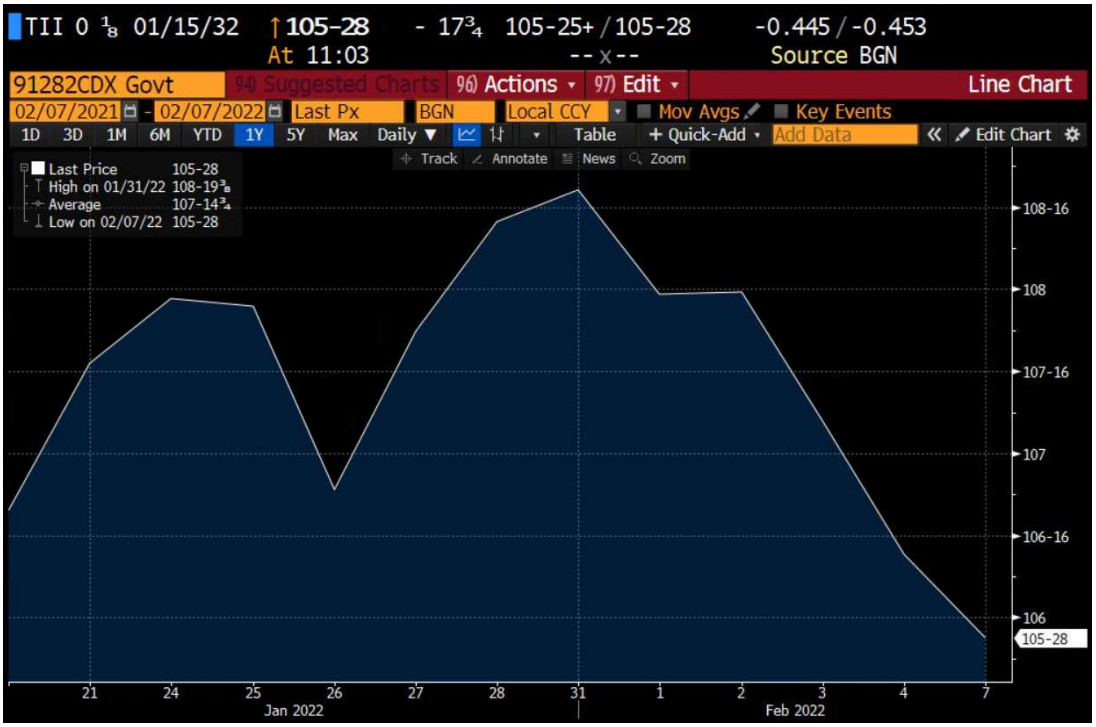
- Why inflation matters ...
    - WSJ, June 10, 2022: U.S. Inflation Hit 8.6% in May. Energy, groceries, shelter costs drive fastest rise in consumer-price index since December 1981
    - WSJ, January 12, 2022: U.S. Inflation Hit 7% in December, Fastest Pace Since 1982
    - WSJ, February 10, 2022: U.S. Inflation Rate Accelerates to a 40-Year High of 7.5%
    - WSJ, February 6, 2022: What Investors Should Know About TIPS



Example of a Treasury TIPS

- How to get there on the Bloomberg terminal?
- Open a terminal and on the keyboard type `Treasury TIPS`.
- In the popup window, select `TII Govt - United States Treasury Inflation Indexed Bonds (Multiple Matches)`.
- Next, click on one of the different Treasury bills in the list.
- Then, click on `DES` on the top-right, or type `DES` on the keyboard and press enter.

- Let's look at price quotes for this Treasury TIPS.
- If you were to purchase this Treasury TIPS, would you pay $105.28?
- The answer is *no*. Prices for Treasury TIPS are quoted in a specific way, which we will discuss in the next lecture.

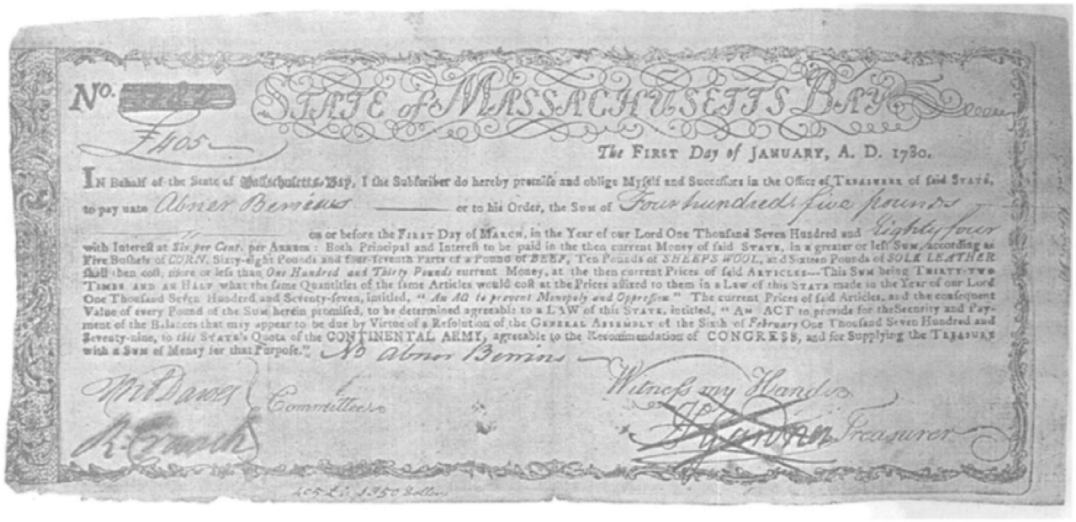


- How to get there on the Bloomberg terminal?
- From the `Description` page where you are currently at, type `GP` and press enter.

Inflation-Linked notes date back centuries

> Both Principal and Interest to be paid in the then current Money of said State, in a greater or less Sum, according as Five Bushels of Corn, Sixty-eight Pounds and four-seventh Parts of a Pound of Beef, Ten Pounds of Sheeps Wool, and Sixteen Pounds of Sole Leather shall then cost more or less than One Hundred and Thirty Pounds current Money, at the then current Prices of said Articles.

Source: "Inflation-indexed Securities: Bonds, Swaps and Other Derivatives", 2nd Edition, M. Deacon, A. Derry, D. Mirfendereski, Wiley.

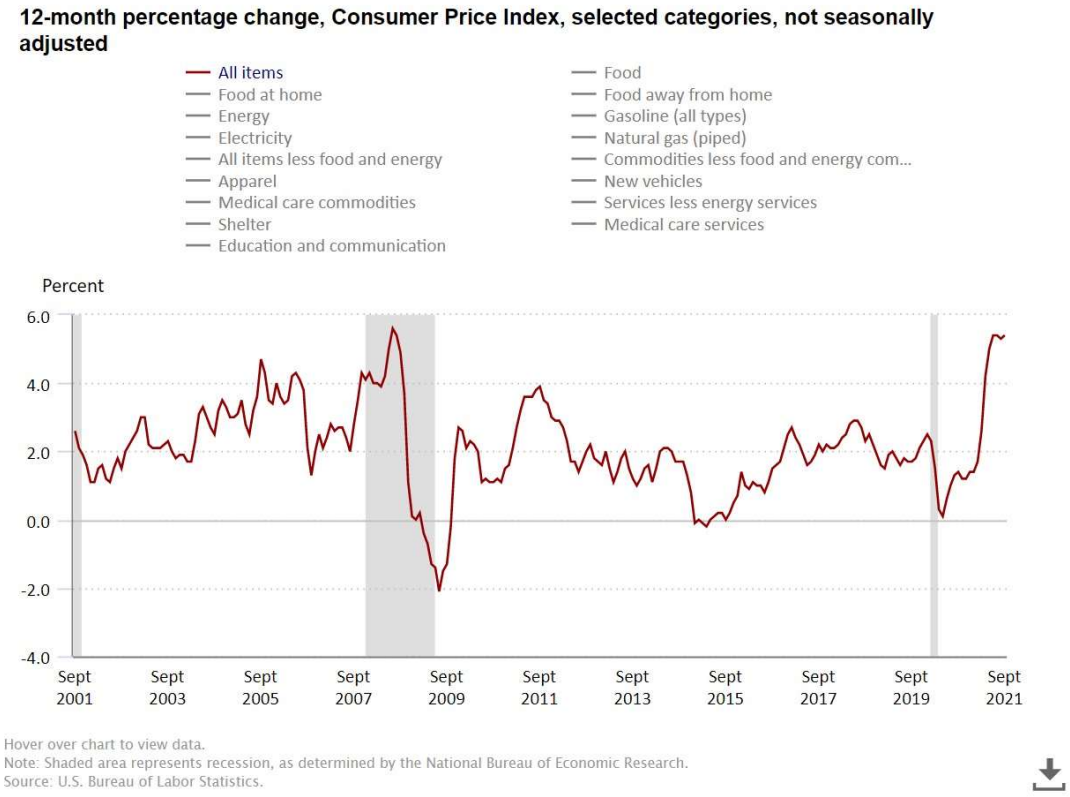


Indexing Bonds to Inflation

- Treasury Inflation-Protected Securities (TIPS) are *index-linked* bonds.
    - An index-linked bond is one whose *cash flows* are linked to movements in a specific price index.
- The *principal amount* of a TIPS is indexed to the price level.
    - Since a fixed coupon rate is applied to the principal that varies with the price level, the actual coupon cash flows vary in response to the realized rate of inflation.
- Index-linked bonds are usually indexed to a broad measure of prices, typically a domestic *Consumer Price Index (CPI)*.

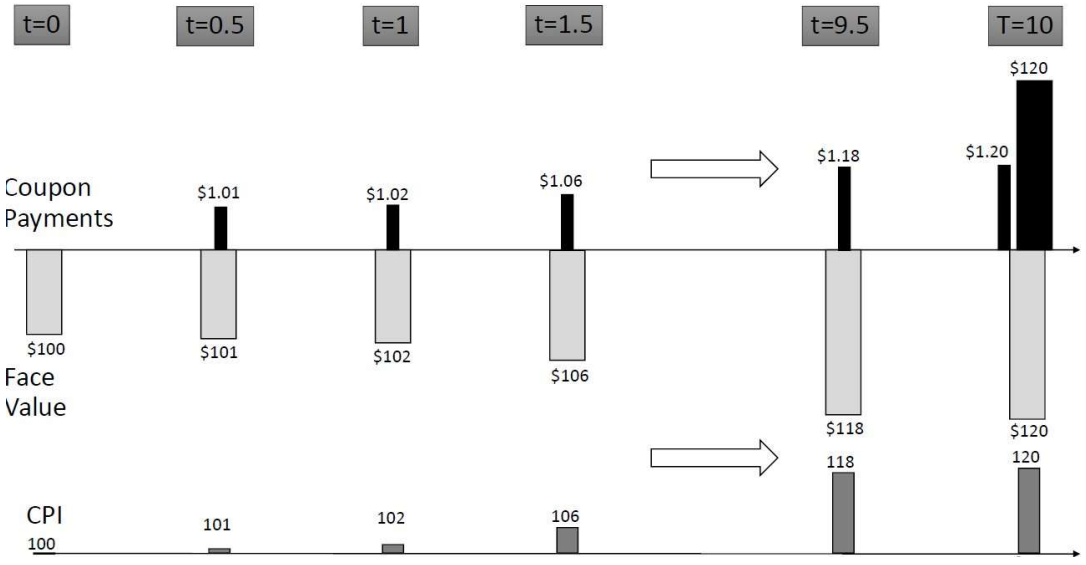
U.S. Consumer Price Index

- In the U.S. this price index is the Consumer Price Index for All Urban Consumers (*CPI-U*).
- The CPI-U measures the level of prices paid by consumers for goods and services.
- This index is published by the Bureau of Labor Statistics (BLS) every month.
- Bureau of Labor Statistics; Bureau of Labor Statistics Release



Source: BLS.gov

TIPS Inflation-Adjustment



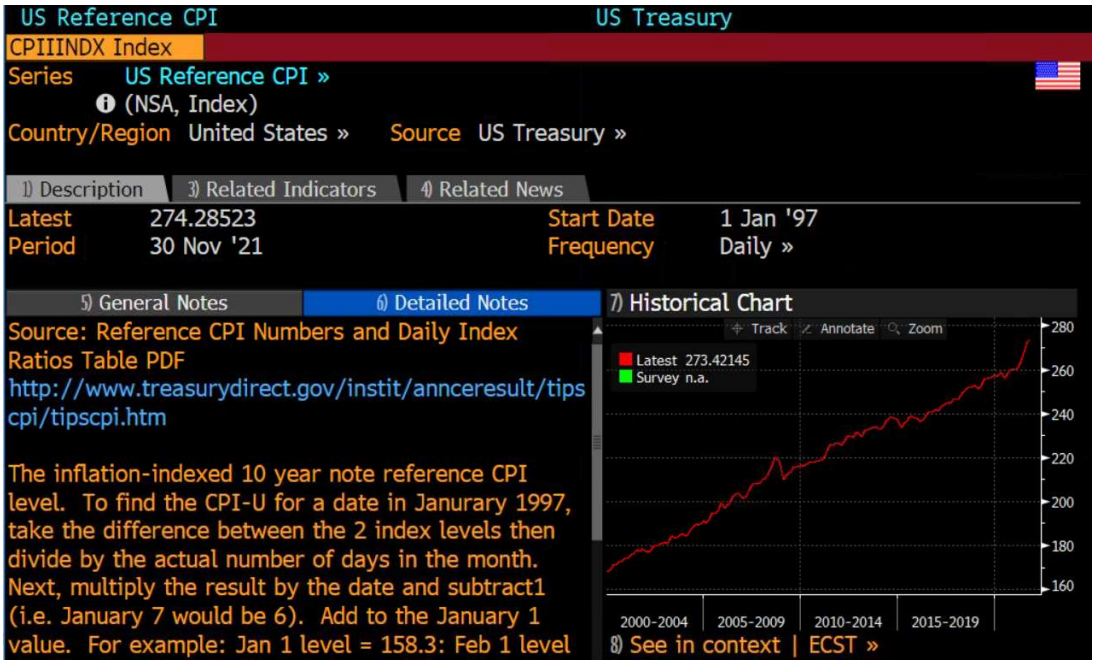
TIPS Inflation Adjustment Details

- The principal amount of a TIPS (assume 100 at issuance) is adjusted daily based on the CPI-U.
- The inflation adjustment I_t is computed as the ratio of the **Reference CPI** at the time t divided by the reference CPI when the TIPS was first issued ($t = 0$).

$$I_t = \frac{\text{Reference CPI at time } t}{\text{Reference CPI at TIPS issue date}}$$

- The **Reference CPI** for a particular date t during a month is linearly interpolated from the **Reference CPI** for the beginning of that month and the **Reference CPI** for the beginning of the subsequent month.
    - The **Reference CPI** for the first day of *any* calendar month is the CPI-U index for the third preceding calendar month.

- *Example 1*: the **Reference CPI** for *April 1* is the CPI-U index for the month of *January* (which is reported by the BLS during February).
- *Example 2*: the **Reference CPI** for *April 15* is roughly the average of the CPI-U index for the month of *January* and the CPI-U index for the month of February.



Deflation Protection

- TIPS have an embedded option that protects against deflation.
- The Treasury guarantees that the *final redemption value is no less than $100 per $100 nominal* amount, irrespective of the movements in the CPI over the life of the bond.
- Let F be the TIPS principal amount and T the time to maturity of the TIPS.
- The principal cash flow at maturity T is

$$F \times \max[\, I_T, 1 \,]$$

- This deflation protection does not apply to coupon cash flows.

Inflation-Adjusted Coupon Interest

Security:	**3-3/8% 10-Year Notes**
Description:	**Series A-2007**
CUSIP Number:	**9128272M3**
Dated Date:	**January 15, 1997**
Original Issue Date:	**February 6, 1997**
Additional Issue Date:	**April 15, 1997**
Maturity Date:	**January 15, 2007**
Ref CPI on Dated Date:	**158.43548**

- The Reference CPI is then turned into a ratio to caclulate the inflation adjustment by taking the Reference CPI on the date and dividing by the Reference CPI at issue.
    - For example, the Reference CPI for January 15, the official issue date of the inaugural TIPS bond is 158.43548. Assume $100 par value at issuance.
    - Suppose we are on July 15 and the first coupon cash flow is about to be paid. Suppose that the reference CPI on July 15 turns out to be 168.53226.
    - Then, the inflation adjustment factor is 168.53226/158.43458 = 1.063734
    - This means coupon rate is paid on par value of $100 $\times$ 1.063734 = $106.3734.

Inflation-Adjusted Coupon Interest Example

- Let F be the TIPS principal value.
- Let c denote the (fixed) *real* coupon rate on the TIPS.
- Let T denote the time to maturity of the TIPS (in years).

- Principal F [$]: 100
- Real Coupon Rate c [%]: 3.0
- Time to Maturity T [years]: 5
- Reference CPI at issue date: 100

- Suppose, $c = 3.0\%$ and $F = 100$.
- In real terms, the coupon cash flows at each coupon date are

$$\frac{c}{2} F = \frac{0.03}{2} 100 = 1.5$$

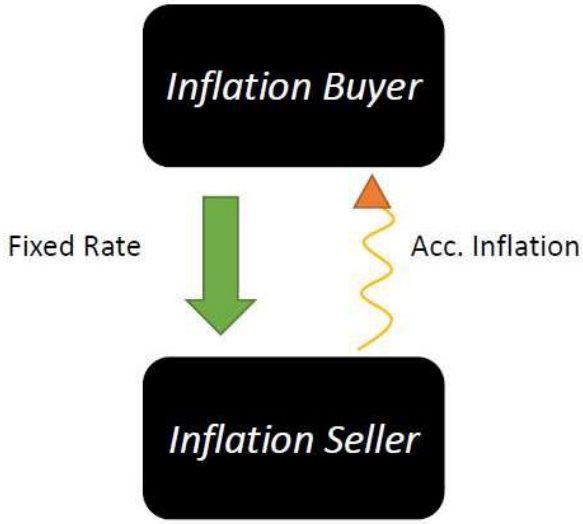
- Suppose there is inflation (or deflation).
- The actual cash flows (in nominal terms) of the TIPS are:

	Time	Reference_CPI	I_t	Adjusted_Principal	Cashflows
1	0.5	101.209	1.01209	101.209	1.51814
2	1.0	100.344	1.00344	100.344	1.50515
3	1.5	102.195	1.02195	102.195	1.53293
4	2.0	103.319	1.03319	103.319	1.54979
5	2.5	104.589	1.04589	104.589	1.56884
6	3.0	103.968	1.03968	103.968	1.55952
7	3.5	103.605	1.03605	103.605	1.55408
8	4.0	104.347	1.04347	104.347	1.5652
9	4.5	104.563	1.04563	104.563	1.56844
10	5.0	105.198	1.05198	105.198	106.776

Inflation Derivatives

- In addition to the cash inflation market, there is an active derivatives market that consists mainly of inflation swap contracts and inflation options.

Inflation Swap Basics



USSWIT1 CMPN Curncy

Properties | Related Instruments | Related Curves

USD Inflation Swap Zero Coupon FIGI BBG009K9TV35

A derivative used to transfer inflation risk from one party to another through an exchange of cash flows. In a zero coupon inflation swap, only one payment is done at maturity where one party pays a fixed rate on a notional principal amount, while the other party pays a floating rate linked to an inflation index.

Overview		Fixed Leg		Inflation Leg	
Currency	USD	Day Count	1/1	Day Count	1/1
Settlement	T+2 Days 26-OCT-2021	Bus Adj	ModifiedFollowing	Index	CPURNSA Index
Term	1 Year 26-OCT-2022	Adjust	Pay Dates	Bus Adj	ModifiedFollowing
Discounting	OIS	Roll Conv	Backward (EOM)	Adjust	Pay Dates
Lag	3 Month	Calc Cal	FD, EN	Roll Conv	Backward (EOM)
Interpolation	Daily	Pay Delay	0 Business Days	Calc Cal	FD, EN
Compound Freq	Annual			Pay Delay	0 Business Days
Quote	3.8700 %			Reset Position	In Advance

USSWIT1 3.8700 As of 22 Oct Source CMPN

USSWIT1 CMPN Curncy | Export | Settings

USD INFL SWAP ZC 1Y

Range 09/29/2006 - 10/31/2006 Period Daily
Market Last Price Currency USD
View Price Table Source CMPN

High 2.1300 on 09/29/06
Low 1.7300 on 10/18/06
Average 1.8417
Net Chg -.3400 -15.96%

Date	Last Price	Date	Last Price
Fr 11/03/06		Fr 10/13/06	1.8100
Th 11/02/06		Th 10/12/06	1.8400
We 11/01/06		We 10/11/06	1.8600
Tu 10/31/06	1.7900	Tu 10/10/06	1.8500
Mo 10/30/06	1.8300	Mo 10/09/06	1.9900
Fr 10/27/06	1.8800	Fr 10/06/06	1.8100
Th 10/26/06	1.9000	Th 10/05/06	1.8500
We 10/25/06	1.8900	We 10/04/06	1.7900
Tu 10/24/06	1.7800	Tu 10/03/06	1.8600
Mo 10/23/06	1.7500	Mo 10/02/06	1.9000

Inflation Swap Cash Flows

- The swap is executed between two counterparties at time $t = 0$ and has only one cash flow that occurs at maturity in T years.

- For example, imagine that at time $t = 0$, the five-year zero-coupon inflation swap rate is 200 basis points and that the inflation swap has a notional of \$1.
- There are no cash flows at time $t = 0$ when the swap is executed.
- At the maturity of the swap in $T = 5$ years, suppose that realized inflation is I_T, then the counterparties to the inflation swap exchange a cash flow of

$$\left[(1 + 0.0200)^5 - 1\right] - [I_T - 1],$$

- Thus, if the realized inflation rate was 1.50% per year over the five-year horizon of the swap,

$$I_T = 1.015^5 = 1.077284$$

- In this case, the net cash flow per \$1 notional of the swap from the swap would be

$$\left[(1 + 0.0200)^5 - 1\right] - [1.077284 - 1] = 0.026797$$

Inflation Swap Example

- Notional N [$]: 100
- Inflation Swap Rate f [%]: 3.0
- Time to Maturity T [years]: 5
- Annual Inflation Rate I [%]: 2.0

- Cash flow on the fixed leg of the inflation swap:

$$N \times \left[(1+f)^T - 1\right] = 100 \times \left[(1+0.03)^5 - 1\right] = 15.9274$$

- Cash flow on the floating leg of the swap:

$$N \times \left[(1+I)^T - 1\right]] = 100 \times \left[(1+0.02)^5 - 1\right] = 10.4081$$

- Net cash flow of inflation buyer: -5.5193

Wrap-Up

Our goals for today

- [x] Introduction to the U.S. Treasury Securities Market
- [x] Treasury Bills
- [x] Treasury Notes and Bonds
- [x] Treasury STRIPS
- [x] Treasury TIPS
- [x] Inflation Swaps

Reading

Fabozzi, Fabozzi, 2021, Bond Markets, Analysis, and Strategies, 10th Edition
Chapter 7