THE COST OF CAPITAL

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The weighted average cost of capital

Free cash flow is what the business produces before any payment to investors. Both claims have a share of it, so the discount rate is the average of the two required returns, weighted by how much of the firm each one finances.

$$\text{WACC} = \frac{E}{E+D} r_E + \frac{D}{E+D} r_D (1 - \tau)$$

> Discounting free cash flow at the WACC gives enterprise value. Subtract net debt for the value of the equity.

The five inputs

INPUT	WHAT IT IS	WHERE IT COMES FROM
E	Market value of equity	Share price times shares outstanding
D	Market value of debt	Usually book debt, including finance leases
r_E	Cost of equity	Usually the CAPM
r_D	Cost of debt	Usually yield on similarly rated bonds
τ	Tax rate	Tax provision over pretax income

Market values, not book values

The weights are what the market says the two claims are worth now. Walmart's book equity is $100 billion and its market capitalization is $861 billion, so the two sets of weights are nowhere near each other.

Debt is the exception in practice. Firms do not report the market value of their debt, and it stays close to book unless rates have moved a long way since the bonds were issued or the firm is in trouble, so book debt stands in.

Finance lease obligations are debt. Walmart's $67.1 billion of total debt includes $22.3 billion of them.

Interest is deducted from taxable income, so a dollar of interest costs the firm $1 - t$ dollars. Walmart's tax provision was 24.4% of pretax income, which turns a 5.80% cost of debt into 4.38% after tax.

> Free cash flow is computed as if the firm had no debt, so the interest deduction never appears in the cash flows. The WACC is where it enters the valuation.

The tax term

Walmart’s weights

92.8%
EQUITY

7.2%
DEBT

24.4%
TAX RATE

$861 billion of equity against $67.1 billion of debt, on October 6, 2026. That leaves r_D and r_E, which are the next two sections.

What the formula assumes

The weights hold

The firm keeps financing itself in the same proportions. Changing leverage moves the weights and r_E at the same time, in opposite directions.

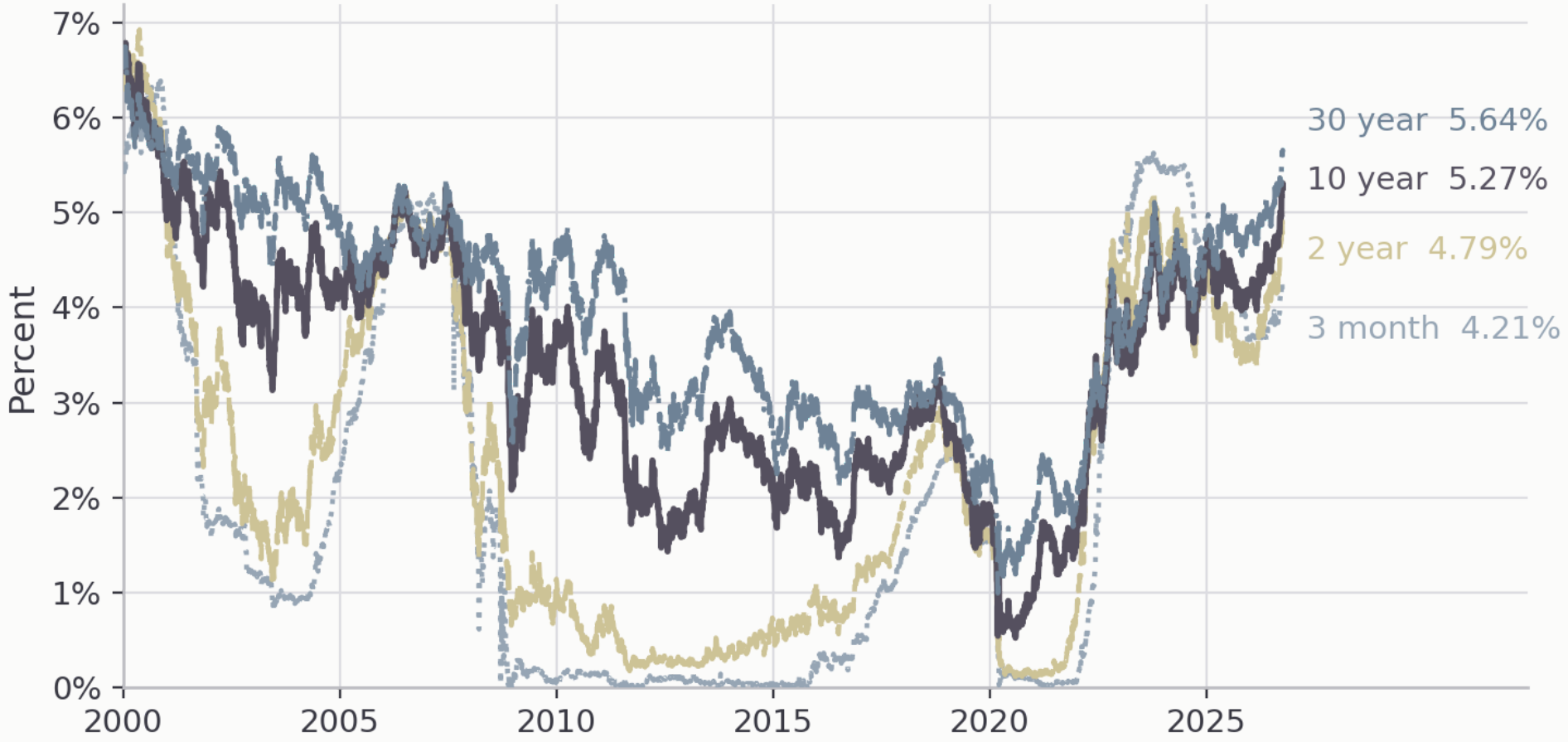
The project has the firm's risk

A rate built from the firm's beta prices a project whose cash flows move with the market the way the firm's do. A division that does not gets its own rate.

WHAT DEBT COSTS

Treasury yields, ratings, and spreads.

Treasury yields this century



The curve on October 6

MATURITY	YIELD	LOW SINCE 2000	HIGH SINCE 2000
3 month	4.21%	0.00%, December 2008	6.42%, November 2000
2 year	4.79%	0.09%, February 2021	6.93%, May 2000
10 year	5.27%	0.52%, August 2020	6.79%, January 2000
30 year	5.64%	0.99%, March 2020	6.75%, January 2000

> For the cost of debt, match the maturity to the life of the cash flows: a company's long-dated bonds price off the long end of this curve. The risk-free rate in the CAPM is a separate choice, and this deck uses the 3-month bill, because that is the rate the market risk premium is measured over.

MOODY'S	S&P AND FITCH	
Aaa, Aa, A, Baa	AAA, AA, A, BBB	Investment grade
Ba, B, Caa, Ca, C	BB, B, CCC, CC, C	High yield

Many institutions are barred from holding non-investment-grade debt.

Walmart is Aa2 at Moody's and AA at S&P.

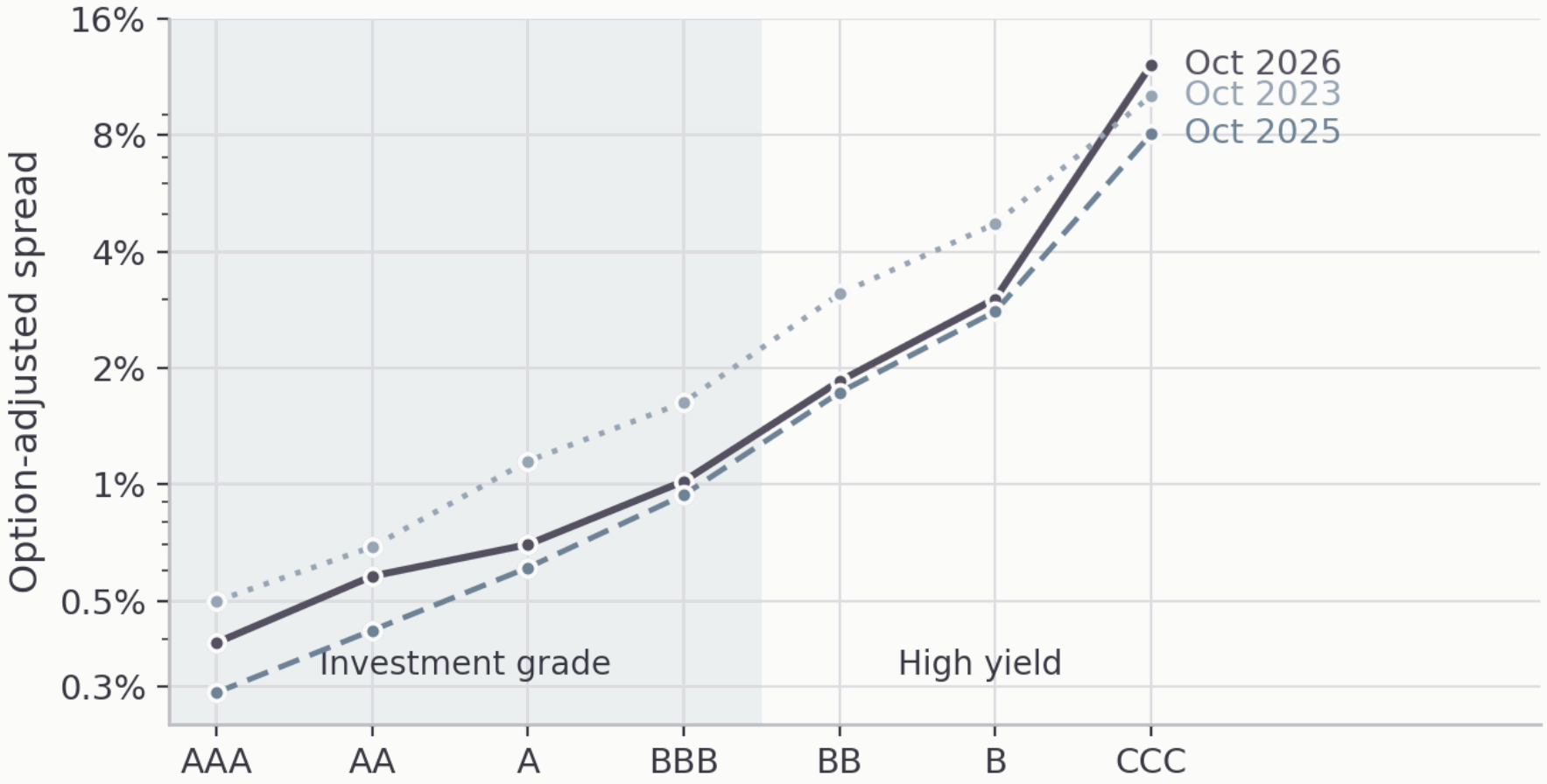
Credit ratings

Spreads on October 6

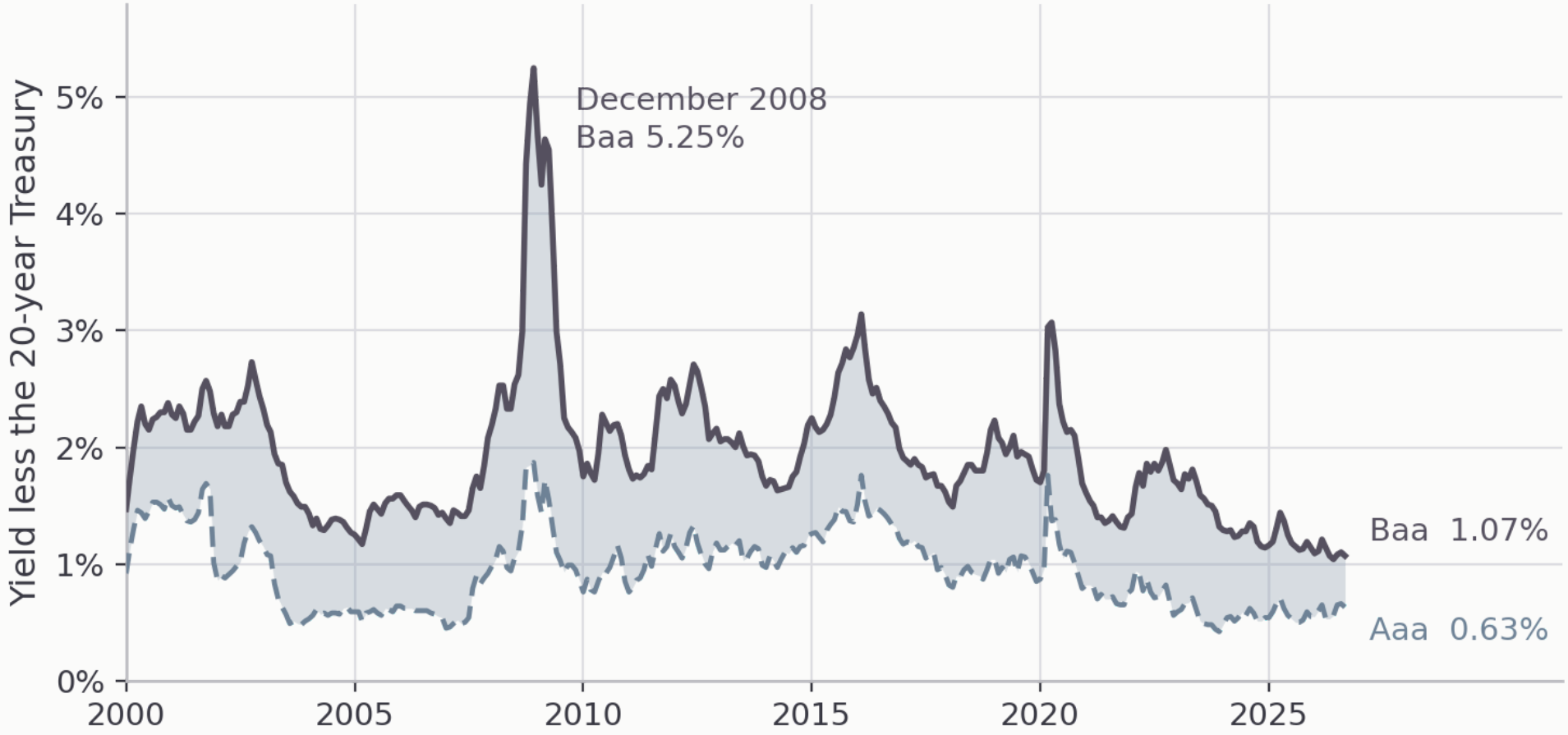
RATING	SPREAD	YIELD	RATING	SPREAD	YIELD
AAA	0.39%	5.82%	BB	1.85%	6.87%
AA	0.58%	5.80%	B	3.02%	8.02%
A	0.70%	5.84%	CCC	12.14%	16.98%
BBB	1.02%	6.19%			

ICE BofA index spreads and yields, from FRED. The spread is option-adjusted and quoted over a Treasury. Different maturity Treasuries may be used for different rating classes.

The shape of the credit curve



Twenty-six years of the Baa spread



A bond's yield is the return if the issuer makes every payment. The expected return is lower:

$$E[r_D] \approx \text{yield} - \text{default probability} \times \text{loss given default}$$

Using the yield in place of r_D overstates the cost of debt by that product. At AA the correction is a few basis points. At the 12.14% CCC spread it is much larger.

The promised yield and the expected return

THE CAPM

Everyone computes the same tangency portfolio

- Give every investor the same means, variances and covariances, and the same rate to lend and borrow at, and they all solve the problem from the first half of today and get the same answer. They differ only in how much of that portfolio they hold against bills.
- Every share is held by someone, so adding up across investors makes the tangency portfolio the market portfolio.

> The tangency portfolios for the sector funds short three of the nine sectors, and the market portfolio shorts nothing. In equilibrium expected returns adjust until the tangency portfolio *is* the market; the sample means that produced those shorts are not equilibrium expected returns.

What that says about one asset

An asset's weight in the tangency portfolio depends on its excess return relative to its covariance with the portfolio. Making the market that portfolio turns the condition into a statement about every asset at once:

$$E[r_i] - r_f \;=\; \beta_i \left(E[r_m] - r_f \right), \qquad \beta_i \;=\; \frac{\operatorname{cov}(r_i,\, r_m)}{\operatorname{var}(r_m)}$$

An asset's own standard deviation is not in the equation. Only the part of its risk that moves with the market is priced.

Beta is a regression slope

The ratio of a covariance to a variance is the slope coefficient from a regression, which gives a way to estimate β_i from returns:

$$r_{it} - r_{ft} = \alpha_i + \beta_i (r_{mt} - r_{ft}) + \varepsilon_{it}$$

The CAPM says $\alpha_i = 0$, so a test of the model is a test of whether the intercept is zero, and an estimate of the cost of equity uses the slope and ignores the intercept.

- R^2 is the share of the asset's variance that comes from the market, and $1 - R^2$ is the share that is potentially diversifiable. The CAPM pays nothing for the second part.
- For Walmart over the last five years R^2 is 0.20. Four fifths of the month-to-month movement in Walmart's return has nothing to do with the market.

What the residual carries

Yahoo Finance and the French data library

Yahoo Finance

Daily and monthly prices for anything with a ticker, adjusted for splits and dividends, back to the listing date. No account and no key. The `yfinance` package wraps it. Percent changes in the adjusted prices are returns.

Ken French's data library

Monthly and daily returns on the market, the risk-free rate, and the factor and portfolio returns behind forty years of asset pricing research, from July 1926. Hosted at Dartmouth, managed by DFA, and read by `pandas_datareader`.

> It is conventional to use the past 60 monthly returns in the CAPM regression.

Walmart against the market



0.57
BETA, STANDARD ERROR 0.15

0.20
R^2

+9.9%
ALPHA A YEAR

The 95% interval for beta runs from 0.27 to 0.87. Alpha’s standard error is 8.5 points a year, so the intercept is not distinguishable from zero.

> Yahoo Finance reports 0.578 for Walmart, from its own five years of months.

Sixty months to August 2026

Five betas

TICKER	BETA	STANDARD ERROR	R^2
KO, Coca-Cola	0.29	0.13	0.08
WMT, Walmart	0.57	0.15	0.20
JPM, JPMorgan	0.99	0.14	0.45
PLTR, Palantir	1.71	0.58	0.13
NVDA, Nvidia	2.17	0.30	0.48

Sixty months to August 2026. Palantir’s standard error is as wide as Walmart’s whole beta, so the interval around 1.71 runs from 0.56 to 2.85.

THE MARKET RISK PREMIUM

The other part of the cost of equity.

A hundred years of the market factor

8.35%
AVERAGE, ANNUALIZED

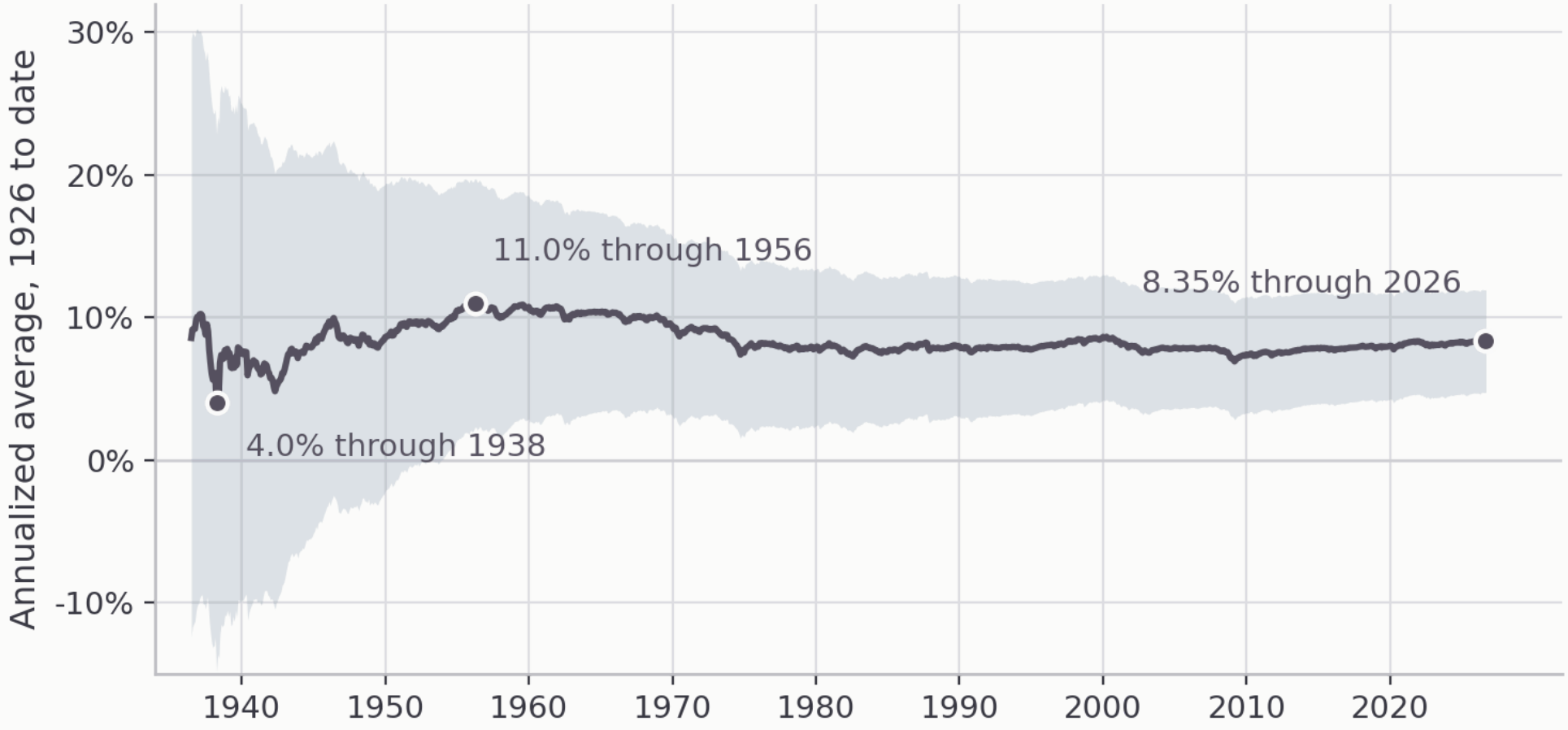
18.37%
STANDARD DEVIATION

4.75% to 11.94%
95% INTERVAL

1,202 months of `Mkt-RF`, July 1926 through August 2026. The standard error is $\sigma/\sqrt{T}$ with T in years: $18.37/\sqrt{100.2} = 1.83\%$.

> The same arithmetic as the interval for SPY earlier today, with a century of data instead of twenty-one years.

The average through each date



Each point is the average from July 1926 through that month, annualized, with its 95% interval around it. The series starts in June 1936, the first month with ten years behind it.

The estimate has run from 4.0% in 1938 to 11.0% in 1956 and sits at 8.35% now.

The expanding window

Walmart’s cost of capital

	VALUE	WHERE IT CAME FROM
Risk-free rate	4.21%	3-month Treasury, October 6
Market risk premium	8.35%	1926 to 2026, annualized
Beta	0.57	60 months to August 2026
Cost of equity	8.97%	$4.21 + 0.57 \times 8.35$
Cost of debt, after tax	4.38%	$5.80 \times (1 - 0.244)$
WACC	8.64%	$0.928 \times 8.97 + 0.072 \times 4.38$

> The premium is measured against the one-month bill, so the bill rate keeps both terms of the cost of equity on the same basis. A 10-year yield instead would add a point to the cost of equity while pairing that premium with a different risk-free rate.

Your company’s cost of capital

The regression

Sixty months of your company against `Mkt-RF`. Report beta, its standard error, and R^2.

The weights

Market capitalization, total debt including leases, and the tax provision over pretax income.

The rate

A cost of debt from the rating and the spread table, with the 3-month bill and the 8.35% premium. If your company has no rated debt, pick the rating its interest expense over average debt implies and say which one you picked.