

# Investment returns, portfolios, and indexes

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# Returns on investing in Treasuries

Specifically, we will look at the returns on *zero-coupon* Treasuries. (Do you remember why?)

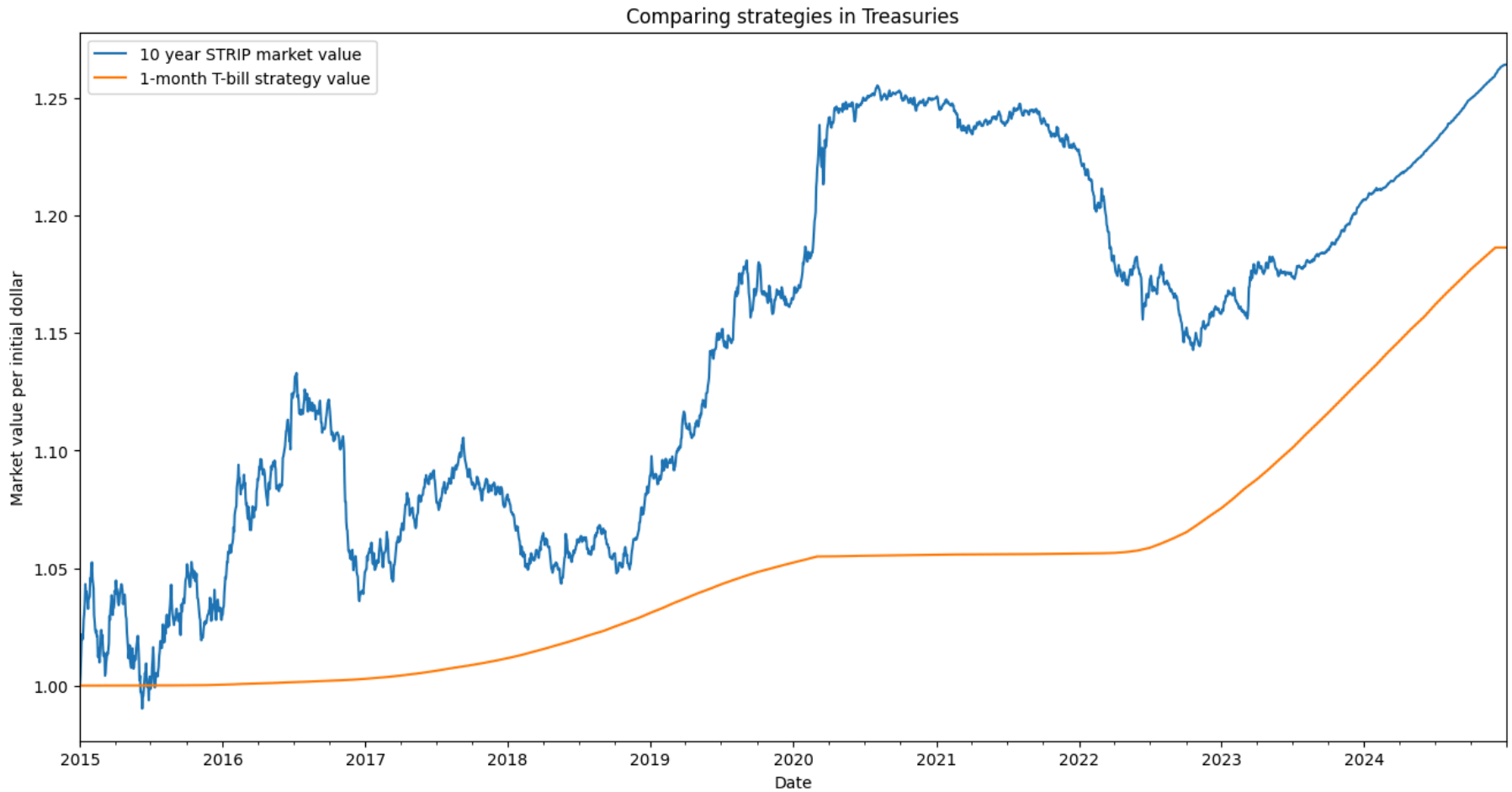
## Interest rate risk

- The yield on a zero-coupon bond is a risk-free rate of return, *if you hold the bond to maturity*.
- But if you need to sell at any point before then, there is no guarantee what the sale price will be.
- As interest rates move around, the price of your zero-coupon bond will move too, even though you know exactly how much it will pay in the future.
- This type of risk is called "interest rate risk," and it can be very large even for a "risk-free" bond!
- In this sense, long-term Treasuries can be a very risky investment over short horizons.
- On the other hand, interest rate risk is negligible for the shortest-maturity Treasuries (1m and 3m). That is why these are called "cash equivalent".

## Investing in Treasuries over the last ten years

- To illustrate, let's consider two different ways you could have invested in Treasuries over the last ten years.
- Idea #1: Buy a ten-year zero-coupon bond on January 1, 2015. Hold until it matures.
  - The initial yield to maturity was 2.3735%.
  - Compound this over 10 years:  $1.023735^{10} = 1.2644374$ .
  - That is, each \$1 invested initially would be worth \$1.26 by the end of 2024.
- Idea #2: Buy a one-month bill on January 1, 1995. When it matures the next month, buy another, and so on.
  - The yield in January was 0.03%. This is already annualized! The yield *during* January was  $1.0003^{1/12}$ .
  - The yield in February was 0.02%. By the end of February an initial dollar was worth  $1.0003^{1/12} \times 1.0002^{1/12}$ . And so on.
  - By the end of 2024 an initial \$1 invested would be worth \$1.19.
- We can imagine many other ideas as well, but let's just look at these two.

# Comparison



# Takeaways

- We will always want to compare risky investments with some kind of risk-free benchmark.  
But you can see that it's not so obvious what that benchmark should be.
- If you are investing for a goal ten years away, it might seem that the ten-year STRIP is the risk-free return.
  - It will generate a definite payoff in ten years, even if its price will fluctuate before then.
  - By contrast, you could *not* have been sure in advance that the strategy of buying 1-month bills would end up where it did.
- But you could also think of the next ten years as a *sequence* of short-term decisions: Every month, or even every day, you have the chance to revisit your decisions and adjust your portfolio.
  - From this perspective, you should approach each of these short-term decisions with the goal of leaving yourself the most possible wealth at the next date.
  - And then the natural way to analyze investments is at a high frequency, with a short-term yield (1 to 3 months) as the risk-free rate, and viewing the long-term STRIP as a *risky* investment due to its price fluctuations.
- This is always a controversial topic! But most finance theory takes the second perspective, and we will too.
  - This is why our risk-free rates will usually come from short-term Treasuries

Returns on investing in the stock market

## Payout and returns on a single stock

- Payout comes in two types: Dividends, and share repurchases.
- In either case, the firm's book value of equity, and its market cap, both fall by the total amount of the payout.
  - With dividends, each share's market price and book value fall by exactly the amount of the dividend.
  - With repurchases, the total amount of shares outstanding decreases, while their individual share prices and book values do not change.
- Keep these points in mind as we look at the return calculations in the next few slides...



## Measuring individual stock returns

The return on a stock between dates 1 and 2, ignoring taxes, is

$$r = \frac{P_2 + D}{P_1} - 1$$

where  $D$  represents all dividends paid between those dates.

Suppose you purchase a stock for \$10 in January, the stock pays a dividend of \$1 during the following year, and you sell the stock for \$12 in December.

$$r = \frac{\$12 + \$1}{\$10} - 1 = 30\%$$

## Capital gains and dividend yield

The return calculation from the previous slide has two pieces:

$$r = \underbrace{\frac{P_2}{P_1} - 1}_{\text{Capital gain}} + \underbrace{\frac{D}{P_1}}_{\text{Dividend yield}}$$

- Capital gain is the return just from price increases.
- Dividend yield is an extra percentage income from dividends.
- If the company repurchases stock instead of paying a dividend, then the dividend yield is lower but the capital gain is higher.
- There is no reason for an investor to prefer one source of return over the other...except for a potential tax detail: see next slide.

## One tax effect worth knowing

We will mostly ignore tax issues, and focus on before-tax returns.

- Taxes are irrelevant for investors with tax-deferred accounts.
- For taxable investors, the exact effects vary greatly depending on the person.

However, one tax issue will come up later in Module 1:

- Capital gains are taxable when realized (when you sell).
- Dividends are taxable when paid, even if you did not want them.
- Thus, dividends can be inconvenient for taxable investors, if paid in a year when the investor has a high income tax bracket.
- This is a major reason behind the trend towards repurchases, and also behind the growth of ETFs.

What's a "typical" monthly stock return?

Panel A: Individual stocks, monthly horizon ( $N = 3,575,216$ )					
Variable	Mean	Median	SD	Skewness	% Positive
Buy-and-hold return, T-bill	0.0037	0.0039	0.003	0.621	92.5%
Buy-and-hold return, stock	0.0113	0.0000	0.181	6.955	48.4%
	% > T-bill	% > VW Mkt return		% > EW Mkt return	
Buy-and-hold return, stock	47.8%	46.3%		45.9%	

# Specific strategies and their portfolios

We will focus on three strategies an investor could use to build a portfolio:

- Price weighting: Assets are weighted by their market price.
- Equal weighting: Assets all receive equal weight in the portfolio.
- Value weighting: Assets are weighted by total supply. (For stocks, by market cap.)
- These are not the only possibilities, but they are common and a good place for us to start.

In each case, using some example data, we will ask:

- How to form a portfolio reflecting that strategy?
- How to compute the return on that portfolio?
- How to rebalance the portfolio to stay in line with the strategy?
- What is the connection with the return on an index?

All the ideas apply to any asset class, but are easiest to describe with stocks.

- Later we will say a few words about applying these ideas to fixed income.

# Takeaways

We will see that the answers to the previous questions depend on:

- The price change of each security in the portfolio,
- The payout of each security (dividends, coupons, etc),
- Changes in the total supply of each investment (for example, stock splits, stock dividends, repurchases).

Most importantly, we will see why value-weighting is always the natural benchmark.

Homework 1 builds on these examples.

# Building and rebalancing a portfolio

A portfolio is just a collection of securities. To build one:

- Decide on the list of securities you want to include.
- Choose a strategy for how much to allocate to each one.
- Calculate the amounts you need to buy at current market prices.

After building a portfolio, you might also want to rebalance regularly, in order to stay in line with the strategy you chose above:

- Recalculate the portfolio that now aligns with your strategy, based on the new prices of each security and any other events that have happened.
- Buy or sell enough of each individual security to arrive at this desired portfolio.

# Measuring portfolio returns

The return on a portfolio between two dates can be calculated as:

- The ending value of securities owned and dividends received, divided by the initial value of the securities, minus 1;
- or, the weighted average return of each individual security, being sure to include the dividends that they paid, where the weights are the portfolio's initial dollar allocations.

Either method will give the same answer.



## Keeping track of trading activity during rebalancing

Different strategies require different amounts of trading to rebalance. It is important to track this activity because trading is costly.

**Turnover** during any time is gross trading activity, as a percent of starting portfolio size.

(To be clear, the exact trading costs are still only a fraction of this amount, and depend greatly on who is doing the trading.)

**Gross trading activity** is total purchases *plus* total sales.

(We add them together because both are costly.)

For comparison, **net trading activity** is purchases *minus* sales.

(This does not measure trading costs, but is still useful: It must equal the amount added or withdrawn from the portfolio, plus reinvestment of dividends or coupons.)

## Example 1: Textbook table 2.2, page 46

Stock	Initial price	Final price	Shares (m)	Initial market cap (\$m)	Final market cap (\$m)
ABC	\$25	\$30	20	\$500	\$600
XYZ	\$100	\$90	1	\$100	\$90

## Example 2: Data on AMGN and GILD from 2017

Stock	Initial price	Final price	Initial shares (m)	Final shares (m)	Dividends paid per share, \$
AMGN	\$146.21	\$173.90	738.2	722.2	\$4.60
GILD	\$71.61	\$71.64	1310	1308	\$2.08

# Importance of the value-weighted portfolio

Earlier on, we looked at simple average returns across stocks.

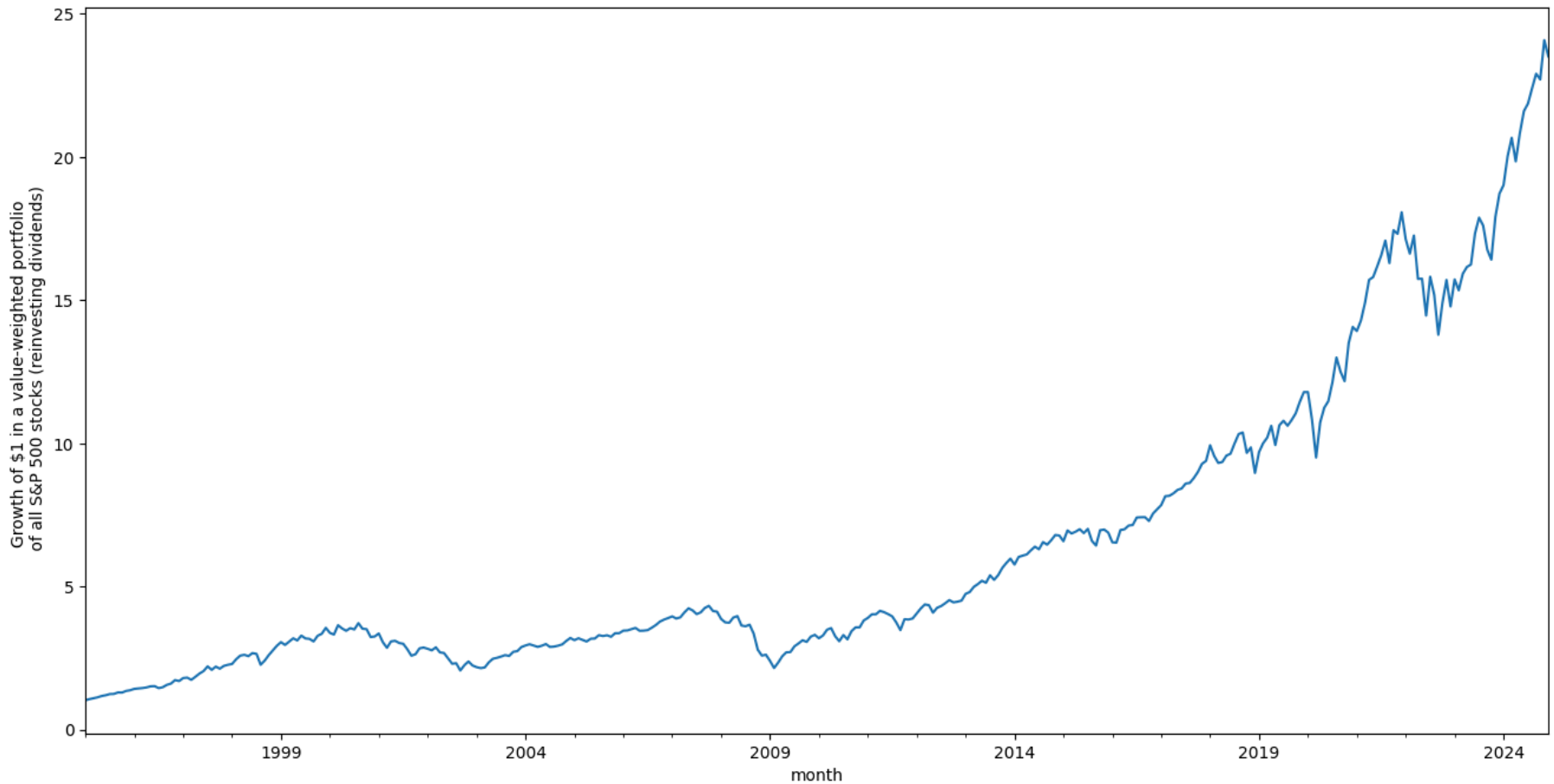
As we have now seen, these averages match the return on an *equal-weighted* portfolio.

But most investors in fact hold a *value-weighted* portfolio. This portfolio represents the "market return" and a "passive strategy", and is the benchmark for everything else.

This may seem surprising, but the value-weighted portfolio has many special features:

- It represents a proportional slice of the overall market. This means it is the only strategy that *everyone* can hold, and also that it requires the least rebalancing.
- It is *guaranteed* to match the overall market return. Any performance you gain or lose with a different portfolio is offset by the rest of the market.
- Although it weights *companies* very unevenly, it diversifies equally across dollars of expected future *profits*.

# Performance of the value-weighted S&P 500 portfolio since 1995



# Indexes of investment performance

An index helps track the performance of a given strategy/portfolio.

Examples:

- **DJIA**: price-weighted portfolio of stocks.
- **S&P 500 index**: value-weighted portfolio of stocks.
- **Bloomberg Agg** (fka Barclay's Agg): value-weighted, bonds.

Each index features a list of investments, and a weighting scheme.

The level of the index by itself is a meaningless, arbitrary number.

Index *changes* are connected to returns on the underlying strategy. But the exact connection depends on how the index is constructed.

# S&P 500 index calculation

Most US stock indexes are designed to measure returns to their underlying strategy from capital gains alone, *excluding dividends*.

For example, the S&P 500 index is calculated with this formula:

$$\text{S\&P 500 index level} = \frac{\sum P \times Q}{\text{Divisor}}$$

The divisor is adjusted in response to events that change market cap without triggering a capital gain for the individual investor, such as share issuance or repurchase. (We will do an example of this.)

So the index return *does not* include the return from dividends. There is an S&P 500 “total return” index, but it is not as well-known.

It doesn't have to be this way! The main German stock index, the DAX, is a total return index.

# S&P 500 index vs total return index

Dividends are important, especially over long horizons!





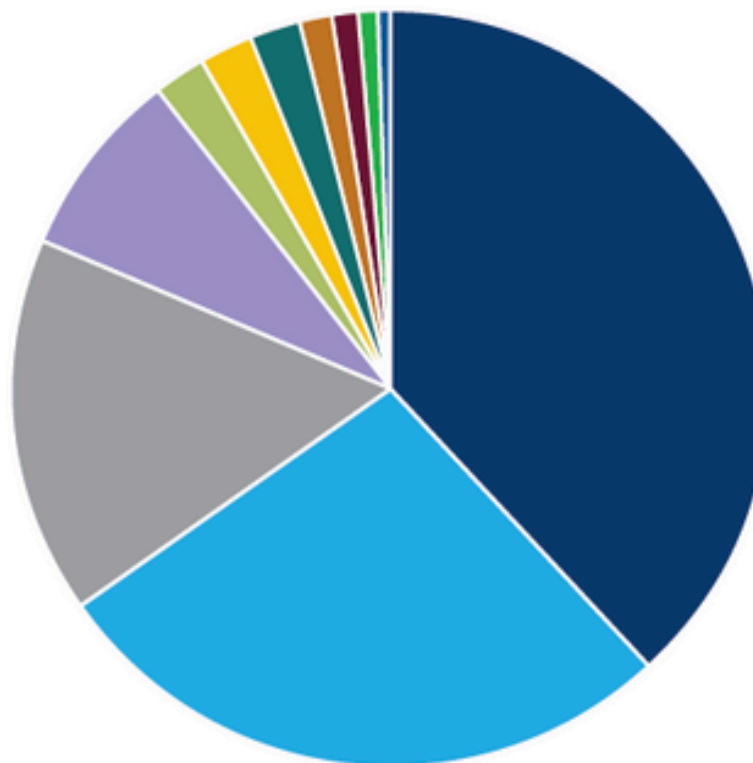
Returns on investing in fixed income

# Bloomberg/Barclays aggregate bond index

- The best-known US bond market index. The formal name has changed several times. It is generally just called the “Agg.”
- It reflects a value-weighted portfolio of a broad range of fixed-income securities. Like most bond indexes, it is a “total return” index, meaning it does include coupon reinvestment.
- But unlike stocks, it is not obvious which securities to include. Currently it’s mostly Treasuries, MBS, and investment-grade corporate. But this is always a source of debate and controversy. For example, some argue for adding munis and junk bonds.
- It’s also not obvious if the portfolio represented by this strategy is really the correct benchmark for investors to use.
- Many basic questions remain open about portfolio management and performance assessment with fixed income.

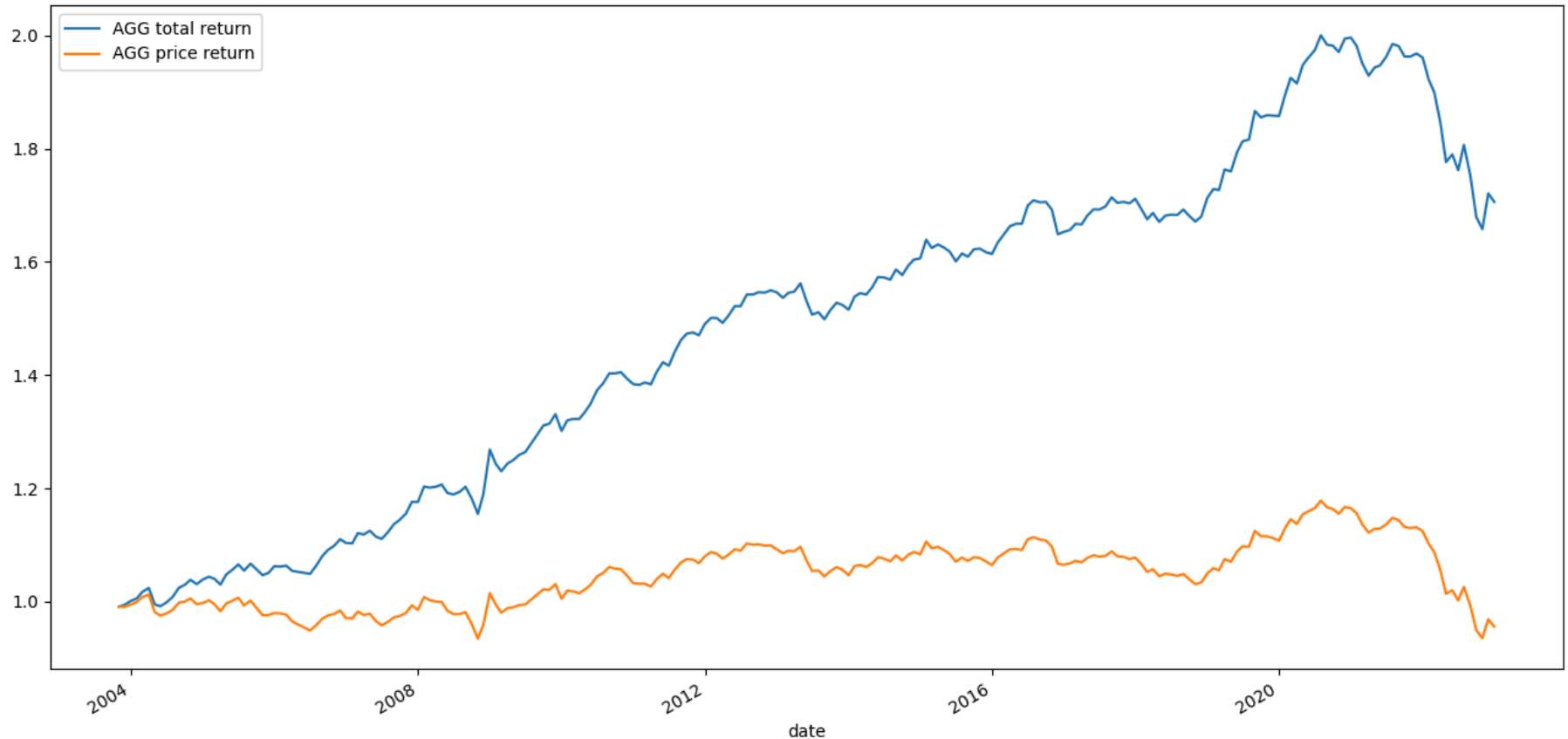
## Bloomberg Barclays U.S. Aggregate Bond Index, sector breakdown (%)

Treasuries	38.2	■
MBS pass-through	27.2	■
Industrial	16.1	■
Financial institutions	8.1	■
Agencies	2.3	■
Utility	2.2	■
CMBS	2.1	■
Supranational	1.4	■
Sovereign	1.1	■
Local authorities	1.0	■
ABS	0.3	■
Covered	0.0	■



Source: Bloomberg, data as of 08/31/21.

# AGG ETF historical performance



(This almost identical to the performance of the index itself. See discussion of ETFs next week.)