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An Analysis of the S&P 500 Index and Cowles's Extensions: Price Indexes and Stock Returns, 1870–1999

This article provides a consistent monthly stock price index from January 1871 through 1999. The broadly defined S&P Weekly Index is reconstructed from 1918 and carried forward as the S&P 500 Composite Index to the present. Cowles's monthly index is improved in order to provide month-end estimates from February 1885. Cowles's estimates of dividends and earnings for this index from 1871 are reevaluated and are carried forward until spliced to the S&P daily estimates that began in 1957. The result is a monthly index of prices, dividends, and earnings based on consistent definitions over a period of 130 years.

> It is probably impossible to produce a stock price index covering an extended period of time that is both continuous and representative of the market as a whole. (STANDARD STATISTICS COMPANY 1930).

I. Introduction

The Standard and Poor's (S&P) Composite Index remains the index of choice for many investors, particularly institutional investors. As such, it serves as a major benchmark of stock market performance. It also has a long history, providing investors with a lengthy time series of returns from which to gauge, among other parameters, "average" returns on an index of commonly held stocks. Furthermore, the S&P monthly index series as originally constructed was extended back to January 1871 by Cowles, making possible a consistent time series of returns covering approximately 130 years.[1]

Because of its prominence as a market measure, it is important that users fully understand the S&P index

1. Data prior to 1871 are very limited. Cowles noted that in 1871 railroad stocks dominated the total stocks available. Wilson and Jones (1987), using the Cowles data, estimated this total to be 48 stocks, 31 of which were railroads. New work by Goetzmann, Ibbotson, and Peng (2000) of a stock price index of securities listed on the NYSE indicates approximately 13 corporations in 1871 in the "industrial and other" category, with that number decreasing back in time to 1815.

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as it is conventionally reported, and the S&P index that could be reported. Confusion continues today over its composition relative to the history of the S&P 500 (weekly) index and the S&P 90 (daily) index and its relation to the work of Alfred Cowles that has been used to extend this index back in time. Although not used, a broad S&P weekly price index does exist for the period 1918 through 1956, and these data are among the highest-quality measures of stock movements over this period. These weekly data were abandoned by S&P in 1957, and considerable confusion of stock price history has resulted. Failure to use a consistently defined time series of S&P 500 returns back to 1871 has resulted in misstatements of how well the "market" has actually performed over long periods and the inability to compare results across studies.

Consider the historical description by Siegel, which has been quoted by other researchers: "In 1939, Alfred Cowles . . . constructed a stock price index back to 1871. . . . The Cowles index became the basis of what is currently the most important benchmark among portfolio analysts, the S&P 500 index . . . . The Standard & Poor's stock price index was inaugurated on March 4, 1957" (Siegel 1998, pp. 60–61). In fact, the Standard Statistics Company began estimating stock price indexes on a weekly basis in 1923 for an "all stocks" index, with subsector indexes, which were carried back to 1918. This series is the basis of what was later to be called the S&P 500 Index. The Cowles index made an important contribution by extending existing S&P data backward in time from 1918, but it most certainly was not the basis of the S&P Composite Index.

This article clarifies the historical record of stock prices and returns using the Standard & Poor's and Cowles monthly indexes from January 1871 to the present, providing precise details of the coverage of the index as well as making some improvements. It will probably surprise many users of the S&P Composite Index to learn that, to date, studies reporting S&P composite returns prior to 1957 (e.g., the Ibbotson Associates data) have not used more than 90 stocks for the time period 1926–56. In fact, it is impossible because prior to March 1957 Standard & Poor's never collected data for 500 companies on a consistent basis, although data for more than 400 S&P stocks were collected and are available.

Studies using Cowles's and the early S&P historical monthly data have failed to recognize the biases inherent with time-averaged data. Percentage changes in such data have a downward-biased variance and an upward-biased measure of autocorrelation relative to month-end data. Also, many studies have combined returns from various indexes when reporting stock returns over long periods, thereby distorting the record with regard to the S&P Composite—in other words, the results reported are not S&P Composite data plus Cowles extensions but rather a mixture of indexes. In contrast, we report a consistent and broad index of "S&P" stock returns over the entire time period for which these data are available, with improved data for the Cowles extensions. The S&P weekly data for the broadly defined Composite index from January 1918 through January 1957 have been improved by our estimation

of month-end prices. We refer to this improved price index as the Standard & Poor's Weekly and Cowles (SPWC).

II. Standard & Poor's Indexes

As noted, the Standard Statistics Company began estimating stock price indexes on a weekly basis in 1923 for an "all stocks" index. This weekly index was carried back to January 1918. The indexes were capitalization weighted and based on Fisher's "ideal index" formula (1927). These stock indexes underwent a major change in 1926 by placing the index on a 1926 = 100 base, which was later changed to 1936–39 = 100, and still later was changed to 1941–43 = 10, which continues as the base today. Standard Statistics Company merged with Poor's in 1940, but the indexes were maintained.

It is important to understand clearly that there were actually two different S&P "Composite" Indexes.[2] First, there is the weekly index (the "all stocks" index) as described above. Second, a daily index of 90 stocks, consisting of 50 industrials, 20 rails, and 20 utilities, was initiated in 1928 (and carried back weekly to December 1925). Going forward, this index of 90 stocks continued until March 1957, when the daily index was shifted to the 500 stocks. In March 1957, S&P abandoned its historical weekly series with the statement, "To avoid confusion, Standard & Poor's has standardized on its former daily price index . . . for the back record."[3] This caution by S&P was repeated in the biennial editions of their historical data (the "Blue Books") for many years, but is not mentioned in recent editions. Simultaneously, S&P ceased estimating the S&P 90 Index. The decision to abandon the historical record of the broad-based weekly index in favor of the S&P 90, which ceased, has been the cause of much confusion.

Figure 1 shows the time periods covered by the various indexes that deal with S&P data, and is useful in sorting out the alternatives. As this figure shows, and using the labels in that figure, the S&P 90 (the daily index) covers the time span 1925–56, while the S&P Weekly Index covers the time period 1918–56. The S&P 500 Index with 500 stocks in it begins in 1957, while the NYSE CRSP begins in 1926. Going back historically, the Cowles index covers the period 1871–1940 (including his updates). The Standard & Poor's Weekly Composite with Cowles extensions, with our modification with month-end price estimates (labeled as SPWC), covers the period 1871–2000. Our reconstructed data based on Cowles's monthly estimates extend from January 1871 and are linked to the S&P weekly data in January 1918, and further

2. The term "Composite" came into use in the early 1930s for the "all stocks" classification. The term was used both for the S&P 90 and the S&P 500, differentiated as "Daily Composite" and "Weekly Composite," respectively. In the 1930–31 *Base Book*, the S&P 90 was called "90 Stocks Combined," while the weekly index was labeled as "Industrials-Rails-Utilities (404 stocks)" (Standard Statistics Company 1930).

3. See Standard & Poor's Statistical Service (1957, p. 1) Many of the abandoned index series are available from Taylor (1999).

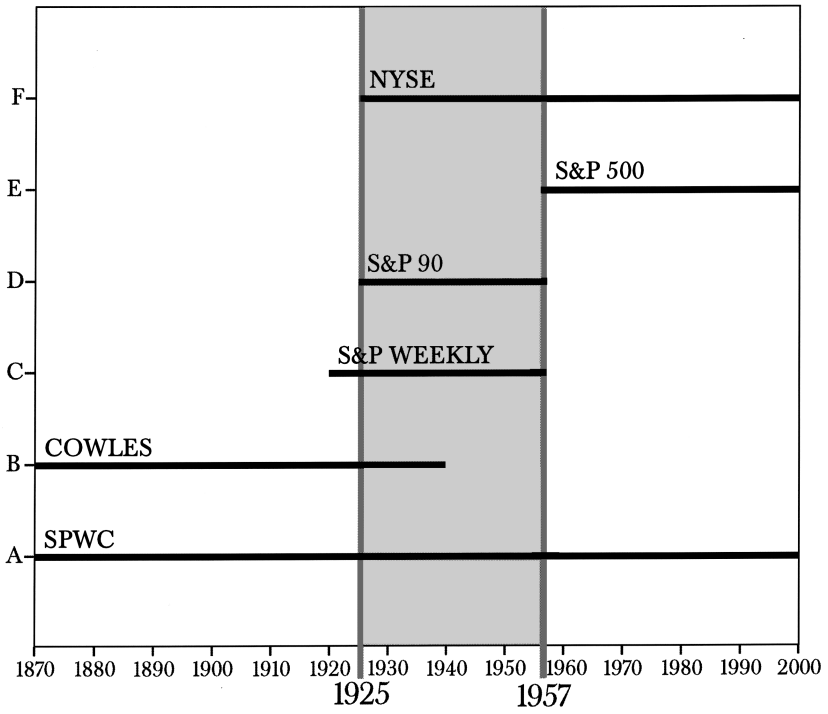

FIG. 1.—Time coverage of the major value-weighted indexes, 1870–1999. A: SPWC (modified S&P Weekly/Cowles) Index, January 1871–December 1999. B: Cowles Monthly Averaged Index, January 1871–December 1940; 1 (1938), January 1871–December 1937, 2 (1939), January 1871–December 1938, 3 (1941), January 1939–December 1939, and 4 (1942), January 1940–December 1940, and conversion of the complete monthly series to the 1935–39 = 100 base period. C: Standard & Poor's Weekly Index, January 1918–February 1957; (1941) January 1918–December 1940, converted to the 1935–39 base, which continued through February 1957. D: Standard & Poor's Daily Index, December 1925–February 1957 (Standard & Poor's Statistical Service 1957). E: Standard & Poor's 500, March 1957–December 1999 (Standard & Poor's Statistical Service 1999). F: NYSE Index, Chicago Research in Security Prices, December 1925–December 1999 (Center for Research in Security Prices 2000).

spliced to the S&P 500 daily price index in February 1957, thereby providing coverage for the entire time period.

Thus, what is commonly referred to as the S&P 500 Composite Index actually consists of 90 stocks for the period 1926–56 and not 500 stocks as most people assume. Although the broader weekly coverage was continued by S&P through March 1957, it basically was lost to researchers because S&P itself did not maintain the data nor preserve it. This study restores these weekly data, making possible for the first time research using the broader (weekly) S&P Composite Index.

We have recovered most of the biennial yearbooks published by the S&P

TABLE 1 Estimated Number of Stocks Covered by Major Industry Group by S&P and CRSP/NYSE, 1918–99

Time Period	Industrial	Transport	Utility	Finance	Composite	CRSP NYSE
December 1918	151	28	19	0	198	. . .
1923	184	31	18	0	233	. . .
December 1927	176	31	21	0	228	592
1928–29	342	33	35	0	410	590–723
1930	337	33	34	0	404	727–747
1932–35	351	33	37	0	421	701–730
1936	347	32	40	0	419	720–745
1937	348	32	40	0	420	745–781
1939–40	350	30	40	0	420	776–794
1941–48	354	20	28	0	402	793–965
1949–51	365	20	31	0	416	968–1,032
1952–56	420	20	40	0	480	1,034–1,059
1957–66	425	25	50	0	500	1,056–1,270
1967–74	425	20	55	0	500	1,240–1,546
1975–76	425	15	60	0	500	1,513–1,553
1977–88	400	20	40	40	500	1,493–1,640
From April 1988		no fixed allocation			500	1,623–2,912
December 1989	388	16	43	53	500	1,671
December 1991	385	15	45	55	500	1,843
December 1993	381	16	47	56	500	2,312
December 1995	371	15	49	65	500	2,584
December 1997	381	11	37	71	500	2,875
December 1998	380	10	39	71	500	2,895
December 1999	376	11	41	72	500	2,813

NOTE.—These dates are approximations in some cases. Due to the scarcity of S&P primary sources, a wide range of secondary sources, primarily U.S. Department of Commerce and Federal Reserve sources, have been used in this compilation. Since the CRSP are continuously updated, it is noted that the source of those data is the 2000 edition (Center for Research in Security Prices 2000). The number of stocks included in the CRSP/NYSE is the high and low for the periods covered. For the S&P 500 coverage in December 1998, 458 of the stocks were traded on the NYSE, 40 on the NASDAQ, and 2 on the AMEX. In December 1999, the capitalization value of the 500 stocks was $9,942 billion.

SOURCES.—Cowles (1939, p. 39, and pp. 447–48), Standard Statistics Co. (1928, 1929, 1930, 1932, 1934), Standard & Poor's Statistical Service (1941, 1952, 1955, 1957, 1968, 1970, 1972, 1976, 1984, 1988, 1990, 1992, 1994, 1996, and 1998), Board of Governors of the Federal Reserve System, monthly issues of the *Federal Reserve Bulletin* (1930–57); U.S. Department of Commerce, monthly issues of *Survey of Current Business* (1930–57); Center for Research in Security Prices (2000).

Statistical Service and have compiled a record of the number of stocks, by major sector, that were included from 1918 to the present in the broader weekly index. Table 1 provides an estimate of the number of stocks included in the S&P Composite Index based on the broader weekly coverage from 1918 to the present.[4] For reference, the last column of the table shows the number of NYSE stocks that are included in the CRSP NYSE index (2000).[5] What is important to note is that the S&P Composite Index, using the weekly data up to 1957, included a large number of companies, in excess of 400 by 1928. Thus, the weekly index data abandoned by S&P were potentially very valuable

4. For the period 1955 through February 1957, the data and number of firms are from Federal Reserve and Department of Commerce sources, because S&P sources for the period could not be located. Over the period 1935–55, these sources were helpful in counting the number of firms in the S&P Composite.

5. Although we believe the dates used in the table to be reasonably accurate, they must be viewed as approximations.

as a measure of the broad market and were comparable to what is used today by S&P, the 500 Composite Index, to measure the market.

When the Standard Statistics Company began estimating the "all stock" index in 1923, 233 stocks were included. Of this total, 184 were industrials, 31 were railroads, and 18 were utilities.[6] When these indexes were carried back weekly to January 1918, the number of stocks available decreased to 198 firms at the beginning of the series (Cowles 1939, p. 448). In 1927, the company made major changes in their sector classifications and established the base of the index as 1926 = 100. The number of firms covered decreased slightly to 228, with 176 industrial, 31 rails, and 21 utilities. The capitalization of these major sectors, as a percentage of total capitalization, was approximately 60% industrial, 30% railroads, and 10% utilities.[7]

As table 1 shows, from December 1927, the number of stocks included in the weekly S&P Composite Index increased sharply to over 400 within 2 years, remained between 404 and 421 stocks through 1951, and reached 480 stocks during the period 1952–56.[8] Over the same time period, the number of stocks on the NYSE, as shown by the CRSP NYSE data in the last column, increased from 539 in December 1927 to 1,059 by the end of 1956.

In March 1957, S&P reconstituted their indexes, making the base period 1941–43 = 10 and fixing the composite at 500 stocks with a pattern of fixed allocation by sector for extended periods, as shown in table 1.[9] Finance was added as a major sector in 1977 with 40 stocks initially. Fixed allocation within sector was discontinued in 1988, although the total number of stocks has remained fixed at 500. As table 1 also shows, the number of NYSE stocks covered by CRSP increased from 1,056 in 1957 to 2,895 by 1998.

III. Cowles's Extension of the S&P Stock Indexes

In the mid-1930s, Alfred Cowles and Associates undertook the task of carrying monthly estimates of stock prices back as far as feasible at the time, ending in January 1871. Their objective was stated as follows: "The purpose of the Cowles Commission common-stock indexes is to portray the average experience of those investing in this class of security in the United States from

6. Initially there was no utilities sector. We have counted the firms in the sectors "Telephone and Cable" and "Traction, Power, and Gas" as utilities.

7. There were 27 sector indexes, with the 17 stocks in the "Petroleum" sector having 17% of the total capitalization of the industrial sector.

8. The early S&P Index included stocks that were actively traded on exchanges other than the NYSE. According to the 1930–31 *Base Book*, "At the beginning of 1928, 304 of the 395 stocks were listed on the New York Stock Exchange, 60 on the New York Curb Market, 9 on the Boston Exchange, 5 at Chicago, and 17 distributed on the Philadelphia, Cleveland, Pittsburgh, Baltimore, St. Louis and Montreal Stock Exchanges" (Standard Statistics Company 1930, p. 63).

9. This base measured the S&P 90 Index over that 3-year period. Since the S&P Weekly differed from the S&P Daily Index, the 1941–43 = 10 base does not hold for our historical compilation for the broad index. Over the 3-year period there were 156 weekly observations of the S&P Weekly, with an arithmetic mean for the Composite of 10.8359. The S&P Weekly measures of the industrial, rail/transport, and utilities indexes were similarly affected.

TABLE 2 **Number of Stocks Covered by the Cowles Commission by Major Sector and Composite, 1870–1915**

Year	Industrials	Railroads	Utilities	Composite
1870	13	31	4	48
1875	10	30	5	45
1880	23	45	9	77
1885	14	53	6	73
1890	21	54	11	86
1895	25	50	13	88
1900	45	46	15	106
1905	67	48	16	131
1910	72	46	18	136
1915	121	44	21	186

NOTE.—Cowles (1939) made a careful analysis of the changing composition of traded stocks relative to the total market value of equity capitalization, showing that the coverage was consistently over 75% of all stocks listed on all domestic exchanges and more than 95% of all stocks traded on the NYSE (93% of rails and practically 100% of industrial and utility stocks). The analysis of the effect of stock quotes that disappeared and then reappeared, loss due to incomplete quotations, loss due to mergers and reorganization, stocks that were permanently dropped from the index, as well as stocks that were excluded by the Standard Statistics Company roughly balanced out.

SOURCES.—Wilson and Jones (1987).

1871 to 1938. The indexes of stock prices are intended to represent, ignoring the elements of brokerage charges and taxes, what would have happened to an investor's funds if he had bought at the beginning of 1871 all stocks quoted on the New York Stock Exchange, allocating his purchases among the individual issues in proportion to their total monetary value, and each month up to 1938 had by the same criterion redistributed his holdings among all quoted stocks" (Cowles 1939, p. 2). This was an ambitious project. After reviewing all of the various measures of U.S. stock indexes and methods for calculation, Cowles chose to use Fisher's "ideal index" with the outstanding shares as weights for the computation of the index values.

Stock price data could have been secured from daily or weekly quotes, but a more convenient (and less costly) source for data on monthly stock prices was the midpoint of the high and low prices available from the *Commercial and Financial Chronicle*.[10] Cowles used the monthly arithmetic averages of the weekly indexes of the Standard Statistics Company from 1918 through 1938. He carried monthly data back from 1918 to January 1871, using, to the full extent possible, the same definitions for inclusion and the same technical construction.[11]

Table 2 provides the number of stocks included in Cowles's early indexes for selected years. Cowles was skeptical about the accuracy of "curb" prices, and relied only on NYSE stocks. Prior to 1871, few stocks had consistent price data; only 48 stocks in January 1871 had reliable quotes. The number of stocks included increased for all three sectors, with rails increasing more

10. Macaulay's (1938) rail stock prices were based on this source.

11. As the data were extended back, the number of firms decreased, and the sector definitions became the very basic manufacturing and mining categories. In January 1871, Cowles's sectors included "Mining and Smelting," "Coal," and "Shipping and Shipbuilding."

slowly than utilities, which increased more slowly than industrials. Cowles estimated that his indexes "include approximately 97 per cent of the market value of all stocks quoted."[12]

In addition to carrying the monthly stock price indexes back to 1871, Cowles undertook the estimation of monthly dividends and annual earnings for the major sectors as well as for subsector indexes. The Standard Statistics Company had not estimated any "all stock" or sector dividends or earnings for their indexes from 1918, only beginning such estimates for the S&P 90 indexes in 1928 (and carried back to December 1925). Therefore, without the Cowles data it would not be possible to construct total returns for the S&P Composite Index for the period prior to December 1925.

These indexes were first published in 1938 (Cowles 1938), but were soon updated "to correct such errors as have been discovered and to bring the indexes down through 1938" (Cowles 1939, p. viii). In two later mimeographed updates, Cowles carried the data through 1939 and 1940, as well as incorporating the revised base from 1926 through 1935–39.[13] The price index data of Cowles added nothing to the information available from the Standard Statistics Company from 1918, and by averaging its weekly indexes to obtain monthly prices may have subtracted from its value because of the bias in averaged data (examined below). However, the monthly dividend and annual earnings information added great value for the returns and valuation series for the period 1918 through 1940. As figure 1 shows, the Cowles data, including extensions, cover the time period 1871–1940. They overlap with S&P's weekly data during the period 1918–40.

IV. An Analysis of the Coverage of Stocks Using the S&P Composite Data

Given the computational technology of the 1920s and 1930s, calculation of a value-weighted index was a tedious, costly, and time-consuming task. In addition, obtaining timely data for a number of stocks was simply not possible. Indeed, S&P attributes the delay of including financial stocks in the composite index until 1976 to "the difficulty of including Over-the-Counter stocks in our computerized calculations."[14] Therefore, it is not surprising that the daily index, which is the index officially reported by S&P for 1926–56, contained only 90 stocks, whereas the S&P indexes including the expanded list of weekly stocks were calculated less frequently.

Regardless of difficulties, the broader weekly S&P composite data provide

12. See Cowles 1939, p. 5. Cowles provides some detail on the increase in the number of industrial stocks: "The industrial index included 12 stocks in 1871. By 1897 the number had grown to 23, and by 1917 to 157" (p. 40).

13. See Cowles (1941, 1942) for data through 1939 and 1940.

14. Standard & Poor's (1984) had provided weekly indexes of bank stocks and insurance stocks back to January 1918, but the price quotations could not be maintained on a timely basis.

a better representation of the overall market during the early period. Cowles's estimate of the capitalization value of the Standard Statistics Company using the broader weekly index was about 90% of the NYSE subsequent to 1917, 73% of the market value of common stocks listed on the 24 various exchanges at that time, and 77% of those stocks that were actively traded (see Cowles 1939, pp. 6–7). The Standard Statistics Company itself estimated in 1927 that the capitalization of the stocks in the weekly index was about 92% of the total of stocks traded on the NYSE. As a comparison, in the biennial editions of their yearbooks S&P estimates capitalization values, as a percentage of the NYSE total capitalization, at 76.5% for 1980. This percentage remains relatively steady through 1997, where the estimate is 81%.[15]

Although total capitalization has been a focus of the Standard & Poor's Index Committee, there has always been an interest in industrial sector representation. Early in the life of the "all stocks" index, the selection process was described: "The stocks were selected largely from the common stocks of over 700 corporations listed regularly by groups in the Standard Earnings Bulletin. The value of the issue . . . was computed for each stock. Then a sufficient number of stocks were selected to obtain a fair representation, varying from about 70 to 100 per cent of total market value for each group of stocks" (Standard & Poor's Statistical Service 1930, p. 63).

For 1918, Cowles counted 32 groups, increasing to 66 in 1937 (Cowles 1939, p. 448). From S&P reports, the number of industrial sectors stood at 68 in 1941, increasing to 84 in 1957. The number of sectors has remained relatively constant since 1957, although many sectors have been added, dropped, or redefined.[16] The goal has been to include the major firms in representative sectors of the market. Over time, the index has not been solely an index of large company stocks, but a collection of representative companies in "broad industry groups that approximates the distribution of . . . the NYSE stock population," taken as the assumed model. A major use of the group indexes is as a standard for comparison of performance of individual stocks within each group (Standard & Poor's Statistical Service 1984, p. 3).

A major development in measuring stock prices and returns occurred with the introduction of the Chicago Research in Security Prices (CRSP), which was enabled by a grant from Merrill Lynch, Pierce, Fenner & Smith in 1960. The data covered all firms traded on the NYSE, included month-end prices and monthly dividends, and were combined into a composite value-weighted price and a total returns index. These data were chronicled by Fisher and Lorie (1964, 1968, and 1977). This effort provided the inspiration for Ibbotson

15. See Standard & Poor's Statistical Service (1981 and 1988). Comparison with the NYSE capitalization is somewhat indirect since the S&P 500 includes stocks from NASDAQ.

16. Group substitutions and redefinitions occur on a continuous basis, as do company changes. Obviously, since about 10% of the 500 stocks are NASDAQ instead of NYSE stocks, the model for the group indexes has changed somewhat over the last 15 years. Currently, there are more than 100 sectors in the S&P Index.

and Sinquefield in 1974 to construct a similar stock and returns index using the data from Standard & Poor's. As shown in figure 1, the CRSP NYSE data begin in 1926 and continue to the present.[17]

The historical data used by Ibbotson and Sinquefield (1976), and updated on a continuous basis by Ibbotson Associates (1999), are based on the S&P 90 daily data from December 1925 through 1956 rather than the more broadly defined S&P "500" weekly data. Therefore, the historical data reported by Ibbotson Associates are not, in actuality, the S&P 500 Composite Index in the sense of a broad market index of hundreds of stocks. As table 1 shows, from 1928 on there were always in excess of 400 stocks available for the broader S&P weekly index. However, Ibbotson and Sinquefield (1976) would have found it very difficult to locate those data. Therefore, they did the only reasonable construction of the S&P index possible at that time and cannot be faulted for presenting the data as they have. Furthermore, Ibbotson Associates clearly states in their publications that their S&P 500 Index is based on the S&P 90 during the period 1926–56, and Ibbotson clearly uses month-end prices, thereby avoiding the use of averaged data.

Standard & Poor's reports a historical series for its index, but it is not based on the best data available. First, the data for 1926 through March 1957 are based on the S&P 90 Index. Second, although S&P reports their monthly prices as both end-of-month and averages, they continue to report their historical series, through all versions, using averaged data. Finally, for the back record prior to 1926, S&P uses Cowles's data, but from the first edition (1938) instead of the revised (corrected) data from his second edition (1939); in addition, the Cowles data are averaged data. Therefore, the data used by Shiller and by Siegel from 1871 through 1925, as described below, are based on inferior estimates. Similarly, the dividends and earnings for the S&P historical series are based on the same sources as their stock price data and therefore contain errors that were later corrected by Cowles.

Research by Shiller (1989) utilizes the January values of the S&P historical index and the calendar year dividends and earnings adjusted to the index. Shiller's data are based on the S&P historical series, for January only, which are averaged data based on the S&P 90 from 1926 through 1956. Shiller's earlier data are also averaged.

Siegel (1992, 1998), in the construction of his index of stock prices and returns, uses Shiller's data from 1871 to 1925, then splices to the Chicago Center for Research in Security Prices (CRSP) from 1926 to the present. Therefore, while Siegel's data and analysis may offer useful insights into the history of stock returns, these data cannot directly be compared to other studies that use only S&P data. Furthermore, for the early period 1871–1925, the data are based on the flawed S&P historical data.

17. The Center for Research in Security Prices has recently added indexes that include the capitalization of the AMEX and NASDAQ to their index of NYSE stocks only.

It is apparent that the historical record of stock prices and returns based on S&P data, with or without the Cowles extension backward in time, consists of a mixture of measures that lacks consistency of definition. To date, the following observations emerge: (1) No study to date has presented a "true" composite of S&P prices and returns for the "modern" period from 1926 based on the S&P weekly data, which contain more than 400 stocks. The 30-year period from 1926 to 1956 contains only 90 stocks, and the performance of the 90 stocks was quite different from the broader market representations (as shown below). (2) No study to date has presented the definitive record of stock returns since 1871 based on the Cowles data and the broad S&P Index, using corrected end-of-month data.

V. Reconstruction of a Monthly Composite Price Index

Cowles's monthly data are flawed for some research purposes because they are "averaged." Cowles used monthly arithmetic means of the S&P weekly indexes from 1918 through 1940 and the midpoint of the monthly high and low prices of stocks in constructing monthly indexes back to January 1871. Working (1960) pointed out that changes in time-averaged data have a downward-biased variance and a built-in-first-order autocorrelation. In fact, Cowles was instrumental in Working's article. Cowles and Jones (1937) did an analysis of stock index and stock price movements in which they concluded that there was an element of predictability in stock price movements. Working's analysis was in response to this article (and others). This led Cowles to revisit his analysis and to revise his conclusions (Cowles 1960).

Schwert (1990) showed that the cross-correlations of averaged data with other series are downward biased as well. Although the problem of stochastic bias has focused on first-order conditions, there now is evidence that autocorrelation problems with monthly changes can persist through at least the second order, and the downward biases in variances and covariances can persist through higher orders, at least up to the twelfth.[18]

We are not the first to attempt to correct for the averaged data inherent in the Cowles series. Schwert (1990) constructed a monthly index of stock prices and returns using Cowles's price and dividend data from 1871 to 1885. He was well aware of the biases in averaged data, and in an attempt to deal with this issue Schwert shifted to the Dow Jones Industrial Averages through 1925, where he then shifted to the CRSP monthly estimates. This dealt with the averaged-data problem because the Dow Jones data use month-end prices. However, the appreciation change in that measure over the December 1885 through 1925 period was 296.75%, compared to an appreciation change in Cowles's monthly averaged composite price index of 139.38%, a difference of 1.27% per annum compound. Thus, the trade-off in accuracy of estimating

18. These results are based on new work by Wilson, Jones, and Lundstrum (2001).

stock returns relative to having desirable stochastic properties in the returns series seems excessive.[19]

These problems can better be addressed with the new data we have constructed. We have reconstructed the S&P weekly data that Cowles averaged over the period 1918–40 and estimated month-end prices based on a "companion" series of stock prices from February 1885 through February 1957, splicing into the S&P end-of-month prices that continue to the present.[20] This provides, for the first time, a consistent long-term series for the S&P Composite Index based on month-end prices (the SPWC series).

With the S&P weekly data, between January 1918 and February 1957 there are 470 monthly closing prices, with 84 (18%) of the S&P weekly price quotations being on the last trading day of the month.[21] There were 384 months when the S&P Index was calculated near the last trading day and required interpolation from a companion series.[22] Candidates for a companion daily series of stock prices for the S&P Weekly Index over the period 1918 through 1956 are few. After reviewing those few daily indexes available, we have chosen what we feel are the best alternatives for various time periods, as explained below.

For each of the 384 affected observations, we calculate a percentage adjustment of the S&P weekly price nearest the end of the month using the percentage change of the daily companion series from that date to month end, multiplied by the S&P weekly price. The S&P 90 prices were used from January 1928 through February 1957, the New York Times Industrial and Rail Averages from January 1921 through 1927, and the Dow Jones Average from January 1918 through 1920. This process maintains the basic average changes of the S&P weekly prices while eliminating the biases of the averaged data.[23]

For the period prior to the S&P weekly series in January 1918, we used as the companion series the Dow Jones Averages, which extend back to 1885. We calculated the monthly closing price as a percentage of the midpoint of the high and low prices, and applied that to Cowles's monthly average. This produced an estimate with greater variability than predicted by Working, and

19. Schwert uses the monthly dividend yield estimates from the Cowles series along with the Dow-Jones prices for his total return series from 1885 through 1925.

20. See Friedman (1962, p. 729), who noted that "most economic time series are highly manufactured products, constructed out of many bits and pieces that must be shaped and rearranged to yield the final series."

21. Trading days over the period until September 29, 1952, included half days on Saturday for a 6-day week.

22. For these 386 months, approximately one-third were plus or minus 1 trading day, one-third were plus or minus 2 trading days, and one-third were plus or minus 3 trading days.

23. As an example of these calculations, consider the month of August 1929. The weekly S&P Index was calculated for August 29, whereas the last trading day of the month was August 30. The value of the index for August 29, on the 1941–43 base, was 32.2879. The S&P 90 values on August 29 and 30, on the original 1926 base, were 248.5 and 251.8, respectively. To estimate the value of the weekly index on August 30, the calculation is: $(251.8/248.5)(32.2879) = (1.013279678)(32.2879) = 32.7167$.

TABLE 3 Statistical Results for Tests of the Variance Differential, the Autocorrelation Difference, and the Covariance of Changes in the Averaged and Period-End Price Data, by Subperiods, Relative to the Expected Amount of the Bias

Time Period	Variance Differential as a Ratio	Autocorrelation Difference	Ratio of Bias in Covariance of Changes
Expected values*	3/2	1/4	2/3
1885/3–1896/12	1.5169	.2794	.6952
1897/1–1917/12	1.5034	.2882	.7579
1918/1–1925/12	1.4432	.2222	.7329
1926/1–1940/12	1.4847	.2091	.6701
1941/1–1957/12	1.3818	.2099	.6996

* The expected values are approximations only, dependent on the number of observations within the period for averaging and the nature of the volatility within the period covered. The variance differences are in terms of month-end logarithmic percentage change values relative to averaged percentage changes. The autocorrelation difference is the autocorrelation of the logarithmic percentage change in month-end data minus the autocorrelation of the monthly averaged data percent changes. The covariance ratio is the covariance of the logarithmic percentage changes of the month-end and averaged prices.

geometric adjustments of the ratios were made to achieve reasonable month-end estimates for Cowles's data. These adjustments were applied back to the beginning of the Dow Jones Averages in February 1885. We have been unsuccessful in finding an appropriate companion series prior to 1885, and have used Cowles's monthly averages back to 1871.[24]

Working estimated that the bias in averaged data would mean that the variance of end-of-period changes would be 50% greater than changes in the averaged data, and that the averaged changes would have first-order autocorrelation of an amount approximating .25 greater than that of the end-of-period data. Schwert (1990) suggested that the covariance of changes in averaged data with other series would be downward biased by about two-thirds relative to the covariance of period-end changes. We determined that, if the method of using the best available companion stock price series with the Cowles averaged data for month-end estimates achieved the 50% increase in the variance of first-order changes, the autocorrelation and covariance problems would take care of themselves.

Table 3 presents the results of a comparison of variances, autocorrelation, and covariances between the month-end estimates and the averaged prices. The time periods for these comparisons are based on dates of changes in companion series and/or S&P/Cowles estimates. The first row of data in table 3 relates to the approximate expected values for each of the three statistics. The variance differential is the variance of the month-end percentage changes relative to the variance of averaged percentage changes, which Working suggested would be "about" 1.5. The autocorrelation differential is an arithmetic difference of the first-order autocorrelation of the month-end percentage

24. We, like Schwert, have experimented with filtering mechanisms to eliminate the biases. We have concluded that any benefits from an artificial process to eliminate biased estimators is overridden by the loss in accuracy of return estimates.

changes minus the autocorrelation in the averaged changes, which Working suggested would be "about" 0.25. The covariance differential is the estimated covariance between the estimated month-end percentage changes and the percentage changes in the averaged prices, which Schwert suggested would be around .60 or .70. For the different subperiods shown in table 3, the estimated values strongly suggest that the methodology used with the companion series has eliminated the biased stochastic percentage changes associated with averaged data.

Our resultant S&P composite price index (SPWC) is that of Cowles's monthly averages from January 1870 through January 1885, a month-end estimate of prices through 1917, and a weekly and month-end price index from January 1918 to the present. This allows estimation, for the first time, of a continuous "S&P Composite Index" based on the broader weekly measure of the market and Cowles's data that have been corrected for the averaging problem.

VI. Dividends and Earnings

Cowles provided monthly price index estimates, as well as cumulative monthly wealth indexes, for the composite and for the subindexes. We have used Cowles's estimates of the two indexes to estimate the dividend amounts adjusted to the index.[25]

For the estimates of monthly dividend amounts adjusted to the price index, we begin with the revised estimates from Cowles's data by Wilson and Jones (1987).[26] These monthly estimates are based on the arithmetic difference of percentage changes in Cowles's total returns index and the price index changes, and cover the period from January 1871 through December 1940 (Cowles's series P and series C, 1939, 1941, and 1942). In the early years, prior to 1900, this procedure sometimes led to estimates of dividend returns that were negative or unrealistically large, usually for adjacent months. These yields were further smoothed and our estimated annual dividend levels checked against annual dividend amounts that were estimated by Cowles.[27] This provides 70 years of monthly dividend data that are consistently defined.

Standard & Poor's provides 12-month moving dividend estimates for the S&P 90 for the period 1926 through 1956.[28] Alternative monthly dividend yields can be calculated from the CRSP NYSE files for the period 1926 to the present. Moody's has estimated monthly dividend amounts and yields for industrial, transportation, and utilities averages for the period 1929 through

25. Cowles provided, using various definitions, annual dividends and earnings estimates in separate tables that are helpful in cases of doubt about these values.

26. For a similar treatment, see Snowden (1987, 1990).

27. This is based on Cowles's D series.

28. The S&P Historical Series includes the 1871–1925 price, dividends, and earnings from the first edition of Cowles, the S&P 90 estimates for 1926–57, and the S&P 500 data from March 1957. (This series is used by Shiller, and by Siegel until 1926.)

1974, and annual estimates for a composite average, when their estimates ceased (Moody's Investment Service 1976).[29] For available overlap periods prior to 1940, or between 1957 and the present, the strongest relation was between the Cowles–S&P Weekly and the CRSP NYSE, followed by estimates based on Moody's, with the weakest relation with the S&P 90 estimates.

Standard & Poor's publishes quarterly 12-month moving dividend estimates for the composite (as well as the major subindexes) from March 1957 to the present, which leaves a 16-year gap in dividend estimates for the index from January 1941 through February 1957.[30] We used the CRSP NYSE yields multiplied by the S&P weekly prices to estimate dividend levels from January 1941 through February 1957. From the S&P 500 quarterly dividend amounts from 1957 to the present, we have estimated monthly dividend amounts within each quarter based on the seasonal pattern of the CRSP NYSE yields.

Cowles, for the period 1870 through 1940, provides two different estimates for earnings: earnings yields for calendar years for stocks for which earnings estimates were available (Series R), and earnings amounts based on the prices of stocks for which earnings are available (Series E with price series P[Ea]). The earnings series are of lesser quality than the corresponding dividend estimates because of the complete absence of data on the earnings of some corporations prior to the end of World War I. With Cowles's estimates an alternative series (downward biased due to the different price indexes P and P[Ea]) can be estimated by multiplying the earnings yields and the all-stock price index. Between 1871 and 1917 we use the average earnings of the two estimates from Cowles's data. Between 1917 and 1940, the two estimates differ little. The only other earnings series available are for the S&P 90 from 1926 through 1957, and those of Moody's, which is annual for the composite, but quarterly for the subsector averages.

We use the annual earnings yields for the composite multiplied by the Cowles price index and use the Moody's Industrial quarterly pattern to check the level of earnings for the overlap period 1930–40. Moody's data were used to estimate quarterly and annual earnings for the period 1941 through March 1957. From March 1957, S&P estimates quarterly and four-quarter moving total earnings. The S&P 90 earnings are available over the period 1926 through March 1957, but the composition of the S&P 90 places relatively too much weight on rails and utilities, and this earnings series is less correlated with the Cowles series during the overlap period than with Moody's estimates.

29. Moody's averages are share weighted and covered 125 industrials, 19 rails, 25 utilities, 21 banks, 29 insurance companies, and 15 "other finance" for 200 total corporations. For a detailed explanation of the construction of these averages, see Cowles (1939, p. 443). The composite average was much broader than the S&P 90. For an early example of splicing this series to the Cowles dividend estimates, see Fellner (1956).

30. It is possible to unchain the 12-month totals into quarterly amounts, but the process is tedious and can lead to quarterly amounts that begin to oscillate. See Ibbotson and Sinquefield (1976, pp. 12–13, n. 5) for an example of dealing with the problem.

TABLE 4 **Total Percentage Appreciation and Cumulative Returns, and Annual Geometric Means and Geometric Standard Deviations, for Four Nonoverlapping Time Periods, 1871–1999, and for the Total Periods December 1925–December 1999 and January 1871–December 1999**

	Total Percentage Change		Per Annum Geometric Means and Standard Deviations (%)			
			Appreciation		Cumulative	
Index	Appreciation	Cumulative	Mean	SD	Mean	SD
A. January 1871–December 1925:						
Cowles	184.91	4,584.23	1.8960	17.2972	7.2457	16.9501
S&P Historical	180.63	4,680.22	1.8938	17.2595	7.2841	16.3750
SPWC	187.01	4,674.72	1.9355	17.1908	7.2819	16.8297
B. December 1925–December 1940:						
Cowles	−19.84	62.09	−1.4635	34.0417	3.2723	33.3568
S&P Historical	−15.49	85.40	−1.1157	34.8662	4.2014	32.9338
Ibbotson	−17.20	81.20	−1.2424	36.9729	4.0424	36.1504
CRSP NYSE	−24.39	56.20	−1.8760	37.0985	3.0176	36.4101
SPWC	−21.07	61.08	−1.5652	36.3771	3.2292	35.6297
C. December 1940–December 1956:						
S&P Historical	331.53	916.90	9.5691	15.8003	15.5996	15.2776
Ibbotson	341.25	991.50	9.7218	16.0839	16.1118	15.8809
CRSP NYSE	311.26	883.80	9.2402	15.2826	15.3604	14.9754
SPWC	302.48	862.24	9.0877	14.9772	15.2007	14.6353
D. December 1956–December 1999:						
S&P Historical	3,044.10	13,482.53	8.3491	16.0897	12.0996	15.6329
Ibbotson	3,048.55	14,287.84	8.3527	16.4143	12.2499	16.1459
CRSP NYSE	2,486.01	11,963.38	7.8579	16.3480	11.7909	16.2026
SPWC	3,073.13	14,427.03	8.3723	16.3780	12.2750	16.0930
E. December 1925–December 1999:						
S&P Historical	11,169.41	237,991.27	6.5929	20.8596	11.0789	19.9337
Ibbotson	11,417.10	284,462.00	6.6243	21.6423	11.3469	21.2054
CRSP NYSE	7,941.41	185,279.46	6.1079	21.5330	10.7039	21.1963
SPWC	9,972.46	225,064.92	6.4313	21.2972	10.9952	20.8671
F. January 1871–December 1999:						
S&P Historical	32,077.47	12,240,723.67	4.5775	19.4833	9.5066	18.5176
SPWC	28,809.16	10,750,883.43	4.4907	19.7001	9.3965	19.2442

VII. Comparisons of Appreciation and Total Returns with Alternatives

Given the alternative estimates of aggregate U.S. stock returns available from Cowles, Ibbotson and Sinquefield, Shiller, Schwert, Siegel, and Wilson and Jones, we now consider the significance of the differences among these series. We review alternative results in terms of appreciation and total returns with reinvestment of dividends for the composite indexes.

Table 4 compares the total and appreciation returns of various indexes for selected time periods covering the life of the indexes. The Cowles (1939) index, with the updates (1941, 1942), extends through 1940, as do the Standard

& Poor's historical returns as used by Shiller and by Siegel. Beginning in December 1925, the S&P series used the S&P 90 prices and dividends, which continued through 1956, and are used by Ibbotson Associates.

Panel A in table 4 provides comparisons from January 1871 through December 1925 for the three series available: Cowles, the S&P historical returns, and our month-end estimates of the S&P Weekly Composite and Cowles Index (SPWC). Included are the total percentage change and the per annum geometric means and standard deviations for both appreciation and cumulative returns. The returns for the S&P historical series are slightly less than either of the others. The differences are attributable to the S&P series being based on the values from the earlier edition of Cowles, rather than the updates that corrected some errors. Also, the dividends are based on reinvestment annually rather than monthly, as is the case for the other two series. The differences between Cowles's returns and the weekly S&P Weekly Composite and Cowles (SPWC) returns are due primarily to our modification of monthly dividend estimates and are influenced only slightly by the use of our month-end price estimates. Our month-end price estimates produce a higher degree of accuracy of returns than the average prices used by Cowles, as well as the effects of monthly reinvestment and compounding.

Panel B of table 4 compares the returns from the end of 1925 through 1940. For this period, we can include the Ibbotson and the CRSP NYSE estimates that began in December 1925.[31] During this volatile period of the Great Depression and the stock market crash, appreciation returns and cumulative returns differ dramatically. The S&P 90 stocks, as reported by Ibbotson and by the S&P historical series, fared better than the stocks in the broader S&P weekly index (SPWC) and in the CRSP NYSE index. The S&P 90, with heavier weighting in utilities and rails than in industrials, relative to the broader measures, had less of an appreciation loss and a greater total return. The CRSP NYSE index was more significantly affected than the Cowles index or the weekly S&P Composite Index because of its broader coverage, but the differences among these three indexes are less dramatic than the comparisons of all three with the S&P 90.

Panel C of table 4, covering the period December 1940 through 1956, is beyond the period covered by Cowles, which now drops out of the comparisons. The S&P historical data and Ibbotson's measure, which are based on the S&P 90 for the period, are available for comparison with the broadly based S&P 500 index using weekly data (SPWC) and with the CRSP NYSE data. The narrower-coverage indexes (S&P historical and Ibbotson Associates) outperformed the broader measures, suggesting once again that the standard measurement of returns during the period 1926–56 is influenced by the relatively narrow coverage of the S&P 90 stocks. The CRSP NYSE returns also suffered by comparison because of the broader coverage but outperformed the weekly S&P Composite Index.

31. Siegel, in December 1925, splices the Shiller data from 1871–1925 to the CRSP series.

Panel D of table 4 covers the period December 1956 through 1999 for S&P historical, Ibbotson, CRSP NYSE, and the S&P Weekly Composite and Cowles Index. For this period any differences between the returns of Ibbotson and the reported S&P Index are generally small. The same S&P 500 prices are being used by both for this later period, and capital appreciation returns will be identical, except for round-off differences in measuring the indexes. The difference in the total returns, with dividends reinvested monthly, is a result of the source of the estimates of the dividend amounts, the allocation of dividend amounts by months within quarter, and the periodicity of dividend reinvestment.

Our S&P dividend estimates, as reflected in the S&P Index as reported here, are based on the S&P 500 quarterly and annual dividends since the first quarter of 1957, with some smoothing from the estimates from the earlier period. The S&P estimates of quarterly dividends lag the price data by from 2 to 4 months and are subject to revision periodically. We use the quarterly dividend estimates, allocated monthly within quarter according to the seasonality of dividends of the CRSP NYSE data. Ibbotson has used various estimates of dividends over this period, all based on S&P data, which may differ slightly from their "official" estimates.[32] Our estimates for this period show a geometric mean for both appreciation and total returns only slightly higher than Ibbotson's, and with geometric standard deviations that are very slightly lower. Over this period, the appreciation returns, as well as the total returns for the CRSP NYSE, are lower than for the other three indexes.

Panels E and F provide a long-term perspective on appreciation and returns. As panel E shows, since 1925 Ibbotson reports a geometric mean for total returns on the S&P 500 of 11.3469%. However, this geometric mean exceeds the other three measures shown. The broader S&P Composite Index shows 10.9952%, while the CRSP NYSE Index is even lower at 10.7039%. Therefore, our analysis clearly suggests that Ibbotson's data, based as they are on 90 stocks for a 30-year period, overstate the rate of return on the S&P 500.

Panel F provides the longest-term comparison, from 1871 through 1999. The S&P historical series produces the greater geometric means for both appreciation and total returns. We believe that these means overstate the returns, for reasons presented earlier.

For the complete period, January 1871 through 1999, our newly reconstructed S&P Weekly plus Cowles Index, with one dollar invested in January 1871, and with dividends reinvested monthly, reaches a value of $107,508.834 at the end of 1999, for a geometric mean return of 9.3965% per annum. The appreciation return for the 129 years totaled 288.0916%, or 4.4907% per annum.

32. For example, for the period 1977 through August 1997, Ibbotson's income returns were calculated from a total returns index with subtraction of appreciation returns on the basis of data furnished by the American National Bank and Trust Company of Chicago. The series assumed reinvestment of income at month end. Since August 1997, a total returns index from Wilshire of S&P total returns is used, which assumes reinvestment of dividends daily.

TABLE 5 Summary Values of Valuation Ratios for the SPWC Index (1870–1999) and Two Subperiods (1870–1935 and 1936–99)

Variable	Quartile			Interquartile Range
	Median	Lower	Upper	
1870–1999:				
Dividend yield (%)	4.5656	3.9190	5.4928	1.5738
Dividend payout (%)	58.7717	51.9029	70.5181	18.6152
Price-earnings ratio	14.2800	11.3300	17.8100	6.4800
1870–1935:				
Dividend yield (%)	5.1231	4.1785	5.6609	.5378
Dividend payout (%)	67.4217	57.6102	78.9652	11.5435
Price-earnings ratio	14.2800	12.7900	16.8600	4.0700
1936–99:				
Dividend yield (%)	4.0980	3.2853	5.2753	1.9900
Dividend payout (%)	54.4370	45.6444	58.8406	13.1962
Price-earnings ratio	14.2900	10.9800	18.0900	7.1100

SOURCE.—Calculated from data in appendix table A1.

VIII. Cowles and S&P Composite Data with Basic Valuation Ratios

The alternative series of Ibbotson Associates, Schwert, and CRSP do not provide earnings estimates for their indexes. Siegel presents graphs of earnings, with dividends, from 1870 through 1996 (1998, p. 79, table 5-1) but does not provide a source. Since the CRSP price and dividend data that he uses from 1926 do not include earnings estimates, we conclude that he must be using the estimates from the S&P historical series, which in turn are based on the S&P 90 estimates from 1926 through 1957 and the (uncorrected) Cowles estimates from his first edition. The data that we have reconstructed include earnings estimates, adjusted to the index, which are described below.

The reconstructed and revised annual data for the broadly defined S&P composite are presented in appendix table A1. The prices are year-end using the 1941–43 = 10 base, and the dividend and earnings levels, adjusted to the index, are for the indicated calendar year. The dividend and earnings levels from 1871 through 1940 are based on Cowles (1939, 1941, 1942), and for 1957 through 1999 are from S&P. The levels from 1941 through 1956 have been estimated by the authors, with dividend levels based on the CRSP NYSE estimates and earnings based on Moody's estimates.

The dividend yields provided are defined as the dividend in the current year divided by the price at the end of the previous year, expressed as a percent. The dividend payout rate is the indicated year's dividend divided by the earnings for that year and expressed as a percent. The Price-Earnings (P/E) ratio represents the price at year end divided by the earnings for that calendar year, or the one-year trailing ratio.

Table 5 summarizes the valuation ratios for the Standard & Poor's Weekly plus Cowles (SPWC) price, dividends, and earnings for the complete 129-year period. For comparison, the summary valuation ratios are provided for two subperiods that are split at December 1935. Because of the volatility in these ratios and large skewness and kurtosis measures, the summary statistics

are given in terms of quartile values as opposed to means, with variance measured as the interquartile range. The interquartile range includes 50% of the values, with 25% of the values being above the upper quartile and 25% below the lower quartile.

The median value of the dividend yield for the complete period is 4.57%, and for the period 1871–1935 is 5.12%, whereas for the 1936–99 period the median is 4.10%. The interquartile range for the complete period is 1.57%, with a lower quartile of 3.92% and an upper quartile of 5.49%, with the range being similar for the early and the late period. These yields are in stark contrast to the decade of the 1990s, where all of the yields are less than the lower quartile for the period. In the 1990s, dividend yields range between a high of 3.69% in 1991 and a low of 1.36% in 1999. The dividend yield in 1999 was the lowest level over the 129 years.[33]

The median payout rate for the complete period is 58.77%, with the lower quartile at 51.90% and the upper quartile at 70.52%, with an interquartile range of 18.62%. The highest payout ratio was 929.12% in 1932 when earnings were near zero. The payout rate was more than 100% in 8 of the 129 years. For the 1871–1935 period the median rate was 67.42% and for 1936 through 1999 was 54.43%. The decrease in the payout rate between the early and late period is similar to the decrease in dividend yields between the two periods and again is in contrast with the 1990s where the payout rate in 1999 was 34.65%, the smallest over the complete period.

The median P/E ratio over the 129-year period is 14.28, with a lower-quartile value of 11.33 and an upper-quartile value of 17.81. The lowest P/E was 5.53 in 1917, and the highest, 136.50, occurred in 1932 when earnings were near zero. For the early and the late periods the median P/E was 14.28 and 14.29, respectively.[34] The P/E ratio in 1933 of 33.66 is the second highest level, and the ratio in 1998 of 32.60 is the third highest, followed closely by the 1999 ratio of 30.50.

Appendix table A1 provides the annual appreciation returns, total returns with dividends reinvested monthly, and the total returns index with monthly reinvestment of income. The summary statistics for these returns were presented in table 4 above.

IX. Conclusion

In this article we reexamine carefully the entire history of the S&P Composite Index as well as develop a corrected and improved composite series from 1871 through the present. The S&P 500 Index price and return data have often been misrepresented, and confusion still continues about their historical coverage. Furthermore, the extensions back in time using Cowles data that

33. Recent research results by Fama and French (2000), using firm-level data, show rather conclusively that dividend yields are decreasing.

34. Earnings for industrials, transportation, and utility sector indexes were negative in some years, providing meaningless P/E ratios.

have been published in numerous sources have been confusing, based on averaged monthly data rather than month-end prices and often failing to incorporate Cowles's own corrections to his data.

We have been able to reconstruct the S&P weekly index, which, unlike their "official" index containing only 90 stocks for the period 1926–56, contained more than 400 stocks for most of that period. There is no S&P composite index of 500 stocks until 1957, regardless of any reconstructions that can be accomplished.

Cowles made an important contribution to the study of returns over long periods of time by extending the original S&P data backward in time to the beginning of 1871. In subsequent reports Cowles corrected errors in his data, which have not been picked up by most sources reporting this historical series. For example, although Standard & Poor's reports their historical series based on Cowles's data, S&P has consistently failed to use the subsequently corrected Cowles data. The uncorrected S&P series, in turn, has been used by Shiller and by Siegel, as well as others, in studying stock returns over long periods.

We have reconstructed the Cowles data based on his updated and corrected series. We have also attempted to reconstruct the data to deal with time-averaging biases, going beyond Schwert's attempt to do so. Averaged data have a downward-biased variance and built-in first-order autocorrelation. Extensive analysis and adjustment were required to produce a series that avoids the averaging problem back to February 1885.

Standard & Poor's did not estimate dividends and earnings for their price series prior to 1925, and then only for the 90 stocks, but Cowles did so for the period 1871–1940. We have used Cowles's estimates of the monthly price index and cumulative monthly wealth index to estimate the dividend amounts adjusted to the index, and carry the dividend and earnings estimates through March 1957, where we pick up the S&P 500 estimates.

Our analysis of the various series dealing with S&P composite data indicates that significant differences do exist when measuring returns over long periods. In particular, the use of only 90 stocks by Standard & Poor's, as duplicated by Ibbotson Associates and others, causes significant differences in both appreciation returns and cumulative total returns. The S&P 90 stocks fared better than stocks in the broader weekly index and in the CRSP NYSE index during the period 1926–56. As a result, the narrower coverage indexes of the S&P historical series and of Ibbotson Associates outperformed the broader measures over a long period of time and effectively overstate the returns to a broader composite index of S&P stocks.

Researchers interested in the long time series offered by S&P composite data, as extended by the Cowles data, should be aware of the nature of the time series and the differences in results that can occur between the narrow coverage of the 1926–56 period and the broader coverage of other series. They should also understand the limitations of the data. In particular, they should understand that several well-known reported series using Cowles's

data are based on the earlier edition of Cowles's work rather than Cowles's own corrected data, and that the Cowles data are averaged data, which have potential statistical problems.

Our alternative stock return data provide new information and a new time series that can be analyzed in connection with long-term studies involving stock returns. Hopefully we will see improvements in the data that are being analyzed and reported on, and better recognition of the possible limitations in these data.

Appendix

TABLE A1 **End-of-Year SPWC Stock Prices, Annual Dividends and Earnings, Dividend Yield, Payout Ratio, and P/E Ratios, Annual Appreciation and Total Returns, and a Total Returns Index, December 1870–December 1999**

							Returns		
Year	Price	Dividend	Earnings	DivYld (%)	Payout (%)	P/E	Appreciation (%)	Total (%)	Total Index
1870	5.0823	. . .	. . .	. . .	. . .	. . .	. . .	. . .	1.0000
1871	5.4383	.3030	.4235	5.9619	71.5466	12.84	7.0047	12.4871	1.1249
1872	5.8084	.3036	.4503	5.5826	67.4217	12.90	6.8054	12.5603	1.2662
1873	5.0682	.3346	.4711	5.7606	71.0253	10.76	−12.7436	−7.3417	1.1732
1874	5.2105	.3739	.4735	7.3774	78.9652	11.00	2.8077	10.3996	1.2952
1875	4.9969	.3274	.3747	6.2835	87.3766	13.34	−4.0994	2.2445	1.3243
1876	4.1000	.3233	.2872	6.4700	112.5696	14.28	−17.9491	−12.0849	1.1642
1877	3.7157	.2184	.3077	5.3268	70.9782	12.08	−9.3732	−3.6942	1.1212
1878	3.9435	.2006	.3206	5.3987	62.5702	12.30	6.1307	11.7701	1.2532
1879	5.6376	.2347	.3912	5.9516	59.9949	14.41	42.9593	50.2407	1.8828
1880	6.6911	.2956	.5139	5.2434	57.5209	13.02	18.6870	24.7197	2.3482
1881	6.8904	.3334	.4635	4.9827	71.9310	14.87	2.9786	7.8935	2.5336
1882	6.6911	.3530	.4739	5.1231	74.4883	14.12	−2.8924	2.3064	2.5920
1883	6.1216	.3707	.4399	5.5402	84.2692	13.92	−8.5113	−3.1102	2.5114
1884	4.9684	.3655	.3391	5.9707	107.7853	14.65	−18.8382	−13.1786	2.1805
1885	6.0203	.2655	.2988	5.3438	88.8554	20.15	21.1718	27.4638	2.7793
1886	6.4507	.2252	.3643	3.7407	61.8172	17.71	7.1491	11.1563	3.0894
1887	6.0602	.2677	.3996	4.1499	66.9920	15.17	−6.0536	−1.9866	3.0280
1888	5.9957	.2514	.2865	4.1484	87.7487	20.93	−1.0643	3.1743	3.1241
1889	6.1277	.2522	.3270	4.2063	77.1254	18.74	2.2016	6.5027	3.3272
1890	5.3984	.2347	.3156	3.8301	74.3663	17.11	−11.9017	−8.4445	3.0463
1891	6.3022	.2487	.3738	4.6069	66.5329	16.86	16.7420	21.9218	3.7141
1892	6.3156	.2750	.4043	4.3636	68.0188	15.62	.2126	4.6253	3.8859
1893	4.8286	.2595	.2911	4.1089	89.1446	16.59	−23.5449	−19.7576	3.1181
1894	4.8437	.2221	.1782	4.5997	124.6352	27.18	.3127	4.8542	3.2695

TABLE A1 (*Continued*)

Year	Price	Dividend	Earnings	DivYld (%)	Payout (%)	P/E	Returns		
							Appreciation (%)	Total (%)	Total Index
1895	4.8777	.2234	.2681	4.6122	83.3271	18.19	.7019	5.1722	3.4386
1896	4.7760	.2068	.2310	4.2397	89.5238	20.68	−2.0850	2.1687	3.5131
1897	5.4931	.2120	.3337	4.4389	63.5301	16.46	15.0147	19.8629	4.2110
1898	6.6038	.2080	.3812	3.7866	54.5645	17.32	20.2199	24.6218	5.2478
1899	6.8635	.2654	.5302	4.0189	50.0566	12.95	3.9326	7.7912	5.6566
1900	8.1732	.3006	.5257	4.3797	57.1809	15.55	19.0821	24.2316	7.0273
1901	9.2767	.3503	.5630	4.2860	62.2202	16.48	13.5014	17.9820	8.2910
1902	9.4735	.3663	.7115	3.9486	51.4828	13.31	2.1214	6.0566	8.7931
1903	7.7252	.3785	.6038	3.9954	62.6863	12.79	−18.4546	−14.5681	7.5121
1904	9.4914	.3416	.5495	4.4219	62.1656	17.27	22.8628	28.1306	9.6254
1905	11.1497	.3966	.7646	4.1785	51.8703	14.58	17.4716	22.0581	11.7485
1906	11.1571	.4321	.8711	3.8754	49.6039	12.81	.0664	4.0732	12.2271
1907	7.4932	.4488	.7616	4.0226	58.9286	9.84	−32.8392	−29.2915	8.6456
1908	10.4558	.4572	.6636	6.1015	68.8969	15.76	39.5372	46.8449	12.6956
1909	11.9448	.5524	.8786	5.2832	62.8728	13.60	14.2409	20.0054	15.2354
1910	10.4333	.4914	.8335	4.1139	58.9562	12.52	−12.6540	−8.5149	13.9381
1911	10.4923	.5269	.6767	5.0502	77.8632	15.51	.5655	5.6730	14.7288
1912	10.6998	.5445	.8039	5.1895	67.7323	13.31	1.9776	7.1851	15.7871
1913	9.3124	.5646	.7244	5.2767	77.9404	12.86	−12.9666	−7.7988	14.5559
1914	8.3503	.4615	.5922	4.9558	77.9298	14.10	−10.3314	−5.5377	13.7498
1915	11.0333	.4727	1.0092	5.6609	46.8391	10.93	32.1306	38.7851	19.0827
1916	11.0101	.6939	1.7614	6.2891	39.3948	6.25	−.2103	6.4054	20.3051
1917	8.1907	.8404	1.4799	7.6330	56.7876	5.53	−25.6074	−18.9136	16.4646
1918	9.0730	.6685	1.1352	8.1617	58.8883	7.99	10.7772	19.6130	19.6938
1919	10.3402	.5760	1.0693	6.3485	53.8670	9.67	13.9667	20.6402	23.7587
1920	7.9789	.5639	.9204	5.4535	61.2668	8.67	−22.8361	−17.8755	19.5117
1921	8.3487	.5071	.3314	6.3555	153.0175	25.19	4.6347	11.6025	21.7756
1922	10.2980	.5586	.7948	6.6909	70.2818	12.96	23.3485	30.6281	28.4450
1923	9.9897	.5796	1.1167	5.6283	51.9029	8.95	−2.9938	2.9926	29.2962

1924	11.9713	.6128	1.0637	6.1343	57.6102	11.25	19.8364	27.0336	37.2161
1925	14.5868	.6666	1.4279	5.5683	46.6839	10.22	21.8481	28.2971	47.7472
1926	15.0317	.7506	1.4295	5.1457	52.5079	10.52	3.0500	8.6052	51.8559
1927	19.1472	.8094	1.2741	5.3846	63.5272	15.03	27.3788	33.5836	69.2710
1928	25.6107	.8386	1.5563	4.3798	53.8842	16.46	33.7569	39.0010	96.2874
1929	22.0524	.9500	1.6866	3.7094	56.3263	13.08	−13.8938	−10.7754	85.9121
1930	15.3148	.8985	1.0099	4.0744	88.9692	15.16	−30.5527	−27.4147	62.3596
1931	7.8926	.7617	.3998	4.9736	190.5203	19.74	−48.4642	−45.1645	34.1952
1932	6.7976	.4627	.0498	5.8625	929.1165	136.50	−13.8738	−7.5690	31.6069
1933	10.1946	.3649	.3029	5.3681	120.4688	33.66	49.9735	56.5038	49.4661
1934	10.1004	.3999	.4008	3.9227	99.7754	25.20	−.9240	3.0259	50.9629
1935	13.9128	.4083	.5790	4.0424	70.5181	24.03	37.7450	42.7834	72.7665
1936	17.5954	.6838	.9249	4.9149	73.9323	19.02	26.4692	31.9201	95.9936
1937	11.1381	.7758	.9843	4.4091	78.8174	11.32	−36.6988	−33.1850	64.1381
1938	13.5956	.5160	.4538	4.6327	113.7065	29.96	22.0639	27.5958	81.8375
1939	13.1861	.5879	.8067	4.3242	72.8772	16.35	−3.0120	1.6273	83.1692
1940	11.5131	.6669	.9857	5.0576	67.6575	11.68	−12.6876	−7.5247	76.9110
1941	9.5853	.7491	1.1139	6.5065	67.2502	8.61	−16.7444	−10.6167	68.7456
1942	10.4452	.6417	1.0893	6.6946	58.9094	9.59	8.9710	16.6604	80.1989
1943	12.5944	.6402	1.0893	6.1291	58.7717	11.56	20.5760	26.8881	101.7629
1944	14.3279	.6816	1.1069	5.4119	61.5774	12.94	13.7641	19.5953	121.7037
1945	18.8722	.6749	1.0436	4.7104	64.6704	18.08	31.7164	37.1269	166.8885
1946	17.0809	.7654	1.2228	4.0557	62.5940	13.97	−9.4917	−5.6506	157.4584
1947	16.7439	.9235	1.7323	5.4066	53.3106	9.67	−1.9730	3.6444	163.1968
1948	16.1064	1.0482	2.2769	6.2602	46.0363	7.07	−3.8074	2.4583	167.2086
1949	18.1056	1.1380	2.0872	7.0655	54.5228	8.67	12.4125	20.4472	201.3981
1950	21.9441	1.3974	2.6951	7.7181	51.8497	8.14	21.2006	29.8947	261.6054
1951	24.9764	1.3534	2.3894	6.1675	56.6418	10.45	13.8183	20.4295	315.0501
1952	26.9358	1.3719	2.3928	5.4928	57.3345	11.26	7.8450	13.7957	358.5135
1953	25.8450	1.4059	2.5277	5.2194	55.6197	10.22	−4.0496	1.3906	363.4988
1954	36.7255	1.4917	2.7075	5.7717	55.0951	13.56	42.0991	49.0319	541.7292
1955	43.8870	1.6756	3.4568	4.5625	48.4726	12.70	19.5001	24.4502	674.1828
1956	46.3029	1.8171	3.3269	4.1404	54.6184	13.92	5.5048	9.7728	740.0691
1957	39.99	1.8713	3.37	4.0414	55.5282	11.87	−13.6339	−9.8847	666.9156

TABLE A1 (*Continued*)

Year	Price	Dividend	Earnings	DivYld (%)	Payout (%)	P/E	Returns		
							Appreciation (%)	Total (%)	Total Index
1958	55.21	1.7528	2.89	4.3831	60.6505	19.10	38.0595	43.3191	955.8176
1959	59.89	1.83	3.39	3.3146	53.9823	17.67	8.4767	11.9507	1070.0442
1960	58.11	1.95	3.27	3.2560	59.6330	17.77	−2.9721	.4684	1075.0567
1961	71.55	2.02	3.19	3.4762	63.3229	22.43	23.1285	26.8871	1364.1078
1962	63.10	2.13	3.67	2.9769	58.0381	17.19	−11.8099	−8.7247	1245.0929
1963	75.02	2.28	4.02	3.6133	56.7164	18.66	18.8906	22.8000	1528.9740
1964	84.75	2.50	4.55	3.3324	54.9451	18.63	12.9699	16.4817	1780.9751
1965	92.43	2.72	5.19	3.2094	52.4085	17.81	9.0619	12.4512	2002.7282
1966	80.33	2.87	5.55	3.1051	51.7117	14.47	−13.0910	−10.0568	1801.3168
1967	96.47	2.92	5.33	3.6350	54.7842	18.10	20.0921	23.9809	2233.2881
1968	103.86	3.07	5.76	3.1823	53.2986	18.03	7.6604	11.0627	2480.3503
1969	92.06	3.16	5.78	3.0426	54.6713	15.93	−11.3614	−8.4480	2270.8114
1970	92.15	3.14	5.13	3.4108	61.2086	17.96	0.0978	3.9460	2360.4172
1971	102.09	3.07	5.70	3.3315	53.8596	17.91	10.7868	14.3124	2698.2503
1972	118.05	3.15	6.42	3.0855	49.0654	18.39	15.6333	18.9746	3210.2315
1973	97.55	3.38	8.16	2.8632	41.4216	11.95	−17.3655	−14.6639	2739.4858
1974	68.56	3.60	8.89	3.6904	40.4949	7.71	−29.7181	−26.4708	2014.3230
1975	90.19	3.68	7.96	5.3676	46.2312	11.33	31.5490	37.2033	2763.7181
1976	107.46	4.05	9.91	4.4905	40.8678	10.84	19.1485	23.9598	3425.8993
1977	95.10	4.67	10.89	4.3458	42.8834	8.73	−11.5050	−7.1475	3181.0341
1978	96.11	5.07	12.33	5.3312	41.1192	7.79	1.0620	6.5636	3389.8258
1979	107.94	5.65	14.86	5.8787	38.0215	7.26	12.3088	18.6246	4021.1687
1980	135.76	6.16	14.82	5.7069	41.5655	9.16	25.7736	32.3968	5323.8980
1981	122.55	6.63	15.36	4.8836	43.1641	7.98	−9.7304	−4.9271	5061.5820
1982	140.64	6.87	12.64	5.6059	54.3513	11.13	14.7613	21.5262	6151.1489
1983	164.93	7.09	14.03	5.0412	50.5346	11.76	17.2710	22.5483	7538.1303
1984	167.24	7.53	16.64	4.5656	45.2524	10.05	1.4006	6.2761	8011.2341
1985	211.28	7.90	14.61	4.7238	54.0726	14.46	26.3334	31.7036	10551.0824
1986	242.17	8.28	14.48	3.9190	57.1823	16.72	14.6204	18.6336	12517.1292

1987	247.08	8.81	17.50	3.6379	50.3429	14.12	2.0275	5.2536	13174.7328
1988	277.72	9.73	23.76	3.9380	40.9512	11.69	12.4008	16.5476	15354.8379
1989	353.40	11.05	22.90	3.9788	48.2533	15.43	27.2505	31.6275	20211.1857
1990	330.22	12.10	21.34	3.4239	56.7010	15.47	−6.5591	−3.1060	19583.4227
1991	417.09	12.20	15.91	3.6945	76.6813	26.22	26.3067	30.3992	25536.6198
1992	435.71	12.38	19.09	2.9682	64.8507	22.82	4.4643	7.6064	27479.0357
1993	466.45	12.58	21.88	2.8872	57.4954	21.32	7.0552	10.0513	30241.0225
1994	459.27	13.18	30.60	2.8256	43.0719	15.01	−1.5393	1.3122	30637.8446
1995	615.93	13.79	33.96	3.0026	40.6066	18.14	34.1107	37.5362	42138.1399
1996	740.74	14.90	38.73	2.4191	38.4715	19.13	20.2637	22.9454	51806.8959
1997	970.43	15.50	39.72	2.0925	39.0232	24.43	31.0082	33.3466	69082.7376
1998	1229.23	16.20	37.71	1.6694	42.9594	32.60	26.6686	28.5731	88821.7934
1999	1469.25	16.69	48.17	1.3578	34.6481	30.50	19.5260	21.0399	107509.8343

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