Although the arithmetic and rebalanced methods of calculating the mean return probably do not portray realistic investment experience, the small-firm premium is calculated as the *difference* between the two mean returns and one might hope that the improper portrayal in these methods would cancel. Unfortunately, this is not likely for several reasons. The intertemporal variance in the portfolio disturbance, $\tilde{h}$, and the cross-sectional variance in individual security expected returns, μ_i, will not be the same in samples of large and small firms. The disturbance, $\tilde{h}$, will almost certainly have a larger variance for portfolios of small firms while the cross-sectional variances of μ_i within large- and small-firm portfolios could conceivably differ in either direction. Furthermore, serial dependence has an effect which is stronger for stocks with lower trading volumes and thus with less synchronous trading and with larger bid/ask spreads.

Empirical evidence is reported in table 1. Small Firm Premia (AMEX–NYSE) are given for the 19 complete calendar years, 1963–1981, according to the method of computation and the 'review' period. As explained earlier, the 'review' period refers to the rebalancing interval for buy-and-hold returns. For example, with a monthly review period, an equal allocation is made to stocks listed on the first day of the month and the original positions are held until the end of the month. This is repeated for each calendar month of the sample. The daily rebalancing method uses the same available returns, but it re-initializes equal positions every day during the month. The arithmetic method simply averages the same available returns during the month.

In order to compare results across the different review periods, returns are annualized by linking together the review period returns obtained during the calendar year.[7] Thus, there are 19 annual observations (one for each calendar year, 1963–81), regardless of the review period.[8] Means and t-statistics are calculated from the 19 annual returns differences between exchanges; t-

[7]See footnote 2 for exact computational formulae.

[8]Daily and bi-daily returns are over trading day intervals, while weekly and longer returns use actual calendar intervals. In the weekly case, the first week of the year ends on the same day of the week as the last trading day of the previous year, say Thursday for a given year. Then weekly returns are computed from Thursday to Thursday during that year. If the year does not terminate on a Thursday trading day, the last 'weekly' return of the year is over the remaining fraction of a calendar week. This method of year-end padding was used to ensure that every daily return during a year was included, regardless of the review period. Only the bi-daily, weekly, and bi-weekly returns are subject to such padding because the other intervals are evenly divisible into years.

Weekly returns are not always for five trading day intervals. During 1968, the exchanges were closed on Wednesdays for part of the year so that a week was composed of only four trading days. Holidays are also a problem for weekly returns; if the calendar week ended on a holiday, the return was computed through the next trading day. Then the subsequent week's return covered four trading days. Bi-weekly returns were treated identically to weekly returns with respect to year-end padding, holidays, and exchange closings.

Table 1

The small firm premium as measured by the difference in returns between American Exchange and New York Exchange listed stocks, 1963–1981 (basic data are daily, January 2, 1963 — December 31, 1981).

Review period[a] (number of review periods in sample)	Return computation method[b]		
	Buy-and-hold (BH)	Arithmetic (AR)	Daily rebalancing (RB)
	AMEX–NYSE mean return differential (% per annum)[c]		
Daily (4767)	14.9 (3.16) [7.76]	14.9 (3.16) [7.76]	14.9 (3.16) [7.76]
Bi-daily (2389)	12.3 (2.64) [5.58]	14.9 (3.16) [7.06]	14.8 (3.15) [7.01]
Weekly (992)	9.81 (2.16) [3.35]	14.8 (3.15) [5.64]	14.7 (3.14) [5.62]
Bi-weekly (498)	8.27 (1.84) [2.46]	14.9 (3.14) [5.09]	14.7 (3.13) [5.07]
Monthly (228)	7.06 (1.58) [1.82]	14.9 (3.14) [4.40]	14.7 (3.11) [4.38]
Quarterly (76)	6.42 (1.43) [1.67]	15.0 (3.15) [3.88]	14.8 (3.12) [3.85]
Annual (19)	7.45 (1.53) [1.53]	15.1 (3.10) [3.10]	14.9 (3.07) [3.07]

[a]For the daily and bi-daily cases, one- and two-trading-day intervals were used respectively. For all other cases, actual calendar intervals were used. (In the weekly and bi-weekly cases, a residual interval was necessary to fill out each calendar year). All returns were compounded to an annual basis by linking successive observations within each year (see footnote 2 of the text).

[b]The computation method follows expressions (1), (2) and (3) of the text. For interested readers, the author will gladly supply a mimeographed sheet containing details on the treatment of delisting and listing securities. The main feature of the treatment of new listings and delistings was to assure that all three mean return methods employed exactly the same sample observations.

[c]t-statistics based on the 19 annual (linked) observations are in parentheses; t-statistics based on the review period returns as independent observations are given in brackets. To understand the difference in the two reported t-statistics, consider the example of the daily review period of which there are 4767 in the sample. The t-statistic in brackets is calculated from these 4767 (daily) observations (mean *daily* return divided by standard error of mean daily return). The t-statistic in brackets is calculated from 19 annual observations; each annual observation having been calculated by linking together approximately 250 (4767/19) daily observations observed during that year. In calculating the review-period-based t-statistics for the weekly and bi-weekly cases, ten days were omitted; these ten days were the reminders of partial weeks at year end. It turned out that in 10 years of the 19, the year was exactly 52 weeks plus one trading day long. An earlier version of the paper, available on request, details the effect of omitting these single-day partial weeks. N.B. This is an issue only for the bracketed t-statistics. The linked annual returns include *every* sample day.

statistics are also given based on review period returns taken as independent observations.[9]

The results most like actual investment experience are those in the first column, buy-and-hold returns. Most actual portfolios pursue a buy-and-hold strategy within a given review period with only minor modifications induced by new information about particular individual issues. The results are frequently expressed on an annual percentage basis by comparing wealth levels at the ends of successive years, i.e., after linking sub-year results.

The review period seems to have little effect on the AR and RB means. The annual average difference in returns between AMEX and NYSE issues is about fifteen percent. But for the BH means, the review period has a large impact. Monthly and longer review periods give an AMEX–NYSE return differential of only around seven percent (and the t-statistic does not indicate an overwhelming probability that the differential is even positive). The drop in the BH mean with lengthening review period is statistically significant and so is the difference between the BH and the other means.[10]

[9]Note that the t-statistics in these tables are based on the assumption that the annual returns (t-statistics in parentheses) and review period returns (t-statistics in brackets) are temporally independent. The results indicate that the AR and RB returns are, in fact, close to independent while there is negative serial dependence in the BH returns. This implies that the t-statistics for the BH means are actually *understated*.

[10]A statistical test of the significance of the review period can be conducted by considering each year's mean difference, AMEX–NYSE, as an independent observation. Let $D_{m,y,\tau}$ be the difference for year y, review period τ, and the method m (m=BH, AR, RB). Then the time series mean of $D_{m,y,\tau}-D_{m,y,\tau'}$ ($\tau \neq \tau'$) can be tested for significance under the presumption that the years constitute independent observations. t-statistics for the AR and RB means, for all combinations of τ and τ', never indicated significance. Of the 42 combinations (21 for each mean AR and RB) none exceeded 2.0, five exceeded 1.5, and 28 were less than 1.0. In contrast, the t-statistics for the BH mean comparisons across review periods are given below:

Review period τ'	Review period τ					
	Daily	Bi-daily	Weekly	Bi-weekly	Monthly	Quarterly
Bi-daily	6.21					
Weekly	6.75	6.82				
Bi-weekly	7.67	8.37	10.8			
Monthly	8.11	8.89	11.3	9.82		
Quarterly	8.10	7.68	8.65	6.49	3.27	
Annual	5.08	4.42	2.81	1.04	−0.532	−1.67

All BH means are significantly different across-review periods except the annual mean versus the bi-weekly, monthly and quarterly means. Note that these table entries are not statistically independent of one another (they were all calculated from the same underlying data).

A similar procedure can be employed to test the statistical significance of mean computational method. The difference $D_{m,y,\tau}-D_{m',y,\tau}$ ($m \neq m'$) forms another time series across years. Based on 19 annual observations, t-statistics for the significance of this difference from zero are as follows:

Given that the BH results in table 1 are most likely to portray actual investment experience, we now turn to the interesting econometric question: What explains the observed pattern of means? To aid in answering this question, the mean returns for each exchange are presented separately in table 2. Notice that the pattern is not predicted by the expected values of the mean returns derived in section 2.2 under the assumption of temporally independent returns. With serial independence, the BH expected mean should be greater than the RB expected mean. The empirical results in table 2 show, however, that serial dependence must be present since $\bar{R}_{BH}$ falls below $\bar{R}_{RB}$ as the review period lengthens.

The arithmetic (AR) mean is larger than the rebalanced (RB) mean as was expected with or without serial dependence. However, these two means are very close and this suggests that serial dependence in *portfolio* returns is not much of an influence [Cf. eq. (14)]. Indeed, the strikingly different behavior of the BH means from the other two means indicates that negative serial dependence in individual securities is the dominant influence on the results.

In order to be certain that the AMEX–NYSE comparison measures the small firm effect properly, table 3 is presented. It contains results for the annual review period and for portfolios classified directly by size. Firm size was calculated as market capitalization (market price times number shares), at the end of each year, 1962–1980. Firms were assigned to fractiles based on market capitalization and their returns were calculated for the following year according to three mean return methods, BH, AR, and RB.

Not surprisingly, the results are consistent with the AMEX corresponding to lower size quintiles and the NYSE to higher quintiles. The overall implication is identical: viz., the estimated small firm premium is much smaller and less significant when mean returns are computed with the buy-

Review period τ	$m=$AR, $m'=$BH	$m=$RB, $m'=$BH	$m=$AR, $m'=$RB
	t-statistic for difference		
Bi-daily	6.82	6.30	1.47
Weekly	7.33	6.80	1.59
Bi-weekly	8.14	7.59	1.74
Monthly	8.44	7.90	2.17
Quarterly	8.21	7.69	2.72
Annual	5.85	5.48	3.16

No statistic was computed in the daily case because all three means are identical by construction in that case. Notice that the BH means are significantly smaller than the other two means for all review periods.

Although the difference between the AR and RB small firm premium is very small (cf. table 1), the AR mean premium is always larger and is significantly larger for monthly, quarterly and annual review periods. This is predicted by eq. (14); the AR mean grows with review period relative to the RB mean.

Table 2
Mean returns on NYSE and AMEX listed securities, 1963–1981.[a]

Review period	Buy-and-hold (BH)		Arithmetic (AR)		Daily rebalancing (RB)	
	NYSE	AMEX	NYSE	AMEX	NYSE	AMEX
	Mean returns (% per Annum)					
Daily	17.24	32.09	17.24	32.09	17.24	32.09
	(2.94)	(3.29)	(2.94)	(3.29)	(2.94)	(3.29)
	[5.09]	[7.72]	[5.09]	[7.72]	[5.09]	[7.72]
Bi-daily	16.93	29.23	17.53	32.42	17.24	32.09
	(2.89)	(3.03)	(2.98)	(3.31)	(2.94)	(3.29)
	[4.59]	[6.25]	[4.76]	[6.96]	[4.68]	[6.88]
Weekly	16.38	26.19	17.79	32.61	17.26	31.99
	(2.80)	(2.78)	(3.02)	(3.34)	(2.94)	(3.28)
	[4.47]	[5.32]	[4.81]	[6.44]	[4.68]	[6.32]
Bi-weekly	15.86	24.14	17.95	32.83	17.29	32.08
	(2.72)	(2.58)	(3.05)	(3.36)	(2.95)	(3.28)
	[4.29]	[4.66]	[4.71]	[5.85]	[4.58]	[5.74]
Monthly	15.34	22.39	18.07	32.96	17.34	32.08
	(2.65)	(2.42)	(3.07)	(3.36)	(2.95)	(3.28)
	[3.11]	[3.08]	[3.67]	[4.54]	[3.51]	[4.41]
Quarterly	15.01	21.42	18.17	33.17	17.38	32.19
	(2.63)	(2.33)	(3.09)	(3.38)	(2.96)	(3.29)
	[2.73]	[2.62]	[3.22]	[3.84]	[3.09]	[3.73]
Annual	15.18	22.63	17.96	33.07	17.16	32.03
	(2.69)	(2.39)	(3.11)	(3.36)	(2.98)	(3.27)
	[2.69]	[2.39]	[3.11]	[3.36]	[2.98]	[3.27]

[a]See footnotes to table 1.

and-hold method than when means are computed with the AR and RB methods.

3.2. *Implications for previous research and for the 'risk-adjusted' small firm premium*

The implications of these findings for previously-published estimates of the small firm premium are: if the basic data were very short-term and arithmetic or rebalanced means were used, the estimated premium overstates the reward investors can expect from a buy-and-hold position in small firms. Papers by Reinganum (1981a, b, 1982) and Roll (1981) used daily data and arithmetic mean returns. Reinganum's (1982) paper gives monthly and quarterly returns but these were computed with the daily rebalancing method since the author states that '... these holding period returns are created by compounding the daily *portfolio* returns' (p. 34, emphasis added).

Table 3
Mean returns and small firm premia for portfolios classified by size[a] at year-end, 1963–1981, annual review period.

Size quintile	Return computation method[b]		
	Buy-and-hold (BH)	Arithmetic (AR)	Daily rebalancing (RB)
	Mean return (% per annum)[c]		
Smallest	27.9	46.0	44.9
	(2.42)	(3.68)	(3.61)
2	21.1	27.6	26.6
	(2.51)	(3.15)	(3.04)
3	17.1	20.7	19.7
	(2.41)	(2.86)	(2.73)
4	14.6	16.9	16.1
	(2.53)	(2.89)	(2.75)
Largest	10.8	12.2	11.5
	(2.50)	(2.85)	(2.68)
	Small firm premium, smallest–largest quintile (% per annum)		
	17.1	33.9	33.4
	(1.88)	(3.47)	(3.46)
	Small firm premium, smallest–largest decile (% per annum)		
	22.8	49.1	48.3
	(2.07)	(3.84)	(3.83)

[a]Firms are included in the kth size fractile if the closing price times the number of outstanding shares is ranked in that fractile among all listed AMEX and NYSE firms.
[b]The computation method follows expressions (1), (2) and (3) of the text. An unpublished appendix (available from the author) contains details on the treatment of listing and delisting.
[c]t-statistics based on 19 annual observations are in parentheses.

Papers with monthly returns are apparently much less subject to mean return estimation problems. Tables 1 and 2 show that there is little additional discrepancy between the BH and other means in going from monthly to annual data. The well-known paper by Banz (1981) used monthly data as did earlier papers on the closely-related stock price effect [Blume and Husic (1973), Bachrach and Galai (1979)]. Thus, it seems unlikely that the results presented in those papers will be much affected by the problem investigated here. In a more recent paper, Reinganum, (1983) used the buy-and-hold method and found results close to those reported above. Reinganum did not, however, contrast the buy-and-hold with other mean returns.

It is important to ascertain whether the *risk-adjusted* small firm premium is attributable solely to econometric problems. Is underestimation of risk for small firms [Roll (1981), Reinganum (1982)], combined with overestimation of expected returns, sufficient to induce the observed risk-adjusted premium; or is the premium really evidence of a misspecified capital asset pricing model (CAPM), perhaps because of omitted factors in the single index CAPM?

This is tantamount to asking whether the implicit CAPM market risk premium $\hat{p}$ ($\hat{p} \equiv \hat{\mathrm{E}}(R_{\mathrm{small}} - R_{\mathrm{large}})/(\hat{\beta}_{\mathrm{small}} - \hat{\beta}_{\mathrm{large}})$), is in a reasonable range. $\hat{p}$ was computed by Reinganum (1983) as 37.5 percent per annum using (a) buy-and-hold means on the smallest and largest deciles of NYSE and AMEX stocks, (b) Dimson's (1979) aggregated coefficient betas, (c) the value-weighted C.R.S.P. index and (d) daily data for 1963–1980. The return on the value-weighted index during this period was only about 9.5 percent, so $\hat{p}$ is grossly too large, thereby indicating a substantial risk-adjusted small firm premium.

The main problem with such a test was described some time ago [Roll (1977)]. Even if we make the dubious assumption that the value-weighted C.R.S.P. index is ex-ante mean/variance efficient, there is no necessity in the generalized Black (1972) C.A.P.M. that $\mathrm{E}(\hat{p}) = \mathrm{E}(R_M - R_F)$. Instead, the model requires that $\mathrm{E}(\hat{p}) = \mathrm{E}(R_M - R_Z)$ where Z is M's 'zero-beta' portfolio. Depending upon M's position on the efficient frontier, $\mathrm{E}(R_Z)$ can be negative and large.

To illustrate the difference in inferences that can be obtained with a different index, I recomputed $\hat{p}$ using (a) buy-and-hold annual means on the smallest and largest deciles of NYSE and AMEX stocks, (b) simple OLS beta coefficients estimated from annual returns,[11] (c) the *equally*-weighted C.R.S.P. index, and (d) annual data for 1963–1981.

The beta estimates (t-statistics) were $\beta_{\mathrm{small}} = 1.78$ (5.59), $\beta_{\mathrm{large}} = 0.598$ (8.60). Using the estimated premium $\mathrm{E}(R_{\mathrm{small}} - R_{\mathrm{large}}) = 22.8\%$ from table 3, we have $\hat{p} = 19.3$ percent. The actual ex post return on this market index was 15.3 percent, so $\hat{p}$ is still somewhat too high (thus indicating a risk-adjusted small-firm premium). Nevertheless, the discrepancy between a $\hat{p}$ of 19.3 and a market return of 15.3 is much less aberrant than the difference Reinganum (1983) reports between $\hat{p} = 37.5$ and $\bar{R}_M = 9.5$ percent.

It still seems that investigation of the observed small firm premium in the context of a more general asset pricing model would be a worthwhile endeavor; but estimation problems in expected returns and in simple risk parameters can explain much of the apparent anomaly.

[11]Instead of the Dimson aggregated coefficient betas, I used betas from annual data because of the now well-documented annual seasonal [Keim (1983), Roll (1983)], which has the potential to induce biases into any betas, including the Dimson type, when they are computed from non-yearly data.

5. Conclusion

Computing mean returns in order to estimate investment experience is not as easy as it sounds. Common stock data have serial dependence which, though seemingly slight, substantially affects the estimates obtained under alternate mean return computational methods. Investment experience is best portrayed by buy-and-hold portfolio returns but scholars often use arithmetic or rebalanced portfolio returns because they are easier to compute.

Perhaps this makes little difference for some studies; but if serial dependence differs systematically with the item being investigated, the computational method can be quite material.

For the small firm premium, as measured by the difference in mean returns of American Exchange and New York Exchange listed stocks, the buy-and-hold mean return difference is only about $7\frac{1}{2}$ percent per annum (for 1963–81) while the rebalanced and arithmetic methods produce annual return differences *with the same stocks and time periods* of over 14 percent. The annual difference in returns between the smallest and largest size quintiles (deciles) is about 34 (49.1) percent using the rebalanced and arithmetic methods and about 17 (22.8) percent using the buy-and-hold method.

The annual small-firm premium is only marginally significant at usual significance levels if mean returns are measured with the buy-and-hold method.

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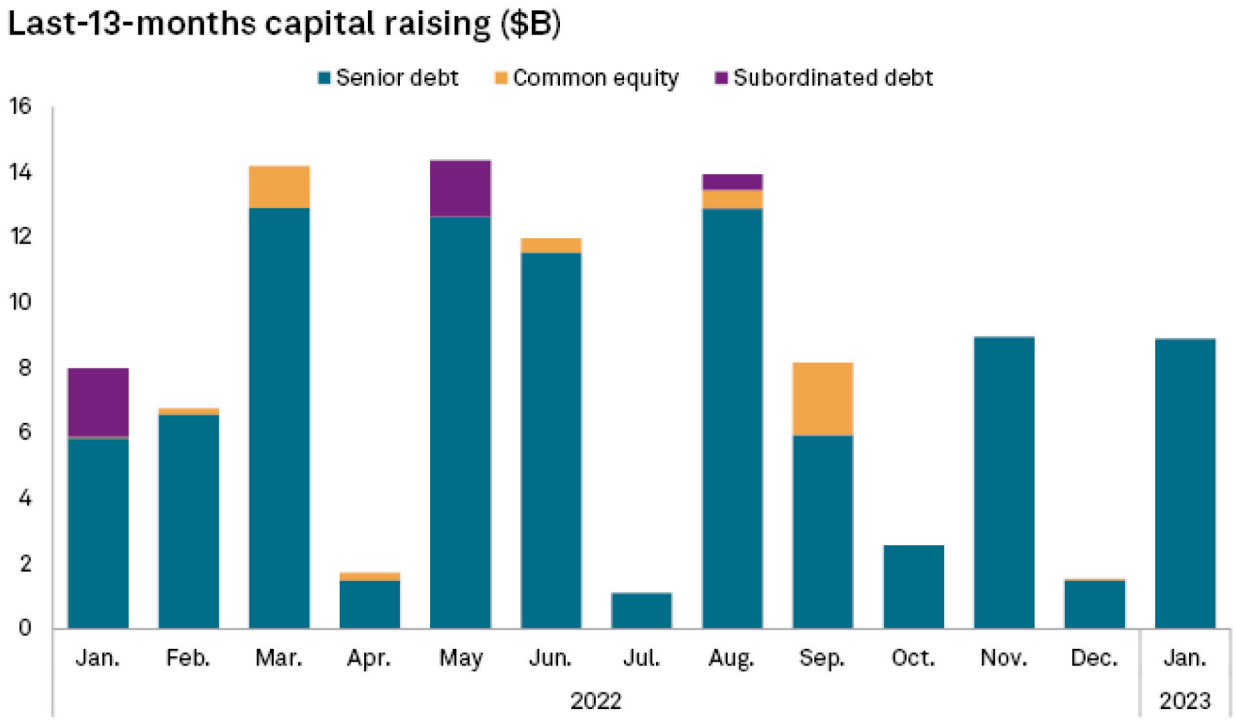
DATA DISPATCH

US, Canadian utilities kick off 2023 with nearly $9B debt issue in January

Friday, February 17, 2023 11:17 AM ET

By Stephen Cedric Jumchai and Susan Dlin
Market Intelligence

U.S. and Canadian electric, gas and water utilities, power producers and energy traders kicked off the 2023 capital offerings market with approximately $8.89 billion capital raises in January, compared to $7.97 billion raised in January 2022, according to data compiled by S&P Global Market Intelligence.

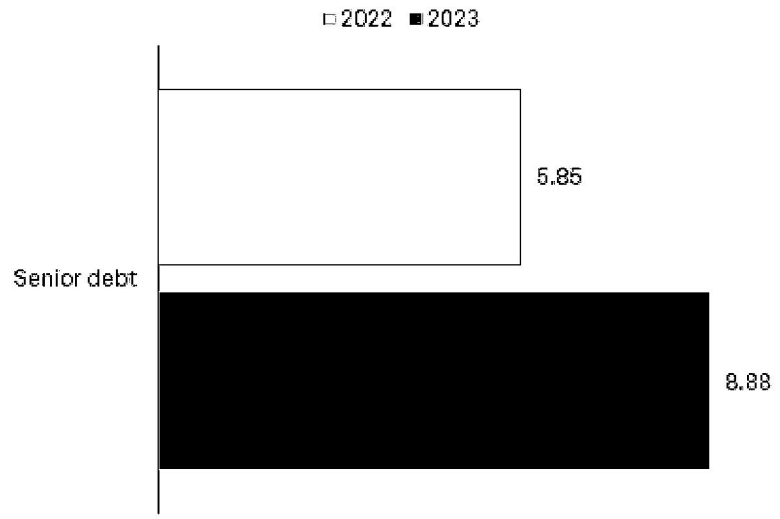


Data compiled Feb. 8, 2023.
Includes capital raises of U.S. and Canadian companies classified by the Global Industry Classification Standard of S&P Global Market Intelligence as electric, gas and multi-utilities, as well as independent power producers and energy traders or renewable electricity.
Amounts displayed reflect gross proceeds raised by the company in instances where offerings had primary and secondary components.
Excludes exchange and shelf offerings.
Debt does not include medium-term notes, branded notes or structured finance issues.
Source: S&P Global Market Intelligence.

January's total includes $8.88 billion in senior debt, compared to the $5.85 billion in senior debt raised in January 2022.

US and Canada power, gas utilities capital raises by security type ($B)

Year-to-date

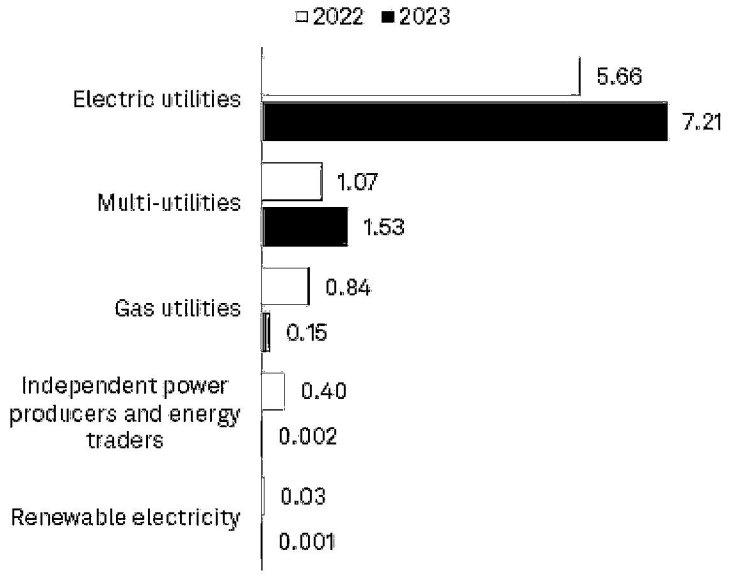


Data compiled Feb. 8, 2023.
Includes capital raises through Jan. 31 of each year of U.S. and Canadian companies classified by the Global Industry Classification Standard of S&P Global Market Intelligence as electric, gas and multi-utilities, independent power producers and energy traders or renewable electricity where capital raised is greater than zero.
Amounts displayed reflect gross proceeds raised by the company in instances where offerings had primary and secondary components.
Excludes exchange and shelf offerings.
Debt does not include medium-term notes, branded notes or structured finance issues.
Source: S&P Global Market Intelligence.

As of Jan. 31, electric utilities raised $7.21 billion, multi-utilities raised $1.53 billion, gas utilities raised $150 million, independent power producers and energy traders raised $2 million, and renewable electricity producers raised $1 million.

US and Canada power, gas utilities capital raises ($B)

Year-to-date



Data compiled Feb. 8, 2023.
Includes capital raises through Jan. 31 of each year of U.S. and Canadian companies classified by the Global Industry Classification Standard of S&P Global Market Intelligence as electric, gas and multi-utilities, independent power producers and energy traders or renewable electricity where capital raised is greater than zero.
Amounts displayed reflect gross proceeds raised by the company in instances where offerings had primary and secondary components.
Excludes exchange and shelf offerings.
Debt does not include medium-term notes, branded notes or structured finance issues.
Source: S&P Global Market Intelligence.

In January, the sector completed 18 senior debt transactions. Duke Energy Carolinas LLC had the largest offering with an issuance of $1.80 billion of first and refunding mortgage bonds, composed of $900 million of 4.95% bonds due 2033 and $900 million of 5.35% bonds due 2053. The Duke Energy Corp. subsidiary plans to use net proceeds to repay at maturity its $500 million of 2.5% bonds and $500 million of 3.05% bonds; pay down part of its outstanding intercompany short-term debt under a money-pool borrowing arrangement with Duke Energy; and for general corporate purposes.

PG&E Corp. utility subsidiary Pacific Gas and Electric Co. issued $1.5 billion of first mortgage bonds consisting of $750 million of 6.150% bonds due 2033 and $750 million of 6.750% bonds due 2053. Proceeds will be used to repay borrowings under its utility revolving credit facility.

WEC Energy Group Inc. issued $1.1 billion of senior debt securities comprising $650 million of 4.75% notes due 2026 and $450 million of 4.75% notes due 2028. Proceeds will be used to repay short-term debt and for general corporate purposes.

Other notable issuers for the month included Hydro One Inc., American Electric Power Co. Inc. unit Public Service Co. of Oklahoma, OGE Energy Corp. subsidiary Oklahoma Gas and Electric Co., CMS Energy Corp. subsidiary Consumers Energy Co. and Entergy Corp. subsidiary Entergy Arkansas LLC.

US and Canada power, gas utilities capital raises in January 2023

Issuer	Completion date	Amount offered including exercised overallotments ($M)
Senior debt		
Hydro One Inc.	01/24/23	336.9
Hydro One Inc.	01/24/23	224.6
Hydro One Inc.	01/24/23	224.6
TriSummit Utilities Inc.	01/11/23	148.9
WEC Energy Group Inc.	01/09/23	650.0
WEC Energy Group Inc.	01/09/23	450.0
Pacific Gas and Electric Co.	01/04/23	750.0
Pacific Gas and Electric Co.	01/04/23	750.0
Public Service Co. of New Hampshire	01/04/23	300.0
Duke Energy Carolinas LLC	01/03/23	900.0
Duke Energy Carolinas LLC	01/03/23	900.0
Commonwealth Edison Co.	01/03/23	575.0
Eversource Energy	01/03/23	500.0
Public Service Co. of Oklahoma	01/03/23	475.0
Oklahoma Gas and Electric Co.	01/03/23	450.0
Consumers Energy Co.	01/03/23	425.0
Entergy Arkansas LLC	01/03/23	425.0
Commonwealth Edison Co.	01/03/23	400.0
Total		**8,884.9**

Data compiled Feb. 8, 2023.
Includes capital raises of U.S. and Canadian companies classified by the Global Industry Classification Standard of S&P Global Market Intelligence as electric, gas and multi-utilities, independent power producers and energy traders or renewable electricity.
Amounts displayed reflect gross proceeds raised by the company in instances where offerings had primary and secondary components.
Excludes exchange and shelf offerings.
Debt does not include medium-term notes, branded notes or structured finance issues.
Source: S&P Global Market Intelligence.

Learn More

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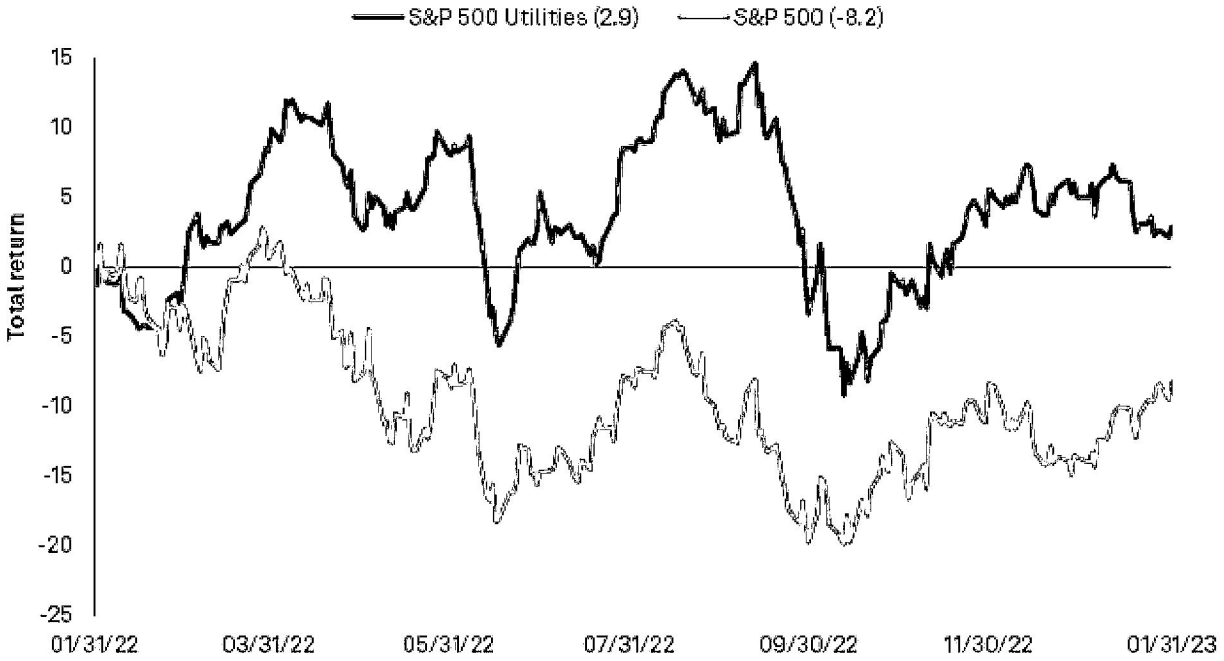
*** Download an excel template on the global energy aggregate debt maturity profile.**
*** Analyze more deals and capital raises with the transactions statistics page.**

Year-to-date through Jan. 31, the S&P 500 Utilities index logged a positive return of 2.9%, compared to the broader S&P 500 index, which was down 8.2%.

S&P 500 Utilities index vs. S&P 500 performance YTD (%)

Total return between Jan. 31, 2022, and Jan. 31, 2023



Data compiled Feb. 8, 2023.
Source: S&P Global Market Intelligence.

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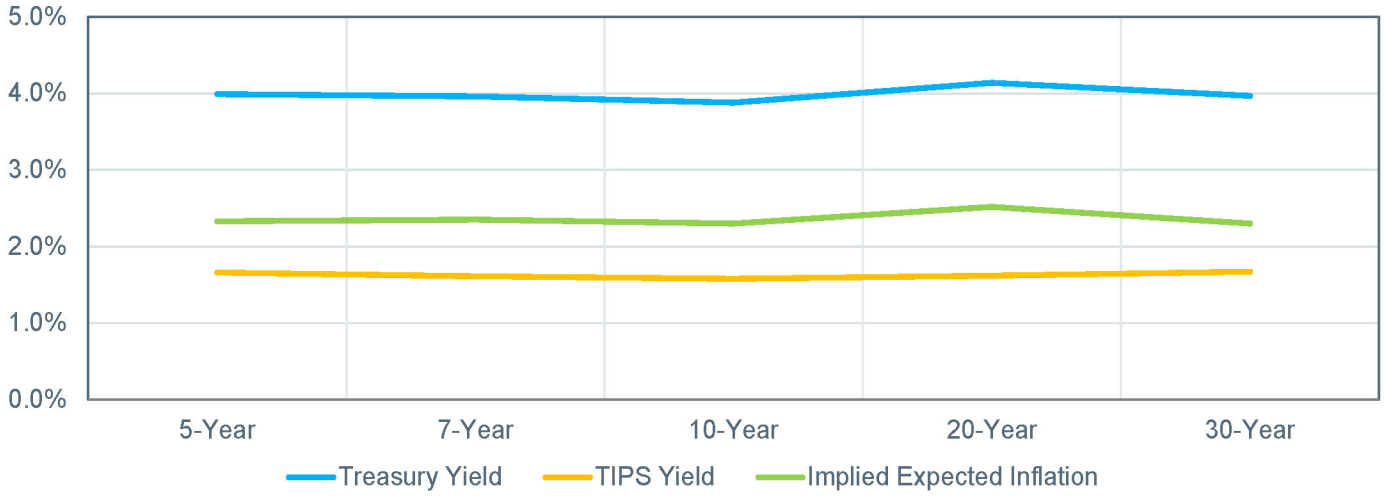
2023 Capital Market Assumptions

Every calendar year RVK produces long-term forward-looking capital market assumptions through a rigorous multi-step process which draws on both quantitative economic and financial inputs as well as qualitative comparisons and analysis. Our return estimates are generally based on return decomposition models, which consider factors such as income, future growth, valuation measures, inflation prospects and economic conditions. The volatility and correlation assumptions are generally driven by an analysis of historical trends, adjusting for changes in volatility regimes, as well as triangulation considerations.

Summary: Our long-term (20 year) return expectations have increased significantly for the vast majority of asset classes reflecting tremendous moves in interest rates — translating to higher yields and incomes — as well as lower starting valuations. Following the tumultuous markets in 2022, there is improvement in the return forecasts for the core 60/40 portfolio after many years of fairly muted long-term forecasts. Fundamentals for many alternative investments have improved as well making them attractive options for portfolio diversification, alpha generation and inflation protection.

Inflation: We maintained our long-term inflation expectation at 2.50%. This reflects short- to medium-term inflationary pressures stemming from ongoing supply chain bottlenecks, declining stimulus driven demand, and continued wage growth pressures; while also accounting for longer-term deflationary factors such as deficits, debt, demographics, automation and globalization. Market expectations for inflation have slightly lowered as compared to expectations at the end of 2021 (as outlined in **Figure 1**).

Figure 1: Market Expectations for Inflation



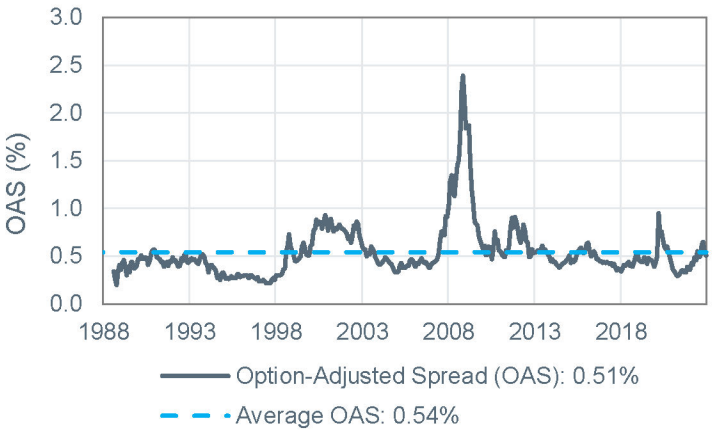
Treasury Yield	3.99%	3.96%	3.88%	4.14%	3.97%
TIPS Yield	1.66%	1.61%	1.58%	1.62%	1.67%
Implied Expected Inflation	2.33%	2.35%	2.30%	2.52%	2.30%

Source: FactSet and US Department of the Treasury. Data as of December 31, 2022.

Fixed Income: We increased our return forecast for most fixed income asset classes based on significantly higher starting yields, spread improvements and an expectation that the year-end yield curve inversion corrects over time (**Figures 2** and **3**). Starting yields have historically been a reasonable starting point when forecasting future bond returns.

Figure 2: Bloomberg US Aggregate Bond Index Yield

Figure 3: Bloomberg US Aggregate Bond Index Option-Adjusted Spread



Equities: Equity return forecasts increased for all equity assumptions relative to 2022. The increase was yield and valuation driven (as shown below in **Figures 4** and **5**), as stocks fell significantly in 2022 due to rising rates and inflation, as well as geopolitical concerns. The year-end valuation for large-cap domestic equities, as represented by the Shiller CAPE, ranked in the 89th percentile of historical values.

Figure 4: S&P 500 CAPE Ratio

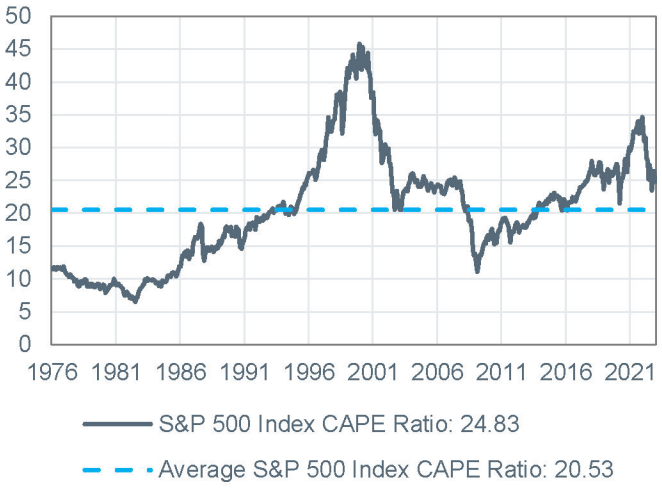
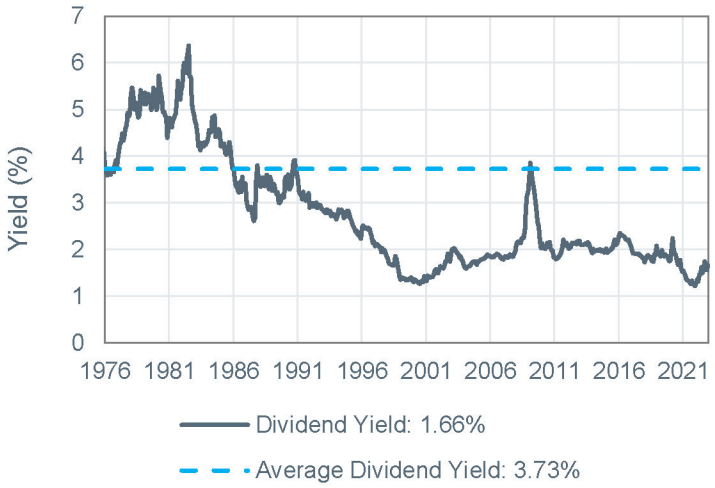


Figure 5: S&P 500 Dividend Index



Source: FactSet . Data as of December 31, 2022.

Real Estate: Our core real estate return expectation decreased by 25 bps given falling net yields (**Figure 6**). On a relative basis – with Treasury rates rebounding off historic lows – income yields for core real estate assets are less attractive than in the recent past.

Hedge Funds: Hedge fund return assumptions improved commensurate with beta returns and collateral yields. And while alpha levels remain fairly robust since inception, post-GFC alpha levels are more muted (**Figure 7**).

Private Equity: The private equity return forecast was positively impacted by the improvement in the underlying public market return forecast. The Large/Mid Cap US Equity assumption was increased by 1.00% due to higher dividend yields and improved valuations. Our spread assumption remained constant at 225 basis points (geometric) above Large/Mid Cap US Equities, similar to the historical spread differential.

Figure 6: Annual Yield: NCREIF ODCE Index

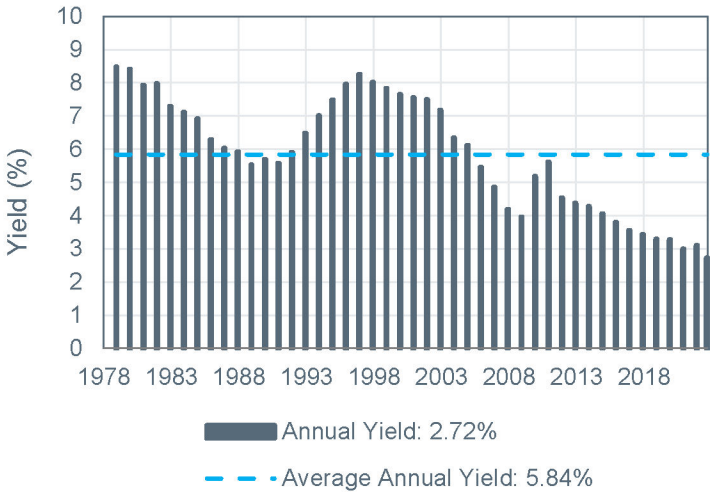
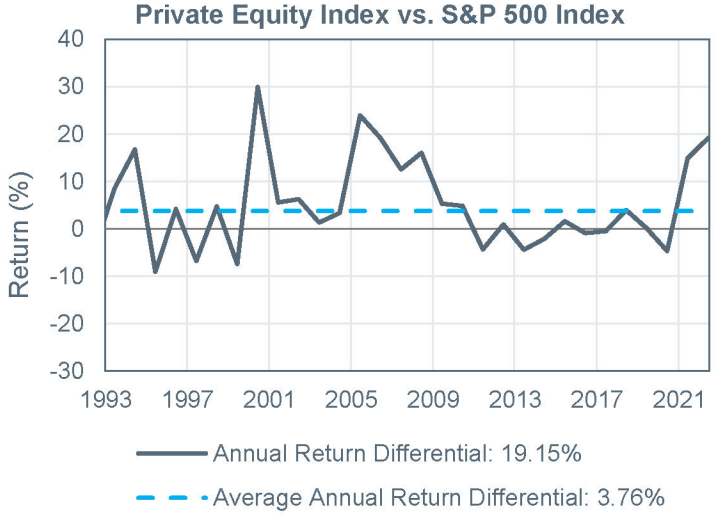


Figure 7: HFRI Multi-Strategy 1-Year Rolling Alpha

Figure 8: Annual Return Differential: Cambridge US Private Equity Index vs. S&P 500 Index

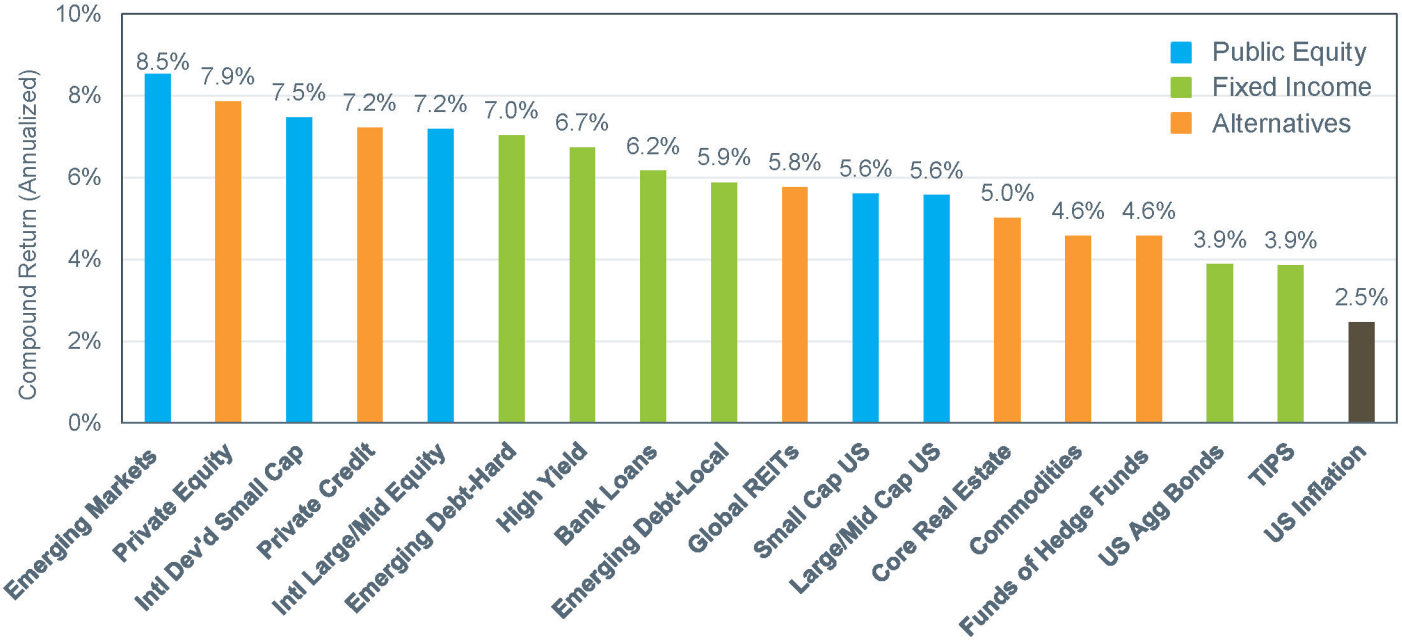


Real estate source: NCREIF. Data as of September 30, 2022. Hedge funds source: FactSet. Data as of December 31, 2022.
Private equity source: Cambridge Associates LLC and FactSet. Data as of June 30, 2022. Cambridge index is pooled horizon internal rates of return net of fees, expenses, and carried interest.

2022 vs. 2023 Capital Market Assumptions

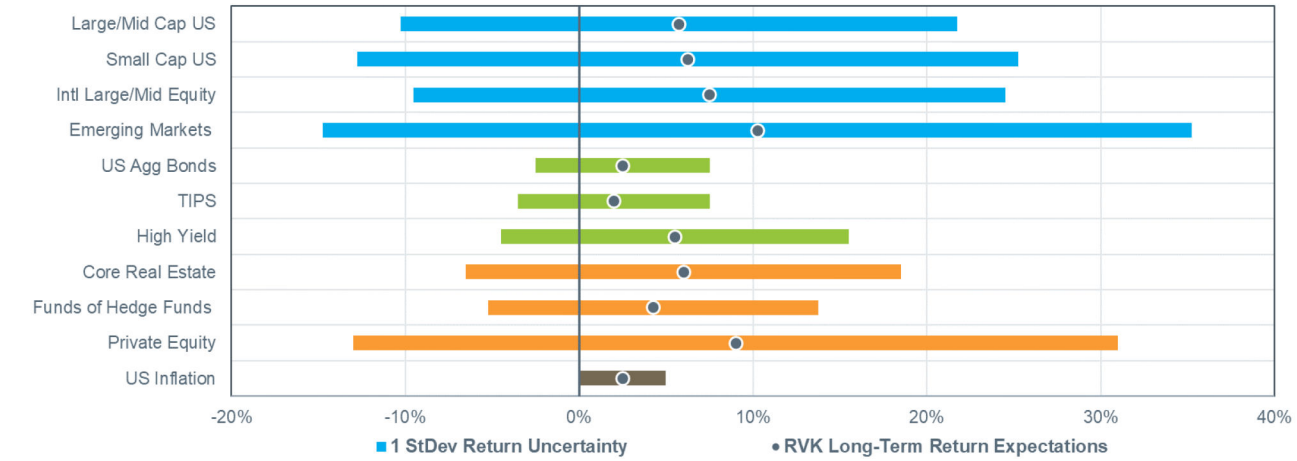
Asset Class	2022 Nominal Return	2022 Risk (St. Dev.)	2023 Nominal Return	2023 Risk (St. Dev.)	Change (2023 - 2022) Nominal Return	Change (2023 - 2022) Risk (St. Dev.)
Large/Mid Cap US	5.75%	16.00%	6.75%	16.00%	1.00%	0.00%
Small Cap US	6.25%	19.00%	7.25%	19.00%	1.00%	0.00%
Intl Large/Mid Equity	7.50%	17.00%	8.50%	17.00%	1.00%	0.00%
Intl Dev'd Small Cap	8.00%	20.00%	9.25%	20.00%	1.25%	0.00%
Emerging Markets	10.25%	25.00%	11.25%	25.00%	1.00%	0.00%
US Agg Bonds	2.50%	5.00%	4.00%	5.00%	1.50%	0.00%
Emerging Debt-Hard	6.00%	10.00%	7.50%	10.00%	1.50%	0.00%
Emerging Debt-Local	5.75%	11.50%	6.50%	11.50%	0.75%	0.00%
TIPS	2.00%	5.50%	4.00%	5.50%	2.00%	0.00%
High Yield	5.50%	10.00%	7.25%	10.50%	1.75%	0.50%
Bank Loans	5.00%	8.00%	6.50%	8.50%	1.50%	0.50%
Core Real Estate	6.00%	12.50%	5.75%	12.50%	-0.25%	0.00%
Global REITs	6.50%	21.00%	7.75%	21.00%	1.25%	0.00%
Funds of Hedge Funds	4.25%	9.50%	5.00%	9.50%	0.75%	0.00%
GTAA	5.00%	9.00%	6.00%	9.00%	1.00%	0.00%
Private Credit	7.25%	13.00%	8.00%	13.00%	0.75%	0.00%
Private Equity	9.00%	22.00%	10.00%	22.00%	1.00%	0.00%
Commodities	5.50%	17.50%	6.00%	17.50%	0.50%	0.00%
US Inflation	2.50%	2.50%	2.50%	2.50%	0.00%	0.00%

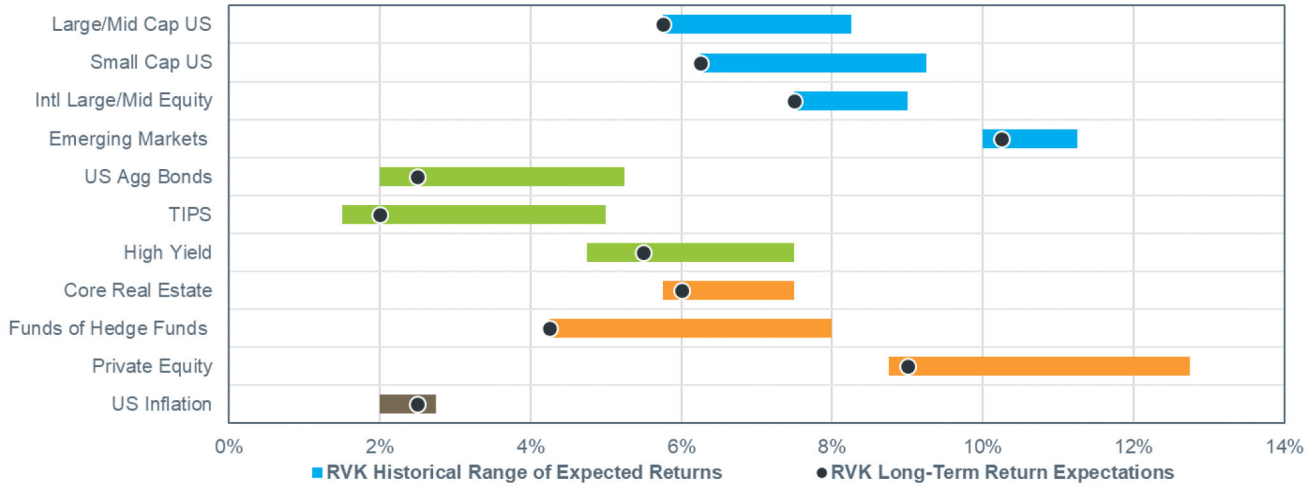
RVK 2023 Compound Return Assumptions



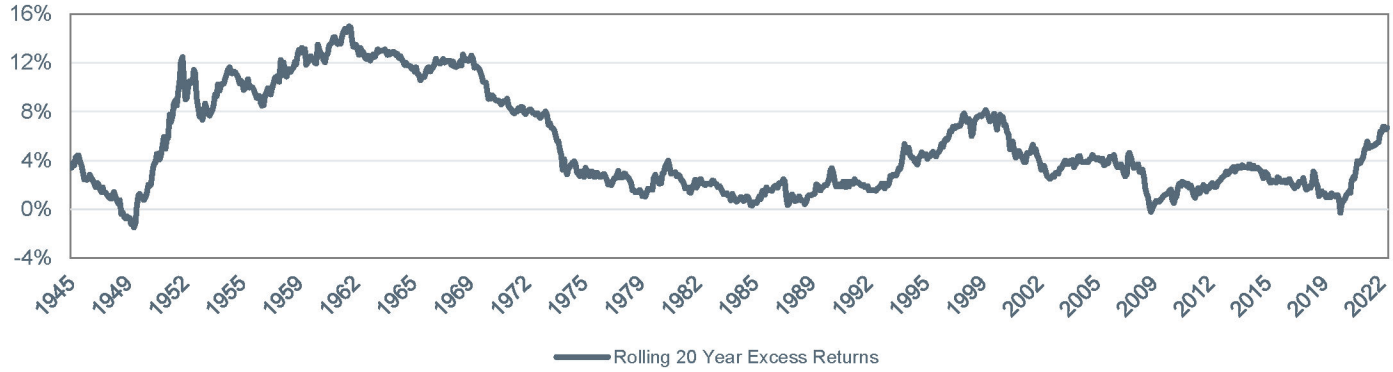
Note: The compound (or geometric) return assumptions account for the dampening effect of volatility on the asset classes' compounding of returns over time, and thus are less than their arithmetic counterparts over time.

2023 Long-Term Return Expectations and Uncertainty of Returns[1]





Historical Return Premium of Stocks vs. Bonds[2]



[1]StDev return uncertainty is based on the RVK 2023 CMA risk assumption for each asset class. Historical range of expected returns include 2006 through 2023 Capital Market Assumptions for selected asset classes.
[2]Stocks are represented by the S&P 500 Index, while fixed income is represented by the Bloomberg US Aggregate Bond Index and US Intermediate bonds prior to 1976.

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RVK was founded in 1985 to focus exclusively on investment consulting and today employs over 100 professionals. The firm is headquartered in Portland, Oregon, with regional offices in Boise, Chicago, and New York City. RVK is one of the five largest consulting firms in the world, as reported by *Pensions & Investments' 2022 Special Report–Consultants*. Additionally, in April 2022, RVK received a notable award as a *Coalition Greenwich Quality Leader* among large US investment consultants, based on Greenwich's 2021 study. Coalition Greenwich is an industry-recognized third-party firm which asks plan sponsors to rank their consultants on a series of key metrics. Notably, RVK is the only firm among large US consultants to receive an award for a fifth consecutive year. Coalition Greenwich issued the award on April 26, 2022 based on their July through October 2021 study. No direct or indirect compensation has been paid by RVK in connection with obtaining or using this award. To read more about the Greenwich award, please refer to the following URL: https://www.rvkinc.com/about/about.php. RVK's diversified client base of nearly 200 clients spans 30 states, and covers endowments, foundations, corporate and public defined benefit and contribution plans, Taft-Hartley plans, and high-net-worth individuals and families. The firm is independent, employee-owned, and derives 100% of its revenue from clients for investment consulting services.

STOCKS, BONDS, BILLS, AND INFLATION® (SBBI®)

2021 SUMMARY EDITION

ROGER G. IBBOTSON
JAMES P. HARRINGTON

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Stocks, Bonds, Bills, and Inflation® (SBBI®)
2021 Summary Edition

Interpretive Analysis and Insights

Through December 31, 2020

MORNINGSTAR®

CFA Institute Research Foundation

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Carla S. Nunes, CFA
Managing Director, D&P/Kroll Valuation Digital Solutions

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Bryan Yelvington
Senior Vice President at Morningstar

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D&P/Kroll, has transitioned its U.S. and international (i) cost of capital data resources and (ii) industry-level statistics data resources to a new online platform, the "Cost of Capital Navigator." The Cost of Capital Navigator is an interactive, web-based platform that guides finance and investment professionals through the process of estimating cost of capital, globally. The Cost of Capital Navigator includes four modules:

▶U.S. Cost of Capital Module

Provides U.S. size premia, equity risk premia, risk-free rates, betas, industry risk premia, and other risk premia that can be used to develop U.S. cost of capital estimates. Studies included: CRSP Deciles Size Study, Risk Premium Report Study.[1] Excel Add-in Included.

▶U.S. Industry Benchmarking Module

Provides industry-level cost of equity, debt, and WACC estimates, performance statistics, valuation multiples, levered and unlevered betas, capital structure, and additional statistics for approximately 170 U.S. industries. Industries are defined by GICS codes.

▶International Cost of Capital Module

Provides measures of relative country risk for over 175 countries from the perspective of investors based in over 50 countries. Other data includes equity risk premia for 16 countries, risk-free rates for developed markets, industry betas for a global index as well as for developed markets, and long-term inflation expectations and corporate income tax rates for over 175 countries. Full country risk premia (CRPs) and relative volatility (RV) factor Tables by country.[2]

▶International Industry Benchmarking Module

Provides industry-level cost of equity, debt, and WACC estimates, performance statistics, valuation multiples, levered and unlevered betas, capital structure, and additional statistics for approximately 90 industries in four global economic areas: (i) the World, (ii) the European Union, (iii) the Eurozone, and (iv) the United Kingdom. Each of the four global economic area's industry analyses are presented in three currencies: (i) the euro (€ or EUR), (ii) the British pound (£ or GBP), and (iii) the U.S. dollar ($ or USD). Industries are defined by GICS codes.

To learn more, visit dpcostofcapital.com.

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Roger G. Ibbotson is Professor in the Practice Emeritus of Finance at Yale School of Management. He is also Chairman of Zebra Capital Management, LLC, a global equity investment and hedge fund manager. He is founder, and former chairman of Ibbotson Associates, now a Morningstar Company. He has written numerous books and articles including *Stocks, Bonds, Bills, and Inflation* with Rex Sinquefield (updated annually) which serves as a standard reference for information and capital market returns.

Professor Ibbotson conducts research on a broad range of financial topics, including popularity, liquidity, investment returns, mutual funds, international markets, portfolio management, and valuation. He has published *The Equity Risk Premium, Lifetime Financial Advice,* and most recently *Popularity: A Bridge between Classical and Behavioral Finance*. He has also co-authored two books with Gary Brinson, *Global Investing* and *Investment Markets*. He is a regular contributor and editorial board member to both trade and academic journals.

Professor Ibbotson serves on numerous boards including Dimensional Fund Advisors' funds. He frequently speaks at universities, conferences, and other forums. He received his bachelor's degree in mathematics from Purdue University, his MBA from Indiana University, and his PhD from the University of Chicago where he taught for more than ten years and served as Executive Director of the Center for Research in Security Prices (CRSP).

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Previously, James was director of valuation research in Morningstar's Financial Communications Business where he led the group that produced the *Stocks, Bonds, Bills, and Inflation® (SBBI®) Valuation Yearbook*, *Stocks, Bonds, Bills, and Inflation® (SBBI®) Classic Yearbook*, *Cost of Capital Yearbook*, various international cost of capital reports, and also created a website dedicated to cost of capital issues.

James is co-author of the D&P/Kroll "Valuation Handbook" series with colleagues Carla Nunes and Roger Grabowski. The Valuation Handbooks were published as physical books starting in 2014; as of 2020 the information and data previously published in the Valuation Handbooks has been transitioned over to the D&P/Kroll Cost of Capital Navigator. The D&P/Kroll Cost of Capital Navigator (dpcostofcapital.com) is an interactive, web-based platform that guides analysts through the process of estimating cost of capital, globally.

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Foreword

Welcome to the *Stocks, Bonds, Bills and Inflation® (SBBI®) 2021 Summary Edition ("SBBI® 2021 Summary Edition")*. CFA Institute Research Foundation is delighted to offer this content free to everyone in the global investment community.

Although the Research Foundation is offering this publication free to all, it is the wonderful folks at D&P/Kroll and co-authors Roger Ibbotson and Jim Harrington, through a licensing agreement with Morningstar, who deserve the credit for developing the content for the *SBBI® 2021 Summary Edition.*[3] The Research Foundation is delighted to be entering a long-term partnership with D&P/Kroll for the annual publication of this content, and we hope that year after year, it becomes a valuable addition to your portfolio of investment knowledge.

Why SBBI?

As a young finance student in the 1970's I recall my professor showing me *Stocks, Bonds, Bills, and Inflation: The Past (1926-1976) and the Future (1977-2000),* originally published by the Research Foundation in 1977[4], and being fascinated by all of the useful information it contained. Now, over four decades later, the "SBBI" is returning home to the RF with the publication of the *SBBI® 2021 Summary Edition.*

Purpose of the SBBI Summary Edition

The primary purpose of the *SBBI® 2021 Summary Edition* is to accompany the raw U.S. historical SBBI® stock and bond data files that are available to all CFA Institute members[5] on the CFA Institute Research Foundation website:
https://www.cfainstitute.org/en/research/foundation/sbbi.

The online raw SBBI® dataset files include capital appreciation, income, and total returns of the major asset classes of the U.S. economy: large-cap stocks, small-cap stocks, corporate bonds, government bonds of various maturities, and inflation (January 1926 to present, monthly).

The *SBBI® 2021 Summary Edition* includes interpretive analysis and insights through December 31, 2020, and is meant to enable investors to understand how to calculate, interpret, and use the U.S. historical SBBI® stock and bond data that we have made available to our members. The *SBBI® 2021 Summary Edition* includes formulae and methodology for using the raw SBBI® dataset to properly calculate summary performance statistics, index values, and optimization inputs.

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3 The *SBBI® 2021 Summary Edition* is an abridged version of the full-version *2021 SBBI® Yearbook*, available from D&P/Kroll here: dpcostofcapital.com/stocks-bonds-bills-inflation-sbbi-yearbook. The full-version *2021 Stocks, Bonds, Bills, and Inflation® (SBBI®) Yearbook* includes all the raw data in printed form with a complete set of graphs and additional interpretive analysis, plus precalculated tables of summary performance statistics, index values, inflation-adjusted returns, various "building block" premia (e.g., bond default premium, bond horizon premium, small stock premium, etc.), and optimization inputs.

4 A free download of *Stocks, Bonds, Bills, and Inflation: The Past (1926–1976) and the Future (1977–2000)* in PDF format is available at https://www.cfainstitute.org/en/research/foundation/1977/rf-v1977-sbbi-past-and-future.

5 In the mainland of China, CFA Institute accepts CFA charterholders only.

A secondary purpose of the *SBBI® 2021 Summary Edition* is to provide those individuals just starting out in the investment industry (but who are not yet CFA Institute members) an excellent way to gain a quick understanding of the major asset classes, to see how returns are calculated, and to get a sense of the long run perspective. Additionally, those investment professionals who are more established in their careers will likely be aware of the SBBI® data but still may not have direct access to the raw SBBI® data. This summary edition will help them to understand the data and its many uses, including the impact of size, value/growth, and liquidity on returns. For this reason, CFA Institute Research Foundation has made the *SBBI® 2021 Summary Edition* available to all investment professionals free of charge.[6,7]

Special Thanks

As with any project such as this, there are many people responsible for its success. Thanks go out to Roger Ibbotson, for getting the ball rolling, and for Roger and Rex Sinquefield for creating the original SBBI® way back in the 1970s. Many thanks to Bryan Yelvington and Daniel Ortiz at Morningstar who were instrumental with getting the SBBI® dataset up and running on our website and approving of the publication for the *SBBI® 2021 Summary Edition*. In addition, Morningstar's Benjamin Cheaney, Joscelyn MacKay, and Stephen Schmitt provided valuable contributions.

Carla Nunes, CFA, and Jim Harrington from D&P/Kroll were both crucial to this publication, and it would not have been published without the efforts of these two. Kevin Madden, Anas Aboulamer, Zach Rodheim, Kevin Latz, and Aaron Russo (all of D&P/Kroll) were also instrumental in its publication.

At CFA Institute Research Foundation, many thanks to our Vice-Chair Ted Aronson, CFA, for his tireless work on behalf of CFA Institute and the Research Foundation and his generous, multi-year donation that helped fund this project. Thanks too to Chair Joanne Hill, and incoming Research Committee Chair Bill Fung and all-of-the Research Foundation board members for their comments and suggestions along the way. And a special thanks to Research Foundation Research Director Larry Siegel who contributed to the original SBBI in the 1970s and is a vital part of today's Research Foundation.

CFA Institute is absolutely critical to the operation of the Research Foundation and provides much of our funding and staffing needs. We thank Marg Franklin, CFA, Paul Andrews and Rhodri Preece, CFA for their continued support of the project, and Jessica Lawson for her work as Research Foundation Project Manager.

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6 The *SBBI® 2021 Summary Edition* is available to all investment professionals free of charge; access to the raw monthly U.S. historical SBBI® stock and bond data on the CFA Institute Research Foundation's website is available to CFA Institute members only.

7 Some investment professionals may prefer to purchase the full-version *2021 SBBI Yearbook*, which includes *precalculated* statistics. The full-version *2021 SBBI Yearbook* (dpcostofcapital.com/stocks-bonds-bills-inflation-sbbi-yearbook) provides an excellent way for an analyst to *cross-check* their own calculations while learning how to properly use and analyze the raw monthly SBBI® data.

Finally, we would like to thank the thousands of donors whose contributions, from $10 to over $1 million (an especially generous donation from Gary Brinson, CFA), have gone directly to support this project and the publication of our content. We couldn't do it without their help.

Our goal for this project is to increase the global investment community's knowledge of quantitative investment strategies by providing the data, and tools to analyze the data, to CFA Institute members and others in the global investment community. An aspirational goal is to provide free/low-cost tools so that the next legendary investment mind, such as Benjamin Graham, William Sharpe, Peter Bernstein, Fischer Black, Martin Leibowitz and the others, can emerge and lead the investment field for the coming decades. By providing a forum for sharing this information, we hope to provide a platform that unlocks the potential of that next great investment mind or minds. We hope this is a good start in that direction.

Bud Haslett, CFA
Executive Director, CFA Institute Research Foundation

Preface by Roger G. Ibbotson

This *Stocks, Bonds, Bills and Inflation® (SBBI®) 2021 Summary Edition* is meant to enable investors to understand how to calculate, interpret, and use the U.S. historical stock and bond data that the CFA Institute Research Foundation has made available to members.

The data includes the capital appreciation, income, and total returns of the major asset classes of the U.S. economy: large-cap stocks, small-cap stocks, corporate bonds, government bonds of various maturities, and inflation. Most of the data starts in 1926, and is presented in monthly, annual, decade, or longer period form. The raw data itself is mostly monthly but is not included in this summary volume. Rather, this summary volume includes illustrative data, methodology, formulae, and analysis that will help investors and analysts learn how to use market time series raw data, which is separately available.

The SBBI® dataset was originally created by Rex A. Sinquefield and myself back in 1976, and initially published in two academic journal issues before being updated in CFA Institute Research Foundation monographs in 1977, 1979, and 1982. Starting in 1983, Ibbotson Associates Inc. published the *Stocks, Bonds, Bills, and Inflation® (SBBI®) Yearbook* every year until 2006, when after acquiring Ibbotson Associates, Morningstar, Inc. continued the annual publication. Starting in 2016, D&P/Kroll (duffandphelps.com) has published the full-version *SBBI® Yearbook* under license agreement from Morningstar Inc. Now through an agreement that the CFA Institute Research Foundation made with Morningstar, Inc., CFA Institute members can access the raw SBBI® directly through the Research Foundation site.

This *SBBI® 2021 Summary Edition* is meant to accompany the raw data files. All the calculation formulae are incorporated herein, along with illustrative examples. Analysts and investors are shown how to link returns together to create asset class indices and returns of any frequency, e.g. monthly, quarterly, or annualized. Users are also shown how to create real (i.e., inflation adjusted) series, as well as derived series measuring various risk premiums (e.g., the equity risk premium, the small-cap premium, the bond horizon or interest rate premium, the bond default premium, or the real interest rate). Investors who just want to examine the results without actually accessing the electronic *SBBI®* raw data are encouraged to purchase the full-version *2021 Stocks, Bonds, Bills, and Inflation® (SBBI®) Yearbook* published each year by D&P/Kroll. The full-version *2021 SBBI® Yearbook* includes all the raw data in printed form with a complete set of graphs and additional interpretive analysis, plus *precalculated* tables of summary performance statistics, index values, and optimization inputs. The full-version *SBBI® Yearbook* is available at: dpcostofcapital.com/stocks-bonds-bills-inflation-sbbi-yearbook.

Even though many readers of the *SBBI® 2021 Summary Edition* will not have direct access to the raw SBBI® dataset, the summary edition is still likely to be of broad interest. CFA Institute is making this edition available for free, and it is an excellent way for those starting out in the investment industry to gain a quick understanding of the major asset classes, how returns are calculated, and to get a sense of the long run perspective. Many of those investment professionals

who are more established in their careers will be aware of the SBBI® data, but still may not have direct access to the raw SBBI® data. This summary edition will help them to understand the data and its many uses, including the impact of size, value/growth, and liquidity on returns. Of course, CFA Institute members will also have free access to the raw SBBI® data itself, and they will be able to develop their own optimization and forecasting techniques, as well as be able to do all sorts of analysis with the SBBI® data by itself, or combined with other time series data from other external sources. It is my hope that this free *SBBI® 2021 Summary Edition* will be of use to investment professionals at all levels of their career, whether or not they have access to the raw SBBI® data, and whether or not they step up to acquire the full-version *2021 Stocks, Bonds, Bills, and Inflation® (SBBI®) Yearbook.*

Today we have such immediate access to stock and bond markets data, that we often take it for granted. We can access real time data as it happens at the individual security level and for a multitude of indices, both for U.S. data and international markets. We often let the multitude of data obscure the big picture. It is the long-term data that can best inform us on how to create vast wealth. Perhaps the strongest consistent relationship over time is that stocks outperform bonds. While not true every year, large-cap stocks have out- performed U.S. Treasury bills in 64 out of the last 95 calendar years. During the period 1926–2020, large cap stocks had a total return of over 10% compared to the U.S. Treasury bill return of just over 3%. This difference is a measure of the equity risk premium.

One might wonder why we created the SBBI® data and the subsequent *SBBI® Yearbooks*. To get a perspective on this we have to go back in time. During the 1950s, Harry Markowitz had developed the mathematics of risk and diversification. By the late 1950s and early 1960s, academics had discovered that stock returns behaved nearly as Random Walks. By the mid-1960s, William Sharpe, John Lintner and others had developed the Capital Asset Pricing Model (CAPM), formalizing a risk return relationship. Soon afterward, Eugene Fama had posited the Efficient Market Hypothesis. And especially important to empiricists, James Lorie and Lawrence Fisher had created the Center for Research in Security Prices (CRSP) data set at the University of Chicago, measuring the monthly returns of NYSE stocks starting in 1926.

By the 1970s when Rex and I entered the scene, risk and return were part of a continuing discussion. Index funds were starting to be developed, because investors were beginning to get interested in investing in the market portfolio. Holding the market portfolio was actually an outcome of the CAPM, and investing in a market index was consistent with random walks and efficient markets. Studies from Fisher and Lorie had demonstrated that stocks had high historical returns, but at the time of our studies the Fisher and Lorie data only went through 1968. Investors were hungry for updates.

In 1976, Rex and I published our original historical SBBI® results in the University of Chicago's now defunct *Journal of Business*.[8] We included a large-cap total return series based upon the Standard & Poor's 500 Index (S&P did not have a total return series until many years later). We also included corporate bonds, long-term U.S. Treasury Bonds and Bills, and the CPI inflation

[8] "Stocks, Bonds, Bills, and Inflation: Year-by-Year Historical Returns (1926-1974)", Roger G. Ibbotson and Rex A. Sinquefield, *The Journal of Business*, Vol. 49, No. 1, January 1976.

index. This enabled us to measure all sorts of risk premiums. The most important was the Equity Risk Premium, both relative to long and short horizon bonds.[9] But other risk premiums were important too. We measured a default premium, a horizon or interest rate premium, and a real (inflation-adjusted) interest rate. We were able to measure all of the series in both real and nominal terms.

Once we recognized that we had many risk premiums across multiple asset classes, we also recognized that it would be the risk premiums that follow the random walks, rather than the nominal series themselves. This is because inflation is itself predictable from current bond yields. The Treasury yield curve provides a year-by-year term structure of forward interest rates, with each forward rate containing three components: the expected inflation rate, a horizon premium, and an expected one-year real interest rate. Since the yield curve is directly observable, it is only necessary to estimate the three component parts, and then add the historical risk premium distributions to create forecasts of all the asset classes.

The second SBBI® paper that Rex and I published in 1976 provided a year-by-year forecast of stocks, bonds, bills, and inflation from 1976 to 2000.[10] This forecast was not similar to conventional forecasts in several ways. First, it was based upon the idea that the bond market was efficient. Thus, the forward rates from the yield curve represented investors' unbiased predictions, after adjusting for the term structure of expected horizon premiums. It was also based upon the idea that in an efficient market, the various risk premiums would follow a random walk. Thus, the historical payoffs were extrapolated and predicted to continue. But most important, all premiums were drawn from historical distributions, so not only the expected returns were forecast, but also risk as well as the entire distribution of returns!

We were using 50 years of data to forecast the next 25 years. As it turned out, we were very accurate on the nominal stock market returns, although we under-forecast the bond returns, given the double-digit bond yields in the early 1980s. Nevertheless, the overall forecasts were reasonably within our probability distributions. I had separately forecast the Dow in 1974 (when it was about 800) to reach 10,000 by the year 2000, and when it did in 1999, I went on a television tour. Of course, the 10,000 in 2000 was not an exact forecast, but just near the center of the probability distribution.

Perhaps the most astonishing thing about analyzing long term data is the vast wealth that can be created by exponential growth. Investing in the SBBI® large cap index at the beginning of 1926 and reinvesting all the dividends until the end of 2020 provided a total return of over 10% per year. A single dollar invested over this 95-year period at this annualized rate (geometric mean) would have grown to nearly $11,000! Of course, this is a gross return. An actual investor would have had to pay transactions costs, fees, and taxes. But if these costs could be kept under control, the index investors would have still dramatically increased their wealth, even without any expertise in stock selection.

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[9] U.S. "historical" and "supply side" 1926–present equity risk premia, (as well as U.S. size premia) are available in the D&P/Kroll Cost of Capital Navigator's U.S. Cost of Capital Module at dpcostofcapital.com.

[10] "Stocks, Bonds, Bills, and Inflation: Simulations of the Future (1976-2000)", Roger G. Ibbotson and Rex A. Sinquefield, *The Journal of Business*, Vol. 49, No.3, July 2016.

I hope you will find this *SBBI® 2021 Summary Edition* helpful. I also hope that many of you can experiment with the raw data from the CFA Institute Research Foundation website. And I remind you, that this summary version does not contain all the data, tables, graphs, and analysis that are available in the full-version *2021 Stocks, Bonds, Bills, and Inflation® (SBBI®) Yearbook* from D&P/Kroll, available at dpcostofcapital.com/stocks-bonds-bills-inflation-sbbi-yearbook.

Roger G. Ibbotson
Professor Emeritus of Finance at the Yale School of Management, Chairman of Zebra Capital LLC, and former Chairman and founder of Ibbotson Associates, now part of Morningstar, Inc.

Chapter 1
Results of U.S. Capital Markets in 2020 and in the Past Decade

This chapter presents newsworthy events in the market from 2020, as well as the returns for the seven basic SBBI® asset classes and describes the construction of these returns. More detail on the construction of some series can be found in the January 1976 *Journal of Business* article, referenced in the Introduction. Annual total returns and capital appreciation returns for each asset class are formed by compounding the monthly returns the CFA Institute Research Foundation has made available to members. Annual income returns are formed by summing the monthly income payments and dividing this sum by the beginning-of-year price. Returns are formed assuming no taxes or transaction costs, except for returns on small capitalization stocks that show the performance of an actual, tax-exempt investment fund including transaction and management costs, starting in 1982.

An Extraordinary Year

The year 2020 was an extraordinary year in many respects. A once in a century pandemic (i.e., COVID-19) uprooted the global economy, created chaos all around the world, and precipitated a global economic slowdown.[11] The world economy shrunk by the most on record, and the U.S. economy's GDP had the worst performance since World War II.[12,13] In an attempt to slow the spread of the virus, the U.S. and other countries adopted unprecedented stay-at-home policies leading to a quasi-halt of economic activities in most countries in the world. This created a tremendous burden on businesses and populations throughout the world.

Given the uncertainty around the impact of the pandemic, financial markets experienced a high level of volatility. Policymakers sought to provide help to the U.S. economy through monetary and fiscal policy. The major themes that dominated U.S. financial markets during 2020 include the following: the COVID-19 pandemic and how to fight it, equity markets' volatility and Economic recovery, monetary policy and fiscal policy, and the political uncertainty and social unrest engendered by the pandemic.

[11] The World Health Organization declared COVID-19 a pandemic on March 11, 2020.

[12] According to the latest update form the International Monetary Fund, the world economy is expected to shrink by 3.5%, the worst performance on record.

[13] According to data from the U.S. Bureau of Economic Analysis (BEA), the U.S. GDP decreased by 9.03% from a year earlier in the second quarter of 2020 and 8.98% from the previous quarter. For more details, visit: www.bea.org.

The COVID-19 Pandemic

On December 31, 2019, the World Health Organization (WHO) was informed of an outbreak of "pneumonia of unknown cause" detected in Wuhan, a large city in the Hubei Province, China.[14]

According to Johns Hopkins University, the virus was determined to be a novel type of coronavirus.[15] On January 10, 2020, gene sequencing further determined that the Wuhan coronavirus was related to the Severe Acute Respiratory Syndrome virus (SARS-CoV) which impacted primarily mainland China and Hong Kong, a special administrative region of China, during 2002 and 2003 and the Middle Eastern Respiratory Syndrome virus (MERS-CoV)that began in Saudi Arabia in 2012.[16] However, the rate of infection of COVID-19 appeared to be higher than that of SARS-CoV and MERS-CoV.[17]

On March 11, 2020, the WHO announced that it was changing its classification of COVID-19 to a "pandemic," which meant the disease was spreading rapidly to different parts of the world.[18] By March 13, 2020, Europe became the epicenter of the pandemic with more reported cases and deaths than in any other part of the world.[19] By April 11, 2020, the U.S. recorded the highest number of COVID-19 deaths in the world, surpassing Italy and other European countries according to John Hopkins University.[20] According to the same source, December was the deadliest month in 2020 for the U.S., with more than 77,500 of the country's 346,000 COVID-19 deaths (as of that time) occurring in that month.[21]

A public-private partnership led to the development of vaccines in record time. On May 15, 2020, the White House announced the launch of "Operation Warp Speed" (OWS) with the objective to fund the development, manufacture, and distribution of COVID-19 vaccines, therapeutics, and diagnostics.[22] One of the major objectives of OWS was to provide substantial quantities of vaccines to Americans by January 2021. The objective was achieved with two vaccines approved for emergency use: Pfizer-BioNTech vaccine on December 11, 2020 and Moderna COVID-19

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14 World Health Organization, "Pneumonia of unknown cause – China", January 5, 2020, accessible here: https://www.who.int/csr/don/05-january-2020-pneumonia-of-unkown-cause-china/en/.

15 Gardner, Lauren, "Mapping 2019-nCoV", Center for Systems Science and Engineering, Johns Hopkins University, January 23, 2020, accessible here: https://systems.jhu.edu/research/public-health/ncov/.

16 Ibid.

17 Cohut, Maria, "Novel coronavirus: Your questions, answered", MedicalNewsToday, March 19, 2020, https://www.medicalnewstoday.com/articles/novel-coronavirus-your-questions-answered.

18 World Health Organization, "WHO Director-General's opening remarks at the media briefing on COVID-19", March 11, 2020, available here: https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19-- 11- march-2020.

19 World Health Organization, "WHO Director-General's opening remarks at the media briefing on COVID-19", March 13, 2020, available here: https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-mission briefing-oncovid- 19---13-march-2020.

20 "U.S. COVID-19 deaths reach 20,200, surpassing Italy as highest in the world." April 11, 2020, https://www.cbc.ca/news/world/u-s-covid-19-deaths-highest-in-world-1.5529861.

21 Maxouris, Christina and Jason Hanna "US surpasses 20 million Covid-19 cases while experts foresee tough times in January." January 1, 2021, https://www.cnn.com/2021/01/01/health/us-coronavirus-friday/index.html.

22 For more details, please see press release here: https://www.hhs.gov/about/news/2020/05/15/trump-administration announcesframework- and-leadership-for-operation-warp-speed.html.

vaccine December 18, 2020.[23,24] As of December 30, 2021, 2.8 million Americans had received a vaccine.[25,26]

The U.S. Equity Market

The U.S. equity markets were volatile in 2020, moving with news of the virus, potential therapeutics and vaccines, monetary and fiscal policy interventions, and the political uncertainty surrounding the 2020 presidential election. Despite these events, the U.S. equity markets ended the year at new record highs.

In the first weeks of 2020 U.S. equity markets rose, and by mid-February all three major U.S. indices had achieved new all-time highs (on February 12, 2020 the Dow Jones Industrial Average (DJIA) reached 29,551.42, and on February 19, 2020 the S&P 500 and NASDAQ Composite Index reached 3,386.15 and 9,817.18, respectively).

As COVID-19 spread and Europe became the new epicenter of infection, fears arose that the virus might have a much bigger impact on the economy than anticipated, especially after various governments decided to close their borders and enact stay-at-home policies.[27] In response, the U.S. Federal Reserve (Fed) (i) lowered the Fed funds target rate by 50 basis points (b.p.) on March 3, 2020 to a range of 1.00%–1.25% and then lowered by an additional 100 b.p. on March 16, bringing the target range to 0% 0.25%, and (ii) provided liquidity to financial institutions and in some cases to non-financial institutions to help them navigate this crisis.[28] Subsequently, Congress issued a series of aid packages to help individuals and businesses.[29]

By March 23, 2020, the DJIA, the S&P 500, and the NASDAQ had fallen by 37.1%, 33.9%, and 30.1%, respectively. Movements in equity markets were so sudden that "circuit breakers" were activated four times in March 2020.[30] Circuit breakers are designed to prevent market crashes and help markets digest information before continuing to trade.[31] Trading was halted for 15

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23 For more details, please see press release here: https://www.fda.gov/news-events/press-announcements/fda-takes-key actionfight- against-covid-19-issuing-emergency-use-authorization-first-covid-19.

24 For more details, please see press release here: https://www.fda.gov/news-events/press-announcements/fda-takes additionalaction- fight-against-covid-19-issuing-emergency-use-authorization-second-covid.

25 Spalding, Rebecca and Carl O'Donnell, "U.S. vaccinations in 2020 fall far short of target of 20 million people." Reuters, December 31, 2020, https://www.reuters.com/article/us-health-coronavirus-usa-vaccinations-idUSKBN29512W.

26 By mid-March 2021, over 120 million vaccine doses had been administered in the U.S. See: https://covid.cdc.gov/covid-data-tracker/#vaccinations.

27 According to the Center for Disease Control and Prevention (CDC), between the period March 1, 2020 and May 31, 2020, 73% of the 3,233 U.S. counties issued mandatory stay-at-home policies. See: Moreland, Amanda, Christine Herlihy, Michael A. Tynan, et al. "Timing of State and Territorial COVID-19 Stay-at-Home Orders and Changes in Population Movement – United States, March 1–May 31, 2020." Morbidity Mortality Weekly Report 2020; 69(35):1198–1203 at: https://www.cdc.gov/mmwr/volumes/69/wr/ mm6935a2.htm. For more details on the stay-at-home orders in the U.S. please visit: https://www.finra.org/rules-guidance/key-topics/covid-19/shelter-in-place.

28 For more details about the actions of the Fed, see: Chenh, Jeffery, Tyler Powell, Fae Skidmore and David Wessel, "What's the Fed doing in response to the COVID-19 crisis? What more could it do?" Brookings-The Hutchins Center Explains Series, January 25, 2021 https://www.brookings.edu/research/fed-response-to-covid19/.

29 For more details on the actions of Congress, see: https://pingree.house.gov/coronavirus/congress-response-on-coronavirus.htm.

30 Circuit-breaker points represent the thresholds at which trading is halted market-wide for single-day declines in the S&P 500 Index. Circuit breakers halt trading on the nation's stock markets during dramatic drops and are set at 7%, 13%, and 20% of the closing price for the previous day. The circuit breakers are calculated daily. Source: https://www.nyse.com/markets/nyse/trading-info.

31 These circuit breakers were created after the October 19, 1987 crash. To learn more, see: Funakosi, Minami and Trabis Hartman "March madness", Reuters, March 18, 2020, https://graphics.reuters.com/USA-MARKETS/0100B5L144C/index.html.

minutes on March 9, 2020 after the index slid 7% in the first three minutes after the opening bell; this was the first time in 20 years that market wide circuit breaker kicked in.[32] The second trading halt was on March 12, 2020, just six minutes after the start of the session. The third was on March 16, 2020 immediately after the session open, and the last time occurred on March 18, 2020 at 12:57 PM EST. All these halts were Level 1, meaning they lasted only 15 minutes.

The circuit breakers did not prevent equities from recording some of the worst daily performances in decades. In March 2020, S&P 500 recoded the third and the sixth worst performance in its history.[33] The S&P 500 dropped 260.74 points (-9.51%) and 324.89 points (-11.98%) on March 12 and March 16, respectively. These negative milestones were only beaten by the 1987 and 1929 market crashes performances. Remarkably, March 2020 also saw S&P record some of its best daily performances. The S&P 500 recorded two of the top ten daily performances in history by gaining 230.38 points (9.29%) and 209.93 points (9.38%) on March 13 and March 24, respectively.

These movements in U.S. equity markets pushed volatility to new highs. The VIX index, dubbed "the fear index," which measures volatility in equity markets, reached a new high of 82.69 on March 16, 2020. This new record surpassed the previous high of 80.86 recorded on November 11, 2008 at the height of the Global Financial Crisis (GFC). Unlike when the VIX shattered its records multiple times during the GFC, during the pandemic the Fed intervention helped soothe markets, and VIX retraced by more than 50% less than a month after it reached its peak.[34] The VIX spiked moderately in the summer and just before the 2020 presidential election on November 3, but it stayed range bound and finished the year at 22.75.[35]

U.S. equity indices ultimately recovered and reached new highs in 2020. The NASDAQ was the first major U.S. equity index to recover and register a new high. Propelled by gains in technology stocks, the NASDAQ closed at 9,924.75 on June 8, 2020, surpassing the previous all-time high set on February 19, 2020 (9,817.18). By the end of the year, the NASDAQ had increased to 12,888.28, representing a 43.64% increase for the year and a 87.9% increase from the 2020 low set on March 23, 2020.

The S&P 500 was the second major U.S. equity index to recover and register a new high. The S&P 500 (price index) closed at 3,389.78 on August 18, 2020, surpassing the previous all-time high set on February 19 (3,386.15). By the end of the year, the S&P 500 had increased to 3,756.07, which represented a 16.3% increase for the year, and a 67.9% increase from the 2020 low set on March 23, 2020.

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32 Pisani, Bob, "Circuit breakers, triggered for the first time in 20 years, pass a crucial test." CNBC.com, March 9, 2020, https://www.cnbc.com/2020/03/09/circuit-breakers-triggered-for-the-first-time-in-20-years-pass-a-crucial-test.html.

33 "Sizzlers and Fizzlers" S&P Global, Accessed on February 20, https://www.spglobal.com/spdji/en/indexology/djia-and-sp-500/sizzlers-and-fizzlers/.

34 VIX crossed 41.38 on April 23, 2020 and did not break this level for the remainder of the year.

35 Source: S&P Capital IQ.

Finally, the DJIA recovered and registered a new all-time high of 29,950.44 on November 16, 2020, surpassing the previous all-time high set on February 12, 2020 (29,551.42). By the end of the year, the DJIA had increased to 30,606.48, which represented a 7.2% increase for the year, and a 64.6% increase from the 2020 low set on March 23, 2020.

The recovery was not even across sectors of the economy, and some sectors never recovered by the end of the year. Given the very unusual character of this recession, some sectors of the economy benefited more than others. Technology stocks were the winners from the stay-at-home policies as people worked from home and rarely ventured outside. Companies like Amazon, Netflix, Zoom, and others expanded their customer bases, whereas companies in hospitality and energy were hit the hardest. The S&P 500 information technology sector index was up 42.21% over the year, whereas the S&P 500 Energy Sector index was down 37.31% over the same period. The uncertainty around work in the office and mall shopping led to a decrease in the performance of real estate stocks. The S&P 500 Real Estate Sector Index did not recover after the pandemic even though it started the year with a good performance (6.43% compared to 4.81% for the S&P 500 from December 31, 2019 to February 23, 2020). By the end of the year, the sector lost 5.17%, the second worst sector sectorial performance after Energy.

The U.S. Economy

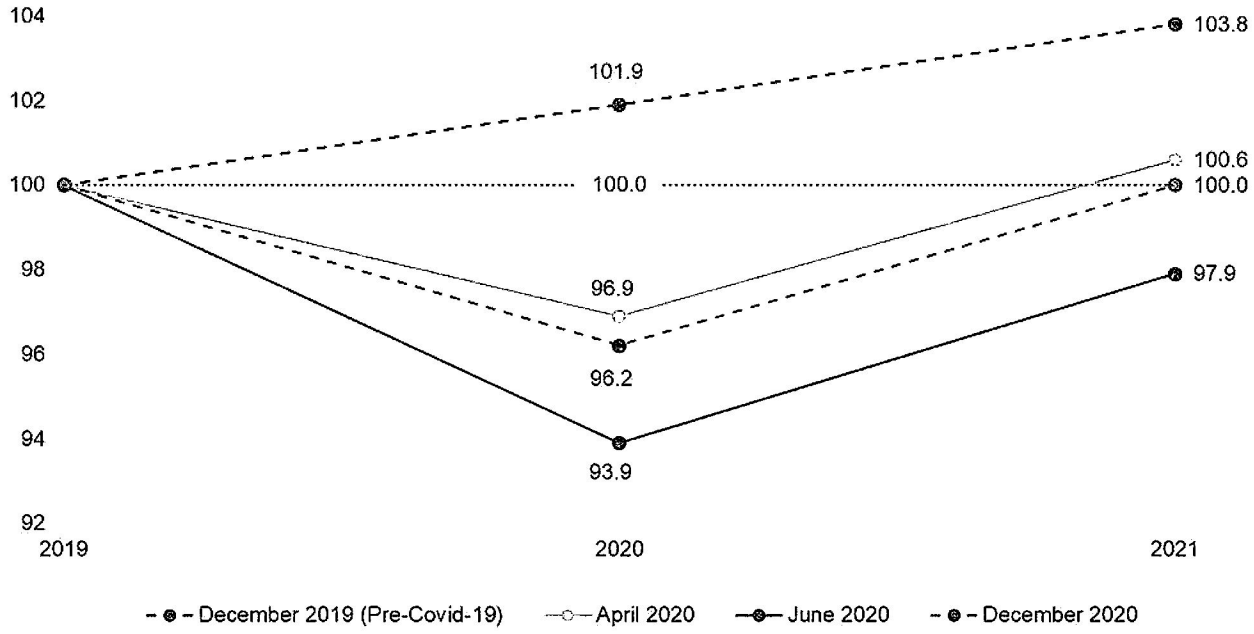
The stock market is not the economy. The economy did not recover by the end of the year as equity markets did. The uncertainty that followed the expansion of COVID-19 and the adoption of stay-at-home orders unsettled markets and made forecasting difficult. As more states started to announce policies to mitigate the expansion of the virus, economists started updating their U.S. real GDP forecasts to reflect the reality on the ground. However, given the unusual character of these events and the inability to understand their effects, forecasts were revised continually as we moved throughout the year.

Exhibit 1.1 compares U.S. GDP growth forecasts for the years 2020 and 2021 made at the end of 2019 (before the COVID-19 outbreak) to forecasts made over the course of 2020 (after the COVID-19 outbreak). The GDP growth estimates are reported as an index (year end 2019 = 100).

The gray dashed line at the top in Exhibit 1.1 represents the path of GDP growth that was expected at the end of 2019 before COVID-19 broke out in the first quarter of 2020. At the end of 2019, economists expected the economy to grow by 1.9% (101.9/100 – 1) by the end of 2020 and by 3.8% by the end of 2021 (compared to year-end 2019 levels).

By April 2020 (solid light gray line) the negative economic effects of COVID-19 began to come into focus, and GDP forecasts indicated a decrease of 3.1% (96.9/100 – 1) by the end of 2020, but it still held an expectation that the economy would recover and actually show a slight 0.6% increase by the end of 2021.

Exhibit 1.1: GDP Growth Estimates Before and After COVID-19



Source of underlying data: OECD, IMF, World Bank, Blue Chip Economic Indicators, Consensus Economics, Economist Intelligent Unit, Fitch Ratings, IHS Markit, Moody's Analytics, Oxford Economics, S&P Global Ratings.

By June 2020 (solid red line at bottom), as many governments imposed sweeping stay-at-home orders, forecasts turned bleak and the U.S. economy was not expected to recover by the end of 2021 as previously expected. As Exhibit 1.1 shows, economists believed that the U.S. economy would shrink by 6.1% (93.9/100 – 1) by the end 2020 and only recover approximately two thirds of that loss by the end of 2021 to a net growth of –2.1%.

At the end of 2020 the U.S. had two COVID-19 vaccines, the expectation of continued low interest rates through at least 2023, the resolution of the U.S. presidential election, and improved business confidence. As of December 2020 (dashed red line), economists' forecasts improved to show that the U.S. economy would shrink by only 3.8% by the end of 2020 and would recover completely by the end of 2021.

The degree to which the large changes in commerce, work life, schooling, travel, etc., that the COVID-19 pandemic forced upon societies in 2020 and 2021 will remain in place is unclear, and economic forecasts will undoubtedly be revised as time passes.

The performance of the U.S. economy was ultimately negative in the first and second quarters. The annualized quarter on quarter change in GDP in the first and second quarters were –5% and –31.4%, respectively. While the economy recovered in the third quarter, the fourth quarter showed that growth was losing steam. Since stay-at-home policies only started in March, the first quarter

performance was negative but not as dismal as the second. The stimulus package offered by Congress and the expansionary monetary policy implemented by the Federal Reserve Bank helped the economy recover some of its loss. The annualized quarter on quarter performance was 33.4% in the third quarter.[36] This performance was not enough for the economy to recover the ground it lost. The last quarter of the year was relatively weak with a performance of 4.1%.[37] On a yearly basis, the U.S. real GDP decreased by 3.5% in 2020.[38]

Unemployment

The labor market was devasted by the pandemic; the unemployment rate went from one of the best job markets in decades to the worst in the post-World War II period. As of February 2020, the U.S. unemployment rate was at 3.5%, the lowest level since December 1969. In two months, the unemployment rate reached 14.8%, the highest post-World war II level. As the stay-at-home order closed the economy, more and more people lost their jobs. The economy was shedding jobs at a higher rate than any other recession in the last 50 years.

The number of unemployment insurance claims filed during this period shows the level of devastation in the labor market. The cumulative number of claims filed as of the end of December 2020 surpassed any other recession on record. Since the National Bureau of Economic Research (NBER) declared the U.S. in a recession in February 2020, the monthly average initial claims filled was 6.77 million claims a month, around three times the highest monthly average number of initial claims filed in a recession since 1969.[39]

Exhibit 1.2 reports the cumulative number of initial claims each month since a recession was declared by NBER in the last 40 years. The cumulative numbers of claims reported each month during the 2020 recession overshadowed the numbers reported in any recession over the last 40 years. Eleven months into this recession in December 2020, the total number of claims in all recessions since 1981 to 2008 was 43.5 million, whereas the total number of claims filed in the 2020 recession alone was 74.5 million. In other words, the number of claims filed through December 2020 was 1.7 times (74.5 million ÷ 43.5 million) the sum of all previous recessions' cumulative claims combined over a similar period.

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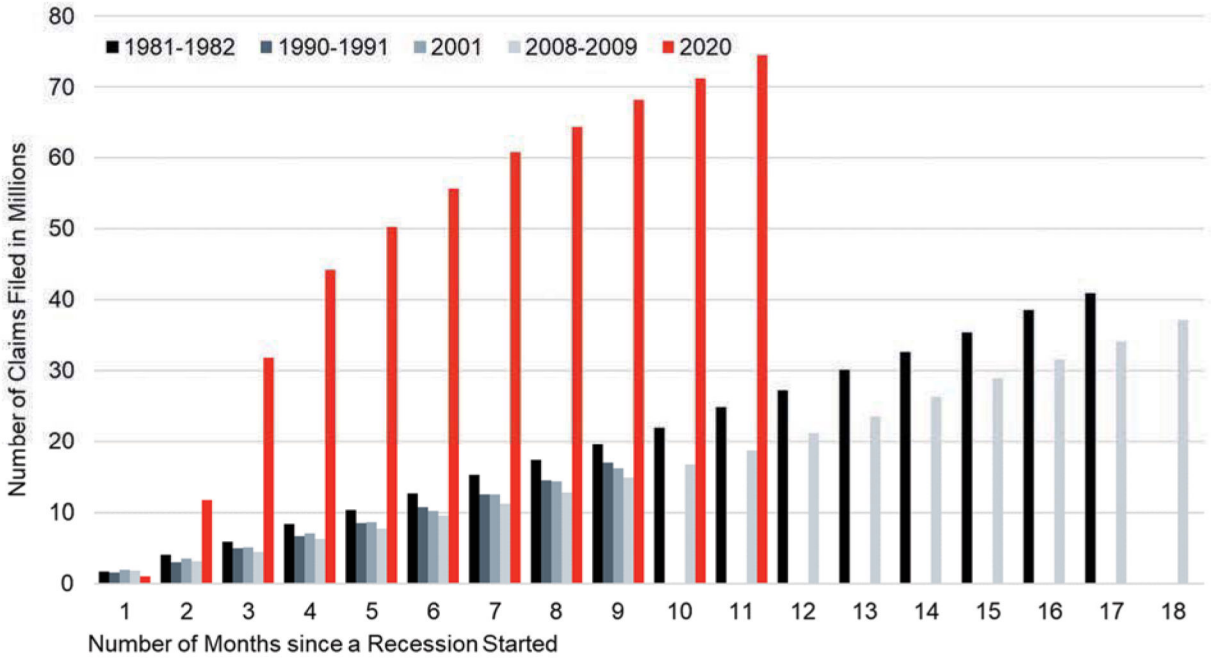
[36] According to the Bureau of Economic Analysis, the year on year GDP growth in the first, second and third quarter was 0.3%, -9% and -2.8%, respectively. For more details visit: www.bea.gov.

[37] The calculation of the fourth quarter U.S. GDP growth is based on the Bureau of Economic Analysis's second estimate. For more details visit: www.bea.gov.

[38] See press release here: https://www.bea.gov/news/2021/gross-domestic-product-fourth-quarter-and-year-2020-second-estimate.

[39] The highest average monthly number of unemployment insurance claims filled in a recession since 1969 was recorded in the 1981-1982 recession which was 2.41 million claims a month. The ratio is calculated as 6.77/2.41=2.8.

Exhibit 1.2: Cumulative Employment Insurance Claims for Each Recession Since 1981



Source of underlying data: Federal Reserve Banks of St Louis database, FRED

Political Uncertainty

According to the Pew research, the U.S. became a politically polarized country over recent years.[40] During 2020, the impeachment of the U.S. President, the spread of the COVID-19 pandemic, the issue of racial justice, and the 2020 presidential election exacerbated disagreements between political rivals and led to heightened uncertainty.

A major political event of 2020 was the impeachment of President Donald Trump. On September 24, 2019, House Speaker Nancy Pelosi launched a formal House inquiry alleging that the president solicited foreign interference in the 2020 U.S. presidential to advance his chances of reelection.[41] The House Judiciary Committee voted to recommend two articles of impeachment: abuse of power and obstruction of Congress. On December 18, 2019, the Democrat controlled House voted to approve both articles, making President Trump the third president in history to be impeached. On January 16, 2020, the Senate trial began, and President Trump was acquitted of both charges three weeks later.[42]

[40] Dimock, Michael and Richard Wike, "America is exceptional in the nature of its political divide.", PEW Research, November 13, 2020 https://www.pewresearch.org/fact-tank/2020/11/13/america-is-exceptional-in-the-nature-of-its-political-divide/.

[41] Przybyla, Heidi and Adam Edelman "Nancy Pelosi announces formal impeachment inquiry of Trump.", NBC News, September 24, 2019, https://www.nbcnews.com/politics/trump-impeachment-inquiry/pelosi-announce-formal-impeachment-inquiry-trump-n1058251.

[42] Kyle Cheney, Andrew Desiderio And John Bresnahan "Trump acquitted on impeachment charges, ending gravest threat to his presidency." Politico.com, February 5, 2020, https://www.politico.com/news/2020/02/05/trump-impeachment-vote-110805.

Research has shown that pandemics tend to increase the likelihood of social unrest.[43] The recent pandemic is no different. On May 25, 2020, George Floyd, an African American man, died while being apprehended by police in Minneapolis, Minnesota. The death of Mr. Floyd led to the eruption of protests in multiple cities across the U.S. in the name of racial justice and social equality. These protests morphed into an international movement. Protesters in countries as far away as Australia, Brazil, France, and Canada echoed the same slogans as in the U.S.[44] However, these protests meant people gathering in large crowds, which might hinder the efforts to contain the expansion of the virus and further the pain of the economy.[45] According to a Bank of America survey, investors are more worried about the pandemic than social unrest.[46] As a result, equity markets shrugged-off these events and continued their ascent.[47]

Mr. Trump lost the 2020 Presidential Election on November 3, 2020, but he contested the election in numerous states.[48] Mr. Trump and his legal team challenged the results in various courts and asked for recounts in states where it was possible, specifically in Georgia and Wisconsin.[49] As more states certified their results, the uncertainty around the results of elections decreased, and Mr. Joe Biden was sworn in as the 46th U.S. president. The resolution of the election uncertainty was seemingly welcomed by the equity markets, and the S&P 500 rose by 13.47% between November 2, 2020 and December 31, 2020.

Another important aspect of the November 2020 election was which party would control the House and the Senate. If the Democrats held the House and had a net gain of three seats in the Senate, the party would control of both houses of Congress.[50] Ultimately in the November 2020 election, Democrats held the House and achieved a net gain of one seat in the Senate. However, two Senate seats in Georgia required a special run-off election because none of the candidates reached the 50% mark.[51] The special run-off election took place on January 4, 2021 and sent two Democrats to the Senate, giving Democrats 50 seats and effective control of both the House and

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43 Barrett, Philip, and Sophia Chen. "Social Repercussions of Pandemics." No. 2021/021. International Monetary Fund, 2021. Accessible here: https://www.imf.org/en/Publications/WP/Issues/2021/01/29/Social-Repercussions-of-Pandemics-50041.

44 Daragahi, Borzou "Why the George Floyd protests went global." June 10, 2020, https://www.atlanticcouncil.org/blogs/new-atlanticist/george-floyd-protests-world-racism/.

45 Reinicke, Carmen, "Here's how 4 financial experts think protests could negatively affect markets and the US economic recovery"June 1, 2020, https://markets.businessinsider.com/news/stocks/protests-negatively-affect-markets-us-economic-recovery-financial-expertsstocks- 2020-6-1029269622.

46 Garber, Jonathan, "Record stock rally faces risks from civil unrest, tech bubble" November 17, 2020 https://www.foxbusiness.com/markets/civil-unrest-stock-market-risk.

47 Wallace, Joe and Paul Vigna, "U.S. Stocks Close Higher Despite Social Unrest", Wall Street Journal, June 2, 2020 https://www.wsj.com/articles/global-stock-markets-dow-update-6-02-2020-11591072455.

48 The president's legal team contested the election in Wisconsin, Arizona, Nevada, Michigan, Minnesota, Georgia and Pennsylvania. See: Schartz, Matthew S., "Trump's Legal Losses Come Fast And Furious." NPR, December 5, 2020, https://www.npr.org/2020/12/05/943535299/trumps-legal-losses-come-fast-and-furious.

49 Breuninger, Kevin and Dan Mangan, "Trump campaign requests partial Wisconsin recount, deposits $3 million to challenge Biden victory" CNBC.com, November 18, 2020 https://www.cnbc.com/2020/11/18/trump-campaign-filing-for-partial-wisconsin recountchallenging- biden-victory.html; Jester, Julia and Dennis Romero "Trump campaign asks for another Georgia recount", NBC News, November 22, 2020 https://www.nbcnews.com/politics/2020-election/trump-campaign-asks-another-georgia-recount n1248538.

50 Before the election, the Republicans controlled the Senate by a majority of 53 to 47. A Democratic net gain of three seats would split the Senate 50-50, and Democratic Vice President Harris would cast the deciding vote in the case of ties. 1.41 Barrett, Philip, and Sophia Chen. "Social Repercussions of Pandemics." No. 2021/021. International Monetary Fund, 2021. Accessible here: https://www.imf.org/en/Publications/WP/Issues/2021/01/29/Social-Repercussions-of-Pandemics-50041.

51 "US Election 2020: Battle for US Senate to be decided in January." BBC, November 7, 2020, https://www.bbc.com/news/election-us-2020-54835724.

the Senate. Although their majorities are slim, democrat control could lead to the enactment of business-unfriendly legislation that lowers future after-tax corporate earnings.

Monetary Policy

At the first FOMC meeting of the year 2020, the committee decided to leave the target range for the federal fund rate at 1.5%–1.75% which was considered by the FOMC an appropriate policy stance given the level of inflation and employment registered at that the time.[52] However, as more information about COVID-19 and its expansion emerged, the risk to the economy became more apparent. In an unscheduled meeting on March 3, 2020, the FOMC decided to lower the Fed funds target range by 50 b.p.[53]

In another unscheduled meeting on March 15, 2020, the FOMC lowered its rate even further and decided to use additional tools to cushion the effect of COVID-19 on the economy.[54] First, the FOMC relaunched its Quantitative Easing program where it announced the purchase of at least $700 billion of Treasury securities and agency mortgage-backed securities. Second, the committee decided to lower the banks' reserve requirement to zero and encouraged banks to use capital and liquidity buffers to provide loans to businesses and households affected by the expansion of the virus. Third, the committee announced a coordinated international action to provide U.S. dollar liquidity swap arrangement to the Bank of Canada, the Bank of England, the Bank of Japan, the European Central Bank, and the Swiss National Bank.[55]

Over the following week, the Fed issued multiple statements in which it announced additional measures to support the economy. On March 17, the Fed announced the creation of Primary Dealer Credit Facility (PDCF) that offers loans to large broker-dealer collateralized by a broad range of securities, including commercial papers and equity securities.[56] On March 18, the Fed announced the creation of Money Market Mutual Fund Liquidity Facility (MMLF) that offers collateralized loans to large banks who buy assets from money market mutual funds.[57]

On March 23, the Fed established new facilities and extended the reach of some of the previously announced ones. Three new emergency lending facilities were announced: Primary Market Corporate Credit Facility (PMCCF) to provide companies access to credit to maintain operations and capacity, Secondary Market Corporate Credit Facility (SMCCF) to support credit to large employers, and the Term Asset-Backed Securities Loan Facility (TALF) to support credit to consumers and businesses. These programs, which provide up to $300 billion in new financing options to firms, are backed by a $30 billion equity provided by the Treasury Department's

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52 For more details, FOMC press release can be found here: https://www.federalreserve.gov/newsevents/pressreleases/monetary20200129a.htm.

53 For more details, please refer to the FOMC press release: https://www.federalreserve.gov/newsevents/pressreleases/monetary20200303a.htm.

54 For more details, please refer to the FOMC press release: https://www.federalreserve.gov/newsevents/pressreleases/monetary20200315a.htm.

55 For more details, please refer to the FOMC press release: https://www.federalreserve.gov/newsevents/pressreleases/monetary20200315c.htm.

56 For more details, please refer to the FOMC press release: https://www.federalreserve.gov/newsevents/pressreleases/monetary20200317b.htm.

57 For more details, please refer to the FOMC press release: https://www.federalreserve.gov/newsevents/pressreleases/monetary20200318a.htm.

Exchange Stabilization Fund (ESF).[58] On June 15, the Fed decided to expand the SMCCF and buy a portfolio index of U.S. corporate bonds rated investment grade as of March 22.[59]

As an effect of all these new lending facilities and interventions, the Fed's balance sheet increased from $4.2 trillion at the end of 2019 to $7.4 trillion at the end of 2020 (an approximate 76% increase). Although the dollar amount increase (approximately $3.2 trillion) was the largest on record, the expansion of the balance sheet during the GFC was larger in percentage terms (151%).[60]

Fiscal Policy

As the pandemic intensified and the economy weakened, lawmakers enacted laws to help businesses and households through the crisis. Four major fiscal packages were enacted by Congress to fight the pandemic and its impact on the economy. The first fiscal package was the "Coronavirus Preparedness and Response Supplemental Appropriations Act" passed by the House and the Senate on March 4, and March 5, respectively, and signed into law by the U.S. President Donald Trump on March 6. This act was mainly directed to help with development of vaccines and therapeutics and the acquisition of medical supplies needed to fight the virus.

The second fiscal package enacted by Congress, the "Families First Coronavirus Response Act," was designed to help finance free COVID-19 tests, establish a 14-day paid leave for workers affected by the pandemic, and increase funding for food stamps. The act was passed by the House March 14, the Senate on March 18, and signed into law by President Trump on the same day.

The third (and possibly most important) fiscal package enacted in 2020 was called the "Coronavirus Aid, Relief, and Economic Security Act" or "CARES Act". It was passed by the Senate on March 25, by the House on March 27, and signed into a law on the same day by the president. This fiscal package was the biggest fiscal package ever voted in the U.S. history, with a total spending power of $2 trillion.[61] It included a direct cash payment to individuals and extra unemployment assistance payments, funding to small businesses, funding for sectors affected by the pandemic like Airlines, public health institutions and state and local governments, as well as relief for college students and graduates.[62]

The CARES Act boosted the Fed's actions by providing capital and legislation to offer more facilities to the economy. Three new facilities issued by the Fed were set up to help small

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58 For more details, please refer to the FOMC press release: https://www.federalreserve.gov/newsevents/pressreleases/monetary20200323b.htm.

59 For more details, please refer to the New York Federal Reserve bank press release: https://www.newyorkfed.org/newsevents/news/markets/2020/20200615

60 According to data from the Federal Reserve Bank of St. Louis, the total assets of the Federal Reserve Bank were $7,363 billion and $4,165 billion as of December 30, 2020 and December 25, 2019, respectively; and $2,239 billion and $890 billion as of December 31, 2008 and December 26, 2007, respectively.

61 Pramuk, Jacob "Trump signs $2 trillion coronavirus relief bill as the US tries to prevent economic devastation", CNBC.com, March 27, 2020, https://www.cnbc.com/2020/03/27/house-passes-2-trillion-coronavirus-stimulus-bill-sends-it-to-trump.html.

62 Snell, Kelsey "What's Inside The Senate's $2 Trillion Coronavirus Aid Package", NPR, March 26, 2020 https://www.npr.org/2020/03/26/821457551/whats-inside-the-senate-s-2-trillion-coronavirus-aid-package.

businesses and local governments recover from the impact the pandemic. The first facility established was the Paycheck Protection Program Liquidity Facility (PPPFL) that would purchase Payment Protection Program (PPP) loans guaranteed by the Small Business Administration (SBA) from lenders.[63] The second facility was the Main Street New Loan Facility. With an equity $75 billion, the facility's objective is to purchase $600 billion of debt from companies employing up to 10,000 workers or with revenues of less than $2.5 billion, with any required payments on these loans deferred for a year.[64] The third facility is the Municipal Liquidity, designed to help local and state government with the loss of revenue from the disruption of economic activity. Its objective was to purchase $500 billion of debt from counties with a population of at least 500,000 and cities with a population of at least 250,000.[65]

As the third wave of the pandemic took hold of the nation, Congress agreed on providing a fourth relief package to further help households and businesses. The bill was signed into law in late December 23, 2020. The bill provided an additional direct cash payment to individuals, more funding for the Payment Protection Program, funding to expand unemployment insurance, funds for rental assistance, help to the transportation and healthcare sector. This last package had a price tag of $900 billion.[66]

Commodities

Like other markets, the pandemic unsettled the commodities market as well, especially for energy. As more and more countries adopted stayed at home policies and air travel slowed, the price of oil started to decrease. The demand for oil collapsed and the price started to follow. This was compounded by a break in negotiation between the leading OPEC+ members, Saudi Arabia and Russia, that resulted in an undeclared oil price war and the flooding of the international oil market.[67]

In early 2020, COVID-19 ravaged the second largest economy in the world (China) as the country's crude imports slowed and refineries decrease their output.[68] In February 2020, the International Energy Agency forecasted that demand growth would fall to the lowest rate since 2011, with full-year growth falling by 325,000 bpd to 825,000 bpd[69] and a first quarter contraction in consumption by 435,000 bpd. Russia and OPEC's leading member, Saudi Arabia, started discussion on the level of cuts required to cope with this fall in demand, but they did not reach an agreement. In a retaliatory move, OPEC members decided to remove all limits on production. On

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63 For more details, please refer to the FOMC press release: https://www.federalreserve.gov/newsevents/pressreleases/files/monetary20200409a6.pdf.

64 For more details, please refer to the FOMC press release: https://www.federalreserve.gov/newsevents/pressreleases/files/monetary20200409a7.pdf.

65 For more details, please refer to the FOMC press release: https://www.federalreserve.gov/monetarypolicy/muni.htm.

66 Rifis B., Jared, Kenneth A. Johnson and Zane S. Hatahet "Federal COVID Relief Bill passed by Congress - December 2020", The National Law Review, December 23, 2020, https://www.natlawreview.com/article/federal-covid-relief-bill-passed-congress-december-2020.

67 OPEC stands for Organization of the Petroleum Exporting Countries. List of member countries in OPEC+: Algeria, Angola, Azerbaijan, Bahrain, Brunei, Congo, Ecuador, Equatorial Guinea, Gabon, Iraq, Iran, Kazakhstan, Kuwait, Libya, Malaysia, Mexico, Nigeria, Oman, Russia, Saudi Arabia, South Sudan, Sudan, Venezuela, and UAE.

68 Aizhu, Chen "ChemChina becomes latest Chinese refiner to slash output due to coronavirus: sources", Reuters, February 13, 2002 https://www.reuters.com/article/us-china-health-chemchina-refinery/chemchina-becomes-latest-chinese-refiner-to-slash-output-due-to-coronavirus-sources-idUSKBN2070E8.

69 IEA (2020), Oil Market Report - February 2020, IEA, Paris https://www.iea.org/reports/oil-market-report-february-2020.

March 7, 2020, Saudi Arabia offered price discounts to customers in Europe, Asia, and the United States.[70]

The West Texas Intermediate (WTI), the U.S. oil benchmark fell by 24.59%, and Brent, the international oil benchmark, fell by 24.10%. The pressure on oil prices continued as demand continued to falter and the spat between Russia and Saudi Arabia intensified. Oil prices reached the lowest level since 2002.[71]

Following pressure from U.S. President Donald Trump, Russia and Saudi Arabia agreed to organize an emergency meeting.[72] During this meeting, both nations along with other members of OPEC+ decided to lower production by 9.7 million bpd until June 2020, and by 7.7 million bpd between July and the December 2020.[73] However, the damage to oil markets had already been done. The excess supply was still lingering in the market and filled storage facilities. The price of WTI May delivery contract expiring on April 21, 2020 turned negative on April 20, 2020 as traders were trying to get contracts off their hands. The price of a WTI contract ended the day at negative $37.62.[74] As the economy started to open up and the recovery started, oil prices started to recover as well. The WTI ended the year at $48.52, a decrease of 20.54%, and the Brent at $51.8, a decrease of 21.52% compared to the end of 2019.

Copper, an important industrial commodity, has seen a different path than Oil throughout 2020. The price of copper decreased as uncertainty unsettled investors. As such, Copper, which is known for its high correlation with the economic cycle, dropped by 23% to $2.15/lb on March 18, 2020 from $2.8/lb at the end of 2019.[75] Some experts were expecting a supply glut because of the pandemic and an important decrease of demand from China, the world largest copper importer.[76] However, this outlook did not materialize, and the demand for copper did not decrease as expected. To the contrary, supply could not keep up.[77] Copper ended the year at $3.52/lb, a performance of 25.54%.

Gold, the traditional safe haven and store value, reached record highs during 2020. As uncertainty around COVID-19 increased and extraordinary monetary measures were taken by central banks

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70 "Saudi Arabia slashes April crude prices after OPEC's supply pact collapsed", Reuters, March 7, 2020, https://www.reuters.com/article/audi-oil-prices-idUSL8N2B00TK.

71 Stevens, Pippa, "Oil falls 24% in 3rd worst day on record, sinks to more than 18-year low" CNBC.com, March 18, 2020 https://www.cnbc.com/2020/03/18/oil-plummets-to-near-18-year-low-on-pace-for-worst-month-ever.html.

72 Gardner, Timothy Steve Holland, Dmitry Zhdannikov, Rania El Gamal "Trump told Saudis: Cut oil supply or lose U.S. military support – sources" , Reuters, April 30, 2020, https://www.reuters.com/article/global-oil-trump-saudi/special-report-trump-told-saudis cutoil- supply-or-lose-u-s-military-support-sources-idUSL1N2CH29V.

73 Jacobs, Trent "OPEC+ Moves To End Price War With 9.7 Million B/D Cut" ,Journal of Petroleum Technology, April 12, 2020, https://jpt.spe.org/opec-moves-end-price-war-10-million-bd-cut.

74 Lee, Nathaniel, "How negative oil prices revealed the dangers of the futures market", CNBC.com, June 16, 2020, https://www.cnbc.com/2020/06/16/how-negative-oil-prices-revealed-the-dangers-of-futures-trading.html#:~:text=A%20historic%20drop%20occurred%20on,around%20negative%20%2437%20per%20barrel.

75 Ashraf, Aoyon, "Copper Tapped as the Next Big Metals Trade of 2020" BNN-Bloomberg, December 16, 2019 https://www.bnnbloomberg.ca/copper-tapped-as-the-next-big-metals-trade-of-2020-1.1363467.

76 Ignacio, Reicelene Joy, "Global copper market in supply glut in 2020, 2021 – IWCC" , S&P Global Intelligence, May 27, 2020, https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/global-copper-market-in-supply-glut-in-2020-2021-8211-iwcc-58811137.

77 Woodall, Toby, "Copper supply faces struggle to keep up with growing demand", S&P Global Intelligence, October 1, 2020, https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/copper-supply-faces-struggle-to-keep-up-with-growing-demand-60471925.

around the world, investors turned to the yellow metal to protect themselves. Gold reached an all-time high of $2058.4/oz on August 8, 2020, but it retracted to end the year at $1895.1/oz, a performance of 24.75% compared to the end of 2019.

Relative Performance of the SBBI® Series in 2020[78]

The relative performance of six U.S. asset classes plus inflation, as represented by the SBBI® series, is illustrated in Exhibit. 1.3. The relative performance of these series is reported for 2020 alone and as the average annual return over 1926–2020.

A few observations about the relationships in Exhibit 1.3:

- Large-Cap Stocks *outperformed* Small-Cap Stocks in 2020[79], counter to the average annual return over the 1926–2020 period where Large-Cap Stocks *underperformed* Small-Cap Stocks.

- Long-term (i.e., 20-year) U.S. corporate bonds and U.S. government bonds both significantly *outperformed* their 1926–2020 average annual returns in 2020, likely due to the Federal Reserve's shift to a more dovish monetary policy.[80]

- Long-term U.S. government bonds *outperformed* long-term U.S. corporate bonds in 2020. U.S. *corporate* bonds typically outperform equivalent-maturity U.S. government bonds due to investors' demand for greater compensation for investing in corporates due to default risk.[81] In 2020, a once in a century pandemic (i.e., COVID-19) uprooted the world economy and created chaos all around the world and precipitated a global economic slowdown. The outperformance in 2020 of U.S. government bonds compared to U.S. long-term corporate bonds in 2020 is likely due to a heightened demand for so-called "safe" securities (e.g., U.S. Treasuries) in times of crisis.

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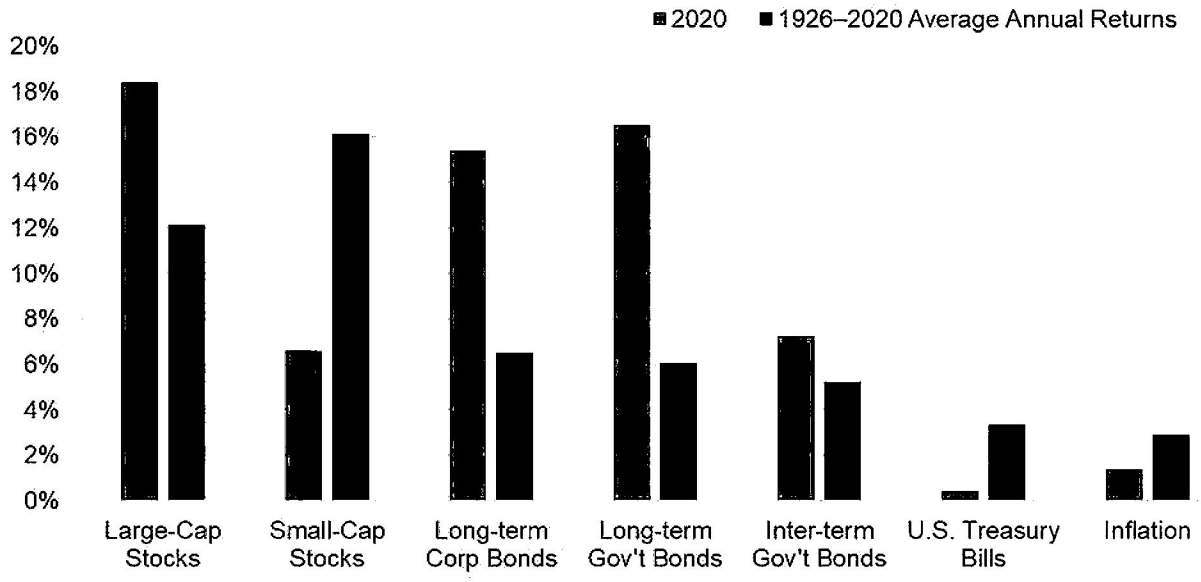
78 *Precalculated* summary statistics of annual returns (1926–2020) are presented in table format in the full-version *2021 SBBI® Yearbook* for the following Ibbotson Associates(IA) Stocks, Bonds, Bills, and Inflation® (SBBI®) series, as follows: Large-Cap Stocks (total return, income return, and capital appreciation return), Small-Cap Stocks (total return), Long-term Corporate (i.e., 20-year) Bonds (total return), Long-term (i.e., 20-year) Government Bonds (total return, income return, and capital appreciation return), Intermediate-term (5-year) Government Bonds (total return, income return, and capital appreciation return), (30-day) U.S. Treasury Bills (total return), and Inflation. For more information, visit dpcostofcapital.com/stocks-bonds-bills-inflation-sbbi-yearbook.

79 One could argue that this is slightly atypical when measured over 12-month periods. For example, from January 1926–December 2020, there were 1,129 periods that were exactly 12 months in length. Small-Cap Stocks outperformed Large Cap Stocks 601 times, or approximately 53% of the time. When measured over longer periods, Small-Cap Stocks tend to outperform Large-Cap Stocks at an increasingly greater rate. For example, from January 1926–December 2020 there were 1,21 periods that were exactly 120 months (10 years) in length. Small-Cap Stocks outperformed Large Cap Stocks 686 times, or approximately 67% of the time. Over 20-year periods Small Cap Stocks did even better when compared to Large Cap Stocks, outperforming in 791 out of the 901 periods that were exactly 240 months (20 years) in length, or approximately 88% of the time.

80 Nick Timiraos, "Fed Signals Low Rates Likely to Last Several Years / Central bank also sets high hurdles for raising rates going forward", *Wall Street Journal*, September 16, 2020. See: https://www.wsj.com/articles/fed-signals-interest-rates-to-stay-near-zero-through-2023-11600279214.

81 Over the 1926–2020 time horizon the average annual return of U.S. long-term corporate bonds exceeded the returns of U.S. long-term government bonds (i.e., "Treasuries") (see Exhibit 1.3). On an annual basis, from 1926–2020 (95 years) U.S. long-term corporate bonds outperformed U.S. long-term government bonds 57 out of 95 years (60% of the time).

Exhibit 1.3: The Relative Performance of the Stocks, Bonds, Bills, and Inflations® (SBBI®) Series in 2020, and Over the 1926–2020 Time Horizon; Average Annual Returns



Source of underlying data: Morningstar, Inc. Used with permission. All rights reserved. Calculations by D&P/Kroll. Asset classes and inflation represented by the Ibbotson Associates (IA) Stocks, Bonds, Bills, and Inflation® (SBBI®) series, as follows: (i) Large-Cap Stocks: IA SBBI® US Large Stock TR USD Ext, (ii) Small-Cap Stocks: IA SBBI® US Small Stock TR USD, (iii) Long-term (i.e., 20-year) Corporate Bonds: IA SBBI® US LT Corp TR USD, (iv) Long-Term (i.e. 20-year) Government Bonds: IA SBBI® US LT Govt TR USD, (v) Intermediate-term (i.e., 5-year) Government Bonds: IA SBBI® US IT Govt TR USD, (vi) U.S. (30-day) Treasury Bills: IA SBBI® US 30 Day TBill TR USD, and (vii) Inflation: IA SBBI® US Inflation. For a detailed description of the SBBI® series, see Chapter 3, "Description of the Basic Series". "Stocks, Bonds, Bills, and Inflation" and "SBBI" are registered trademarks of Morningstar, Inc. All rights reserved. Used with permission.

Relative Performance of the SBBI® Series by Decade

The great stock and bond market rise of the 1980s and 1990s was one of the most unusual in the history of the capital markets. In terms of the magnitude of the rise, these decades most closely resembled the 1920s and 1950s. These four decades accounted for a majority of the market's cumulative total return over the past 95 years. While the importance of a long-term view of investing is noted consistently in this book and elsewhere, the counterpart to this observation is this: to achieve high investment returns, one needs to participate only in the few periods of truly outstanding returns. The bull markets of 1922 to mid-1929, 1949–1961 (roughly speaking, the 1950s), mid-1982 to mid-1987, and 1991 1999 were such periods. More recently, in the 12-year period since the 2008 financial crisis and ending December 2020, an investor in large stocks would have realized an annual compound return of 15.0%, and an investor in small stocks would have realized an annual compound return of 13.1%.

It is interesting to place the decades of superior performance in historical context. The 1920s were preceded by mediocre returns and high inflation and were followed by the most devastating stock market crash and economic depression in U.S. history. This sequence of events mitigated the impact of the 1920s bull market on investor wealth. Nevertheless, the stock market became a

liquid secondary market that decade, rendering it important for reasons other than return. In contrast, the 1950s were preceded and followed by decades with roughly average equity returns. The 1980s were preceded by a decade of "stagflation," where modest stock price gains were seriously eroded by inflation and were followed by a period of stability in the 1990s.

The bond market performance of the 1980s and 1990s has no precedent. Bond yields, which had risen consistently since the 1940s, reached unprecedented levels in 1980–1981. (Other countries experiencing massive inflation have had correspondingly high interest rates.) Never before having had so far to fall, bond yields dropped further and faster than at any other time, producing what is indisputably the greatest bond bull market in history. Unfortunately, the boom came to an end in 1994. After falling to 21-year lows one year earlier, bond yields rose in 1994 to their highest level in over three years. Both long-term and intermediate-term government bond yields have generally fallen since 2000.[82]

The historical themes of the past decade, as they relate to the capital markets, can be summarized in three observations. First, the 17.5-year period starting in mid-1982 and ending in 1999 was a rare span of time in which investors quickly accumulated wealth.

Second, the postwar aberration of ever-higher inflation rates ended with a dramatic decrease in inflation in the early 1980s. In the 1990s, inflation was at a 2.9% compound annual rate, significantly lower than the 5.1% and 7.4% annual compound rate of the 1980s and 1970s, respectively, and lower than the longer-term compound annual rate at the end of that decade as measured over the 1926–1999 period (3.1%). The trend of relatively low inflation has continued through the 2000s and beyond. For example, the long-term compound annual rate of inflation over the 1926–2020 period (95 years) was 2.9%, but the compound annual rate over the 2000–2009 period, and the most recent 10-year period (2011–2020) were significantly lower at 2.5% and 1.7%, respectively.

Finally, participation in the returns of the capital markets since 1982 reached levels not approached in the 1920s, the 1950s, or even in the atypical boom period of 1967–1972. The growth since 1982 in the importance of pension funds and defined contribution pension plans, like the 401(k), as well as the rapidly increasing popularity of stock and bond mutual funds and exchange-traded products as basic savings vehicles, have enabled more individuals to experience the returns of the capital markets than ever before.

Exhibit 1.4 ranks the performance (as measured by compound annual rates of return) of the six basic U.S. asset classes plus inflation, as represented by the SBBI® series, for each decade from best performer (at top) to worst performer (at bottom). For example, in the 2010s the best performer was Large-Cap Stocks, and the worst performer was U.S. Treasury Bills.

---

[82] The yield of SBBI® long-term (i.e., approximately 20 years maturity) U.S. government bonds at the end of 1999 was 6.82%; at the end of 2020 the yield of SBBI® long-term U.S. government bonds had fallen to 1.37%. The yield of SBBI® intermediate-term (i.e., approximately 5 years maturity) U.S. government bonds at the end of 1999 was 6.45%; at the end of 2019 the yield of SBBI® intermediate-term U.S. government bonds had fallen to 0.44%.

Exhibit 1.4: The Relative Performance of the Stocks, Bonds, Bills, and Inflations® (SBBI®) Series by Decade (Best Performer at Top, Worst Performer at bottom)

1920s*	1930s	1940s	1950s
Large-Cap Stocks	Long-term Corp Bonds	Small-Cap Stocks	Large-Cap Stocks
Long-term Corp Bonds	Long-term Gov't Bonds	Large-Cap Stocks	Small-Cap Stocks
Long-term Gov't Bonds	Inter-term Gov't Bonds	Inflation	Inflation
Inter-term Gov't Bonds	Small-Cap Stocks	Long-term Gov't Bonds	U.S. Treasury Bills
U.S. Treasury Bills	U.S. Treasury Bills	Long-term Corp Bonds	Inter-term Gov't Bonds
Inflation	Large-Cap Stocks	Inter-term Gov't Bonds	Long-term Corp Bonds
Small-Cap Stocks	Inflation	U.S. Treasury Bills	Long-term Gov't Bonds

1960s	1970s	1980s
Small-Cap Stocks	Small-Cap Stocks	Large-Cap Stocks
Large-Cap Stocks	Inflation	Small-Cap Stocks
U.S. Treasury Bills	Inter-term Gov't Bonds	Long-term Corp Bonds
Inter-term Gov't Bonds	U.S. Treasury Bills	Long-term Gov't Bonds
Inflation	Long-term Corp Bonds	Inter-term Gov't Bonds
Long-term Corp Bonds	Large-Cap Stocks	U.S. Treasury Bills
Long-term Gov't Bonds	Long-term Gov't Bonds	Inflation

1990s	2000s	2010s
Large-Cap Stocks	Long-term Gov't Bonds	Large-Cap Stocks
Small-Cap Stocks	Long-term Corp Bonds	Small-Cap Stocks
Long-term Gov't Bonds	Small-Cap Stocks	Long-term Corp Bonds
Long-term Corp Bonds	Inter-term Gov't Bonds	Long-term Gov't Bonds
Inter-term Gov't Bonds	U.S. Treasury Bills	Inter-term Gov't Bonds
U.S. Treasury Bills	Inflation	Inflation
Inflation	Large-Cap Stocks	U.S. Treasury Bills

* Based on the period 1926–1929.

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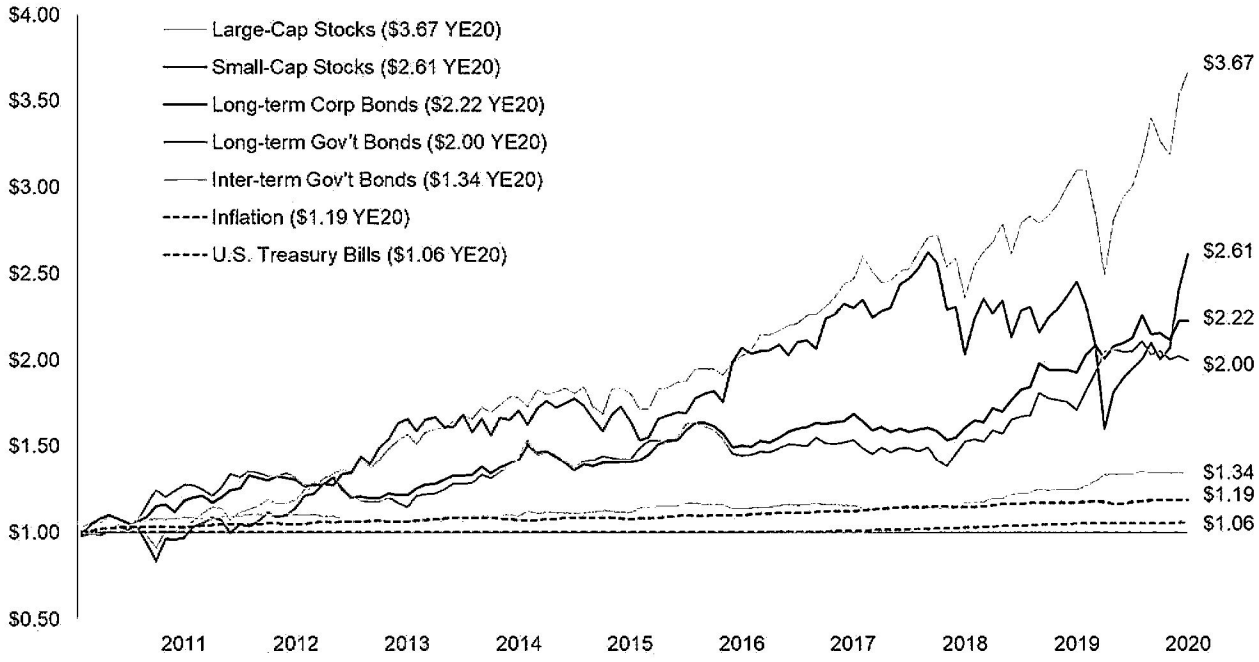
Using Index Values to Measure Relative Performance

Relative performance can also be measured by using index values.[83] Exhibit 1.5 shows the market results for the most recent 10-year period (2011–2020) as illustrated by the growth of $1.00 invested on December 31, 2010 in each of the six basic U.S. asset classes plus inflation, as represented by the SBBI® series. A dollar invested at the end of 2010 in Large-Cap Stocks would have turned into $3.67 by the end of 2020, while a dollar invested at the end of 2010 in U.S. Treasury Bills would have turned into $1.06 by the end of 2020.

Exhibit 1.5: Wealth Indexes of $1.00 Investments in Each of the Six Basic U.S. Asset Classes Plus Inflation, as Represented by the Stocks, Bonds, Bills, and Inflation® SBBI® Series Over the Most Recent Decade (2011–2020) (Year-end 2010 = $1.00)



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[83] To learn more about calculating index values, see Chapter 5, "Annual Returns and Indexes".

Chapter 2
The Long-Run Perspective

A long view of capital market history, illustrated by the 95-year period (1926–2020) examined here, uncovers the basic relationships between risk and return among the different asset classes and between nominal and real (inflation adjusted) returns. The goal of this study of asset returns is to provide a period long enough to include most or all of the major types of events that investors have experienced and may experience in the future. Such events include war and peace, growth and decline, bull and bear markets, inflation and deflation, and other less dramatic events that affect asset returns.

By studying the past, one can make inferences about the future. While the actual events that occurred during 1926–2020 will not be repeated, the event-types of that period can be expected to recur. It is sometimes said that only a few periods had unusual events, such as the stock market crash of 1929–1932 and World War II. This logic is suspicious because events that are deemed unusual happen with a certain regularity.[84] Some of the most unusual events of the century – the market crash of 1987, the equally remarkable inflation of the 1970s and early 1980s, the more recent events of September 11, 2001, the 2008–2009 financial crisis, and most recently, the market crash in the first quarter of 2020 that was precipitated by the spread of the COVID-19 virus – took place over the last three decades or so. To the degree that historical event-types tend to repeat themselves, the examination of past capital market returns is likely informative about what may be expected in the future.

Using a Logarithmic Scale on Index Graphs

Previously in Exhibit 1.5 in Chapter 1, the market results over the most recent decade were illustrated by the growth of $1.00 invested on December 31, 2010 in each of the six basic U.S. asset classes plus inflation, as represented by the SBBI® series. A logarithmic scale was used on the vertical axis of Exhibit 1.5.[85] A logarithmic scale (see Exhibit 2.1a) allows for the direct comparison of the series' behavior at different points in time.

Specifically, the use of a logarithmic scale allows the following interpretation of the data: the same vertical distance, no matter where it is measured on the graph, represents the *same* percentage change in the series. For example, on a logarithmic scale, a 50% gain from $10 to $15 occupies

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[84] In 2010, Laurence B. Siegel, research director at the CFA Institute Research Foundationat the time, famously referred to these events as "black turkeys." The reference was to "black swans," the term author Nassim Nicholas Taleb gave to unfortunate events that aren't easily foreseeable. Siegel explained in a paper, "Black Swan or Black Turkey?" that market events like the global financial crisis are "everywhere in the data—(they) happen all the time" but investors are "willfully blind" to them. See: Laurence B. Siegel, "Black Swan or Black Turkey? The State of Economic Knowledge and the Crash of 2007–2009," *Financial Analysts Journal,* July/August 2010, Volume 66 Issue 4.

[85] If creating a graph using Microsoft Excel, the vertical axis can be changed to logarithmic scale by right clicking the vertical axis and selecting "Format Axis…", and then selecting "Logarithmic scale" in the "Format Axis" dialog box.

the same vertical distance as a 50% gain from $1,000 to $1,500. On a linear scale, the same percentage gains look different (see Exhibit 2.1b). A logarithmic scale allows the viewer to compare investment performance across different periods; thus, the viewer can concentrate on rates of return without worrying about the number of dollars invested at any given time.

An additional (and practical) benefit of a logarithmic scale is the way the scale spreads the action out over time. It makes the graph easier to see and makes it easier to more carefully examine the fluctuations of the individual time series in different periods.

Exhibit 2.1a: Logarithmic Scale

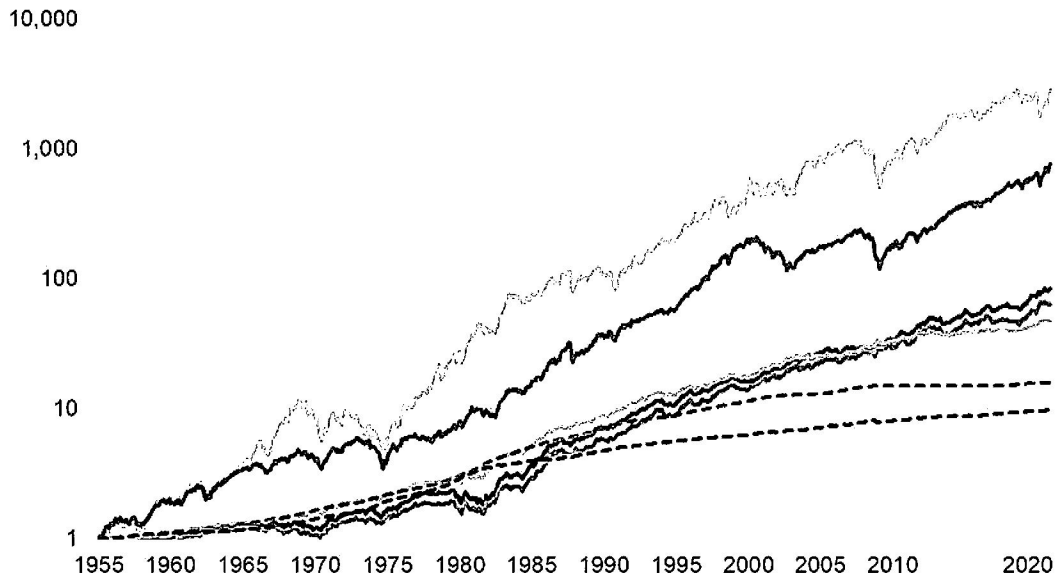
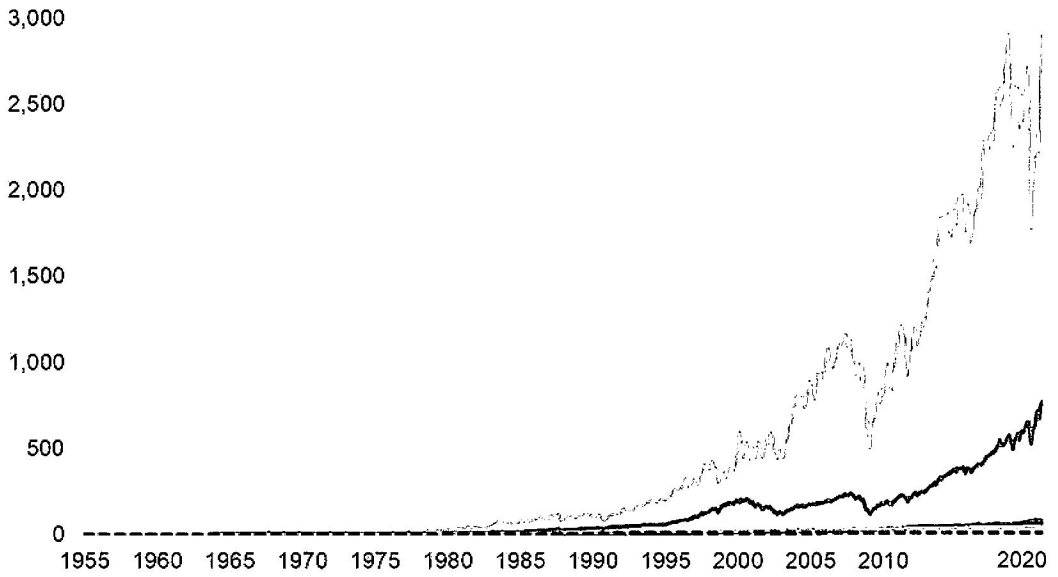


Exhibit 2.1b: Linear Scale



Using Index Values to Measure the Relative Performance of the SBBI® Series

The relative performance of six U.S. asset classes plus inflation, as represented by the SBBI® series, was previously illustrated in Exhibit. 1.1 using average annual returns. In Exhibit 2.2 and Exhibit 2.3, the relative performance of the SBBI® series is illustrated using terminal index values. A "terminal index value" is defined here as the amount that an investment would have grown (or declined) to over a specific time period.[86]

Exhibit 2.2 illustrates the growth of $1 invested in the SBBI® large-cap stock series and $1 dollar invested in the SBBI small-cap stock series over the over the time horizon 1926 through 2020 (95 years total).[87]

A few observations about Exhibit 2.2:

- Small-cap stocks *outperformed* large-cap stocks over the 1926–2020 period: a hypothetical investment of $1 in small-cap stocks grew to nearly $42,000 by the end of 2020, and a hypothetical investment of $1 in large-cap stocks grew to nearly $11,000 by the end of 2020.[88]

- Both equity series in Exhibit 2.2 significantly *outperformed* the bond and bill series in Exhibit 2.3.

Over the long-term, smaller stocks tend to outperform larger stocks. This is known as the "size effect" and is discussed in greater detail in Chapter 7, "Company Size and Return".[89]

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86 For detailed descriptions of how to use monthly SBBI® data to calculate index values over any time horizon, see Chapter 5, "Annual Returns and Indexes".

87 Each hypothetical $1 investment is made on December 31, 1925, at midnight.

88 Pre-calculated index values for the growth of $1 as of each month-end over the January 1926–December 2020 time horizon for each of the seven SBBI® series are presented in table format in the *2021 SBBI® Yearbook* at: dpcostofcapital.com/stocks-bonds-bills-inflation-sbbi-yearbook.

89 "Size Premia" are often used in the development of discount rates for use in discounted cash-flow (DCF) models to value a business, business ownership interest, security, or intangible asset. The CRSP Deciles Size Study and Risk Premium Report Study, both of which provide size premia and other risk premia based upon data licensed from the Center for Research in Security Prices (CRSP) at the University of Chicago Booth School of Business, are fully available in the D&P/Kroll online Cost of Capital Navigator platform at dpcostofcapital.com. CRSP® is a registered trademark and service mark of Center for Research in Security Prices, LLC and has been licensed for use by D&P/Kroll. The D&P/Kroll publications and services are not sponsored, sold or promoted by CRSP®, its affiliates or its parent company. To learn more about CRSP, visit www.crsp.com.

Exhibit 2.2: Using Index Values to Measure the Relative Performance of the SBBI® Large-Cap Stock and SBBI® Small-Cap Stock Series; 1926–2020 (Year-end 1925 = $1.00)

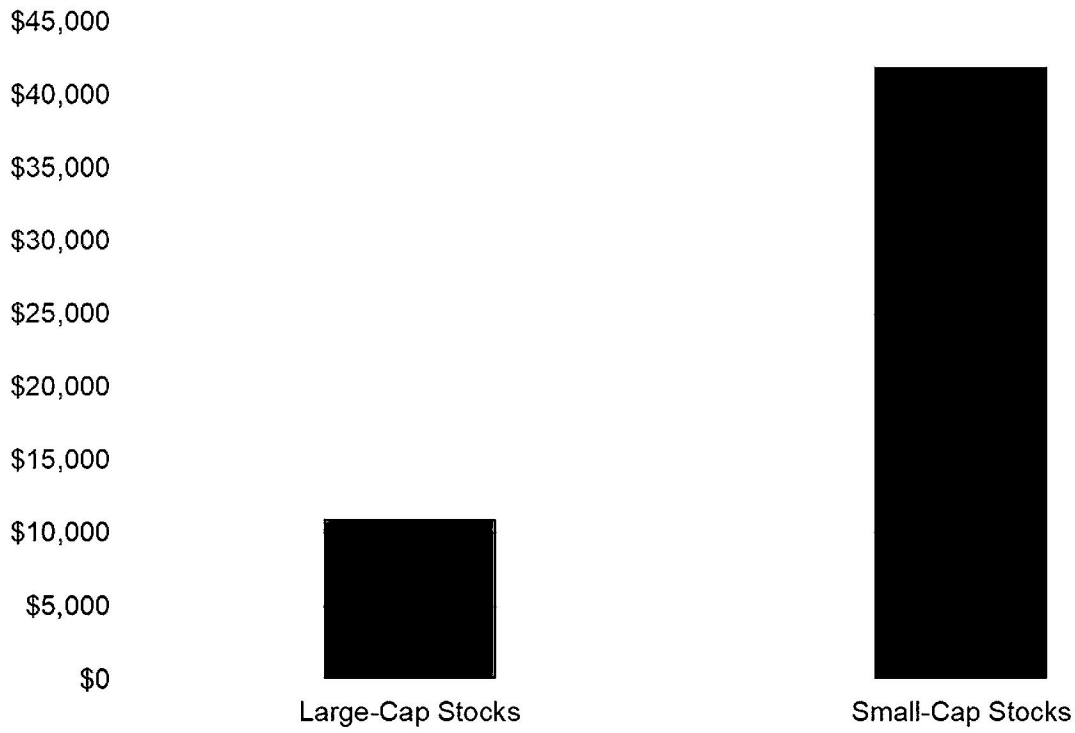

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Exhibit 2.3 illustrates the growth of $1 invested in each of the SBBI® long-term corporate bonds (approximately 20 years maturity), long-term government bonds (approximately 20 years maturity), intermediate-term government bonds (approximately 5 years maturity), 30-day U.S. Treasury bills, and inflation series over the over the time horizon 1926 through 2020 (95 years total).[90]

A few observations about the relationships in Exhibit 2.3:

- All of the bond and bill series in Exhibit 2.3 *underperformed* the equity series in Exhibit 2.2.

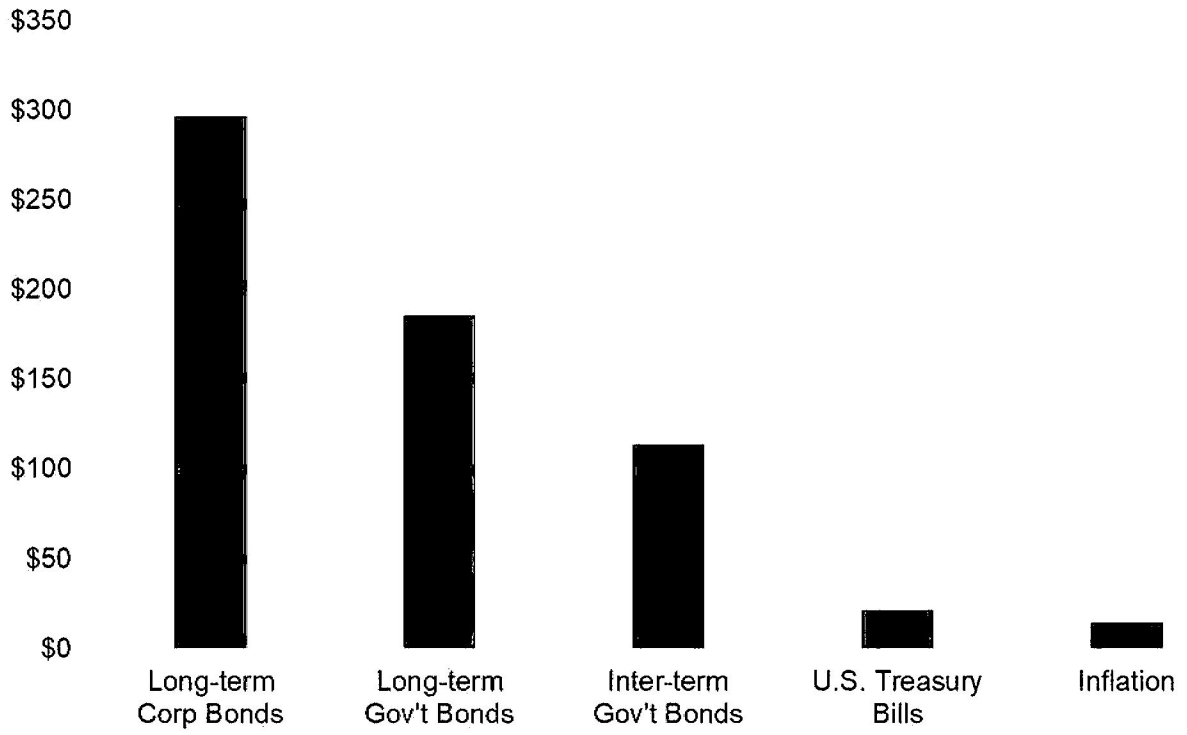
- Long-term corporate bonds *outperformed* long-term government bonds: a hypothetical investment of $1 in long-term corporate bonds grew to nearly $300 by the end of 2020, and a hypothetical investment of $1 in long-term government bonds grew to just a little

[90] Each hypothetical $1 investment is made on December 31, 1925, at midnight.

over $185 by the end of 2020.[91] The bond default premium is defined as the net return from investing in long-term corporate bonds rather than long-term government bonds of equal maturity. Because there is a possibility of default on a corporate bond, bondholders receive a premium that reflects this possibility.[92]

- Long-term government bonds *outperformed* intermediate-term government bonds, which *outperformed* U.S. Treasury bills. The bond horizon premium is the extra return investors demand for holding long-term bonds instead of shorter-term fixed income securities.[93]

Exhibit 2.3: Using Index Values to Measure the Relative Performance of the SBBI® Long-Term Corporate Bond, Long-Term Government Bond, Intermediate Government Bond, U.S. Treasury Bills, and Inflation Series; 1926–2020 (Year-end 1925 = $1.00)



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91 Pre-calculated index values for the growth of $1 as of each month-end over the January 1926–December 2020 time horizon for each of the seven SBBI® series are presented in table format in the full-version *2021 SBBI® Yearbook* at: dpcostofcapital.com/stocks-bonds-bills-inflation-sbbi-yearbook.

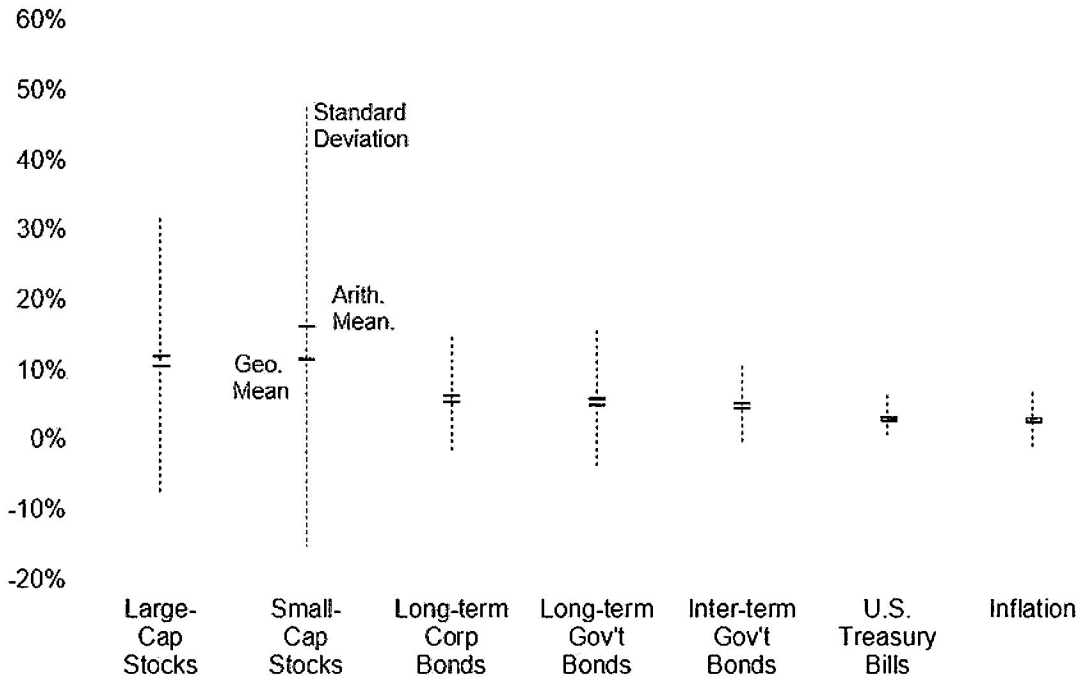
92 To learn more about the bond default premium, see Chapter 4, "Description of the Derived Series".

93 To learn more about the bond horizon premium, see Chapter 4, "Description of the Derived Series".

Summary Statistics of Total Returns

Exhibit 2.4 is a visual presentation of selected summary statistics (geometric mean, arithmetic mean, and standard deviation) of the annual total returns on each asset class over the entire 95-year period of 1926–2020. The data presented in these exhibits are described in detail in Chapters 3 and 6.

Exhibit 2.4: Basic Series, Summary Statistics of Annual Total Returns (%) 1926–2020[94]



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A few observations about Exhibit 2.4 are as follows:

- The returns of riskier assets, such as large- and small-cap stocks, tend to have larger standard deviations (standard deviation is shown as the vertical, red, dashed lines), reflecting the broad distribution of returns from very poor to very good. The returns of less

[94] *Pre-calculated* annual summary statistics (geometric mean, arithmetic mean, standard deviation, etc.) are presented in table format for each of the SBBI® series over various time periods (including 1926–2020) in the full-version *2021 SBBI® Yearbook* at dpcostofcapital.com/stocks-bonds-bills-inflation-sbbi-yearbook. Annualized monthly returns can be used to compare the performance of each asset class for the same year.

risky assets, such as bonds, tend to have smaller standard deviations, indicating the tightness of the return distribution around the mean of the series.[95]

- The arithmetic mean returns (the short, red, horizontal lines) are all *higher* than the geometric mean returns (the short, dark gray, horizontal lines). The difference between these two means is related to the standard deviation, or variability, of the series. Specifically, the *higher* the standard deviation of the returns, the *larger* the difference will be between geometric and arithmetic averages. Alternatively, if there were no variability in the returns (i.e., the same return is experienced in each period being examined), then the geometric and arithmetic averages would be identical.

Capital Appreciation, Income, Reinvestment, and Total Returns

Total annual returns are shown as the sum of three components: capital appreciation returns, income returns, and reinvestment returns. The capital appreciation and income components are explained in Chapter 3. The third component, reinvestment return, reflects monthly income reinvested in the total return index in subsequent months in the year. Thus, for a single month the reinvestment return is zero, but over a longer period of time it is nonzero.

The annual total return formed by compounding the monthly total returns does not equal the sum of the annual capital appreciation and income components; the difference is reinvestment return. A simple example illustrates this point (see Exhibit 2.5). In 1995, an "up" year on a total return basis, the total annual return on large-cap stocks was 37.58%. The annual capital appreciation was 34.11% and the annual income return was 3.04%, totaling 37.15%. The remaining 0.43% (37.58% minus 37.15%) of the 1995 total return came from the reinvestment of dividends in the market.[96] For more information on calculating annual total and income returns, see Chapter 5, "Annual Returns and Indexes."[97]

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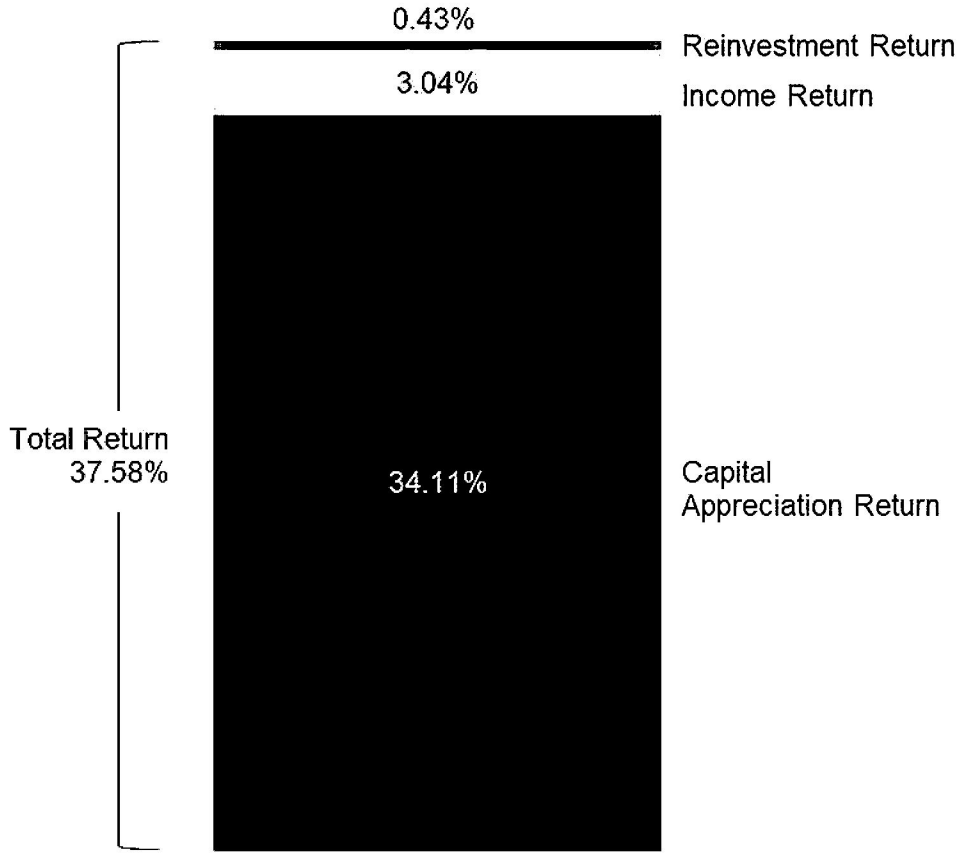
[95] The distribution of the returns of Treasury bills is one-sided, lying almost entirely above zero; that is, Treasury bills almost never experienced negative returns on a yearly basis over the 1926–2020 period (the only negative year was 1938). Although a few deflationary months and quarters have occurred recently, the last negative annual inflation rate (on a calendar year basis) occurred in 1954.

[96] *Pre-calculated* annualized capital appreciation returns, income returns, reinvestment returns, and total returns for the SBBI® Large-Cap Stock series, Long-term Government Bond series, and Intermediate-term Government Bond series for each year over the 1926–2020 time horizon are presented in table format in the full-version *2021 SBBI® Yearbook*. For more information, visit: dpcostofcapital.com/stocks-bonds-bills-inflation-sbbi-yearbook.

[97] *Precalculated* annualized monthly returns for each of the six SBBI series plus inflation, for each year over the 1926–2020 time horizon, are presented in table format in the full-version *2021 SBBI® Yearbook* in that book's appendices. For more information, visit dpcostofcapital.com/stocks-bonds-bills-inflation-sbbi-yearbook .

Exhibit 2.5: Illustration of the Decomposition of the 1995 Total Return of Large-Cap Stocks into Capital Appreciation Return, Income Return, and Reinvestment Return



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Rolling Period Returns

Rolling period returns can be obtained by rolling a data window of fixed length along each time series. They are useful for examining the behavior of returns for holding periods similar to those actually experienced by investors and show the effects of time diversification. Holding assets for long periods of time has the effect of lowering the risk of experiencing a loss in asset value.

If you wanted to calculate 12-month (1 year) rolling period geometric (i.e. compound) returns, you could use the framework illustrated in Exhibit 2.6.[98,99]

[98] Geometric (i.e. compound) returns are used here for example purposes only; rolling period analysis can be performed on any calculable statistic desired.

[99] To learn more about calculating period returns (including annualized monthly returns), see Chapter 6, "Statistical Analysis of Returns".

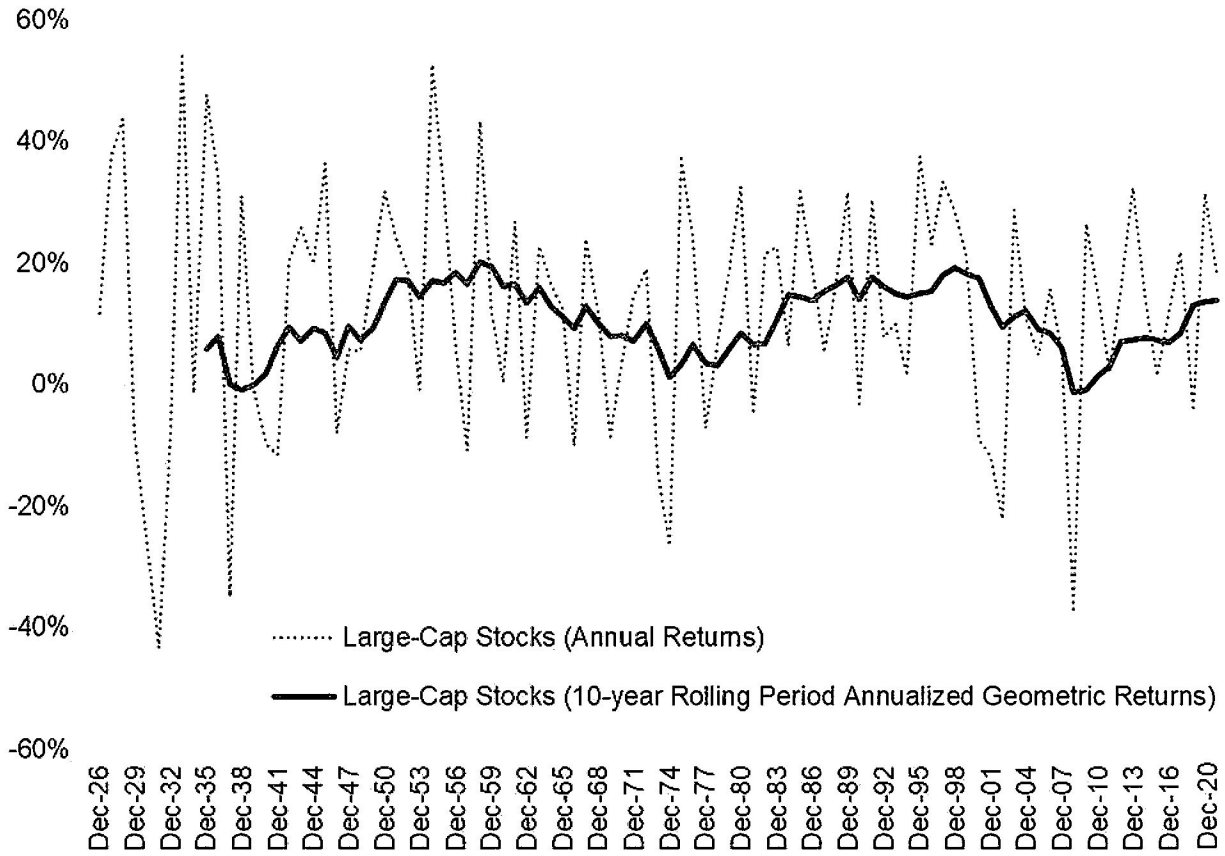
Exhibit 2.6: Framework for Calculating Rolling Period Statistics (geometric return over 12-month periods used for example purposes).

Time Period	Calculations
Month 1	–
Month 2	–
Month 3	–
Month 4	–
Month 5	–
Month 6	–
Month 7	–
Month 8	–
Month 9	–
Month 10	–
Month 11	–
Month 12	Calculate geometric (i.e., compound) return over months 1–12
Month 13	Calculate geometric (i.e., compound) return over months 2–13
Month 14	Calculate geometric (i.e., compound) return over months 3–14
	Etc…

The same framework illustrated in Exhibit 2.6 could be used for any rolling period desired (e.g., 60 months, 120 months, etc.).

Exhibit 2.7 provides a visual representation of annual Large-Cap Stock returns compared to rolling 10-year annual geometric returns.

Exhibit 2.7: Large-Cap Stocks: Annual and 10-year Rolling Period Annual Geometric Returns (1926–2020)



Source of underlying data: Morningstar, Inc. Used with permission. All rights reserved. Calculations by D&P/Kroll. Large-Cap Stocks represented by the following series: IA SBBI® US Large Stock TR USD Ext. For a detailed description of the SBBI® series, see Chapter 3, "Description of the Basic Series". "Stocks, Bonds, Bills, and Inflation" and "SBBI" are registered trademarks of Morningstar, Inc. All rights reserved. Used with permission.

A few observations about Exhibit 2.7 are as follows:

- The 10-year rolling period geometric returns are *less* volatile than the annual returns.
- The 10-year rolling period geometric returns rarely drop below 0%. This implies that holding assets for longer periods of time has the effect of lowering the risk of experiencing a loss in asset value.[100]

[100] *Precalculated* annualized monthly returns (essentially a 1-year holding period) and 5-, 10-, and 20-year rolling geometric (i.e., compound) returns for each of the six SBBI® series plus inflation, and for each year and applicable holding period (from 1926–2020), are presented in table format in the full-version *2021 SBBI® Yearbook*. Precalculated statistics for each year and applicable holding period presented in these tables include: (i) maximum return for each holding period, (ii) the year (or period *ending* in year) of the maximum return for each holding period, (iii) the minimum return for each holding period, (iv) the year, or period *ending* in year of the minimum return for each holding period, (v) the number of times the holding period return was positive over the 1926–2020 period, and (vi) the number of times each of the six SBBI® series plus inflation had the *highest* return for each

Portfolio Performance Returns

A portfolio is a group of assets, such as stocks and bonds, held by an investor. Because stocks, bonds, and cash generally do not react identically to the same economic or market stimulus, combining these assets can often produce a better risk-adjusted return. There were plenty of years in which stock returns were up at times when bond returns were down and vice versa. These offsetting movements can assist in reducing portfolio volatility. Some recent examples include the years 2000 through 2002: Large-cap stocks posted returns of -9.10%, -11.89%, and 22.10%, respectively, while long-term government bonds posted positive returns of 21.48%, 3.70%, and 17.84%, respectively. This illustrates the low correlation of stocks and bonds; that is, they tend to (but not always) move independently of each other.[101,102]

While bond prices tend to fluctuate less than stock prices, they are still subject to price movement. Investing in a mix of asset classes, such as stocks, bonds, and Treasury bills (cash), may protect a portfolio from major downswings in a single asset class. One of the main advantages of diversification is that it makes investors less dependent on the performance of any single asset class.

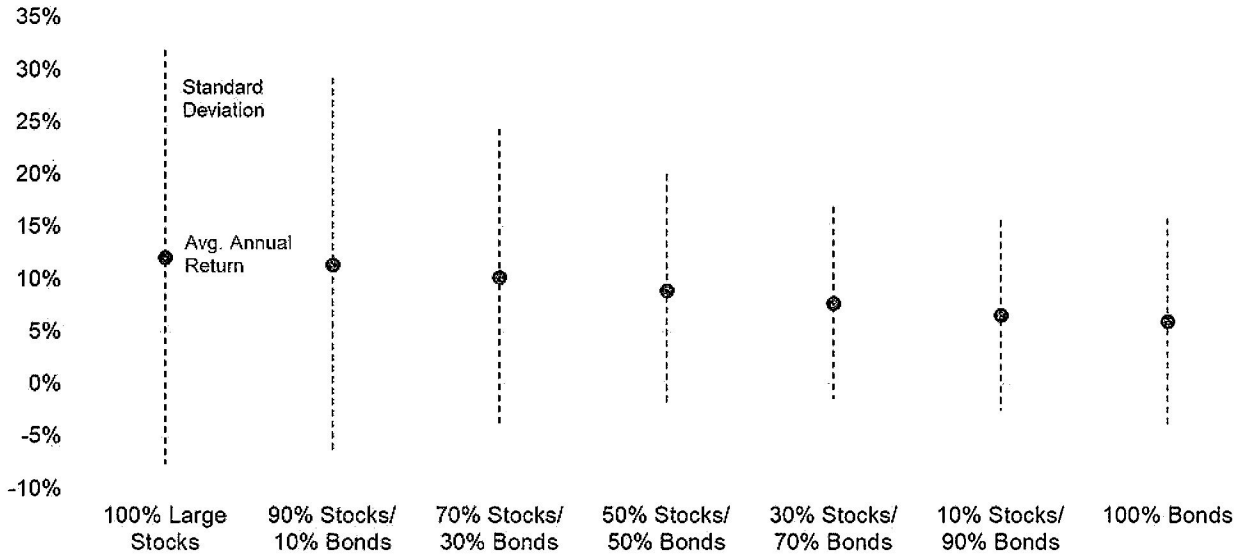
There is generally a tradeoff. As bonds are added to a stock portfolio, the risk as measured by standard deviation tends to decline, but so does return. In Exhibit 2.8 this concept is illustrated for various portfolio mixes over the 1926–2020 time horizon.

holding period over the 1926–2020 period. For more information, visit dpcostofcapital.com/stocks-bonds-bills-inflation-sbbi-yearbook.

101 See Chapter 6, "Statistical Analysis of Returns", for a more detailed discussion of correlation.

102 See Chapter 10, "Using Historical Data in Wealth Forecasting and Portfolio Optimization" for a discussion about forecasting portfolio returns.

Exhibit 2.8: Average Annual Return and Standard Deviation of Large-Cap Stock and Long-Term Government Bond Portfolios (1926–2020)



Source of underlying data: Morningstar, Inc. Used with permission. All rights reserved. Calculations by D&P/Kroll. Asset classes represented by the following Ibbotson Associates (IA) Stocks, Bonds, Bills, and Inflation® (SBBI®) series: (i) Large-Cap Stocks: IA SBBI® US Large Stock TR USD Ext, (ii) Long-Term (i.e. 20-year) Government Bonds: IA SBBI® US LT Govt TR USD. Portfolios were rebalanced monthly over the January 1926–December 2020 time horizon. For a detailed description of the SBBI® series, see Chapter 3, "Description of the Basic Series". "Stocks, Bonds, Bills, and Inflation" and "SBBI" are registered trademarks of Morningstar, Inc. All rights reserved. Used with permission.

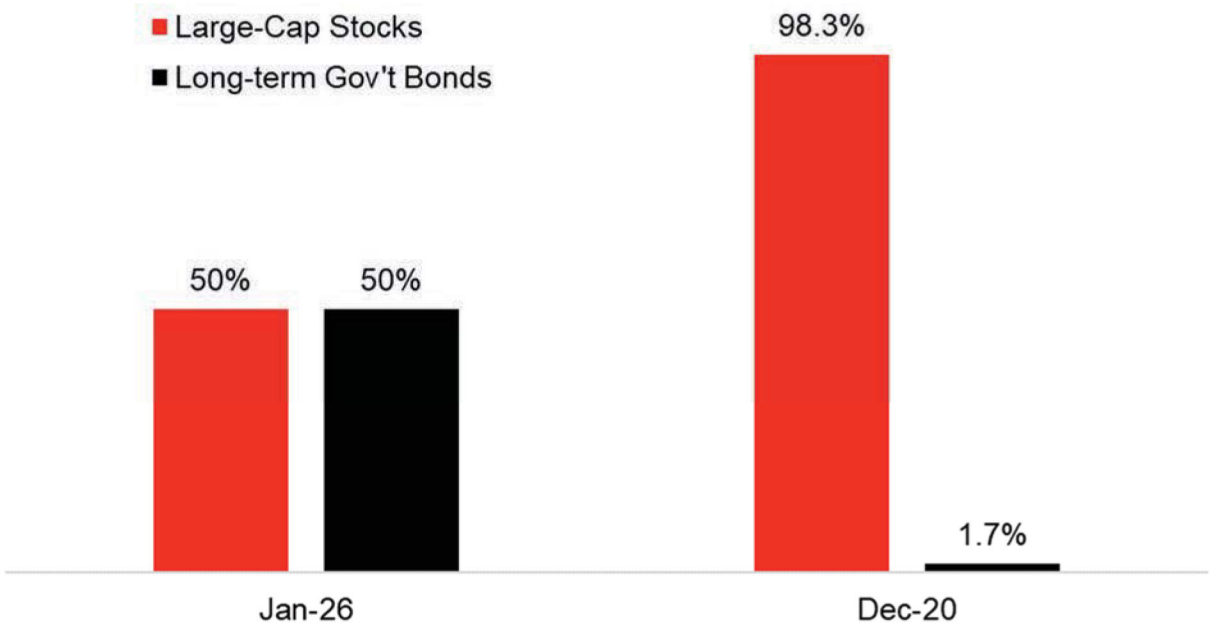
Portfolio Rebalancing

Without periodic rebalancing, a portfolio's asset mix can change from its original percentages as a result of differing returns among the various asset classes held in the portfolio. Thus, asset allocation percentages can change over time without the investor's input.

For example, if a hypothetical investor invests $1.00 in stocks and $1.00 in bonds, the portfolio that he holds is initially 50% stocks and 50% bonds. If the returns of stocks and bonds over the next year are 20% and 5%, respectively, the "stock" portion of his portfolio has now increased to $1.20, and the "bond" portion of his portfolio has now increased to $1.05. The investor's portfolio mix has also changed: it is now approximately 53.3% stocks ($1.20/($1.20 + $1.05)) and 46.7% bonds ($1.05/($1.20 + $1.05)).

This concept is illustrated in Exhibit 2.9. The portfolio mix of a portfolio originally comprised of 50% stocks and 50% bonds at the end of 1925 would (if never rebalanced) become a portfolio comprised of 98.3% stocks and 1.7% bonds by the end of 2020.

Exhibit 2.9: Ending Asset Mix of a Never Rebalanced 50-50 Stock/Bond Portfolio
January 1926–December 2020[103]



Source of underlying data: Morningstar, Inc. Used with permission. All rights reserved. Calculations by D&P/Kroll. Asset classes represented by the following Ibbotson Associates (IA) Stocks, Bonds, Bills, and Inflation® (SBBI®) series: (i) Large-Cap Stocks: IA SBBI® US Large Stock TR USD Ext, (ii) Long-Term (i.e. 20-year) Government Bonds: IA SBBI® US LT Govt TR USD. For a detailed description of the SBBI® series, see Chapter 3, "Description of the Basic Series". "Stocks, Bonds, Bills, and Inflation" and "SBBI" are registered trademarks of Morningstar, Inc. All rights reserved. Used with permission.

[103] *Precalculated* annualized monthly returns (essentially a 1-year holding period) and 5-, 10-, and 20-year rolling geometric (i.e., compound) returns for each year and applicable holding period (from 1926–2020) are presented in table format in the full-version *2021 SBBI® Yearbook* for the following portfolios of SBBI® large-cap stocks and SBBI® long-term (i.e., 20-year) government bonds: (i) 100% Large Stocks, (ii) 90% Stocks/10% Bonds, (iii) 70% Stocks/30% Bonds, (iv) 50% Stocks/50% Bonds, (v) 30% Stocks/70% Bonds, (vi) 10% Stocks/90% Bonds, and (vii) 100% LT Gov't Bonds. The *precalculated* statistics for each year and applicable holding period presented in these tables include: (i) maximum return for each holding period, (ii) the year (or period *ending* in year) of the maximum return for each holding period, (iii) the minimum return for each holding period, (iv) the year, or period *ending* in year of the minimum return for each holding period, (v) the number of times the holding period return was positive over the 1926–2020 period, and (vi) the number of times each of the portfolio mixes had the *highest* return for each holding period over the 1926–2020 period. For more information about the full-version *2021 SBBI® Yearbook*, visit: dpcostofcapital.com/stocks-bonds-bills-inflation-sbbi-yearbook.

Real Estate Investment Trusts (REITs)[104]

Real estate properties can be *directly* owned by individuals (i.e., sole proprietorship), partnerships, corporations (either subchapter C or subchapter S), limited liability company (LLCs) or trusts. An equity investment in real estate can also be made indirectly by purchasing shares of an entity holding real property interests. Real estate entities exist substantially for the purpose of holding, directly or indirectly, title to or beneficial interest in real property. The value of a real estate entity includes many components, such as land, buildings, furniture, fixtures and equipment, intangible assets, and often the business operation.

A real estate investment trust, or REIT, "is a company dedicated to owning, and in most cases, operating income-producing real estate, such as apartments, shopping centers, offices and warehouses. Some REITs also engage in financing real estate."[105,106] Most REITs trade on major stock exchanges. To qualify as a REIT a company must:[107]

- Invest at least 75% of its total assets in real estate
- Derive at least 75% of its gross income from rents from real property, interest on mortgages financing real property or from sales of real estate
- Pay at least 90% of its taxable income in the form of shareholder dividends each year
- Be an entity that is taxable as a corporation
- Be managed by a board of directors or trustees
- Have a minimum of 100 shareholders
- Have no more than 50% of its shares held by five or fewer individuals

REITs can be classified in two broad categories, (i) equity REITs, and (ii) mortgage REITs:[108]

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104 Data presented throughout this section comes from the National Association of Real Estate Investment Trusts® (Nareit®). Nareit® is the worldwide representative voice for real estate investment trusts – REITs – and publicly traded real estate companies with an interest in U.S. real estate and capital markets. Nareit® advocates for REIT-based real estate investment with policymakers and the global investment community. To learn more, visit: https://www.reit.com/.

105 Glossary of REIT Terms, National Association of Real Estate Investment Trusts® (Nareit®), available at: https://www.reit.com/what-reit/glossary-reit-terms.

106 For more information, visit the U.S. Securities and Exchange Commission (SEC) website at: https://www.investor.gov/introduction-investing/basics/investment-products/real-estate-investment-trusts-reits.

107 Source: National Association of Real Estate Investment Trusts® (Nareit®) website at https://www.reit.com/what-reit.

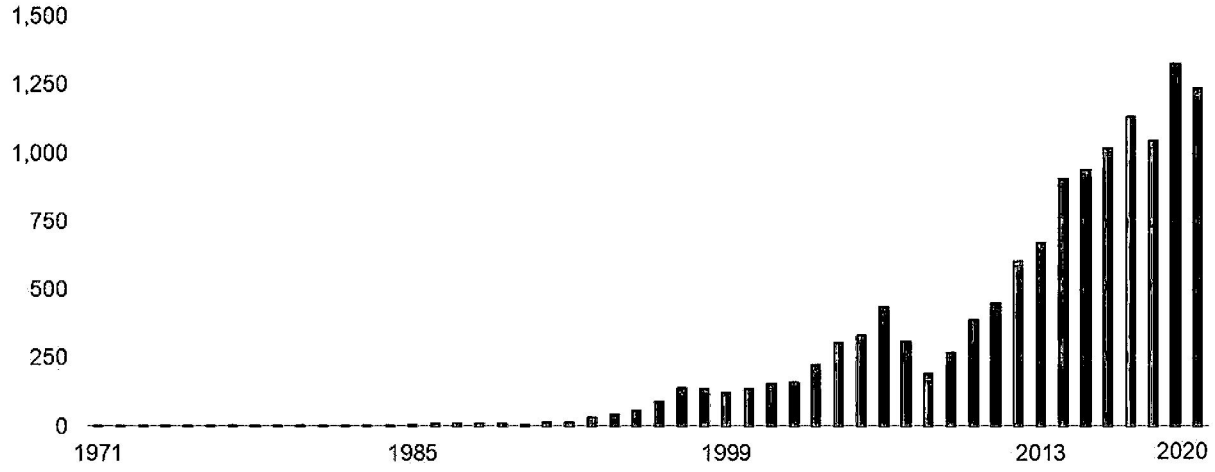
108 Smaller categories of REITs include: (i) Public, non-listed REITs (PNLRs). PNLRs are registered with the SEC, but do not trade on national stock exchanges. (ii) Private REITs are offerings that are exempt from SEC registration and whose shares do not trade on national stock exchanges. Source: National Association of Real Estate Investment Trusts® (Nareit®) at: https://www.reit.com/what-reit.

- **Equity REIT**: A REIT which owns, or has an "equity interest" in, rental real estate (rather than making loans secured by real estate collateral). The majority of REITs are publicly traded equity REITs.[109]

- **Mortgage REIT**: A REIT that makes or owns loans and other obligations that are secured by real estate collateral. Mortgage REITs are commonly referred to as mREITs.[110]

The number of REITs in the U.S. grew dramatically in the last several decades from 34 in 1971 to over 200 at the end of 2020.[111] This growth enabled a broader group of investors to add real estate to their portfolios and enjoy greater liquidity than they would otherwise be able. Exhibit 2.10 displays the growth in market cap of U.S. REITs between 1971 and 2020.

Exhibit 2.10: REITs Market Cap ($ Billions) 1971–2020



Source of underlying data: (i) U.S. REIT Industry Equity Market Cap is available at the National Association of Real Estate Investment Trusts (Nareit®) website at: https://www.reit.com/data-research/reit-market-data/us-reit-industry-equity-market-cap

Historical Returns on Equity REITs

Exhibit 2.11 depicts the growth of $1.00 invested in equity REITs, U.S. small-cap and large-cap stocks, long-term government bonds, Treasury bills, and a hypothetical asset returning the inflation rate over the period from the end of 1971 to the end of 2020. Of the asset classes shown, small-cap stocks accumulated the highest ending wealth. An investment of $1.00 in small-cap stocks at year-end 1971 would have grown to $345.72 by year-end 2020, a compound return of 12.7%. Notice, however, that the same investment in equity REITs would have returned $201.01,

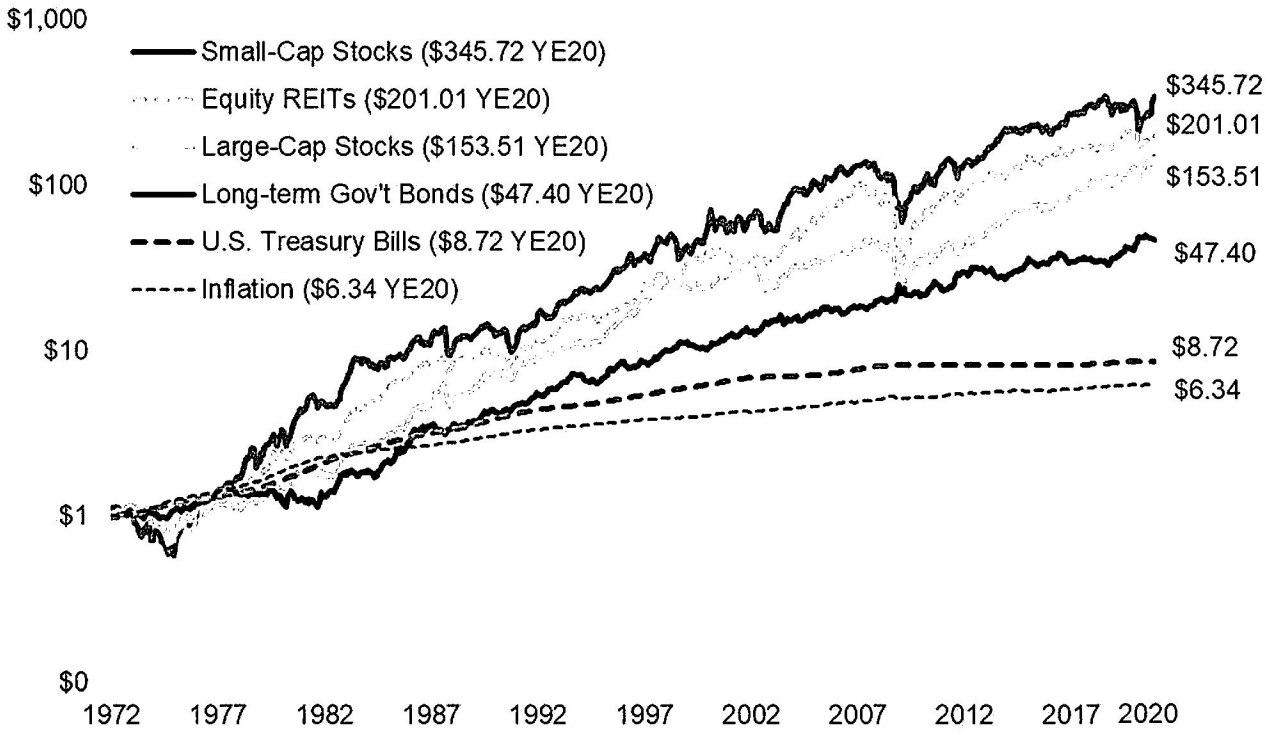
[109] Glossary of REIT Terms, National Association of Real Estate Investment Trusts® (Nareit®), available at: https://www.reit.com/what-reit/glossary-reit-terms.

[110] For more information, visit the U.S. Securities and Exchange Commission (SEC) website at: https://www.investor.gov/introduction-investing/basics/investment-products/real-estate-investment-trusts-reits.

[111] Source: National Association of Real Estate Investment Trusts® (Nareit®) website at https://www.reit.com/what-reit.

a compound return of 11.4%. Equity REITs outperformed all the remaining asset classes and inflation during the period.

Exhibit 2.11: Wealth Indices of Investments in Equity REITs and Basic Series Index (Year-end 1971 = $1.00) 1972–2020



Source 1 of underlying data: Morningstar, Inc. Used with permission. All rights reserved. Calculations by D&P/Kroll. Asset classes and inflation represented by the following Ibbotson Associates (IA) Stocks, Bonds, Bills, and Inflation® (SBBI®) series: (i) Large-Cap Stocks: IA SBBI® US Large Stock TR USD Ext, (ii) Small-Cap Stocks: IA SBBI® US Small Stock TR USD, (iii) Long-Term (i.e. 20-year) Government Bonds: IA SBBI® US LT Govt TR USD, (iv) U.S. (30-day) Treasury Bills: IA SBBI® US 30 Day TBill TR USD, and (v) Inflation: IA SBBI® US Inflation. For a detailed description of the SBBI® series, see Chapter 3, "Description of the Basic Series". "Stocks, Bonds, Bills, and Inflation" and "SBBI" are registered trademarks of Morningstar, Inc. All rights reserved. Used with permission. Performance measured by compound annual rates of return. **Source 2 of underlying data:** National Association of Real Estate Investment Trusts® (Nareit®) at https://www.reit.com/. FTSE Nareit U.S. Real Estate Index Series used: "All Equity REITs" total return series.

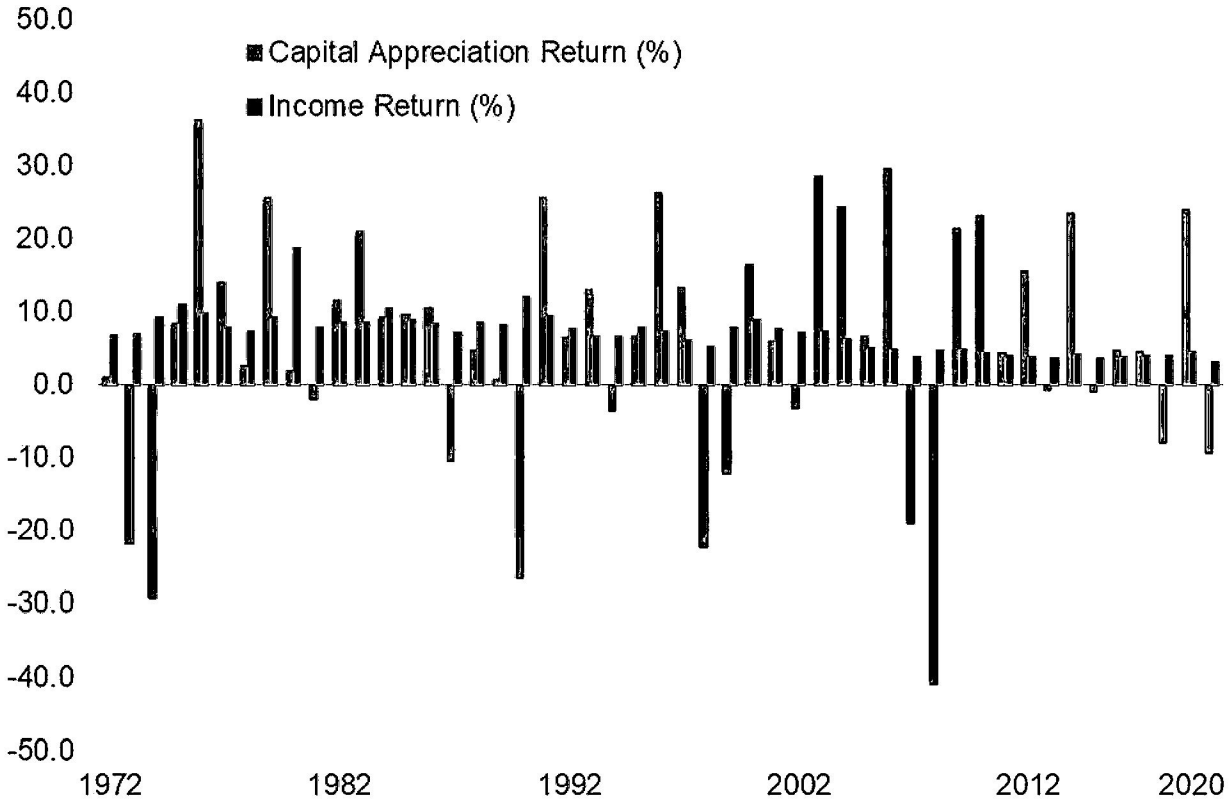
Income Returns on Equity REITs

REITs must pay to shareholders at least 90% of their taxable income each year. As a result, income generated from REITs has proven to be steady and reasonably predictable.

Exhibit 2.12 shows both the income return and capital appreciation return of REITs annually from 1972 to 2020. REITs, similar to equity, can be quite volatile but offer the potential for price appreciation. However, price appreciation is by no means guaranteed (note the large negative price returns of 2007 and 2008). On the other hand, the income produced by REITs has been relatively stable since 1972. Equity REITs posted an average annual income return during that

period of 7.0%. The highest annual income return was 18.8% in 1980 while the lowest was 3.7% in 2015.[112]

Exhibit 2.12: Annual Returns on Equity REITs (%) 1972–2020



Source of underlying data: National Association of Real Estate Investment Trusts® (Nareit®) at https://www.reit.com/. FTSE Nareit U.S. Real Estate Index Series used: (i) "All Equity REITs" price return series, (ii) "All Equity REITs" income return series.

[112] The annualized monthly income returns in Exhibit 2.12 are calculated in accordance with the methodology outlined in Chapter 5, Annual Returns and Indexes."

Correlation of U.S. REITs Compared to Other U.S. Asset Classes

Diversification is "spreading a portfolio over many investments to avoid excessive exposure to any one source of risk."[113] Put simply, diversification is "not putting all your eggs in one basket." Diversification offers the potential of higher returns for the same level of risk or lower risk for the same level of return.

REITs have been an attractive investment vehicle to investors because they have traditionally had a relatively low and declining correlation to stocks and bonds. Though the reasons are not quite clear, this relationship changed in the early 2000s when REITs became increasingly correlated with both stocks and bonds, though correlation levels remain fairly low. A low correlation between assets in a portfolio allows for the possibility of an increase in returns without a corresponding increase in risk, or alternatively, a reduction in risk without a corresponding decrease in return. For example, from 1972 to 2020, a portfolio (rebalanced annually) with a mix of 75% stocks and 25% bonds returned 10.5% annually with a standard deviation of 13.2%. Adding a 20% allocation to REITs to the portfolio increases returns to 10.9% annually and at the same time decreases standard deviation to 13.1%.

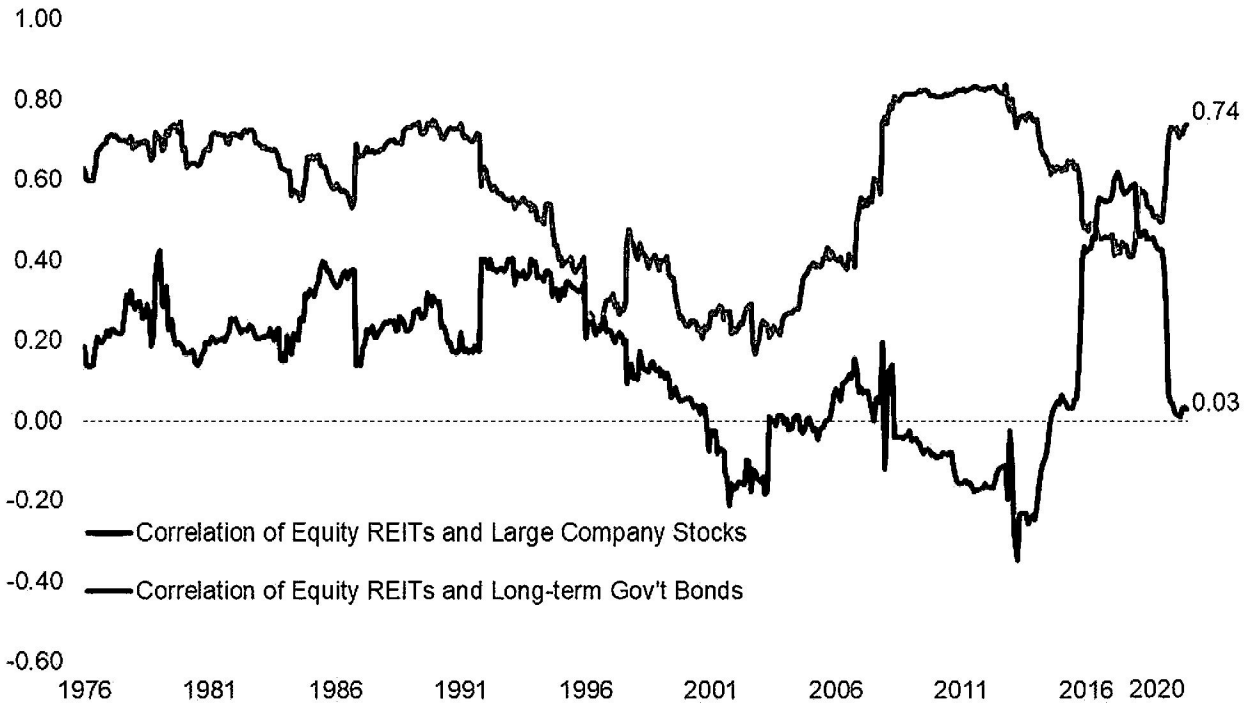
In Exhibit 2.13, the correlation of U.S. REITs and (i) U.S. large company stocks and (ii) long-term U.S. government bonds is shown. Correlation is a measure of how alternative investments "move" relative to each other and is thus a measure of potential diversification benefit. The *higher* the correlation (the more investments "move" together), the *less* potential diversification benefit, whereas the *lower* the correlation (the less investments "move" together), the *greater* the potential diversification benefit. The thinking is that by holding a portfolio of assets that do not have high correlation with each other, as some investments decrease in value, others will increase (and vice versa) and thus potentially mitigate overall portfolio losses.

The correlation of U.S. REITs with both stocks and bonds declined during the 1990s, thus increasing the potential diversification benefit.

In the immediate years leading up to and following the 2008–2009 Financial Crisis, the correlation of U.S. REITs with stocks generally *increased*, decreasing the potential diversification benefit between these two asset classes. This increase in the correlation was likely due, at least in part, to the Federal Reserve's tamping down of interest rates through various market interventions and moral suasion. The publicly-stated intention of these interventions by the Federal Reserve was to boost asset prices (e.g., stocks, housing).

[113] Cara Griffith, "Practical Tax Considerations for Working with REITs", State Tax Notes (October 31, 2011): 315–320, quoting Jennifer Weiss: 316. In 2009, the IRS issued guidance that indicates that the distributions may be in the form of cash or stock in certain instances.

Exhibit 2.13: Rolling 60-month Correlation of U.S. Equity REITs and (i) U.S. Large Company Stocks, and (ii) U.S. Long-term Government Bonds 1972–2020



Source 1 of underlying data: Morningstar, Inc. Used with permission. All rights reserved. Calculations by D&P/Kroll. Asset classes represented by the following Ibbotson Associates (IA) Stocks, Bonds, Bills, and Inflation® (SBBI®) series: (i) Large-Cap Stocks: IA SBBI® US Large Stock TR USD Ext, (ii) Long-Term (i.e. 20-year) Government Bonds: IA SBBI® US LT Govt TR USD. For a detailed description of the SBBI® series, see Chapter 3, "Description of the Basic Series". "Stocks, Bonds, Bills, and Inflation" and "SBBI" are registered trademarks of Morningstar, Inc. All rights reserved. Used with permission. **Source 2 of underlying data:** National Association of Real Estate Investment Trusts® (Nareit®) at https://www.reit.com/. FTSE Nareit U.S. Real Estate Index Series used: "All Equity REITs" total return series.

From 2014 through 2019 these trends seemed to reverse, with the correlation of U.S. REITs with stocks generally decreasing and the correlation of U.S. REITs with long-term U.S. government bonds generally increasing. These correlations' regression to values more typical of pre-financial-crisis levels is likely due, at least in part, to the Federal Reserve's stated public desire to normalize U.S. interest rates.[114,115]

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[114] During the 2008 Financial Crisis and subsequent recession, total assets increased significantly from $870 billion in August 2007 to $4.5 trillion in early 2015. Then, reflecting the Federal Open Market Committee's (FOMC) balance sheet normalization program that took place between October 2017 and August 2019, total assets declined to under $3.8 trillion. Beginning in September 2019, total assets again began to increase. The Federal Reserve's balance sheet increased from approximately $4.2 trillion on February 10, 2020 to approximately $7.4 trillion by the end of 2020 in response to the outbreak of COVID-19 and the surrounding economic upheaval that accompanied it. To learn more about the Federal Reserve's "Monetary Policy Implementation and Balance Sheet Normalization", visit: https://www.federalreserve.gov/monetarypolicy/bst_recenttrends.htm.

[115] The Federal Reserve maintained a target federal funds range of 0.00%–0.25% through open market operations from December 16, 2008 through December 16, 2015. On December 17, 2015, the Federal Reserve raised the target federal funds range 25 bps to 0.25% –0.50%, and again raised the target range an additional 25 bps in each of December 2016, and March 2017, June 2017, December of 2017, March 2018, June 2018, September 2018, and December 2018 to a level of 2.25%–2.50% as of December 31, 2018. In the second half of 2019 the Federal Reserve reversed course and lowered the target federal funds range 25 bps in each of August 2019, September 2019, and October 2019, ending at a level of 1.5%–1.75%. On March 3, 2020 and

In 2020 the rolling 60-month correlation of REITs with stocks increased dramatically while the correlation of REITs with long-term U.S. government bonds decreased dramatically. This was primarily driven by a strong de-coupling in the first quarter of 2020 of the returns of REITs and stocks with havens of safety like U.S. treasuries likely due to the spread of COVID-19 and risks associated with that. REITs moved even more strongly contra to bonds than stocks did in this period[116] and then failed to recover to the degree that stocks did after the first quarter. The respective total return of REITs, stocks (as measured by the SBBI Large Company Stocks series), and long-term U.S. government bonds (as measure by the SBBI Long-term Government Bond series) in 2020 was –5.9%, 18.4%, and 16.7%, respectively.

Summary Statistics for Equity REITs and Basic Series

Exhibit 2.14 shows summary statistics of annual total returns for REITs and the SBBI® basic series from 1972 to 2020. The summary statistics presented are geometric mean, arithmetic mean, and standard deviation. While small-cap stocks posted the highest geometric mean over the period analyzed, they also had the highest amount of risk. Equity REITs produced a higher return than large -cap stocks with only slightly higher risk.

Exhibit 2.14: Summary Statistics of Annual Returns (%) 1972–2020

	Geometric Average	Arithmetic Average	Standard Deviation
Equity REITs	11.4	12.9	17.7
Large-Cap Stocks	10.8	12.3	17.2
Small-Cap Stocks	12.7	14.9	22.2
Long-term Corp Bonds	8.5	9.0	10.1
Long-term Gov't Bonds	8.2	8.8	12.0
Inter-term Gov't Bonds	6.8	7.0	6.4
U.S. Treasury Bills	4.5	4.6	3.5
Inflation	3.8	3.9	3.0

Source1 of underlying data: Morningstar, Inc. Used with permission. All rights reserved. Calculations by D&P/Kroll. Asset classes and inflation represented by the Ibbotson Associates (IA) Stocks, Bonds, Bills, and Inflation® (SBBI®) series, as follows: (i) Large-Cap Stocks: IA SBBI® US Large Stock TR USD Ext, (ii) Small-Cap Stocks: IA SBBI® US Small Stock TR USD, (iii) Long-term (i.e., 20-year) Corporate Bonds: IA SBBI® US LT Corp TR USD, (iv) Long-Term (i.e. 20-year) Government Bonds: IA SBBI® US LT Govt TR USD, (v) Intermediate-term (i.e., 5-year) Government Bonds: IA SBBI® US IT Govt TR USD, (vi) U.S. (30-day) Treasury Bills: IA SBBI® US 30 Day TBill TR USD, and (vii) Inflation: IA SBBI® US Inflation. For a detailed description of the SBBI® series, see Chapter 3, "Description of the Basic Series". "Stocks, Bonds, Bills, and Inflation" and "SBBI" are registered trademarks of Morningstar, Inc. All rights reserved. Used with permission. **Source 2 of underlying data:** National Association of Real Estate Investment Trusts® (Nareit®) at https://www.reit.com/. FTSE Nareit U.S. Real Estate Index Series used: "All Equity REITs" total return series.

on March 16, 2020 the Federal Reserve lowered the target federal funds range (again, in response to the outbreak of COVID-19) an additional 50 bps and 100 bps, respectively, bringing the range to 0.00%–0.25%, where it remained through the end of 2020. This marks the lowest the target federal funds range has been since 2015. For a list of Federal Reserve open market operations, visit: https://www.federalreserve.gov/ monetarypolicy/openmarket.htm. For a detailed discussion of monetary policy and interest rates, see the Cost of Capital Navigator's Resources (subscription required) at dpcostofcapital.com.

[116] By the end of March 2020 REITs and stocks experience large losses (down 25.4% and 19.6% through March 2020 YTD, respectively) while long-term U.S. government bonds showed large gains (up 19.6% through March 2020 YTD).

Exhibit 2.15 presents annual serial correlations and cross-correlations from 1972 to 2020 for equity REITs and the six basic SBBI® asset classes plus inflation. The serial correlation, or the extent to which the return in one period is related to the return in the next period (discussed in greater detail in Chapter 6) of equity REITs suggests no strong pattern; it can best be interpreted as mostly random or unpredictable.

Exhibit 2.15: Serial and Cross-Correlations of Annual Returns 1972–2020

	Equity REITs	Large-Cap Stocks	Small-Cap Stocks	Long-term Corp Bonds	Long-term Gov't Bonds	Inter-term Gov't Bonds	U.S. Treasury Bills	Inflation
Equity REITs	1.00							
Large-Cap Stocks	0.54	1.00						
Small-Cap Stocks	0.74	0.72	1.00					
Long-term Corp Bonds	0.28	0.29	0.12	1.00				
Long-term Gov't Bonds	0.05	0.04	-0.12	0.89	1.00			
Inter-term Gov't Bonds	0.04	0.05	-0.04	0.82	0.86	1.00		
U.S. Treasury Bills	0.05	0.03	0.06	0.03	0.08	0.42	1.00	
Inflation	0.00	-0.11	0.08	-0.32	-0.26	-0.03	0.70	1.00
Serial Correlation	0.07	-0.02	0.00	-0.12	-0.28	0.09	0.89	0.75

Source 1 of underlying data: Morningstar, Inc. Used with permission. All rights reserved. Calculations by D&P/Kroll. Asset classes and inflation represented by the Ibbotson Associates (IA) Stocks, Bonds, Bills, and Inflation® (SBBI®) series, as follows: (i) Large-Cap Stocks: IA SBBI® US Large Stock TR USD Ext, (ii) Small-Cap Stocks: IA SBBI® US Small Stock TR USD, (iii) Long-term (i.e., 20-year) Corporate Bonds: IA SBBI® US LT Corp TR USD, (iv) Long-Term (i.e. 20-year) Government Bonds: IA SBBI® US LT Govt TR USD, (v) Intermediate-term (i.e., 5-year) Government Bonds: IA SBBI® US IT Govt TR USD, (vi) U.S. (30-day) Treasury Bills: IA SBBI® US 30 Day TBill TR USD, and (vii) Inflation: IA SBBI® US Inflation. For a detailed description of the SBBI® series, see Chapter 3, "Description of the Basic Series". "Stocks, Bonds, Bills, and Inflation" and "SBBI" are registered trademarks of Morningstar, Inc. All rights reserved. Used with permission. **Source 2 of underlying data:** National Association of Real Estate Investment Trusts® (Nareit®) at https://www.reit.com/. FTSE Nareit U.S. Real Estate Index Series used: "All Equity REITs" total return series.

In conclusion, equity REITs have historically offered an attractive risk/return trade-off for investors. They have provided a current income stream along with the potential for long-term capital appreciation. The recent increase in correlation of REIT returns with other investments may lead to a decrease in the overall diversification benefit to investors, but they remain an attractive option.

Chapter 3
Description of the Basic Series

Large-Cap Stocks

Large-cap stocks are represented by the Ibbotson Associates (IA) Stocks, Bonds, Bills, and Inflation® (SBBI®) series "IA SBBI® US Large Stock TR USD Ext."[117] This series is essentially the S&P 500 Index. Large-cap stock total returns ranged from a high of 54.0% in 1933 to a low of -43.3% in 1931.

Total Returns

From February 1970 to the present, the large-cap stock total return is provided by S&P Dow Jones Indices which calculates the total return based on the daily reinvestment of dividends on the ex-dividend date. S&P uses closing pricing from stock exchanges in its calculation. Prior to February 1970, the total return for a given month was calculated by summing the capital appreciation return and the income return as described below.

The large-cap stock total return index is based upon the S&P Composite Index. This index is a readily available, carefully constructed, market-capitalization-weighted benchmark of large-cap stock performance. Market-capitalization-weighted means that the weight of each stock in the index, for a given month, is proportionate to its market capitalization (price times the number of shares outstanding) at the beginning of that month. Currently, the S&P Composite includes 500 of the largest stocks (in terms of stock market value) in the U.S.; prior to March 1957 it consisted of 90 of the largest stocks.

Capital Appreciation Return

The capital appreciation component of the large-cap stock total return is the change in the S&P 500 index as reported by S&P Dow Jones Indices from March 1928 to December 2020 and in Standard & Poor's *Trade and Securities Statistics* from January 1926 to February 1928.

Income Return

From February 1970 to December 2020, the income return was calculated as the difference between the total return and the capital appreciation return. From January 1926 to January 1970, quarterly dividends were extracted from rolling yearly dividends reported quarterly in S&P's *Trade and Securities Statistics*, then allocated to months within each quarter using proportions taken from the 1974 actual distribution of monthly dividends within quarters.

[117] This is the formal name of the series in Morningstar Direct.

Contributors to Total Return

As discussed previously in Chapter 2, total return is the sum of three components: capital appreciation return, income return, and reinvestment return. When investors invest in equities (i.e., stocks), they typically tend to focus on the "capital appreciation" component of total return. In other words, investors focus on buying Stock ABC at, say, $10 and then selling it at some higher value.

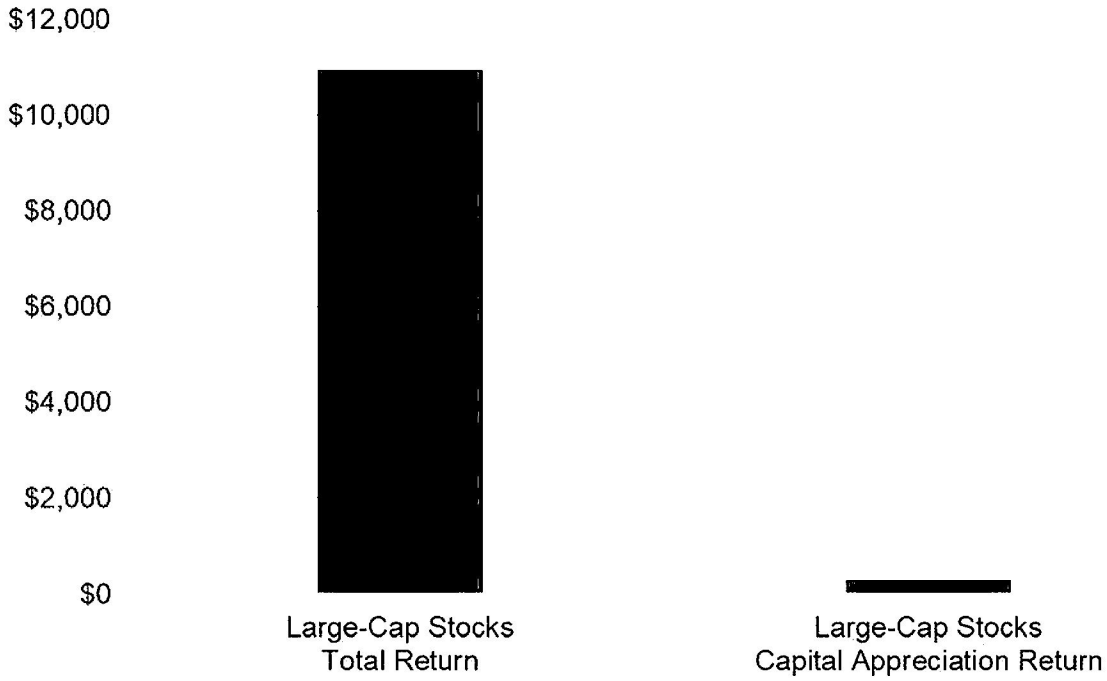
But is the capital appreciation component actually the largest contributor to investors' total return over the long-term? To investigate this, the growth of $1 hypothetically invested at the end of 1925 in each of the SBBI® large-cap stocks total return series and the SBBI® large-cap stocks capital appreciation return series is compared in Exhibit 3.1. The terminal index value of $1 invested over the 1926–2020 time horizon in the total return series far outstrips the terminal index value of $1 invested over the 1926–2020 time horizon in the capital appreciation return series.

This implies that over the long-term, capital appreciation's contribution to total return is relatively *small* compared to the other two components of total return, income return and reinvestment return. [118,119]

[118] To learn more about calculating index values, see Chapter 5, "Annual Returns and Indexes".

[119] Pre-calculated index values at each month-end over the January 1926–December 2020 time horizon are presented in table format in the *2021 SBBI® Yearbook* available at dpcostofcapital.com/stocks-bonds-bills-inflation-sbbi-yearbook: Large-Capitalization Stocks: Total Return Index, Large-Capitalization Stocks: Capital Appreciation Index, Small-Capitalization Stocks: Total Return Index, Long-term Corporate Bonds: Total Return Index, Long-term Government Bonds: Total Return Index, Long-term Government Bonds: Capital Appreciation Index, Intermediate-term Government Bonds: Total Return Index, Intermediate-term Government Bonds: Capital Appreciation Index, U.S. Treasury Bills: Total Return Index, Inflation Index.

Exhibit 3.1: Large-Cap Stocks Total Return and Capital Appreciation Return; Terminal Index Value as of December 31, 2020 (Year-End 1925 = $1.00)



Source of underlying data: Morningstar, Inc. Used with permission. All rights reserved. Calculations by D&P/Kroll. Asset classes represented by the following Ibbotson Associates (IA) Stocks, Bonds, Bills, and Inflation® (SBBI®) series: (i) Large-Cap Stocks total return series: IA SBBI® US Large Stock TR USD Ext, (ii) Large-Cap Stocks capital appreciation return series: IA SBBI US Large Stock Cap App Ext. For a detailed description of the SBBI® series, see Chapter 3, "Description of the Basic Series". "Stocks, Bonds, Bills, and Inflation" and "SBBI" are registered trademarks of Morningstar, Inc. All rights reserved. Used with permission.

Small-Cap Stocks

Small-cap stocks are represented by the Ibbotson Associates (IA) Stocks, Bonds, Bills, and Inflation® (SBBI®) series, "Small-Cap Stocks: IA SBBI® US Small Stock TR USD".[120] Small-cap stock total returns ranged from a high of 142.9% in 1933 to a low of -58.0% in 1937.

DFA U.S. Micro Cap Portfolio (April 2001 December 2020)

For April 2001 to December 2020, the small-cap stock return series is the total return achieved by the DFA U.S. Micro Cap Portfolio net of fees and expenses. In April 2001, Dimensional Fund Advisors renamed the DFA U.S. 9–10 Small Company Portfolio (see next page) the DFA U.S. Micro Cap Portfolio and changed some of the criteria. The fund is designed to capture the returns and diversification benefits of a broad cross-section of U.S. small companies on a market-cap weighted basis. The fund's target buy range includes those companies whose market cap falls in the lowest 5% of the market universe defined as the aggregate of the NYSE, NYSE AMEX, and

[120] This is the formal name of the series in Morningstar Direct.

NASDAQ National Market System or companies smaller than the 1,500th largest U.S. company in the same market universe, whichever results in a higher market cap break.

The market universe is examined on a dynamic basis to determine which stocks are eligible for purchase or sale based on market capitalization. To minimize turnover, a hold or buffer range is created for stocks that migrate above the buy range. The upper bound of the hold range is the fifth percentile of the market universe. Stocks that grow above the hold range are eligible for sale and proceeds are reinvested into the portfolio.

At year-end 2020, the DFA U.S. Micro Cap Portfolio contained 1,618 stocks with a weighted average market cap of $1.763 billion.

DFA U.S. 9–10 Small Company Portfolio (January 1982–March 2001)

For January 1982 to March 2001, the small-cap stock return series was the total return achieved by the DFA U.S. Small Company 9–10 (for ninth and 10th deciles) Portfolio. The fund's target buy range was a market-cap-weighted universe of the ninth and 10th deciles of the New York Stock Exchange, plus stocks listed on the NYSE Amex (now the NYSE MKT) and NASDAQ National Market with the same or less capitalization as the upper bound of the NYSE ninth decile. Because the lower bound of the 10th decile is near zero, stocks were not purchased if they were smaller than $10 million in market cap (although they were held if they fell below that level).

NYSE Fifth Quintile Returns (1926–1981)

The equities of smaller companies from 1926 to 1980 are represented by the historical series developed by Professor Rolf W. Banz (see Acknowledgements). This is composed of stocks making up the fifth quintile (i.e., the ninth and 10th deciles) of the New York Stock Exchange (NYSE); the stocks on the NYSE are ranked by capitalization, and each decile contains an equal number of stocks at the beginning of each formation period. The ninth and 10th decile portfolio was first ranked and formed as of December 31, 1925. This portfolio was "held" for five years with value weighted portfolio returns computed monthly. Every five years the portfolio was rebalanced (i.e., all of the stocks on the NYSE were re-ranked, and a new portfolio of those falling in the ninth and 10th deciles was formed) as of December 31, 1930 and every five years thereafter through December 31, 1980. This method avoided survivorship bias by including the return after the delisting or failure of a stock in constructing the portfolio returns. (Survivorship bias is caused by studying only stocks that have survived events such as bankruptcy and acquisition.)

For 1981, Dimensional Fund Advisors updated the returns using Professor Banz's methods. The data for 1981 are significant to only three decimal places (in decimal form) or one decimal place when returns are expressed in percent.

Long term Corporate Bonds

Long-term (i.e., 20-year) corporate bonds are represented by the Ibbotson Associates (IA) Stocks, Bonds, Bills, and Inflation® (SBBI®) series, "IA SBBI® US LT Corp TR USD."[121] Long-term corporate bond total returns ranged from a high of 42.6% in 1982 to a low of -8.1% in 1969.

Total Returns

For 1969 to 2020, corporate bond total returns are represented by the FTSE USBIG Corp AAA/AA 10+ Yr (formerly Citigroup Long-Term High-Grade Corporate Bond Index). Because most large corporate bond transactions take place over the counter, a major dealer is the natural source of these data. The index includes nearly all Aaa- and Aa-rated bonds. If a bond is downgraded during a particular month, its return for the month is included in the index before removing the bond from future portfolios.

For 1926 to 1968, total returns were calculated by summing the capital appreciation returns and the income returns. For the period 1946 to 1968, Ibbotson and Sinquefield (1976) backdated the Salomon Brothers index, using Salomon Brothers' monthly yield data; a methodology similar to that used by Salomon was used for 1969 to 2016. Capital appreciation returns were calculated from yields assuming (at the beginning of each monthly holding period) a 20-year maturity, a bond price equal to par, and a coupon equal to the beginning-of-period yield.

For the period 1926 to 1945, Standard & Poor's monthly High Grade Corporate Composite yield data were used, assuming a 4% coupon and a 20-year maturity. The conventional present-value formula for bond price was used for the beginning and end-of-month prices.[122] The monthly income return was assumed to be one-twelfth the coupon.

Long-term Government Bonds

Long-term (i.e., 20-year) government bonds are represented by the Ibbotson Associates (IA) Stocks, Bonds, Bills, and Inflation® (SBBI®) series, "IA SBBI® US LT Govt TR USD."[123] Long-term government bond total returns ranged from a high of 40.4% in 1982 to a low of -14.9% in 2009.

Total Returns

The total returns on long-term government bonds from 1977 to 2020 are constructed with data from The Wall Street Journal. The data for 1926 to 1976 is obtained from the Government Bond File at the Center for Research in Security Prices at the University of Chicago Booth School of Business.

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121 This is the formal name of the series in Morningstar Direct.

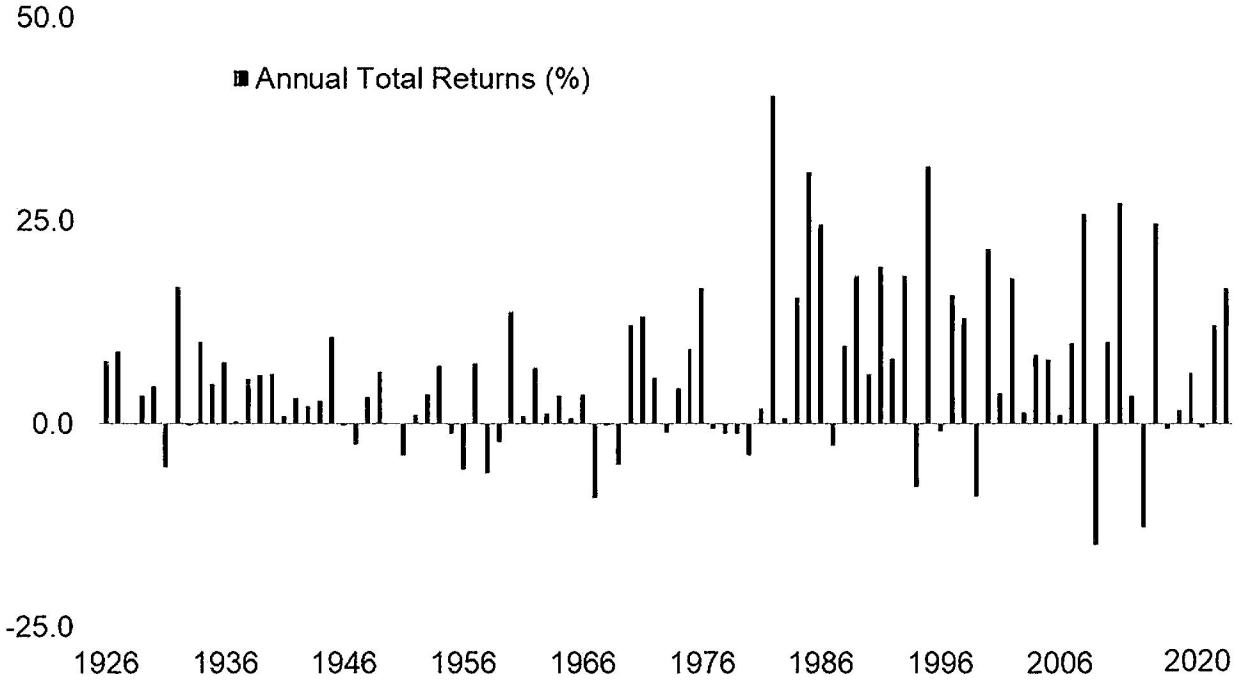
122 This formula is presented in Ross, S. A., & Westerfield, R.W. 1988. "Level-Coupon Bonds." P. 97 in *Corporate Finance* (St. Louis: Times Mirror/Mosby).

123 This is the formal name of the series in Morningstar Direct.

The bonds used to construct the index from 1926–2020 are shown in Exhibit 3.3. The bond used in 2020 is the 4.25% issue that matures on November 15, 2040. To the greatest extent possible, a one-bond portfolio with a term of approximately 20 years and a reasonably current coupon – whose returns did not reflect potential tax benefits, impaired negotiability, or special redemption or call privileges – was used each year. Where "flower" bonds (tenderable to the Treasury at par in payment of estate taxes) had to be used, the bond with the smallest potential tax benefit was chosen. Where callable bonds had to be used, the term of the bond was assumed to be a simple average of the maturity and first call dates minus the current date. The bond was "held" for the calendar year and returns were computed.

The annual total returns for the long-term government bond series from 1926–2020 is illustrated in Exhibit 3.2.

Exhibit 3.2: Long-term Government Bonds Annual Total Returns (%) 1926–2020



Source of underlying data: Morningstar, Inc. Used with permission. All rights reserved. Calculations by D&P/Kroll. Asset classes represented by the Ibbotson Associates (IA) Stocks, Bonds, Bills, and Inflation® (SBBI®) series, as follows: (i) Long-Term (i.e. 20-year) Government Bonds: IA SBBI® US LT Govt TR USD. For a detailed description of the SBBI® series, see Chapter 3, "Description of the Basic Series". "Stocks, Bonds, Bills, and Inflation" and "SBBI" are registered trademarks of Morningstar, Inc. All rights reserved. Used with permission.

The U.S. Treasury has periodically changed the maturities that it issues. For example, in April 1986 the U.S. Treasury stopped issuing 20-year Treasuries, and from October 2001 through January 2006 the U.S. Treasury did not issue 30-year bonds (it resumed issuing 30-year Treasury bonds in February 2006), making the 10-year bond the longest-term Treasury security issued over the October 2001–January 2006 period. Most recently, on January 16, 2020, the U.S. Department of the Treasury announced its plans to issue a 20-year nominal coupon bond in the

first half of calendar year 2020, the first time a 20-year maturity will be offered since March 1986.[124,125]

Total returns for 1977 to 2020 are calculated as the change in the flat (or and-interest) price.[126] The flat price is the average of the bond's bid and ask prices plus the accrued coupon.[127] The accrued coupon is equal to zero on the day a coupon is paid and increases over time until the next coupon payment according to the formula below:

$$A = fC$$

Where:

A = Accrued coupon

C = Semiannual coupon rate

f = (number of days since last coupon payment)/(number of days from last coupon payment to next coupon payment)

Income Return

For 1977 to 2020, the income return for the long-term government bond series is calculated as the change in flat price plus any coupon actually paid from one period to the next, holding the yield constant over the period. As in the total return series, the exact number of days composing the period is used. For 1926 to 1976, the income return for a given month is calculated as the total return minus the capital appreciation return.

Capital Appreciation or Return in Excess of Yield

For 1977 to 2020, capital appreciation is taken as the total return minus the income return for each month. For 1926 to 1976, the capital appreciation return (also known as the return in excess of yield) is obtained from the CRSP Government Bond File.

A bond's capital appreciation is defined as the total return minus the income return; that is, the return in excess of yield. This definition omits the capital gain or loss that comes from the movement of a bond's price toward par (in the absence of an interest-rate change) as it matures.

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124 To learn more, visit the U.S. Department of the Treasury website at: https://home.treasury.gov/news/press-releases/sm878

125 See Kate Davidson, "Treasury to Issue New 20-Year Bond in First Half of 2020", *The Wall Street Journal*, January 16, 2020 at: https://www.wsj.com/articles/treasury-to-issue-new-20-year-bond-in-first-half-of-2020-11579217450

126 "Flat price" is used here to mean the unmodified economic value of the bond, i.e., the and-interest price, or quoted price plus accrued interest. In contrast, some sources use flat price to mean the quoted price.

127 For the purpose of calculating the return in months when a coupon payment is made, the change in the flat price includes the coupon.

Capital appreciation, as defined here, captures changes in bond prices caused by changes in the interest rate.

Yields

The yield on the long-term government bond series is defined as the internal rate of return that equates the bond's price (the average of bid and ask, plus the accrued coupon) with the stream of cash flows (coupons and principal) promised to the bondholder. The yields reported for 1977 to 2020 were calculated from *The Wall Street Journal* prices for the bonds listed in Exhibit 3.3. For non-callable bonds, the maturity date is shown. For callable bonds, the first call date and the maturity dates are shown as in the following example: 10/15/47–52 refers to a bond that is first callable on Oct. 15, 1947, and matures on Oct. 15, 1952. Dates from 47–99 refer to 1947 to 1999; 00–12 refers to 2000 to 2012. For callable bonds trading below par, the yield to maturity is used; for those trading above par, the yield to call is used. The yields for 1926 to 1976 were obtained from the CRSP Government Bond File.

Exhibit 3.3: Long-term and Intermediate-term Government Bond Issues

Long-term Gov't Bonds

Period Bond Is Held In Index	Coupon (%)	Call/Maturity Date
1926–1931	4.250	10/15/47–52
1932–1935	3.000	9/15/51–55
1936–1941	2.875	3/15/55–60
1942–1953	2.500	9/15/67–72
1954–1958	3.250	6/15/78–83
1959–1960	4.000	2/15/1980
1961–1965	4.250	5/15/75–85
1966–1972	4.250	8/15/87–92
1973–1974	6.750	2/15/1993
1975–1976	8.500	5/15/94–99
1977–1980	7.875	2/15/95–00
1981	8.000	8/15/96–01
1982	13.375	8/15/2001
1983	10.750	2/15/2003
1984	11.875	11/15/2003
1985	11.750	2/15/05–10
1986–1989	10.000	5/15/05–10
1990–1992	10.375	11/15/07–12
1993–1996	7.250	5/15/2016
1997–1998	8.125	8/15/2019
1999–2001	8.125	8/15/2021
2002	6.250	8/15/2023
2003–2004	7.500	11/15/2024
2005	6.875	8/15/2025
2006	6.750	8/15/2026
2007	6.375	8/15/2027
2008	5.500	8/15/2028
2009	5.250	2/15/2029
2010–2012	5.375	2/15/2031
2013	4.500	2/15/2036
2014	4.500	2/15/2036
2015	4.500	2/15/2036
2016	4.500	2/15/2036
2017	4.750	2/15/2037
2018	4.500	5/15/2038
2019	4.250	5/15/2039
2020	4.250	11/15/2040

Intermediate-term Gov't Bonds

Period Bond Is Held In Index	Coupon (%)	Call/Maturity Date
1934–1936	3.250	8/1/1941
1937	3.375	3/15/1943
1938–1940	2.500	12/15/1945
1941	3.000	1/1/1946
1942	3.000	1/1/1947
1943	1.750	6/15/1948
1944–1945	2.000	3/15/1950
1946	2.000	6/15/1951
1947	2.000	3/15/1952
1948	2.000	9/15/1953
1949	2.500	3/15/1954
1950	2.250	6/15/1955
1951–1952	2.500	3/15/1958
1953	2.375	6/15/1958
1954	2.375	3/15/1959
1955	2.125	11/15/1960
1956	2.750	9/15/1961
1957–1958	2.500	8/15/1963
1959	3.000	2/15/1964
1960	2.625	2/15/1965
1961	3.750	5/15/1966
1962	3.625	11/15/1967
1963	3.875	5/15/1968
1964	4.000	2/15/1969
1965	4.000	8/15/1970
1966	4.000	8/15/1971
1967	4.000	2/15/1972
1968	4.000	8/15/1973
1969	5.625	8/15/1974
1970	5.750	2/15/1975
1971	6.250	2/15/1976
1972	1.500	10/1/1976
1973	6.250	2/15/1978
1974	6.250	8/15/1979
1975	6.875	5/15/1980
1976	7.000	2/15/1981
1977	6.375	2/15/1982
1978	8.000	2/15/1983
1979	7.250	2/15/1984

Intermediate-term Gov't Bonds (cont.)

Period Bond Is Held In Index	Coupon (%)	Call/Maturity Date
1980	8.000	2/15/1985
1981	13.500	2/15/1986
1982	9.000	2/15/1987
1983	12.375	1/1/1988
1984	14.625	1/15/1989
1985	10.500	1/15/1990
1986	11.750	1/15/1991
1987	11.625	1/15/1992
1988	8.750	1/15/1993
1989	9.000	2/15/1994
1990	8.625	10/15/1995
1991–1992	7.875	7/15/1996
1993	6.375	1/15/1999
1994	5.500	4/15/2000
1995	8.500	2/15/2000
1996	7.750	2/15/2001
1997	6.375	8/15/2002
1998	5.750	8/15/2003
1999	7.250	8/15/2004
2000	6.500	8/15/2005
2001	6.500	10/15/2006
2002	6.125	8/15/2007
2003	5.625	5/15/2008
2004	5.500	5/15/2009
2005	5.750	8/15/2010
2006	5.000	8/15/2011
2007	4.875	2/15/2012
2008	3.625	5/15/2013
2009	4.250	8/15/2014
2010	4.125	5/15/2015
2011	3.250	7/31/2016
2012	2.750	5/31/2017
2013	2.375	5/31/2018
2014	3.125	5/15/2019
2015	3.500	5/15/2020
2016	3.125	5/15/2021
2017	2.125	6/30/2022
2018	2.500	8/15/2023
2019	2.125	11/30/2024
2020	2.125	5/15/2025

Intermediate-term Government Bonds

Intermediate-term (i.e., 5-year) government bonds are represented by the Ibbotson Associates (IA) Stocks, Bonds, Bills, and Inflation® (SBBI®) series, "IA SBBI® US IT Govt TR USD."[128] Intermediate-term government bond total returns ranged from a high of 29.1% in 1982 to a low of -5.1% in 1994.

Capital appreciation caused $1.00 to increase to $1.84 over the 95-year period, representing a compound annual growth rate of 0.6%. This increase was unexpected; because yields rose on average over the period, capital appreciation on a hypothetical intermediate-term government bond portfolio with a constant five-year maturity should have been negative. An explanation of the positive average return is given at the end of this chapter.

Total Returns

Total returns of the intermediate-term government bonds for 1987 to 2020 are calculated from *The Wall Street Journal* prices using the coupon accrual method described above for long-term government bonds (see equation in previous section). The bond used in 2020 is the 2.125% issue maturing on May 15, 2025. Returns for 1934 to 1986 are obtained from the CRSP Government Bond File. The bonds used to construct the index for 1934 to 2020 are shown in Exhibit 3.3.

As with long-term government bonds, one-bond portfolios are used to construct the intermediate-term government bond index. The bond chosen each year is the shortest non-callable bond with a maturity not less than five years, and it is "held" for the calendar year. Monthly returns are computed. Bonds with impaired negotiability or special redemption privileges are omitted, as are partially or fully tax-exempt bonds starting with 1943.

For 1934 to 1942, almost all bonds with maturities near five years were partially or fully tax-exempt and selected using the rules described above. Personal tax rates were generally low in that period so that yields on tax-exempt bonds were similar to yields on taxable bonds.

For 1926 to 1933, there are few bonds suitable for construction of a series with a five-year maturity. For this period, five-year bond yield estimates are used. These estimates are obtained from Thomas S. Coleman, Lawrence Fisher, and Roger G. Ibbotson, *Historical U.S. Treasury Yield Curves*: 1926– 1992 with 1995 update (Ibbotson Associates, Chicago, 1995). The estimates reflect what a "pure play" five-year Treasury bond, selling at par and with no special redemption or call provisions, would have yielded had one existed. Estimates are for partially tax-exempt bonds for 1926 to 1932 and for fully tax-exempt bonds for 1933. Monthly yields are converted to monthly total returns by calculating the beginning and end-of-month flat prices for the hypothetical bonds. The bond is "bought" at the beginning of the month at par (i.e., the coupon equals the previous month-end yield), assuming a maturity of five years. It is "sold" at the end of the month, with the flat price calculated by discounting the coupons and principal at the end-of-month yield,

[128] This is the formal name of the series in Morningstar Direct.

assuming a maturity of four years and 11 months. The flat price is the price of the bond including coupon accruals so that the change in flat price represents total return. Monthly income returns are assumed to be equal to the previous end-of month yield, stated in monthly terms. Monthly capital appreciation returns are formed as total returns minus income returns.

Income Return and Capital Appreciation

For 1987 to 2020, the income return is calculated according to the methodology stated under "Long-term Government Bonds." Monthly capital appreciation (return in excess of yield) over this same period is the difference between total return and income return.

For 1934 to 1986, capital appreciation (return in excess of yield) is taken directly from the CRSP Government Bond File. The income return is calculated as the total return minus the capital appreciation return. Prior to 1934, the income and capital appreciation components of total return are generated from yield estimates as described earlier for total returns.

Yields

The yield on an intermediate-term government bond is the internal rate of return that equates the bond's price with the stream of cash flows (coupons and principal) promised to the bondholder. The yields reported for 1987 to 2020 are calculated from *The Wall Street Journal* bond prices listed in Exhibit 3.3. For 1934 to 1986, yields were obtained from the CRSP Government Bond File. Yields for 1926 to 1933 are estimates from Coleman, Fisher, and Ibbotson, *Historical U.S. Treasury Yield Curves*: 1926–1992 with 1995 update.

U.S. Treasury Bills

U.S. Treasury bills are represented by the Ibbotson Associates (IA) Stocks, Bonds, Bills, and Inflation® (SBBI®) series, "IA SBBI® US 30 Day TBill TR USD."[129] Treasury bill total returns ranged from a high of 14.7% in 1981 to a low of 0.0% in 1938.[130]

In Exhibit 3.4, all years in which the annual total return of U.S. Treasury Bills was less than 0.5% are shown. The years in which Treasury bills had less than 0.5% annual total return primarily occurred during the following periods: (i) the Great Depression (the 1930s), (ii) World War II (the 1940s), (iii) in the period after the 2008 financial crisis (2009–2016), and (iv) in 2020 during the COVID-19 pandemic.[131] The U.S. Treasury Bill annual total return in 2020 was 0.4%, a significant decrease when compared to U.S. Treasury Bills total returns in 2018 and 2019 which were 1.8% and 2.1%, respectively (see Exhibit 3.6).

[129] This is the formal name of the series in Morningstar Direct.

[130] At a 4-decimal level, the low in 1938 was -0.0162%.

[131] The first three "periods" are multi-year. The last of the four periods (2020) is a single year as of date of publication

Exhibit 3.4: Years in which Annual Total Returns of U.S. Treasury Bills Were Less than 0.5% 1926–2020

Year	Total Return	Year	Total Return
1933	0.3%	2009	0.1%
1934	0.2%	2010	0.1%
1935	0.2%	2011	0.0%
1936	0.2%	2012	0.1%
1937	0.3%	2013	0.0%
1938	0.0%	2014	0.0%
1939	0.0%	2015	0.0%
1940	0.0%	2016	0.2%
1941	0.1%	2020	0.4%
1942	0.3%		
1943	0.3%		
1944	0.3%		
1945	0.3%		
1946	0.4%		

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Total Returns

For the U.S. Treasury bill index, data from *The Wall Street Journal* is used for 1977 to 2020; the CRSP U.S. Government Bond File is the source until 1976. Each month a one-bill portfolio containing the shortest-term bill having not less than one month to maturity is constructed. (The bill's original term to maturity is not relevant.) To measure holding-period returns for the one-bill portfolio, the bill is priced as of the last trading day of the previous month end and as of the last trading day of the current month. The price of the bill (P) at each time (t) is given as:

$$P_t = \left[1 - \frac{rd}{360}\right]$$

Where:

P_t = Price of the bill at time t

r = decimal yield (the average of bid and ask quotes) on the bill at time t

d = number of days to maturity as of time t

The total return on the bill is the month-end price divided by the previous month-end price, minus one.

Negative Returns on Treasury Bills

Monthly Treasury bill returns were negative in February 1933, and in 12 months during the 1938 to 1941 period. More recently since July 2011, monthly Treasury bill returns have been negative in 8 months. Annual total returns have been negative only once, in 1938. Because negative Treasury bill returns seem to contradict logic, an explanation is in order.

Negative yields observed in the data do not imply that investors purchased Treasury bills with a guaranteed negative return. Rather, Treasury bills of that era were exempt from personal property taxes in some states, while cash was not. Further, for a bank to hold U.S. government deposits, Treasury securities were required as collateral. These circumstances created excessive demand for the security, and thus bills were sold at a premium. Given the low interest rates during the period, owners of the bills experienced negative returns.

In 2008, yields on U.S. Treasury bills fell from a little over 3.0% at the beginning of the year to approximately zero percent by the end of the year, but the dynamics were different from those for 1938 to 1941. In the wake of the 2008 financial crisis, investors' behavior could be described as an extreme flight to safety; investors were willing to accept little (if anything) in return for the assurance that they would get their principal back. In other words, the return *of* capital took precedence over the return *on* capital.

From 2009 to 2016, U.S. Treasury bill yields remained close to historical lows near zero percent. These low yields can be at least partially explained by the Federal Funds target rate, which was actually a range 0% to 0.25% from December 16, 2008 through December 16, 2015.

In 2017, 2018, and 2019 the annual total return of U.S. Treasury bills was 0.8%, 1.8%, and 2.1%, respectively, a significant increase over the annual total return seen over the 2009–2016 period. These higher yields can be at least partially explained by the accompanying general increase in the Fed Funds target rate. On December 17, 2015, the Federal Reserve raised the target federal funds range 25 basis points ("bps") to 0.25%–0.50% and again raised the target range an additional 25 bps in each of December 2016, March 2017, June 2017, December of 2017, March 2018, June 2018, September 2018, and December 2018 to a level of 2.25%–2.50% as of December 31, 2018. In the second half of 2019 the Federal Reserve reversed course and lowered the target federal funds range 25 bps in each of August 2019, September 2019, and October 2019, ending at a level of 1.5%–1.75%.[132]

In response to the outbreak of COVID-19, on March 3, 2020 and on March 16, 2020 the Federal Reserve lowered the target federal funds range an additional 50 bps and 100 bps, respectively,

[132] For a list of Federal Reserve open market operations, visit https://www.federalreserve.gov/monetarypolicy/openmarket.htm. For a detailed discussion of monetary policy and interest rates, see the Cost of Capital Navigator's Resources Section (subscription required) at dpcostofcapital.com.

bringing the range to 0.00%–0.25%, where it remained through the end of 2020. The low yields of U.S. Treasury bills in 2020 (0.4%) can at least be partially explained by the Fed's return to a 0.00%–0.25% Federal Funds target range for most of 2020.[133]

Inflation

Inflation is represented by the Ibbotson Associates (IA) Stocks, Bonds, Bills, and Inflation® (SBBI®) series, "IA SBBI® US Inflation."[134] Inflation rates ranged from a high of 18.1% in 1946 to a low of -10.3% in 1932.[135]

Consumer Price Index

The Consumer Price Index for All Urban Consumers, or CPI-U, non-seasonally adjusted, is used to measure inflation, which is the rate of change of consumer goods prices. Unfortunately, the CPI is not measured over the same period as the other asset returns. All the security returns are measured from one month-end to the next month-end. CPI commodity prices are collected during the month. Thus, measured inflation rates lag the other series by about one-half month. Prior to January 1978, the CPI (rather than the CPI-U) was used. For 1978 to 1987, the index uses the year 1967 in determining the items composing the basket of goods. After 1987, a three-year period, 1982 to 1984, was used to determine the items making up the basket of goods. All inflation measures are constructed by the U.S. Department of Labor, Bureau of Labor Statistics, Washington.

Bond Capital Appreciation Despite Rising Yields

The capital appreciation component of intermediate-term government bond returns caused $1.00 invested at year end 1925 to grow to $1.84 by the end of 2020, representing a compound annual growth rate of 0.6%. This is surprising because yields, on average, rose over the period.

An investor in a hypothetical five-year constant maturity portfolio, with continuous rebalancing, suffered a capital loss (that is, excluding coupon income) over 1926 to 2020. An investor who rebalanced yearly, choosing bonds according to the method set forth above, fared better. This investor would have earned the 0.6% annualized capital gain recorded here.

This performance relates to the construction of the intermediate-term bond series. For 1926 to 1933, the one bond portfolio was rebalanced monthly to maintain a constant maturity of five years. For 1934 to 2020, one bond (the shortest bond not less than five years to maturity) was chosen at the beginning of each year and priced monthly. New bonds were not picked each month to maintain a constant maturity intra-year.

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133 This marks the lowest the target federal funds range has been since 2015.

134 This is the formal name of the series in Morningstar Direct.

135 Revised to 18.1% from 18.2% (as reported in previous editions). On February 26, 2021 Morningstar revised the "IA SBBI US Inflation" series. The revisions were applied to various dates from February 1926 through December 2020. The revisions were small and did not affect long-term averages materially.

There are several possible reasons for the positive capital appreciation return. Chief among these reasons are convexity of the bond portfolio and the substitution of one bond for another at each year-end.

Convexity

Each year, we "bought" a bond with approximately five years to maturity and held it for one year. During this period, the market yield on the bond fluctuates. Because the duration of the bond shortens (the bond becomes less interest-rate sensitive) as yields rise and the duration lengthens as yields fall, more is gained from a fall in yield than is lost from a rise in yield. This characteristic of a bond is known as convexity.

For example, suppose an 8% coupon bond is bought at par at the beginning of a year; the yield fluctuates (but the portfolio is not rebalanced) during the year; and the bond is sold at par at the end of the year. The price of the bond at both the beginning and end of the year is $100; the change in bond price is zero. However, the fluctuations will have caused the gains during periods of falling yields to exceed the losses during periods of rising yields. Thus, the total return for the year exceeds 8%. Because our measure of capital appreciation is the return in excess of yield, rather than the change in bond price, capital appreciation for this bond (as measured) will be greater than zero.

In 1992, the yield for intermediate-term government bonds started the year at 5.97%, rose, fell, and finally rose again to end at 6.11%, slightly higher than the starting point. In the absence of convexity, the capital appreciation return for 1992 would be negative. Because of the fluctuation of yields during the year, however, the capital appreciation return on the intermediate-term government bond index was positive 0.64%.

It should be noted that the return in excess of yield, or capital gain, from convexity is caused by holding, over the year, a bond whose yield at purchase is different from the current market yield. If the portfolio were rebalanced each time the data were sampled (in this case, monthly), by selling the old bond and buying a new five-year bond selling at par the portfolio would have no convexity. That is, over a period where yields ended where they started, the measured capital appreciation would be zero. However, this is neither a practical way to construct an index of actual bonds nor to manage a bond portfolio.

Bond Substitution

Another reason the intermediate term government bond series displays positive capital appreciation despite rising yields is the way in which bonds were removed from the portfolio and replaced with other bonds. In general, it was not possible to replace a bond "sold" by buying one with exactly the same yield. This produces a spurious change in the yield of the series – one that should not be associated with a capital gain or loss.

For example: Suppose a five-year bond yielding 8% is bought at par at the beginning of the year; at that time, four-year bonds yield 7%. Over the year, the yield curve rises in parallel by 1 percentage point so that when it comes time to sell the bond at year-end, it yields 8% and has four years to maturity. Therefore, at both the beginning and end of the year, the price of the bond is $100.

The proceeds from the sale are used to buy a new five-year bond yielding 9%. While the bond price change was zero over the year, the yield of the series has risen from 8% to 9%. Thus, it is possible because of the process of substituting one bond for another for the yield series to contain a spurious rise that is not, and should not be expected to be, associated with a decline in the price of any particular bond. This phenomenon is likely to be the source of some of the positive capital appreciation in our intermediate-term government bond series.

Other Issues

Although convexity and bond substitution may explain the anomaly of positive capital appreciation in a bond series with rising yields, there are other incomplete-market problems that may also help explain the capital gain. For example, intermediate-term government bonds were scarce in the 1930s and 1940s. As a result, the bonds chosen for this series occasionally had maturities longer than five years, ranging as high as eight years when bought. The 1930s and the first half of the 1940s were bullish for the bond market. Longer bonds included in this series had higher yields and substantially higher capital gain returns than bonds with exactly five years to maturity might have had if any existed. This upward bias is particularly noticeable in 1934, 1937, and 1938.

In addition, callable and fully or partially tax-exempt bonds were used when necessary to obtain a bond for some years. The conversion of the Treasury bond market from tax-exempt to taxable status produced a one-time upward jump in stated yields but not a capital loss on any given bond. Therefore, part of the increase in stated yields over 1926 to 2020 was a tax effect that did not cause a capital loss on the intermediate-term bond index. Further, the callable bonds used in the early part of the period may have commanded a return premium for taking this extra risk.

Chapter 4
Description of the Derived Series

Historical data suggests that investors are rewarded for taking risks and that returns are related to inflation rates. The risk/return and the real/nominal relationships in the historical data are revealed by looking at the risk-premium and inflation-adjusted series derived from the basic asset series.

Derived Series Calculated Using Geometric Differences

Derived series are calculated as the geometric differences between two basic asset classes. Returns on basic series A and B and derived series C are related as follows:

$$(1+C)=\left[\frac{1+A}{1+B}\right]$$

where the series returns for A, B, and C are in decimal form (e.g., 5% is indicated by 0.05). Thus, C is given by:

$$C=\left[\frac{1+A}{1+B}\right]-1\approx A-B$$

As an example, suppose return A equals 15%, or 0.15; and return B is 5%, or 0.05; then C equals (1.15 / 1.05) — 1 = 0.0952, or 9.52%. This result, while slightly different from the simple arithmetic difference of 10%, is conceptually the same.

Definitions of the Derived Series[136]

From the seven basic asset classes (large-cap stocks, small-cap stocks, long-term corporate bonds, long-term government bonds, intermediate-term government bonds, U.S. Treasury bills, and Inflation), 10 additional series are derived that represent the component or elemental parts of the asset returns.

Two Categories of Derived Series

The 10 derived series are categorized as (i) risk premiums, or payoffs for taking various types of risk and (ii) as inflation-adjusted asset returns. The risk premiums are (i) the bond horizon

[136] Precalculated annual statistics for each of the derived series in Exhibit 4.1 for each year over the 1926–2020 time horizon are presented in table format in the full-version *2021 SBBI® Yearbook*. For more information, visit dpcostofcapital.com/stocks-bonds-bills-inflation-sbbi-yearbook.

premium, (ii) the bond default premium, (iii) the equity risk premium, and (iv) the small-stock premium. The inflation-adjusted asset return series are constructed by geometrically subtracting inflation from each of the six asset total return series. The 10 derived series are summarized in Exhibit 4.1.

Exhibit 4.1: The Derived Series

Risk Premia Series	Derivation
Equity Risk Premium	$\frac{(1 + \textit{Large Stock TR})}{(1 + \textit{Treasury Bill TR})} - 1$
Small-Stock Premium	$\frac{(1 + \textit{Small Stock TR})}{(1 + \textit{Large Stock TR})} - 1$
Bond Default Premium	$\frac{(1 + \textit{LT Corp Bond TR})}{(1 + \textit{LT Govt Bond})} - 1$
Bond Horizon Premium	$\frac{(1 + \textit{LT Govt Bond TR})}{(1 + \textit{Treasury Bill TR})} - 1$

Inflation–Adjusted Series	Derivation
Large-Cap Stock Returns	$\frac{(1 + \textit{Large Stock TR})}{(1 + \textit{Inflation})} - 1$
Small-Cap Stock Returns	$\frac{(1 + \textit{Small Stock TR})}{(1 + \textit{Inflation})} - 1$
Corporate Bond Returns	$\frac{(1 + \textit{LT Corp Bond TR})}{(1 + \textit{Inflation})} - 1$
Long-term Government Bond Returns	$\frac{(1 + \textit{LT Govt Bond TR})}{(1 + \textit{Inflation})} - 1$
Intermediate-term Government Bond Returns	$\frac{(1 + \textit{IT Govt Bond TR})}{(1 + \textit{Inflation})} - 1$
Treasury Bill Returns (Real Riskless Rate of Returns)	$\frac{(1 + \textit{Treasury Bill TR})}{(1 + \textit{Inflation})} - 1$

Equity Risk Premium

Large-cap stock returns are composed of inflation, the real riskless rate, and the equity risk premium. The equity risk premium is the geometric difference between large-cap stock total returns and U.S. Treasury bill total returns. Because large-cap stocks are not strictly comparable with bonds, horizon and default premiums are not used to analyze the components of equity returns (large-cap stocks have characteristics that are analogous to horizon and default risk, but they are not equivalent).

The monthly equity risk premium is given by:

$$\frac{(1+Large\,Stock\,TR)}{(1+Treasury\,Bill\,TR)}-1$$

Small-Stock Premium

The small-stock premium is the geometric difference between small-cap stock total returns and large-cap stock total returns. The monthly small-stock premium is given by:

$$\frac{(1+Small\,Stock\,TR)}{(1+Large\,Stock\,TR)}-1$$

Bond Default Premium

The bond default premium is defined as the net return from investing in long-term corporate bonds rather than long-term government bonds of equal maturity. Because there is a possibility of default on a corporate bond, bondholders receive a premium that reflects this possibility, in addition to inflation, the real riskless rate, and the horizon premium. The monthly bond default premium is given by:

$$\frac{(1+LT\,Corp\,Bond\,TR)}{(1+LT\,Govt\,Bond\,TR)}-1$$

Components of the Bond Default Premium

Bonds susceptible to default have higher returns (when they do not default) than those of riskless bonds. Default on a bond may be a small loss, such as a late or skipped interest payment, or it may be a larger loss, such as the loss of any or all principal as well as interest. In any case, part of the default premium on a portfolio of bonds is consumed by the losses on those bonds that do default.

The remainder of the default premium (the portion not consumed by defaults) is a pure risk premium, which the investor demands and, over the long run, receives for taking on the risk of default. The expected return on a corporate bond, or portfolio of corporate bonds, is less than the bond's or portfolio's yield. The portion of the yield that is expected to be consumed by defaults must be subtracted. The expected return on a corporate bond is equal to the expected return on a government bond of similar maturity, plus the pure risk premium portion of the bond default premium.

Callability Risk Is Captured in the Default Premium

Callability risk is the risk that a bond will be redeemed (at or near par) by its issuer before maturity, at a time when market interest rates are lower than the bond's coupon rate. The possibility of redemption is risky because it would prevent the bondholder of the redeemed issue from reinvesting the proceeds at the original (higher) interest rate. The bond default premium, as measured here, also inadvertently captures any premium investors may demand or receive for this risk.

Bond Horizon Premium

Long-term government bonds behave differently from short-term bills in that their prices (and hence returns) are more sensitive to interest-rate fluctuations. The bond horizon premium is the extra return investors demand for holding long-term bonds instead of U.S. Treasury bills.

The monthly bond horizon premium is given by:

$$\frac{(1+LT\ Govt\ Bond\ TR)}{(1+Treasury\ Bill\ TR)}-1$$

Long-term rather than intermediate-term government bonds are used to derive the bond horizon premium so as to capture a "full unit" of price fluctuation risk. Intermediate-term government bonds may display a partial horizon premium, which is smaller than the difference between long-term bonds and short-term bills.

Determining the Bond Premium: Maturity vs. Duration

Duration is the present-value weighted average time to receipt of cash flows (coupons and principal) from holding a bond, and can be calculated from the bond's yield, coupon rate, and term to maturity. The duration of a given bond determines the amount of return premium arising from differences in bond life. The bond horizon premium is also referred to as the "maturity premium," based on the observation that bonds with longer maturities command a return premium over shorter-maturity bonds. However, duration, not term to maturity, is the bond characteristic that determines this return premium.

Why a "Horizon" Premium?

Investors often strive to match the duration of their bond holdings (cash inflows) with the estimated duration of their obligations (cash outflows). Consequently, investors with short time horizons regard long-duration bonds as risky (due to price fluctuation risk) and short-term bills as riskless. Conversely, investors with long time horizons regard short-term bills as risky (due to the uncertainty about the yield at which bills can be reinvested) and long-duration bonds as riskless or less risky.

Empirically, long-duration bonds bear higher yields and greater returns than short-term bills; that is, the yield curve slopes upward on average over time. This indicates that investors are more averse to the price fluctuation risk of long-duration bonds than to the reinvestment risk of bills.

Bond duration risk is thus in the eye of the beholder, or bondholder. Therefore, rather than identifying the premium as a payoff for long-bond risk (which implies a judgment that short-horizon investors are "right" in their risk perceptions), it is better to go directly to the source of the return differential (the differing time horizons of investors) and use the label "horizon premium."

Large-Cap Stock Real Returns

Construction

The inflation-adjusted return is a geometric difference and is approximately equal to the arithmetic difference between the large-cap stock total return and the inflation rate. The monthly inflation adjusted large-cap stock return is given by:

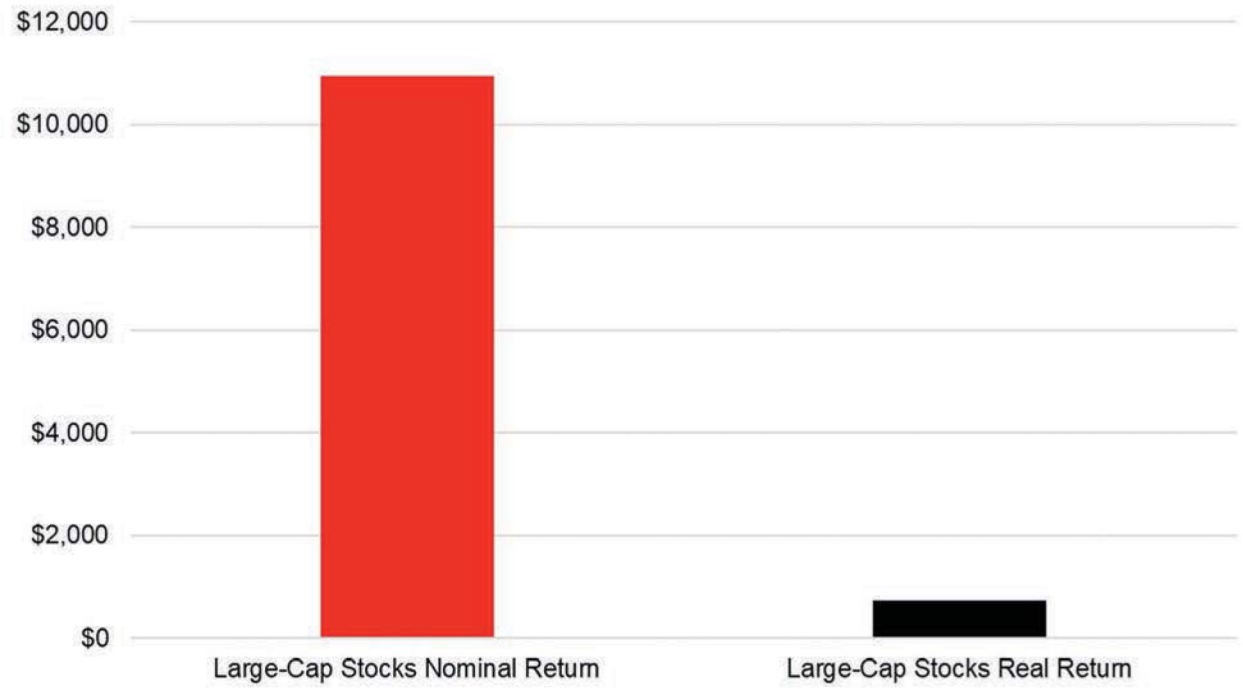
$$\frac{(1+Large\,Stock\,TR)}{(1+Inflation)}-1$$

The inflation-adjusted large-cap stock return may also be expressed as the geometric sum of the real riskless rate and the equity risk premium:

$$\left[(1+Real\,Riskless\,Rate)\times(1+Equity\,Risk\,Premium)\right]-1$$

Exhibit 4.2 depicts (i) what $1.00 invested at the end of December 1925 in large cap stocks would have grown to by the end of 2020, and (ii) what $1.00 invested at the end of December 1925 in large-cap stocks would have grown to by the end of 2020 if large-cap stock returns were adjusted for inflation.

Exhibit 4.2: Large-cap Stocks, Real and Nominal Return Terminal Index Value 1926–2020 (Year-end 1925 = $1.00)



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Small-Cap Stock Real Returns

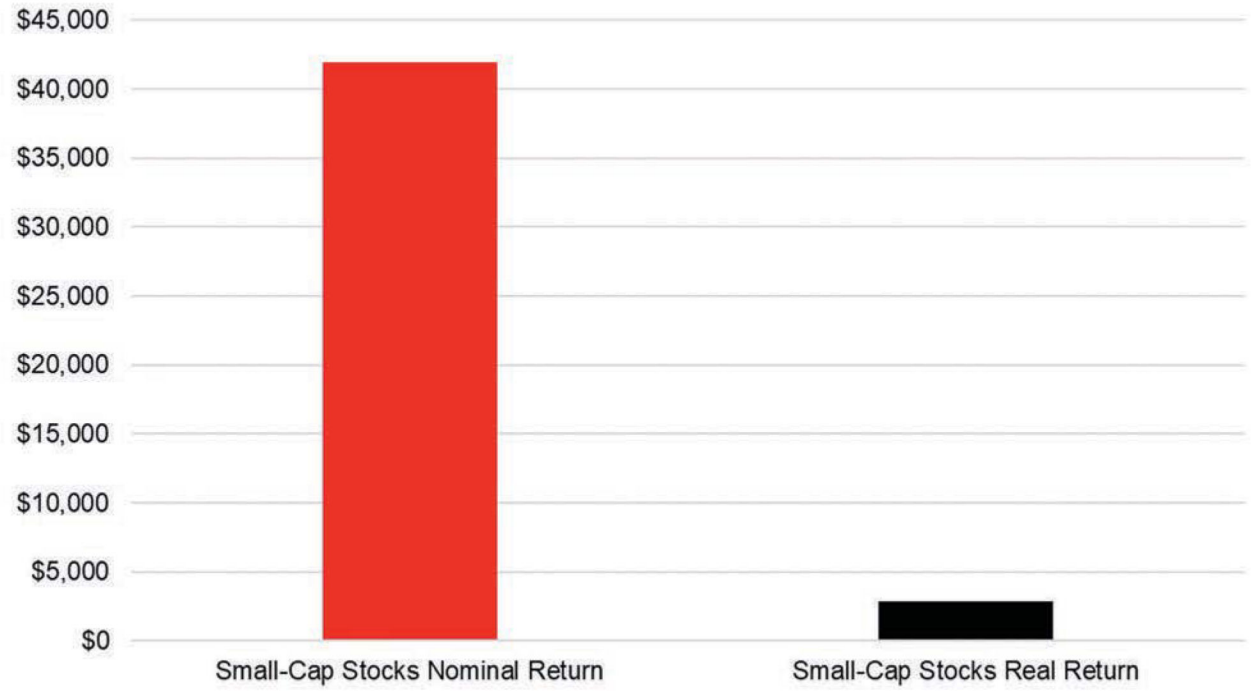
Construction

The inflation-adjusted return is a geometric difference and is approximately equal to the arithmetic difference between the small-cap stock total return and the inflation rate. The monthly inflation-adjusted small-cap stock return is given by:

$$\frac{(1+Small\ Stock\ TR)}{(1+Inflation)}-1$$

Exhibit 4.3 depicts (i) what $1.00 invested at the end of December 1925 in small-cap stocks would have grown to by the end of 2020 and (ii) what $1.00 invested at the end of December 1925 in small-cap stocks would have grown to by the end of 2020 if small-cap stock returns were adjusted for inflation.

Exhibit 4.3: Small-cap Stocks, Real and Nominal Return Terminal Index Value 1926–2020 (Year-end 1925 = $1.00)



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Long-term Corporate Bond Real Returns

Construction

The inflation-adjusted return is a geometric difference and is approximately equal to the arithmetic difference between the long-term corporate bond total return and the inflation rate. The monthly inflation-adjusted corporate bond total return is given by:

$$\frac{(1+CorpBondTR)}{(1+Inflation)}-1$$

Exhibit 4.4 depicts (i) what $1.00 invested at the end of December 1925 in long-term corporate bonds would have grown to by the end of 2020, and (ii) what $1.00 invested at the end of December 1925 in long term corporate bonds would have grown to by the end of 2020 if long-term corporate bond returns were adjusted for inflation.