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End of an era: The coming long-run slowdown in corporate profit growth and stock returns*

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Abstract

I show that the decline in interest rates and corporate tax rates over the past three decades accounts for the majority of the period's exceptional stock market performance. Lower interest expenses and corporate tax rates mechanically explain over 40 percent of the real growth in corporate profits from 1989 to 2019. In addition, the decline in risk-free rates alone accounts for all of the expansion in price-to-earnings multiples. I argue, however, that the boost to profits and valuations from ever-declining interest and corporate tax rates is unlikely to continue, indicating significantly lower profit growth and stock returns in the future.

Key words: long-run prediction, stock returns, equity premium, corporate profits, interest rates, corporate taxes.

JEL classifications: G10, G12, G17.

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From 1989 to 2019, the S&P 500 index grew at an impressive real rate of 5.5 percent per year, excluding dividends. The rate of U.S. real GDP growth over the same period was 2.5 percent. What accounts for this enormous discrepancy? And is it sustainable?

I argue that it is not. To reach this conclusion, I consider 60 years of data on the earnings and stock price performance of S&P 500 nonfinancial firms, from 1962 to 2022.[1]

My central finding is that the 30-year period prior to the pandemic was exceptional. During these years, both interest rates and corporate tax rates declined substantially. This had the mechanical effect of significantly boosting corporate profit growth. Specifically, I find that the reduction in interest and corporate tax rates was responsible for over 40 percent of the growth in real corporate profits from 1989 to 2019. Moreover, the decline in risk-free rates over this period explains the entirety of the expansion in price-to-earnings (P/E) multiples. Together, these two factors therefore account for the majority of this period's exceptional stock market performance.

I first consider corporate profits. From 1989 to 2019, real corporate profits grew at the robust rate of 3.8 percent per year. This was almost double the pace seen from 1962 to 1989. The difference in profit growth between these two periods is entirely due to the decline in interest and corporate tax rates from 1989 to 2019. One way to see this is to compare the growth of earnings before subtracting interest and tax expenses (EBIT). In fact, real EBIT growth was slightly lower from 1989 to 2019 compared to 1962 to 1989: 2.2 percent versus 2.4 percent per year.

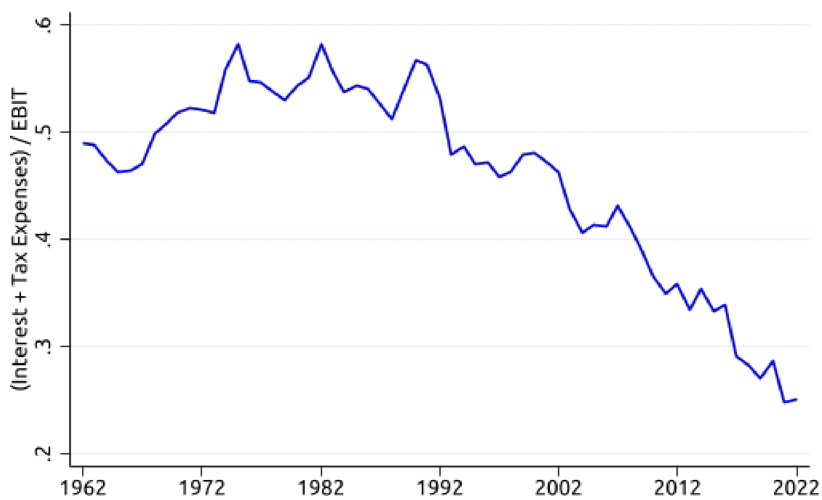
Figure 1 shows the importance of declining interest and tax expenses as a key driver of corporate profit growth. The figure plots aggregate interest and tax expenses as a share of aggregate EBIT for S&P 500 nonfinancial firms. In 1989, this measure stood at 54 percent, close to its average over the period 1962 to 1989. By 2019, the measure had halved, to 27 percent. In other words, from 1989 to 2019, an ever-declining share of corporate earnings was paid out to debtholders and tax authorities. This left an ever-increasing share available to stockholders.

What does this imply for the future? As I show below, growth in corporate profits can only come from: (1) EBIT growth; (2) a decline in interest expenses relative to EBIT; or (3) a decline in

[1] I exclude financial firms from the analysis because interest expenses are a primary input for them. Moreover, the leverage of financial firms fell dramatically in response to regulatory reforms following the Global Financial Crisis.

effective corporate tax rates. In other words, interest and tax rates must continue to fall if they are to mechanically boost corporate profit growth, as they did from 1989 to 2019.

Figure 1: Interest and tax expenses as a share of EBIT



Note: Aggregate values for S&P 500 nonfinancial firms, 1962 to 2022.
Source: Compustat.

I argue, however, that it is very unlikely that profit growth in the future will benefit much from declining interest and corporate tax rates. In the case of interest rates, these reached exceptionally low levels even prior to the pandemic. In December 2019, the 10-year Treasury yield stood at 1.9 percent, having fallen a full 6 percentage points since 1989. Corporate bond yields fell by the same amount. Simply put, there is very limited scope for interest rates to fall much below their 2019-levels—and, of course, interest rates have since risen substantially in the wake of elevated inflation readings.[2]

A similar argument applies to corporate tax rates. The effective corporate tax rate for S&P 500 nonfinancial firms declined from 34 percent in 1989 to 15 percent in 2019. Could corporate tax rates fall further? It's possible. However, the Tax Cuts and Jobs Act of 2017 cut the statutory corporate tax rate from 35 percent to 21 percent. With the ratio of U.S. debt-to-GDP near all-time highs, another deficit-financed cut in corporate taxes does not appear likely anytime soon.

An optimistic scenario, therefore, is for both interest rates and effective tax rates to remain close to their low 2019 levels. In that event, corporate profits can only grow at the same rate as EBIT.

[2] Firms can also lower interest expenses by reducing leverage. Doing so, however, is costly, as I argue below.

What is a reasonable rate of EBIT growth to expect? A relevant fact is that EBIT growth from 1962 to 2019 came in *below* GDP growth (the pandemic was an exception, which I discuss separately). There is thus a very strong case that long-run profit growth in the future will be no higher than GDP growth. In fact, it may well be lower if interest and tax rates rise above 2019-levels over the longer-run. The optimistic scenario is thus for real corporate profits to grow at no more than about 2 percent per year.[3]

This has serious implications for stock returns. Stock price growth can only come from either earnings growth or from an expansion in P/E multiples. If real earnings growth is not likely to exceed 2 percent per year over the long run, then the outlook for stocks is bleak. Stock price performance above this 2 percent real rate could only be accomplished by the perpetual expansion of P/E multiples. Clearly, this is unsustainable.

Moreover, as I explain below, P/E multiples are primarily a function of earnings growth expectations and discount rates. The relevant discount rate equals the risk-free rate plus a risk premium component. From 1989 to 2019, the decline in risk-free rates accounts for all of the expansion in P/E multiples. Looking ahead, any further expansion in P/E multiples will be severely constrained by the extent to which risk-free rates can fall below 2019 levels.

Likewise, P/E multiples are unlikely to get a boost from higher earnings growth expectations. Indeed, it is questionable whether the market is currently pricing in the substantially lower earnings growth that I argue is likely to prevail in the future. If it is not, then P/E multiples could contract significantly, leading to lower stock prices. This leaves a possible decline in risk premia as one way for multiples to expand. However, simply assuming that lower risk premia will “save the day” is very optimistic.

The overall conclusion, then, is that—with the expected slowdown corporate profit growth and no offsetting expansion in P/E multiples—real longer-run stock returns in the future are likely to be no higher than about 2 percent, the rate of GDP growth. While this conclusion is certainly dramatic, it follows from minimal assumptions. The main assumptions are that interest and corporate tax rates cannot fall much further below 2019-levels. Everything else logically follows.

[3] The Congressional Budget Office, for example, projects real GDP growth of 1.9 percent per year over the next decade.

I. Contribution to the literature

A lower rate of longer run stock market growth has profound implications for individual investors, for corporations, for retirement and pension funds, and for the U.S. and world economies more broadly.

In addition, my analysis also speaks to the literature on the equity risk premium—i.e., the return earned on stocks in excess of that earned on Treasury bills. This literature starts with Mehra and Prescott (1985), who argued that the historical equity premium—usually about 6 to 7 percent per year—is far higher than what could be justified theoretically. Since then, the central paradigm in financial economics has sought to reconcile the high level of the equity premium with risk-based explanations: Campbell and Cochrane (1999), Bansal and Yaron (2004), Barro (2006).

My analysis shows, however, that over past thirty years, declining interest and corporate tax rates can explain much of the realized equity premium. In my sample, the realized equity premium for the period 1989 to 2019 was 7.2 percent per year, compared to 3.6 percent for the years 1962 to 1989. Higher risk is an unlikely explanation for the return difference. Indeed, stock price volatility was *lower* during 1989 to 2019 than it was during 1962 to 1989.

Rather, the decline in interest and corporate tax rates can explain the entirety of the performance difference between the two periods. Importantly, this decline in interest and corporate tax rates could not have been anticipated in 1989. Much of the realized equity premium over the past 30 years therefore had more to do with luck than with compensation for bearing risk. I contend that this spell of good luck is most likely at an end.

Fama and French (2002) also argued that the realized return on stocks in the second half of the twentieth century was a lot higher than expected. They attribute the large capital gains earned on stocks to a decline in discount rates (i.e., expected future returns). However, they do not consider the role of lower risk-free rates in driving down discount rates, as I do.

Moreover, Fama and French argue that historical earnings and dividend growth provide good estimates of long run expected stock returns. My analysis casts doubt on this argument. Over the last three decades, earnings growth (and dividend growth, too) was artificially boosted by declining interest and corporate tax rates. As such, the historical growth rates offer poor guide for what investors should expect in the future.

More recent work by Greenwald, Lettau, and Ludvigson (2022) also argues that much of the excess return on equities during the past 30 years was unexpected and thus did not reflect true compensation for bearing risk. However, in stark contrast to my own conclusions, the authors argue that interest and taxes combined played zero role in explaining the rise in corporate earnings (relative to output). Rather, they argue that the reallocation of rewards away from labor compensation and toward shareholders was the dominant driver of earnings growth and high equity returns. While I do not examine this possible explanation directly, I find that the expansion of profit margins—which may be viewed as a measure of the reallocation of rewards toward stockholders—contributed relatively little to corporate earnings growth and stock returns over the past 30 years. Moreover, a central aim of my paper is long-run prediction, which is not something that Greenwald, Lettau, and Ludvigson (2022) consider.

The differences between our respective conclusions are due to data sources and methodologies. Greenwald, Lettau, and Ludvigson (2022) use Flow of Funds data on the equity of nonfinancial corporate businesses, which includes private companies. In contrast, I use data from CRSP and Compustat for S&P 500 nonfinancial firms. More importantly, Greenwald, Lettau, and Ludvigson (2022) reach their conclusions by estimating a very specific structural model of the U.S. economy. The layers of assumptions upon which their model is built and estimated are hardly innocuous.

My approach is different. I reach my conclusions on the drivers of corporate profit growth based on straightforward accounting identities, which are true by definition. In that sense, the decompositions of earnings growth that I present are assumption-free. However, the limitation of using accounting identities is that they can only speak to the direct, mechanical effects of interest and corporate taxes, and thus do not take into account indirect, or general equilibrium, effects. For example, with my approach, I can say that the decline in interest and corporate tax rates mechanically explains over 40 percent of corporate profit growth, with the rest attributable to growth in EBIT. However, I cannot say how EBIT growth was itself affected by the decline in interest and tax rates. Under the assumption that lower interest and tax rates are at least mildly stimulative, this would have provided some boost to EBIT growth. My conclusions are therefore conservative—they provide a *lower bound* on how much declining interest and corporate tax rates boosted profit growth and stock returns.

II. Methodology and data

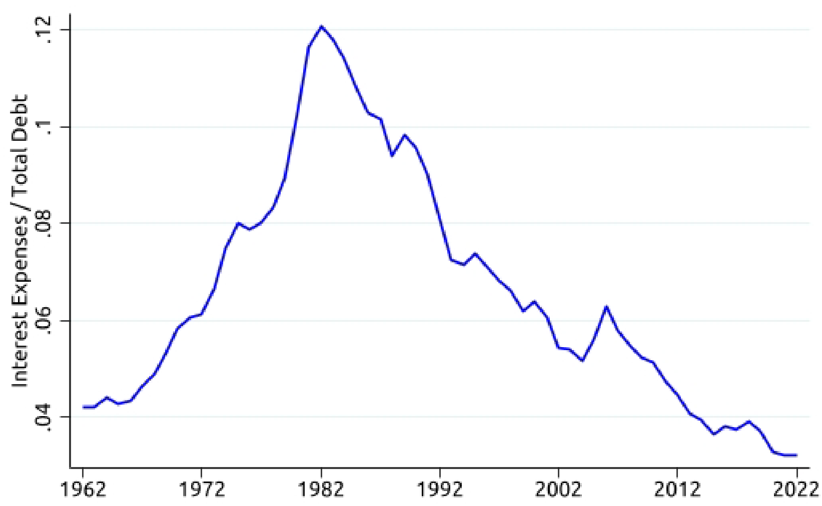
The analysis requires that I construct an index of S&P 500 nonfinancial firms and compute an associated index "divisor," which is analogous to the divisor on the overall S&P 500. The divisor adjusts for changes in the composition of the index as well as changes in shares outstanding of individual stocks. This makes it possible to compute the growth in index earnings per share, and related measures. Details on the methodology and data sources are contained in the Appendix.

III. Interest and tax expenses, 1962-2022

What explains the decline in interest and tax expenses relative to EBIT, shown in Figure 1?

Figure 2 makes clear that a key driver was the fall in corporate interest rates. This pattern itself largely reflects the steady, decades-long march down in Treasury yields since the 1980s. In 1989, interest rates faced by S&P 500 nonfinancial firms—as measured by the ratio of their aggregate interest expenses to aggregate debt—stood at about 10 percent. By the end of 2019, before the COVID-19 pandemic, this measure had declined to about 3.7 percent, only to fall even further by 2022, to the exceptionally low level of 3.2 percent.

Figure 2: Corporate interest rates



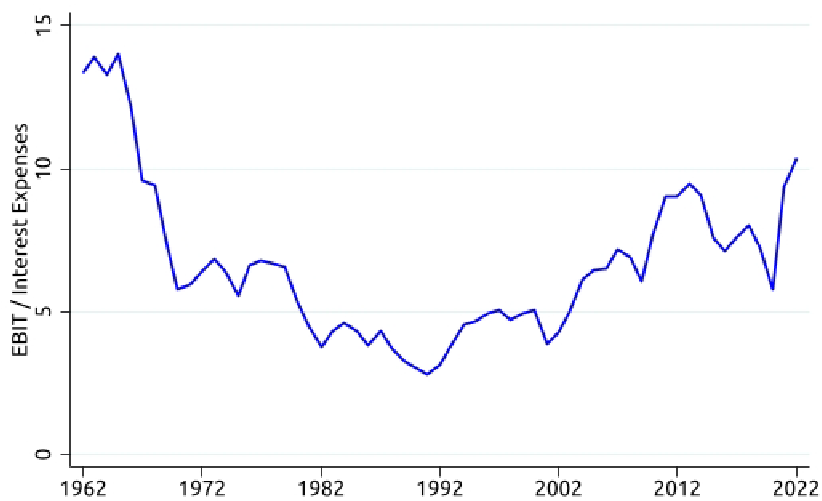
Note: Aggregate values for S&P 500 nonfinancial firms, 1962 to 2022.

Source: Compustat.

It is noteworthy that the increase in interest rates during 2022 has yet to show up in Figure 2. This is because, in 2020 and 2021, large corporations locked in long-term funding at historically low rates. As this debt matures, it will need to be refinanced at prevailing interest rates, which are now substantially higher.

The significant decline in corporate interest rates allowed interest expenses to decline as a share of EBIT. In other words, the interest coverage ratio—defined as aggregate EBIT divided by aggregate interest expenses, shown in Figure 3—improved substantially. This measure now stands at very high levels relative to its history—which underscores just how low interest expenses are relative to EBIT.

Figure 3: Interest coverage ratios

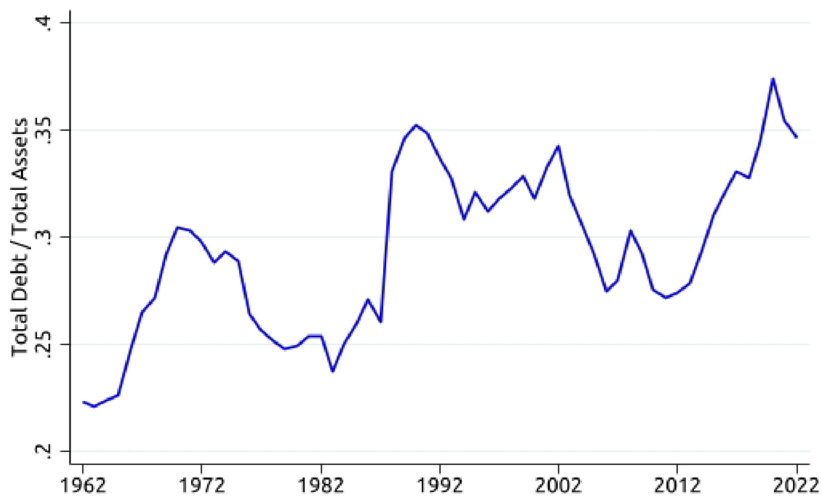


Note: Aggregate values for S&P 500 nonfinancial firms, 1962 to 2022.
Source: Compustat.

Importantly, as shown in Figure 4, the decline in interest expenses relative to EBIT occurred even as corporate leverage—total debt to total assets—reached near all-time highs. By 2019, corporate leverage stood at 35 percent.[4] As it happens, this was actually unchanged, on net, since 1989. In general, however, corporate leverage has trended up over the sample. An alternative measure of leverage—aggregate debt to aggregate EBIT, which will be useful later—rose somewhat, from 3.1 in 1989 to 3.7 in 2019 (not shown).

[4] Some of the increase in leverage in 2019 specifically is due to a change in accounting rules that required that operating leases be included as liabilities on firms' balance sheets, see Palazzo and Yang (2019).

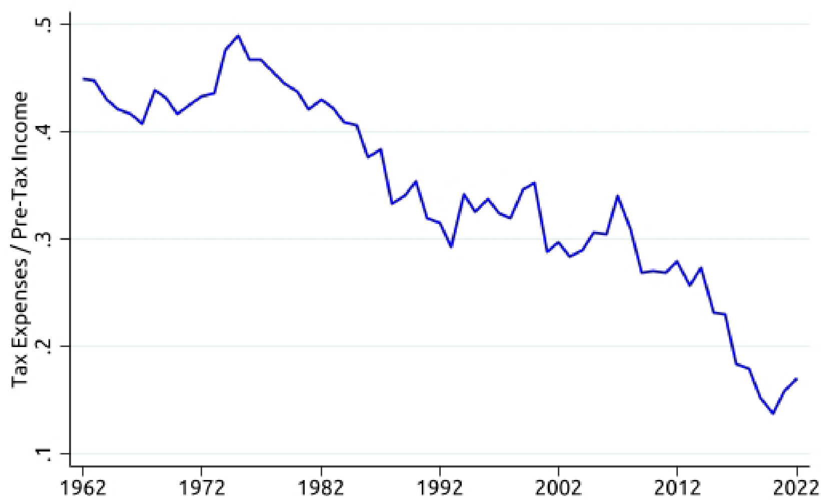
Figure 4: Corporate leverage



Note: Aggregate values for S&P 500 nonfinancial firms, 1962 to 2022.

Source: Compustat

Figure 5: Effective corporate tax rates



Note: Aggregate values for S&P 500 nonfinancial firms, 1962 to 2022.

Source: Compustat.

Moreover, as interest rates declined, so too did effective corporate tax rates, shown in Figure 5. This process commenced in the early 1980s, under the Reagan administration. By 1989, the effective corporate tax rate—measured as aggregate tax expenses divided by aggregate pre-tax income—stood at 34 percent, having fallen from an average of 44 percent over the period 1962 to 1982. From 1989 to 2007, ending just prior to the financial crisis, effective corporate tax rates averaged 32 percent. They then drifted somewhat lower in the years immediately following the financial crisis. The next major step down occurred following the passage of the Tax Cuts and Jobs Act of 2017, which cut the statutory corporate tax rate from 35 percent to 21 percent. With this reform, effective corporate tax rates fell from 23 percent in 2016 to 15 percent in 2019.

IV. The contribution of changes in interest and corporate tax rates to earnings growth

How much did the relative decline in interest and tax expenses over the past three decades contribute to earnings growth? Table 1 seeks to answer this question.

Panel A shows the real annualized growth rates of various earnings indicators for S&P 500 nonfinancial firms.[5] All indicators are adjusted for inflation using the GDP deflator and are expressed on a per-share basis: see the Appendix for details. Given that most of the decline in relative interest and tax expenses occurred starting the early-1990s (Figure 1), I split the sample into roughly two 30-year periods: 1962 to 1989 and 1989 to 2019.[6] I consider the years around the pandemic, 2019 to 2022, separately in the Appendix, since this period was anomalous.

Before turning to Panel A, it useful to consider the possible sources of corporate income growth.[7] This can be seen from the following accounting identity: $Income = (EBIT - Int) \times (1 - \tau)$, where Int is the interest expense and τ is the effective corporate tax rate; i.e., $\tau = Tax\ Expense/(EBIT - Int)$. From this, we obtain the following decomposition:

$$Income = EBIT \times (1 - Int/EBIT) \times (1 - \tau). \qquad \text{(Eq. 1)}$$

It is therefore clear that growth in income can only come from three sources: (1) EBIT growth; (2) a decline in interest expenses as a share of EBIT (in other words, an increase in the interest coverage ratio); or (3) a decline in the effective corporate tax rate.

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[5] I.e., annualized growth rates represent the geometric average over the period.

[6] These start- and end-dates were at roughly similar points in the business cycle. E.g., the unemployment rates for December of 1962, 1989, and 2019 were 5.5%, 5.4%, and 3.6%, respectively.

[7] I used the terms income, net income, earnings, and profits interchangeably. See the Appendix for variable definitions.

Table 1: Earnings growth for S&P 500 nonfinancial firms

Row #	*Panel A: Annualized real growth rates, %*	1962-1989	1989-2019
1.	Net Income	2.0	3.8
2.	EBIT	2.4	2.2
3.	EBITDA	2.5	2.3
4.	Dividends	1.1	3.3
5.	Sales	2.6	1.9
6.	U.S. GDP	3.6	2.5

Row #	*Panel B: Contribution to net income growth (total = 1)*	1962-1989	1989-2019
1.	EBIT	1.20	0.58
1.a.	EBIT / Sales	-0.08	0.09
1.b.	Sales	1.28	0.50
2.	1 - Interest/EBIT	-0.53	0.19
3.	1 - Effective tax rate	0.33	0.22

Panel A shows annualized real growth for various earnings indicators, expressed on a per-share basis, for S&P 500 nonfinancial firms. It also shows U.S. real GDP growth. Panel B shows the contribution of EBIT, interest expenses relative to EBIT, and effective corporate tax rates to net income growth. The contributions, by construction, sum to one.

We now turn to Panel A. Row 1 shows that, from 1989 to 2019, real net income grew almost twice as fast compared to the period 1962 to 1989: 3.8 percent versus 2.0 percent.

Row 2 makes clear, however, that the difference in net income growth between these two periods was driven entirely by the relative decline in interest and tax expenses since 1989. In particular, real EBIT growth was slightly lower from 1989 to 2019 compared to 1962 to 1989: 2.2 percent versus 2.4 percent. This is the main result from Panel A.

For robustness, Row 3 shows that growth in earnings before interest, tax, and depreciation (EBITDA) was essentially the same as EBIT growth for both periods.

Row 4 considers dividend growth. With higher profit growth from 1989 to 2019, firms were able to grow dividends at a faster rate compared to the prior 30 years. Specifically, dividends grew at a real rate of 3.3 percent per year from 1989 to 2019 versus 1.1 percent from 1962 to 1989. In other words, firms did what they are supposed to do: they distributed their higher profits to shareholders in the form of dividends. This occurred even as firms tilted their payout policy from dividends to share buybacks in recent decades. It is also apparent that, for both periods, the rate of dividend growth was somewhat below the rate of income growth.

Rows 5 of Panel A considers the sales growth of S&P 500 nonfinancial firms, while Row 6 shows overall U.S. GDP growth. Interestingly, for both periods, sales growth came in below GDP growth. On some level, this may be surprising, since GDP is the aggregate of all final sales produced in the U.S. On the other hand, S&P 500 firms are among the largest in the economy. With diminishing returns to scale, one might therefore expect their sales growth to be below overall GDP growth.

More importantly, for both periods, EBIT growth also came in below GDP growth. Given this 60-year pattern, it is reasonable to extrapolate that EBIT growth going forward will also probably not exceed GDP growth over the longer-run.

Panel B of Table 1 quantifies the contribution of the various components of corporate profit growth. Specifically, by taking the log-difference of Eq. 1, we arrive at the following decomposition of income growth over a given period:

$$\Delta\ln(Income) = \Delta\ln(EBIT) + \Delta\ln(1 - Int/EBIT) + \Delta\ln(1 - \tau). \qquad \text{(Eq. 2)}$$

If we divide both sides of this equation by $\Delta\ln(Income)$, we obtain the contribution of each of these components to overall income growth. The contributions, by construction, sum to one (ignoring small rounding errors).

One can further decompose EBIT into sales and profit margins: i.e., $EBIT = (EBIT/Sales) \times Sales$, where $EBIT/Sales$ is the profit margin. Thus, Eq. 2 can also be written as:

$$\Delta\ln(Income) = \Delta\ln(Sales) + \Delta\ln(EBIT/Sales) + \Delta\ln(1 - Int/EBIT) + \Delta\ln(1 - \tau).$$

Importantly, these decompositions are assumption-free. They are based on accounting identities and therefore hold simply by definition. However, as noted in Section I, this approach can only quantity the direct, mechanical effects of how various factors boosted income growth. In that sense, the decompositions do not take into account indirect, or general equilibrium, effects. So, for example, I can say that the decline in effective corporate tax rates—i.e., $\Delta\ln(1 - \tau)$—mechanically contributed a certain amount to income growth. However, I am unable to say how much of the growth in EBIT was itself due to the decline in corporate tax rates. The same goes for the decline in interest rates.

In practice, this means that my conclusions are conservative. Under the assumption that lower interest and tax rates are at least mildly stimulative, this would have provided some boost to EBIT growth.[8] Since the decompositions do not take into account this indirect effect, they therefore provide a *lower bound* on how much declining interest and corporate tax rates actually boosted profit growth.

Turning to Panel B, for the period 1989 to 2019, Row 1 shows that growth in EBIT accounted for 58 percent of overall profit growth. In other words, 42 percent of overall profit growth was due to the decline in relative interest expenses and effective corporate tax rates.

Rows 1.a. and 1.b. consider the contributions of sales and profit margins to corporate profit growth. From 1989 to 2019, an expansion in profit margins accounted for 9 percent of overall profit growth, while growth in sales accounted for 50 percent. The sum of these two equals the overall contribution of EBIT growth (ignoring rounding errors).

Row 2 shows that the decline in interest expenses relative to EBIT explains 19 percent of the overall growth in corporate profits from 1989 to 2019.

The ratio of interest expenses to EBIT reflects both interest rates and corporate leverage decisions. That is, $Int/EBIT = Int/Debt \times Debt/EBIT$, where $Int/Debt$ represents corporate interest rates, shown in Figure 2, and $Debt/EBIT$ is one measure of corporate leverage. As noted in Section III, $Int/Debt$ fell from about 10 percent in 1989 to 3.7 percent by 2019. Over the same period, $Debt/EBIT$ rose from 3.1 to 3.7. Thus, all of the decline in the term $Int/EBIT$ was due to the decline in corporate interest rates. As interest rates fell, corporations increased leverage (as measured by debt relative to EBIT), which had some offsetting effect on $Int/EBIT$.

Turning to Row 3, this shows that 22 percent of profit growth for the period 1989 to 2019 was due to the decline in effective corporate tax rates. Thus, the decline in corporate tax rates and relative interest expenses contributed about equally to profit growth over these years.

[8] In the case of interest rates, this assumes that at least part of the observed decline was due to discretionarily accommodative monetary policy and cannot be entirely attributed to purely structural factors, which seems reasonable.

For 1962 to 1989, the story is very different. Row 1 shows that EBIT growth over this period accounted for 120 percent of overall profit growth. This means that relative interest expenses and effective corporate tax rates together account for negative 20 percent—i.e., these two factors subtracted from overall income growth.

Row 1.a. shows that profit margins accounted for negative 8 percent of overall profit growth from 1962 to 1989, meaning that profit margins contracted over the period. Sales growth therefore accounted for 128 percent of profit growth, shown in Row 1.b.

Row 2 shows that an increase in interest expenses relative to EBIT was an enormous drag during these years—it was responsible for negative 53 percent of overall income growth. Both interest rates and corporate leverage increased over the period. Specifically, $Int/Debt$ rose from 4.2 percent in 1962 to about 10 percent in 1989, while $Debt/EBIT$ rose from 1.8 to 3.1. Together, these drove the substantial increase in $Int/EBIT$.

Effective corporate tax rates began declining in the early 1980s (Figure 5). As a result, Row 3 shows that the decline in effective corporate tax rates from 1962 to 1989 was responsible for 33 percent of income growth over the period.

V. The contribution of interest and corporate tax rates to stock market performance

The next question is how did the decline in interest and corporate tax rates boost stock returns in recent decades? This has direct implications for what is likely to transpire in the future.

Panel A of Table 2 shows real annualized stock returns and volatility for S&P 500 nonfinancial firms.[9] Note, the numbers are very similar for the overall S&P 500 index (not shown). This is not surprising given that the correlation between the overall S&P 500 index and the index of S&P 500 nonfinancial firms is 99.9%, see the Appendix for more details.

[9] For Rows 1-5, real annualized returns represent the geometric average over the period. I adjust for inflation using the GDP deflator. In the case of 3-month Treasury bills, I assume that these are rolled forward every quarter.

Table 2: Market performance indicators

Row #	*Panel A: Real annualized market returns and volatility, %*	1962-1989	1989-2019
	S&P 500 nonfinancials:		
1.	Dividends reinvested in index	5.6	7.9
2.	Dividends reinvested in Treasury bills	4.3	6.6
3.	Price index only (excluding dividends)	1.6	5.7
4.	Volatility	16.2	14.8
5.	3-month Treasury bills	2.0	0.7
6.	Equity premium (Row 1 - Row 5)	3.6	7.2
7.	Equity premium (Row 2 - Row 5)	2.3	5.9

Row #	*Panel B: Contribution to price index growth (total = 1)*	1962-1989	1989-2019
1.	P/E	-0.26	0.33
2.	EBIT	1.51	0.39
2.a.	EBIT / Sales	-0.10	0.06
2.b.	Sales	1.61	0.33
3.	1 - Interest/EBIT	-0.67	0.13
4.	1 - Effective tax rate	0.42	0.15

Panel A shows real annualized stock market performance and volatility for S&P 500 nonfinancial firms. It also shows the real annualized return of investing in 3-month Treasury bills. Volatility is the annualized standard deviation of percent changes in the real price index, computed from quarterly data. Panel B shows the contribution of P/E multiples, EBIT, interest expenses relative to EBIT, and effective corporate tax rates to growth in the price index for S&P 500 nonfinancial firms. The contributions, by construction, sum to one.

The main takeaway from Panel A is that stocks performed substantially better from 1989 to 2019 compared to 1962 to 1989. I argue that the decline in interest and corporate tax rate can explain much of the exceptional performance of stocks over the past 30 years.

Row 1 shows stock market performance assuming that dividends are reinvested back into the index. Row 2 assumes that dividends are reinvested into 3-month Treasury bills. Row 3 considers just the returns on the index, ignoring dividends. In all three cases, the returns from 1989 to 2019 are notably higher than those from 1962 to 1989.

Rows 6 and 7 consider the realized equity premium over the two periods—i.e., the difference between returns on stocks and returns on 3-month Treasury bills. For 1989 to 2019, the equity premium was as high as 7.2 percent per year (assuming dividends were reinvested back into the index, Row 6).

The numbers look far less impressive, however, for the years 1962 to 1989. During this period, an investor would have earned an equity premium of only 3.6 percent (assuming dividends were reinvested back into the index). In other words, the equity premium was 3.6 percentage points higher for the period 1989 to 2019 versus 1962 to 1989.

Over long samples—like the three decades from 1989 to 2019—the standard approach in financial economics is to explain the high realized equity premium as reflecting compensation for bearing risk. I would argue, however, that the substantial difference in the equity premium for 1989 to 2019 compared to 1962 to 1989 had little to do with compensation for bearing risk. Indeed, stock price volatility was *lower* during 1989 to 2019 than it was during 1962 to 1989.

Rather, the decline in interest and corporate tax rates can entirely explain the substantially higher equity premium from 1989 to 2019. These declines in interest and corporate tax rates could not have been anticipated ex ante. Investors therefore got lucky.

Panel B of Table 2 quantifies the contribution of the various drivers of stock price growth. The panel presents a decomposition analogous to that presented for earnings in Table 1. Stock prices can rise because P/E multiples expand or because earnings grow—i.e., $Price = P/E \times E$. By combining this with the decomposition for earnings presented above, one obtains the following decomposition for the percent change in stock prices over a given period:

$$\Delta\ln(Price) = \Delta\ln(P/E) + \Delta\ln(EBIT) + \Delta\ln(1 - Int/EBIT) + \Delta\ln(1 - \tau). \qquad \text{(Eq. 3)}$$

Thus, stock price growth can come from: (1) an expansion in P/E multiples; (2) EBIT growth; (3) a decline in interest expenses relative to EBIT; or (4) a decline in the effective corporate tax rate. In other words, without a decline in relative interest expenses and corporate tax rates, and without an expansion in P/E multiples, stock prices can only grow by as much as EBIT.

Dividing both sides of Eq. 3 by $\Delta\ln(Price)$ gives the contribution of each of the factors to stock price growth. Just like in Table 1, these contributions, by construction, sum to one (ignoring small rounding errors).

Focusing on the period 1989 to 2019, Panel B shows that an expansion in P/E multiples accounted for 33 percent of stock price growth for S&P 500 nonfinancial firms (Row 1); EBIT growth accounted for only 39 percent (Row 2); and the decline in relative interest expenses and corporate tax rates together accounted for 28 percent (Row 3 + Row 4).

As before, EBIT growth can be decomposed into profit margins and sales. Row 2.a. shows that an expansion in profit margins accounted for 6 percent of stock price growth, while Row 2.b. shows that sales growth accounted for 33 percent. Together, these two numbers sum up to the fraction of stock price growth explained by growth in EBIT (i.e., Row 2).

I next argue that the decline in risk-free rates from 1989 to 2019 can explain the entirety of the expansion in P/E multiples. Together, the decline in interest and corporate tax rates therefore accounts for the majority of the very strong stock price performance over this period.

Returning to Row 1, it is notable that, over the period 1962 to 1989, P/E multiples negatively contributing to stock price growth—i.e., multiples contracted. This was a period during which interest rates rose.

There are several ways to show that the decline in risk-free rates explains all of the expansion in P/E multiples from 1989 to 2019. Here, I present a simplified argument based on the Gordon growth model. In the Appendix, I present a more general argument based on the Campbell-Shiller (1988) decomposition. Under either approach, the conclusion is the same.

Before turning to the Gordon growth model, it will be useful to consider a general formula for the P/E ratio. The formula is based on the idea the price of a stock is equal to the present discounted valued of all future dividends. The trailing P/E ratio can then be written as:

$$\frac{P_0}{E_0} = \frac{\mathbb{E}[y_1(1+g_1)]}{(1+r_1+x_1)} + \frac{\mathbb{E}[y_2(1+g_1)(1+g_2)]}{(1+r_2+x_2)^2} + \frac{\mathbb{E}[y_3(1+g_1)(1+g_2)(1+g_3)]}{(1+r_3+x_3)^3} + \cdots \quad \text{(Eq. 4)}$$

Where, on the left-hand side of the equation, P_0 is the stock price today (time 0) and E_0 is the earnings per share today. On the right-hand side of the equation, $\mathbb{E}$ is the expectations operator conditional on information known today; y_t is the dividend payout ratio for year t, i.e., $y_t = dividends_t/earnings_t$; g_t is the nominal growth in earnings per share for year t;[10] r_t is the nominal risk-free interest rate used to discount certain cash flows occurring at year t; and x_t is the risk premium associated with uncertain year t cash flows.

[10] Since g_t is growth in earnings per share, the formula implicitly accounts for the effect of share buybacks.

The P/E ratio is therefore positively related to earnings growth expectations and dividend payouts and negatively related to risk-free rates and risk premia.

The Gordon growth model can be thought of as providing a rough approximation of Eq. 4. Specifically, assume that: the payout ratio is constant ($y_t = y$), earnings per share are expected to grow at a constant rate ($g_t = g$), the yield curve is flat ($r_t = r$), and the term-structure of risk premia is also flat ($x_t = x$). Note, y, g, r, and x are still random variables in that they can randomly change to new values each period, giving a new P/E ratio. In this formulation, y, g, r, and x can be roughly thought of as averages of all y_t, g_t, r_t, and x_t, respectively.

With this approximation, we have: $P_0/E_0 \approx y \times (1+g)/(r+x-g)$.[11] The log change in the trailing P/E ratio is then given by:

$$\Delta\ln\,(P_0/E_0) \approx \Delta\ln(y) + \Delta\ln\,(1+\text{g}) - \Delta\ln(r+x-g). \qquad \text{(Eq. 5)}$$

We can now turn to the data. From December 1989 to December 2019, 10-year Treasury yields fell from about 8 percent to about 2 percent (the numbers are very similar for the 30-year Treasury yield). In 1989, the trailing P/E ratio for S&P 500 nonfinancial firms stood at 11.8; by 2019, it had risen 20.3. Thus, $\Delta\ln(P_0/E_0)$ = 0.54.

Assume, for the sake of argument, that the risk-free rate, r, is the only variable that changes from 1989 to 2019. Under that assumption, the decline in risk-free rates will imply a larger increase in the P/E ratio than what was actually realized. In other words, holding all else equal, the decline in risk-free rates from 1989 to 2019 accounts for more than all of the expansion in P/E multiples. In fact, for both sides of Eq. 5 to balance, other variables, like y, g, and x, would need to change in such a way as to offset the decline in r.

Specifically, if r is the only variable that changes, then the right-hand side of Eq. 5 equals $-\Delta\ln(r+x-g)$ = $\ln((.08+x-g)/(0.02+x-g))$. This value decreases as $x-g$ increases. Suppose we want to make it as hard as reasonably possible to conclude that the decline in risk-free rates accounts for all of the expansion in P/E multiples—i.e., we want to make the right-hand side of Eq. 5 as small as possible. We therefore need to choose the largest reasonable value for the risk premium, x, and the smallest reasonable value for the nominal earnings growth rate,

[11] The Gordon growth model requires that $r+x-g > 0$.

g. To this end, consider an extreme risk premium of 8 percent. Suppose inflation averages 2 percent and real earnings growth averages a meagre 1 percent. Thus, $x - g$ = 0.05. Under these quite extreme assumptions, the right-hand side of Eq. 5 equals 0.62. This is greater than the actual log change in the P/E ratio on the left-hand side of Eq. 5, i.e., $\Delta\ln(P_0/E_0)$ = 0.54. For smaller (more reasonable) values of $x - g$, the discrepancy would be even larger. Overall, we can therefore confidently conclude that the decline in risk-free rates is more than sufficient to explain all of the expansion in P/E multiples from 1989 to 2019.

VI. Implications for the future

It may be tempting to assume that the exceptional stock market performance over the last three decades will continue indefinitely. My analysis, however, indicates otherwise. Both stock returns and corporate profit growth are very likely to be substantially lower in the future. This conclusion follows from the minimal assumption that interest rates and effective corporate tax rates have very little scope to fall below 2019-levels.

In the case of interest rates, in December 2019, the benchmark 10-year Treasury yield stood at 1.9 percent. The argument that, over the long run, it is not likely to fall much further is as follows. Assume that inflation averages 2 percent—i.e., the Federal Reserve's target level. A 10-year Treasury yield that also averages 2 percent would imply that the U.S. government will forever be able to lock in 10-year funding at an average real cost of zero. This is quite an extreme assumption.

Note, even if interest rates do in fact fall noticeably below 2019-levels, this would likely not be good news either. Interest rates that remain that low for a prolonged period would reflect anemic economic growth, which would likely be harmful for corporate profits and stock returns.

Effective corporate tax rates are also unlikely to fall much further. In fact, they have recently moved up slightly. The Inflation Reduction Act of 2022, for example, imposed a 15 percent corporate minimum tax. In contrast, just a few years earlier, the Tax Cuts and Jobs Act reduced the statutory corporate tax rate from 35 percent to 21 percent. With the ratio of U.S. debt-to-GDP near all-time highs, investors should not expect another deficit-financed corporate tax cut anytime soon.[12]

An optimistic scenario, therefore, is for interest and corporate tax rates to remain close to their 2019-levels over the longer run. In this scenario, corporate profits could only grow by as much as EBIT (Eq. 2).

I briefly note the possibility that firms could reduce their leverage. All else equal, this would lower interest expenses relative to EBIT and thus boost corporate profits.[13] However, reducing leverage is costly. It would require either issuing equity, which would dilute existing shareholders, or paying down debt, which would involve lower payouts to shareholders in the form of either dividends or buybacks. Both issuing equity or lowering payouts would be harmful for stockholders.

Overall, the outlook for stock price growth is bleak. My analysis has shown that, from 1989 to 2019, the decline in interest and corporate tax rates was a fundamental driver of stock market returns. In other words, much of the realized equity premium over these years had more to do with luck than compensation for bearing risk. What's relevant for the future is the fact that stock price growth can only come from either earnings growth or from an expansion in P/E multiples.

However, P/E multiples in the future—averaged over the longer run—are unlikely to expand much beyond 2019-levels. P/E multiples can only expand if: (1) risk-free rates decline; (2) risk premia decline; (3) earnings growth expectations increase; or (4) payouts to shareholders increase (Eq. 4). Notably, from 1989 to 2019, the decline is risk-free rates can account for all of the expansion in P/E multiples. Since risk-free rates are not expected to fall much below 2019-levels, this severely constrains the extent to which P/E multiples can continue to expand.

Likewise, P/E multiples are unlikely to get a boost from higher earnings growth expectations. Indeed, it is questionable whether the market is currently pricing in the substantially lower earnings growth that I argue is very likely to prevail in the future. There is some chance that the market is simply assuming that the very strong earnings growth experienced over the past thirty

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[12] There has also been a recent effort to impose a global minimum tax on multinational corporations, which would limit their ability to engage in international tax arbitrage, potentially leading to higher effective tax rates.

[13] I.e., since $Int/EBIT = Int/Debt \times Debt/EBIT$, even if $Int/Debt$ remains constant, $Int/EBIT$ could decline if firms reduce leverage, as represented by the term $Debt/EBIT$.

years will continue indefinitely. In other words, it is unclear whether the market is taking into account the fact that this growth was mechanically boosted by declining interest and corporate tax rates—a trend that has reached its limits. If the market is not taking this into account, then P/E multiples will not expand, but contract, once the market adjusts its longer-run earnings expectations downward to more reasonable levels. Obviously, stock market performance would suffer as a result.

This leaves a possible increase in average payouts to shareholders or a decline in risk premia as the only ways that P/E multiples might expand. Payouts to shareholders are constrained by firms' need to fund investment and retain cash buffers for precautionary reasons. Moreover, while it is possible that risk premia might decline, it is wishful thinking to simply assuming that this will happen.

An optimistic scenario, therefore, is for P/E multiples to remain close to their 2019-levels, just like interest and corporate tax rates. In that event, both stock returns and corporate profits could only grow at the same rate as EBIT.

What is a reasonable rate growth of EBIT growth to expect? As noted earlier, from 1962 to 2019, EBIT growth came in below GDP growth. Given this 60-year pattern, it is reasonable to extrapolate that, over the long run, EBIT growth in the future will also probably not exceed GDP growth.

For the 15 years prior to the pandemic, U.S. real GDP grew at annual rate of 1.9 percent. Going forward, the Congressional Budget Office projects real GDP growth of 1.9 percent per year over the next decade.

In the future, the real longer run growth rate of both stock prices and corporate earnings is therefore unlikely to exceed 2 percent per year. Given that this represents an optimistic scenario, the risks to this forecast, if anything, are to the downside.

Appendix

A1. Construction of the S&P 500 nonfinancial index

I construct a monthly price index for S&P 500 nonfinancial firms.[14] The correlation between this index and the overall S&P 500 price index, from 1962 to 2022, is 99.9%.

To construct the index, I obtain from CRSP a list of historical S&P 500 index constituents as well as monthly firm-level data on stock prices and shares outstanding. I match this to Compustat using the CRSP/Compustat Merged, Fundamentals Annual Database. Financial firms are filtered out using the SIC, NAICS and GICS codes. I also require that firms have non-missing information on sales, cost of goods sold, operating income, pre-tax income, total assets, total taxes, interest expense, and long term-debt. I begin the sample in 1962 because data availability prior to that is relatively poor.

Constructing a price index for S&P 500 nonfinancial firms requires computing an index "divisor." This is analogous to the divisor for the overall S&P 500 index.[15] The divisor adjusts for changes in the composition of the index as well as changes in shares outstanding of individual stocks. The divisor makes it possible to compute the growth in index earnings per share, and related measures, shown in Table 1.

The following explains how I compute the divisor. Consider a hypothetical investor who, at time t, owns a fraction w_t of the market capitalization of all S&P 500 nonfinancial firms. For stock i in the index, the price at time t is $P_{i,t}$ and the total shares outstanding is $Q_{i,t}$. At time t, the market capitalization of the index is $\sum_i P_{i,t}\, Q_{i,t}$, and the value of the investor's portfolio is $w_t \sum_i P_{i,t}\, Q_{i,t}$.

There are two key points. First, the value of the index of S&P 500 nonfinancial firms will be set equal to the value of this hypothetical investor's portfolio. Thus, at any point in time, the value of the index is $w_t \sum_i P_{i,t}\, Q_{i,t}$. Second, at the end of each month, the investor will rebalance their portfolio to reflect changes in shares outstanding and changes in the composition of the index.

[14] Note, there exists an official S&P 500 ex-financials index. However, this only goes back to December 1997, which is not adequate for my purposes.
[15] See, *S&P Dow Jones Indices: Index Mathematics Methodology*.

Importantly, this rebalancing will be done by adjusting the value of w_t so that *no new capital is contributed*.

Note, w_t is defined to be the inverse of the divisor—i.e., $w_t = 1/Divisor_t$. For all expressions, I use w_t simply for convenience.

The value of the investor's portfolio at time $t + 1$—before the portfolio is rebalanced—is $w_t \sum_i P_{i,t+1}\, Q_{i,t}$. However, at time $t + 1$, each stock will potentially have a different number of shares outstanding: i.e., we will now have $Q_{i,t+1}$ instead of $Q_{i,t}$. The number of shares outstanding could change, for example, because a firm buys back some of its stock. In this case, $Q_{i,t+1}$ will be less than $Q_{i,t}$ (and the opposite would be true if the firm, on net, issued equity).

For stocks that are not in the index at time t, it will be convenient to think of their $Q_{i,t}$ as equal to zero. So, for example, if a stock leaves the index at time $t + 1$, its $Q_{i,t+1}$ would be set equal to zero. For a firm that enters the index at time $t + 1$, and is not in the index at time t, its $Q_{i,t}$ would be zero, while its $Q_{i,t+1}$ would be equal to the number of its shares outstanding at time $t + 1$.

At time $t + 1$, the market capitalization of the index is $\sum_i P_{i,t+1}\, Q_{i,t+1}$. After rebalancing, the investor will own a new share, w_{t+1}, of this market capitalization. Since no new capital is contributed, the value of the portfolio before rebalancing equals the value after rebalancing. This requires that the following condition holds: $w_t \sum_i P_{i,t+1}\, Q_{i,t} = w_{t+1} \sum_i P_{i,t+1}\, Q_{i,t+1}$. Thus, w_t evolves, at the monthly frequency, according to the following recursion:

$$w_{t+1} = w_t \frac{\sum_i P_{i,t+1}\, Q_{i,t}}{\sum_i P_{i,t+1}\, Q_{i,t+1}}.$$

Note, the first value, w_0, can be arbitrarily set to any positive number, e.g., $w_0 = 0.01$.

With these w_t in hand, one can compute the growth in index earnings per share (and sales per share, etc.). For example, let $E_{i,t}$ be the earnings of firm i in the index at time t. The earnings per share of the index, at time t, is then given by $w_t \sum_i E_{i,t}$. From this quantity, I compute the geometric growth rate of earnings per share, and related measures, shown in Table 1. Specifically, for each of the relevant start and end years in Table 1, I compute the growth rates for firms in the index in December of the relevant year.

A2. Variable definitions

Earnings, income, net income, profits**:** these terms are used interchangeably to mean income before extraordinary and special items, which equals operating income after depreciation (OIADP) *plus* nonoperating income (NOPI) *minus* interest expense (XINT) *minus* total income taxes (TXT). Note, this is equivalent to income before extraordinary items (IB) *minus* special items (SPI) *plus* minority interest (MII).

Earnings before interest and tax, EBIT**:** operating income after depreciation (OIADP) *plus* nonoperating income (NOPI).

Earnings before interest, tax, and depreciation, EBITDA**:** operating income before depreciation (OIBDP) *plus* nonoperating income (NOPI).

Effective corporate tax rate**:** total income taxes (TXT) *divided by* pre-tax income, where pre-tax income equals operating income after depreciation (OIADP) *plus* nonoperating income (NOPI) *minus* interest expense (XINT).

A3. Earnings growth and stock returns around the pandemic, 2019-2022

The years around the pandemic are outliers. I therefore briefly discuss them separately. Table A1 is the analogue of Table 1 from the main text for the years 2019 to 2022.

Table A1: Growth indicators for S&P 500 nonfinancial firms

	Panel A: Annualized real growth rates, %	
Row #		2019-2022
1.	Net Income	7.2
2.	EBIT	6.3
3.	EBITDA	3.4
4.	Dividends	-2.0
5.	Sales	1.9
6.	U.S. GDP	1.7
	Panel B: Contribution to net income growth (total = 1)	
Row #		2019-2022
1.	EBIT	0.88
1.a.	EBIT / Sales	0.60
1.b.	Sales	0.27
2.	1 - Interest/EBIT	0.23
3.	1 - Effective tax rate	-0.11

Row 1 shows that real net income around the pandemic grew at a stellar pace of 7 percent per year. EBIT growth, shown in Row 2, was not far behind, at 6 percent. Interestingly, there is a steep drop off from EBIT to EBITDA growth. The latter, shown in Row 3, grew notably, at a 3.2 percent real rate. The reason for this drop-off is that real depreciation expenses (not shown) declined about 4 percent per year during these years. The decline in depreciation expenses boosted EBIT growth relative to EBITDA growth. Firms invested at a much slower pace during the pandemic, which may explain why their depreciation expenses were notably lower.

EBITDA grew by significantly more than sales (Row 5). In other words, the profit margins of S&P 500 nonfinancial firms expanded substantially since 2019. This likely reflects the peculiar set of circumstances around the pandemic—e.g., supply chain bottlenecks coupled with enormous fiscal and monetary stimulus which bolstered demand. As such, the expansion in profit margins is likely unsustainable.

For completeness, Table A2 presents the analogue of Table 2 from the main text, for the years 2019 to 2022.

Table A2: Market performance indicators

	Panel A: Real annualized market returns and volatility, %	
Row #		2019-2022
	S&P 500 nonfinancials:	
1.	Dividends reinvested in index	3.6
2.	Dividends reinvested in Treasury bills	3.6
3.	Price index only (excluding dividends)	1.9
4.	Volatility	23.0
5.	3-month Treasury bills	-3.8
6.	Equity premium (Row 1 - Row 5)	7.4
7.	Equity premium (Row 2 - Row 5)	7.4

	Panel B: Contribution to price index growth (total = 1)	
Row #		2019-2022
1.	P/E	-2.66
2.	EBIT	3.21
2.a.	EBIT / Sales	2.20
2.b.	Sales	1.00
3.	1 - Interest/EBIT	0.84
4.	1 - Effective tax rate	-0.39

A4. Campbell-Shiller decomposition

In the main text, I presented as simplified argument, based on the Gordon growth model, that the decline in risk-free rates explains all of the expansion in P/E multiples from 1989 to 2019. Here, I present a more general argument based on the Campbell-Shiller (1988) decomposition.

Start with the following definition of the one-period return from t to $t+1$, R_{t+1}, of an asset with the current price P_t and a current dividend D_t:

$$R_{t+1} = \frac{P_{t+1} + D_{t+1}}{P_t} = \left(1 + \frac{P_{t+1}}{D_{t+1}}\right) \times \frac{D_{t+1}}{D_t} \times \frac{D_t}{P_t}.$$

This equation can be written in logarithmic form as

$$r_{t+1} = \ln(1 + e^{pd_{t+1}}) + \Delta d_{t+1} - pd_t, \qquad \text{(Eq. 1A)}$$

where $r_{t+1} = \ln(R_{t+1})$, $\Delta d_{t+1} = \ln(D_{t+1}) - \ln(D_t)$ is the dividend growth rate, and $pd_t = \ln(P_t) - \ln(D_t)$ is the log of the price-dividend ratio. Following Campbell and Shiller (1988), we take a first-order Taylor approximation such that

$$\ln(1 + e^{pd_{t+1}}) \approx \kappa + \rho \times pd_{t+1}.$$

The approximation coefficients are

$\rho = \frac{e^{\overline{pd}}}{1+e^{\overline{pd}}}$, $\kappa = -(1-\rho)\ln(1-\rho) - \rho\ln(\rho)$, and $\overline{pd}$ is the unconditional mean of log price-dividend ratio.

Rearranging Eq. 1A, we have

$$pd_t = \Delta d_{t+1} - r_{t+1} + \kappa + \rho \times pd_{t+1}.$$

The latter expression can be iterated forward to obtain

$$pd_t = \frac{\kappa}{1-\rho} + \sum_{i=1}^{\infty} \rho^{i-1} \Delta d_{t+i} - \sum_{i=1}^{\infty} \rho^{i-1} r_{t+i} + \lim_{n\to\infty} \rho^n pd_{t+n}. \qquad \text{(Eq. 2A)}$$

We assume a no "rational bubble" terminal condition, meaning that $\lim_{n\to\infty} \rho^n pd_{t+n} = 0$.

Since $P_t/D_t = P_t/E_t \times E_t/D_t$, we have $pd_t = pe_t - de_t$, where $pe_t = ln(P_t/E_t)$ is the log P/E ratio and $de_t = ln(D_t/E_t)$ is the log of the dividend payout ratio. Applying the conditional expectations operator, $\mathbb{E}_t$, the log P/E ratio is therefore given by:

$$pe_t = \frac{\kappa}{1-\rho} + de_t + \mathbb{E}_t \sum_{i=1}^{\infty} \rho^{i-1}\,\Delta d_{t+i} - \mathbb{E}_t \sum_{i=1}^{\infty} \rho^{i-1}\,r_{t+i}.$$

Consider the last term in the above expression: $\mathbb{E}_t \sum_{i=1}^{\infty} \rho^{i-1}\,r_{t+i} = \sum_{i=1}^{\infty} \rho^{i-1}\mathbb{E}_t\,r_{t+i}$. The term $\mathbb{E}_t r_{t+i}$ is the time t expectation of the return earned from $t+i-1$ to $t+i$. It is always possible to decompose this expected return into a risk premium and a risk-free forward rate. I.e., $\mathbb{E}_t r_{t+i} = x_{t+i} + f_{t+i}$, where x_{t+i} is the risk premium associated with an uncertain return from $t+i-1$ to $t+i$, and f_{t+i} is the risk-free forward rate, known at time t, for the period $t+i-1$ to $t+i$. In this formulation, the risk premium, x_{t+i}, is defined tautologically as the expected return in excess of the riskless return that one can lock in today using the forward rate, i.e., $x_{t+i} = \mathbb{E}_t r_{t+i} - f_{t+i}$. Overall, we then have the following expression for the log P/E ratio:

$$pe_t = \frac{\kappa}{1-\rho} + de_t + \mathbb{E}_t \sum_{i=1}^{\infty} \rho^{i-1}\,\Delta d_{t+i} - \sum_{i=1}^{\infty} \rho^{i-1}\,x_{t+i} - \sum_{i=1}^{\infty} \rho^{i-1}\,f_{t+i}.$$

Suppose, for the sake of argument, that the only thing that changes from 1989 to 2019 is that risk-free rates fall. We then have:

$$\Delta pe_t = -\sum_{i=1}^{\infty} \rho^{i-1}\,\Delta f_{t+i}, \qquad \text{(Eq. 3A)}$$

where Δ in the above expression now represents the change from 1989 to 2019.

From the main text, Δpe_t = 0.54. We also know that, from December 1989 to December 2019, both 10-year and 30-year Treasury yields fell by about 6 percentage points. It is fair to say, then, that at least through to the 30-year maturity, there was a level-shift down in the Treasury yield curve, such that $\Delta f_{t+i} \approx$ -0.06, for all i from 1 to 30. We do not observe risk-free rates beyond the 30-year maturity. As in the main text, the aim is to make it as hard as possible to conclude that the decline in risk-free rates accounts for all of the expansion in P/E multiples. I will therefore make the extreme assumption that there was no change in risk-free rates beyond the 30-year maturity. The right-hand side of Eq. 3A is then given by: $0.06 \times (1 - \rho^{30})/(1 - \rho)$.

We will choose ρ to be as small as possible. Recall, $\rho = e^{\overline{pd}}/(1 + e^{\overline{pd}})$, where $\overline{pd}$ is the unconditional mean of log price-dividend ratio. The latter quantity was a lot smaller in the first half of the sample, from 1962 to 1989, so we will use the mean from that period, i.e., $\overline{pd} \approx 3$. Thus, $\rho \approx 0.95$. The right-hand side of Eq. 3A therefore equals 0.94. This is notably larger than the actual change in the log P/E ratio of 0.54. There is no doubt then that fall in risk-free rates is more than sufficient to explain all of the expansion in P/E multiples from 1989 to 2019.

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