

# **The Dow Jones Industrial Average: The Impact of Fixing Its Flaws**

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## **Abstract:**

The Dow Jones Industrial Average is a flawed index. The index uses price weights instead of conceptually superior market valuation weights, the companies included in the index are not chosen systematically and are not very representative of the U.S. market, and the index ignores returns from dividends. This paper shows that alternative stock price indices which use superior weighting methods and a more systematic inclusion criterion perform very similarly to the Dow Jones Industrial Average. However, ignoring dividends underestimates the long-run returns earned by stock market investors dramatically. If Dow Jones & Co. had included dividend returns in the DJIA when it was reformed in 1928, the index would be over 250,000 today.

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## 1. Introduction

The Dow Jones Industrial Average (DJIA) is the most quoted stock market index in the world. The changes in the index are often perceived to be representative of the entire stock market. This paper discusses whether the performance of the DJIA differs significantly from the performance of better-constructed indices and whether investors make a large mistake in paying attention to this flawed index.

Charles Dow, one of the founders of Dow Jones & Co. (which also publishes *Barrons* and *The Wall Street Journal*), created the first stock market index. He began in 1884 with 11 liquid and highly capitalized stocks, most of them railways. On May 26, 1896 the Dow Industrial Average was first published. It included all 12 industrial companies listed on the New York Stock Exchange, as industrial and manufacturing firms were increasing in importance relative to the previously dominant railroads.<sup>1</sup> Only one of the original twelve industrial companies, General Electric, is in the DJIA today. In 1916, the Industrial average was increased to 20 stocks, and in October 1928 the number was expanded to 30. Also in 1928, the *WSJ* editors began calculating the average with a special divisor to avoid distortions when constituent companies split their shares or when one company was substituted for another. Through habit, this index was still identified as an “average.” The 30 companies currently in the DJIA are large, but not necessarily “industrial.” The 30 companies represent every important sector in the stock market (except transportation companies and utilities).<sup>2</sup> Table A.1 in the Appendix lists the companies currently in the DJIA.

The DJIA has three major flaws. First, each company in the index is weighted by the price of its stock. The importance of each company in the index does not depend on the total market capitalization (a measure of the size) of the company. Instead, a highly priced stock has a higher weight than a lower priced stock. Each time a company in the DJIA splits the weight of this company decreases because the stock price falls by the ratio of the split. Second, the companies in the index are not representative of the market as a whole. The components of the DJIA are chosen more or less arbitrarily by the Dow Jones & Co. to represent different industries, but they are not chosen according to fixed or well-defined rules. In particular, the DJIA is not an index of the 30 largest companies in the United States. A more representative index would include a much larger number of companies. Third, the DJIA is not a total return index because it excludes dividend distributions. Dividends account for a considerable portion of returns to shareholders in the long run. If a stock index is used to gauge the return earned by market participants over long periods of time, a total return index would be far superior to a stock price index.

We find that the DJIA did not perform significantly different from alternative stock price indices over the period from 1928 until 1998. However, ignoring dividends results in a

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<sup>1</sup> The Dow Jones Rail Average, whose name was changed in 1970 to the Transportation Average, separately represented the railroad companies. The Dow Jones Utility Average came along in 1929.

<sup>2</sup> See Pierce (1996) and Siegel (1998). The official web-page of Dow Jones & Co. includes additional historical information about the DJIA (<http://averages.dowjones.com/home.html>).

considerable underestimation of the performance of stock markets over the long run. We summarize the different methods of constructing indices in Section 2. Section 3 reviews the long-run performance of the DJIA. In Sections 4 to 6 we discuss the effects of fixing the flaws of the DJIA. Section 4 shows how different weighting methods affect the performance of an index. Section 5 discusses the effects of the composition of the index and Section 6 shows that dividends account for a significant portion of the total returns of stocks and should not be ignored. Section 7 looks at the relative performance of the Nasdaq Composite Index and the DJIA over the 1973-98 period. Section 8 concludes the paper with a summary of our major findings.

## 2. Construction of Indices

The DJIA is a price-weighted index. The actual value of the index can be determined using the following formula:

$$(1) \quad DJIA_t = \frac{1}{d_t} \sum_i P_{i,t} .$$

The price of the stock of company  $i$  at time  $t$  is denoted by  $P_{i,t}$  and the divisor is given by  $d_t$ . The divisor of the DJIA originally equaled the number of companies in the average. Since 1928, the divisor changes each time a member stock splits or pays a large stock dividend and each time the composition of the index is modified. These changes of the divisor ensure that these splits, stock dividends and membership changes do not cause a discontinuity in the value of the index. The divisor was 0.20145268 on January 28, 2000. Table A.1 in the Appendix lists the 30 companies currently in the index. Adding the stock prices in Table A.1 and dividing by the divisor gives the value of the DJIA on this day which was 10,738.87 points. American Express has the highest and Philip Morris the lowest weight. J.P. Morgan is weighted ten times higher than its relative market capitalization. On the other hand, Microsoft's weight in the DJIA is almost three times lower than its relative market-capitalization. The weight of a company in the index drops whenever its stock splits. This treatment of stock splits by price-weighted indices is clearly inappropriate. The DJIA corresponds to the value of a portfolio which is invested in  $1/d = 4.9639$  shares in each company in the DJIA. Investors trying to replicate the performance of the DJIA average would need to rebalance their portfolio whenever the divisor changes.

A value-weighted index (VWI) is constructed in the following way:

$$(2) \quad VWI_t = VWI_{t-1} \sum_i w_{i,t} \frac{P_{i,t}}{P_{i,t-1}} ,$$

where

$$w_{i,t} = \frac{P_{i,t-1} N_{i,t-1}}{\sum_i P_{i,t-1} N_{i,t-1}} .$$

The relative market capitalization of company  $i$  in the previous period is denoted with  $w_{i,t-1}$  and  $N_{i,t-1}$  is the number of shares outstanding in the previous period. A stock split does not affect the value of a value-weighted index unless it affects the holding period returns of the stock. Microsoft has the highest relative market capitalization of the 30 Dow-components of 13.16 percent and Caterpillar has the lowest weight of 0.40 percent as shown in Table A.1. A value-weighted index corresponds to a portfolio where each asset is held in proportion to its market capitalization. The changes of a value-weighted index correspond to the changes of the total market value of all the companies included in the index. Investors trying to match the index only need to adjust their portfolio when a constituent company issues new stock or repurchases shares.

An equally weighted index (EWI) gives each of the  $n$  companies in the index the same weight:

$$(3) \quad EWI_t = EWI_{t-1} \frac{1}{n} \sum_i \frac{P_{i,t}}{P_{i,t-1}}.$$

The number of shares in each company that an investor would need to hold in order to replicate an equally-weighted index would be proportional to  $1/P_{i,t}$ . Investors would hold more shares in the low priced stocks such that the dollar-amount invested in each stock is identical. Investors desiring to continuously hold an equally-weighted index would need to readjust their portfolio in each period by selling shares in companies that had out-performed the index in the previous period and by buying shares in the companies that had under-performed the index. This strategy would generate considerable tax liabilities for investments in conventional savings accounts as shown in Dickson, Shoven, and Sialm (1999). Stock splits would not affect the value of an equally weighted index and would not necessarily require any rebalancing.

### 3. Long-Run-Performance of the DJIA

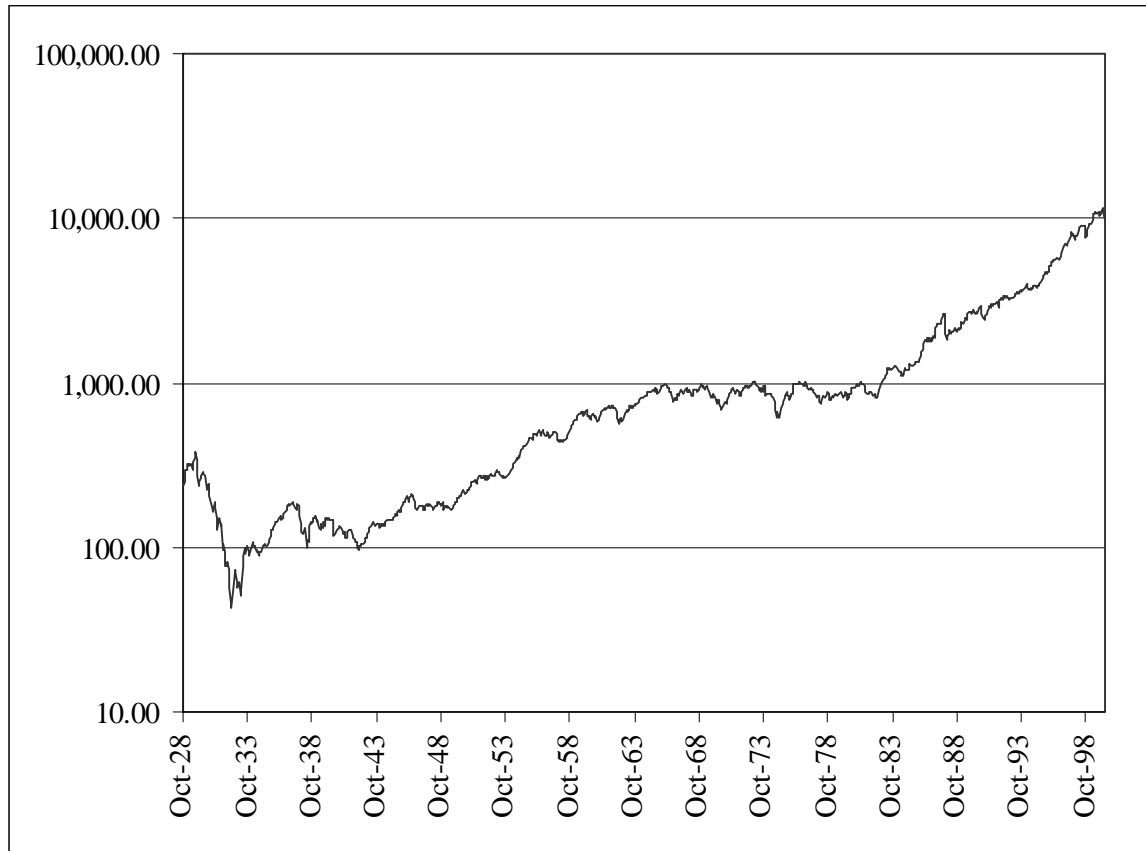
Figure 3.1 shows the performance of the Dow Jones Industrial Average in monthly intervals between October 1928 and February 2000. The month-end values of the index were taken from the Wharton Research Data Service. Our analysis focuses on this period because before October 1928 the Dow-Jones index did not adjust the divisor when the composition of the index was changed or when stocks in the index split.

There have been 48 company substitutions in the index since 1928. Of the original 30 companies in 1928 only 4 are still Dow-components at the end of January 2000.<sup>3</sup> The DJIA had a value of 239.43 points in October 1928. By September 1929 its level had increased to 380.33 points. The index subsequently dropped to 42.84 (June 1932) during the Great Depression and it did not reach a new all-time high until November 1954. The DJIA increased significantly in the 1950s and early 60s, but remained relatively flat

<sup>3</sup>The four companies are Honeywell International, Exxon-Mobil, General Electric, and General Motors. Allied Chemical & Dye changed their name to Allied Signal and merged into Honeywell International. Standard Oil changed to Exxon and then merged into Exxon-Mobil.

during the late 1960s and the 70s. The 1980s and 90s saw a more than 10-fold increase of the index. On March 29, 1999 the DJIA closed for the first time above 10,000 points.

Figure 3.1: The Dow Jones Industrial Average (Month-End Data from Oct-1928 until Feb-2000)



#### 4. Different Weighting

The first major flaw of the DJIA is that the companies are not weighted according to their importance in the market. We evaluate the effect of the price weighting of the DJIA by computing alternative value weighted and equally weighted indices for the companies that were included in the DJIA. The composition of the Dow was taken from Dow Jones & Co. and the individual stock data were taken from the Center of Research on Security Prices (CRSP). CRSP only provides monthly data for most of the sample period. Therefore it is not possible to change the composition of the alternative indices on the same date as the DJIA unless the composition changes happened to occur on the last day of the month. To mitigate any biases linked to the announcement of changes in the composition of the index, we assumed that all the composition changes occurred at the end of the month. We only have CRSP data up to December 1998 so we examine the period between October 1928 and December 1998. We used the 'holding period returns

without dividends' from CRSP as the returns of the individual stocks. The 'price' and the 'number of shares outstanding' were used to determine the market capitalization of each company. We used the quotes from *The Wall Street Journal* if the corresponding data of CRSP were missing.

Figure 4.1: The Dow Jones Industrial Average (DJIA) vs. a Value-Weighted Index of the Dow-Components (VW-DOW) and an Equally-Weighted Index of the Dow-Components (EW-DOW) (Month-End Data from Oct-1928 until Dec-1998)

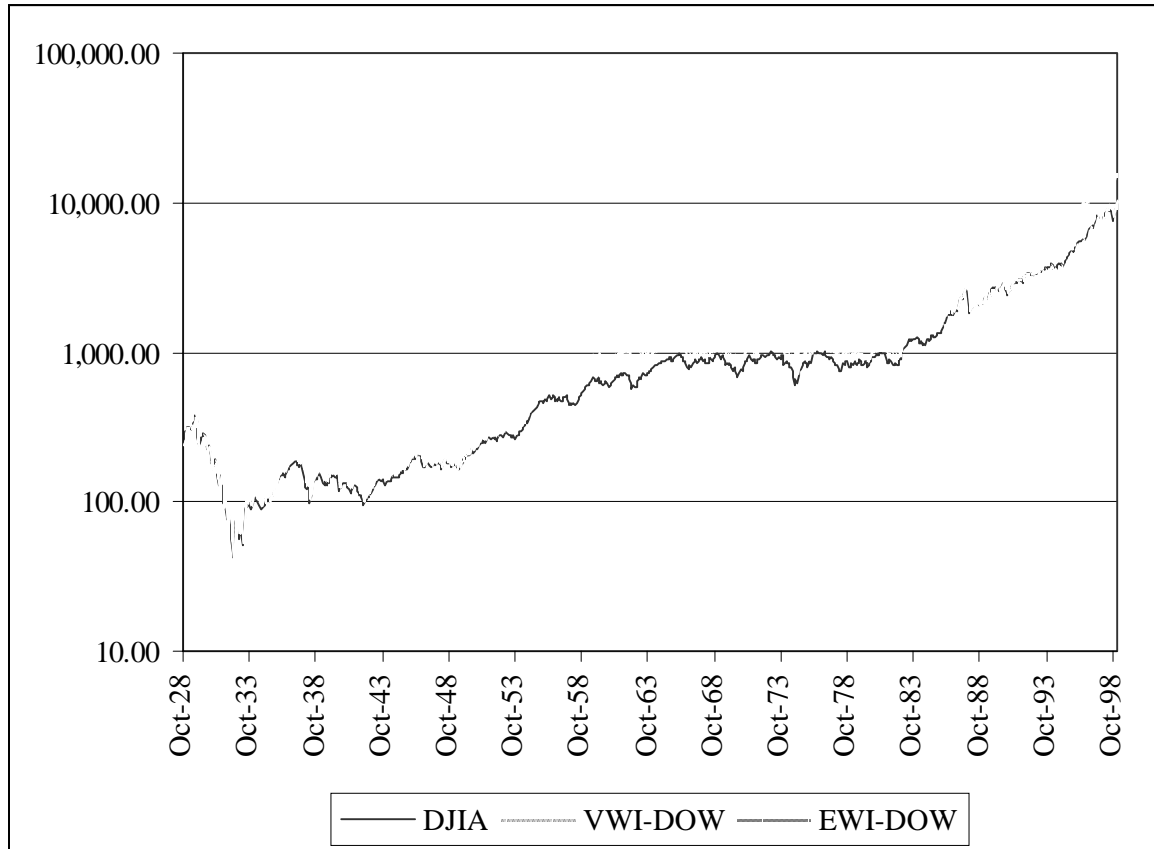


Figure 4.1 shows the time-series of the DJIA compared to a value-weighted index of the 30 companies included in the DJIA (VW-DOW) over the period from October 1928 until December 1998. The initial value of the value-weighted index in October 1928 is equalized to the value of the DJIA (i.e., 239.43 points). The two series are very close throughout the 70-year period. The VW-DOW performed slightly better than the DJIA during the 50s and slightly worse during the 80s. The DJIA closed in December 1998 at a level of 9,181.43 points, whereas the value-weighted index of the Dow-components closed at 9,842.37 points. The mean monthly simple returns equal 0.5885 percent for the DJIA and 0.5962 percent for the VW-DOW. The standard deviations of the monthly returns are 5.5490 (DJIA) and 5.5733 percent (VW-DOW). The correlation between the two return series is 0.9778. A statistical hypothesis test of the equality of the mean returns cannot be rejected at any conventional confidence level (the t-statistic is 0.1921).

The amazing thing is that the VW-DOW outperforms the DJIA in 422 out of 843 months, while the DJIA average does better in 421 months. Our interpretation of these results is that while the difference between price and value weights may be theoretically important, in actual fact the price weighting has not caused the DJIA to differ significantly from what it would have been with the superior system of market capitalization weights.

We also computed an equally weighted index of the Dow-components. The equally weighted index would have performed considerably better than the DJIA or the value-weighted index just examined. It would have closed at a level of 15,545.25 points in December 1998. This equally weighted index would have crossed the 10,000 milestone in October 1996. The equally weighted index performed particularly well in the first third of the sample. For the whole 1928-98 period the average monthly return of this index was 0.6793 percent with a standard deviation of 6.0930 percent. The correlation with the DJIA is 0.9881. A test of the equality of the mean returns of the DJIA and our equally weighted index can be rejected at a 5-percent confidence level (the t-statistic equals 2.5120). The EW-DOW outperforms the DJIA in 432 of the 843 months in our sample. Our interpretation of the superior performance of the equally weighted index is that it is another manifestation of the well-known small-stock effect.<sup>4</sup> An equally weighted index invests the same amount of money in each of the thirty stocks. Therefore, it puts far more weight on the smallest companies than does a value-weighted index and more weight on low priced stocks than a price weighted index.

## **5. Different Composition**

A second major flaw of the DJIA is that the companies in the index are not representative of the whole stock market. First, the 30 companies included in the DJIA only account for a relatively small share of all the companies publicly traded in the United States.<sup>5</sup> Second, the 30 companies are chosen somewhat arbitrarily by the Dow Jones & Co. and do not correspond to the 30 largest companies according to market capitalization. It is our assumption that many people believe that the Dow is an index of the thirty largest companies in the country, even though it is not. In this section we discuss whether price indices with different compositions would have performed significantly differently than the DJIA over the long run.

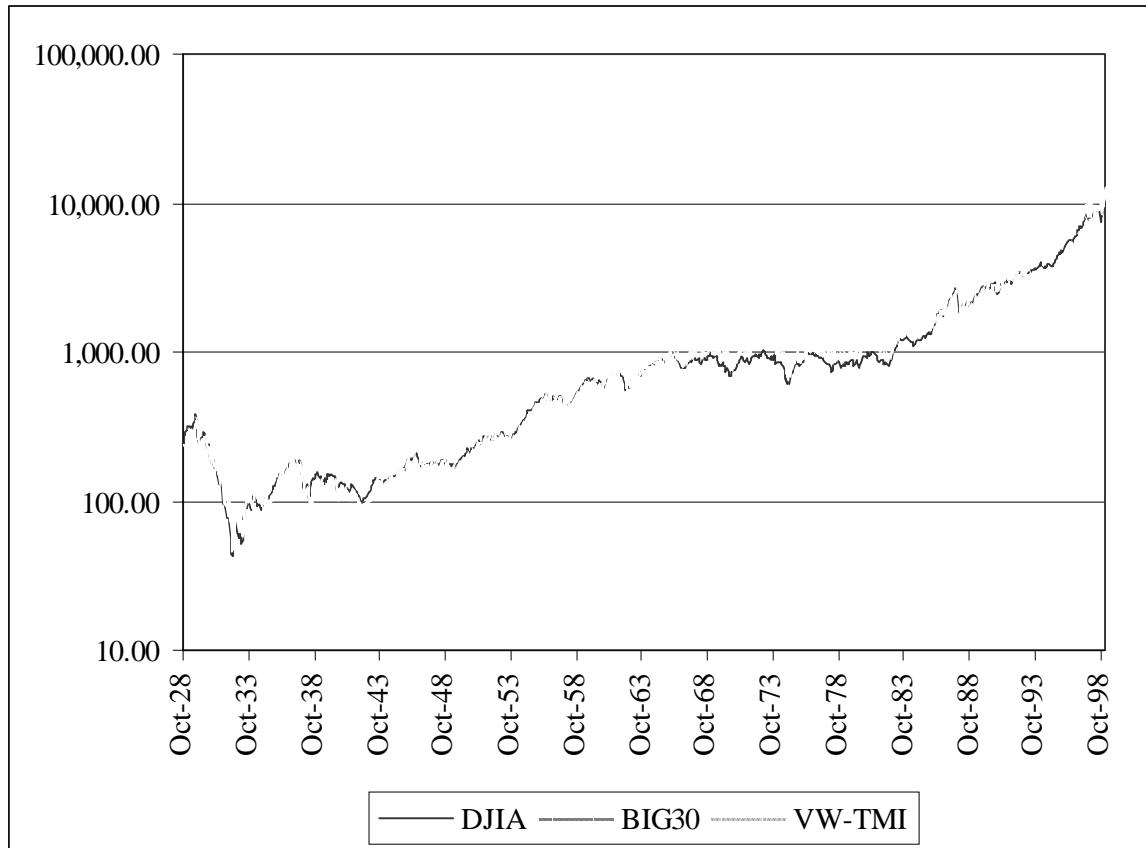
Other major indices in the United States include the Standard & Poor's 500 and the Wilshire 5000 Index. The S&P 500 Index consists of 500 stocks chosen for market size, liquidity, and industry group representation. It is a market value weighted index. The S&P 500 was inaugurated in 1957 and it was calculated back to 1926, although for many years before 1957 the index did not contain 500 stocks. The Wilshire 5000 Total Market Index was created in 1974 with 5,000 stocks and measures the performance of all U.S. headquartered equity securities with readily available price data. Over 7,000 capitalization weighted security returns are used to adjust the index.

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<sup>4</sup> Banz (1981) found that small stocks systematically outperformed large stocks, even after adjusting for risk within the framework of capital asset pricing models.

<sup>5</sup> An index including only a few highly liquid stocks might be superior to a broader index if investors are interested in very short-run movements in aggregate stock values.

Figure 5.1: The Dow Jones Industrial Average (DJIA) vs. the Index of 30 Largest Publicly Traded U.S. companies (BIG 30) and the Value-Weighted Total-Market Index (VW-TMI) (Month-End Data from Oct-1928 until Dec-1998)



We constructed an index of the 30-largest publicly traded companies in the United States over the period from 1928-1998. We chose the 30 companies with the largest market valuations in the previous month, if the companies were incorporated in the United States and if the companies were included in the CRSP database. The Center for Research in Security Prices (CRSP) maintains the most comprehensive collection of standard and derived security data available for the NYSE, AMEX and Nasdaq Stock Market. The monthly adjustments of the composition of the index resulted in 829 stock substitutions over a period of 843 months. This value-weighted index of the 30 largest publicly traded companies will be called the BIG 30 index. Data for the S&P 500 index are taken from Ibbotson Associates (1999). The Total Market Index (TMI) was computed by CRSP using data from the NYSE, AMEX and Nasdaq Stock Market. In December 1998 the total market capitalization of the 8,371 companies included in the index was \$13,176bn.

Figure 5.1 plots the performance of the DJIA, the BIG 30, and the value-weighted Total Market Index (VW-TMI). All three indices start at the level of the DJIA in October 1928. The DJIA and the BIG 30 index are very close during most of the period. The BIG 30 index performs considerably worse than the DJIA during the Great Depression and



performs better in the 1950s and in the 1990s. The Big 30 index closes at 11,211.32 points in December 1998 and has a mean monthly return of 0.5920 percent and a monthly standard deviation of 5.1723 percent. The correlation between the BIG 30 and the DJIA equals 0.9518. The mean return of the BIG 30 index is not significantly different from the mean return of the DJIA (the t-statistic is 0.0602). The BIG 30 index outperforms the DJIA in 425 of the 843 months.

Table 5.1: Performance of Different Indices (October 1928-December 1998)

Index	Index Value 12/31/98 (10/1/28 =239.43)	Mean Monthly Return (%)	Monthly Standard Deviation (%)	Correlation Coefficient with DJIA
Dow Jones Industrial Average	9,181.43	0.5885	5.5490	1
VW-Dow	9,842.37	0.5962	5.5733	0.9778
EW-Dow	15,545.25	0.6793	6.0930	0.9881
VW-Big 30	11,211.32	0.5920	5.1723	0.9518
EW-Big 30	12,660.11	0.6149	5.3284	0.9506
S&P 500	13,776.55	0.6453	5.7282	0.9718
VW-TMI	12,141.95	0.6220	5.5685	0.9661
EW-TMI	111,104.40	1.0075	7.6457	0.8467

The value-weighted Total Market Index would have closed at 12,141.95 points in December 1998 if it had been normalized to equal the DJIA in October 1928. Its mean monthly return was 0.6220 percent and the standard deviation was 5.5685 percent. The correlation with the DJIA was 0.9661. We are again not able to reject the hypothesis that the mean return of the Total Market Index is the same as the mean return of the DJIA (the t-statistic is 0.6709). The Total Market Index outperforms the DJIA in 419 months.

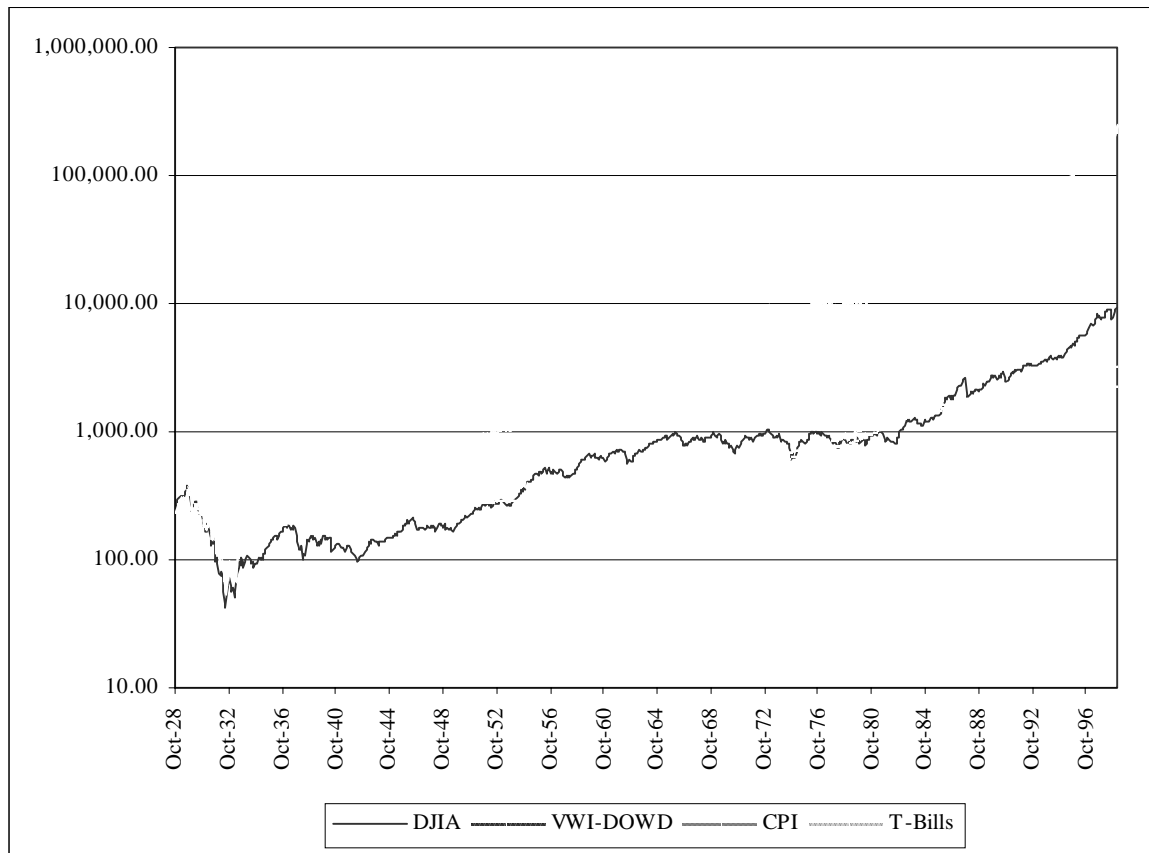
Table 5.1 gives some summary statistics of the alternative indices. The S&P 500 index performed better than the other value-weighted indices. The equally-weighted indices outperform the value-weighted indices significantly. An equally-weighted Total-Market Index would have closed in December 1998 at 111,104 points. The effect of the previously mentioned small-firm-effect is largest for broad market indices where the size of the constituent companies differs significantly. Of course, focusing on an index that gives the same weight to all the companies would not be very sensible. Value-weighted indices perform very similarly even over very long time periods. Thus, concentrating on a flawed index like the DJIA would not have been seriously misleading over long time periods.

## 6. Dividend Payments

The third flaw of the DJIA is that it ignores dividend payments of the stocks. Dividend payments increase the total performance of stock portfolios considerably. This flaw is common to all of the other major stock indices – the S&P 500, the NYSE index, the Nasdaq, and the Wilshire 5000. Stock market indices are usually used to gauge the

returns that stock market investors have earned over various time intervals. But, investors earn returns from both price appreciation and dividend payments. An index of stock prices only reflects one component of the total return enjoyed by investors. Stock prices naturally fall when stocks go ex-dividend. Most of the Dow stocks pay quarterly dividends. Therefore, there are more than 100 ex-dividend day events each year and with each event the DJIA systematically understates the return of investors in the Dow stocks. The average dividend yield on the Dow stocks has varied from between 1.96 (1998) and 9.72 (1950) percent per year.<sup>6</sup> The average dividend yield over the whole period was 4.87 percent. Ignoring this return leads to enormous understatements of the long run payoff to owning stocks. It would not be difficult to publicize a total return index rather than a stock price index. On a daily basis, the difference would be barely noticeable. However, over time horizons longer than three months, the difference becomes noticeable. Over decades, the difference becomes enormous.

Figure 6.1: The Dow Jones Industrial Average (DJIA) vs. the Value-Weighted Index of the Dow-Components with Dividends, the T-Bill-Index, and the CPI (Month-End Data from Oct-1928 until Dec-1998)



We have computed alternative indices including dividend payments. The dividend payments were taken from CRSP. A value-weighted index of the Dow-components

<sup>6</sup> We defined the annual dividend yield of a portfolio as  $DY_t = (VD_{t+1} / VD_t - V_{t+1} / V_t)$ , where  $VD_t$  denotes the total value of the portfolio at time  $t$  including dividend payments and where  $V_t$  denotes the value without dividend payments.

including dividend payments (VW-DOWD) would have closed at 233,060 points at the end of December 1998 had it started off in October 1928 at 239.43 points. The actual DJIA closed at 9,181 points as shown in Figure 6.1. Adding dividends increases the value of the index after 70 years by a factor of more than 25. Including dividends mitigates the effects of the Great Depression. A new all-time high is reached in January 1945 instead of November 1954 if dividends are included. Figure 6.1 also depicts an index of T-Bill returns and of Consumer Prices. The data for the returns of T-Bills and Consumer Prices are taken from Ibbotson (1999).

Table 6.1 summarizes the performance of the different indices over the period from October 1928 until December 1998. The value-weighted index of the Dow-components including dividends has a mean monthly return of 0.9730 percent and a standard deviation of 5.5664 percent. This mean return is significantly different from the mean return of the DJIA (the t-statistic is 9.4429). The equally weighted index of the Dow-components including dividends performed considerably better than the value-weighted index and its risk was slightly higher. The two Big 30 indices including dividends performed slightly worse than the value-weighted Dow with dividends. The S&P 500 index with dividends would have closed at 294,683 points had it started at the beginning of October 1928 at the same level as the DJIA. The value-weighted Total Market Index with dividends performs very similarly to the other value-weighted indices. The performance of the DJIA is worse than the performance of the Total Market Index if dividends are ignored. Adding dividends increases the value of the Dow slightly above the Total Market Index. An equally weighted Total Market Index would have closed in December at a level of over one million points.

Table 6.1: Performance of Different Indices including Dividends (October 1928-December 1998)

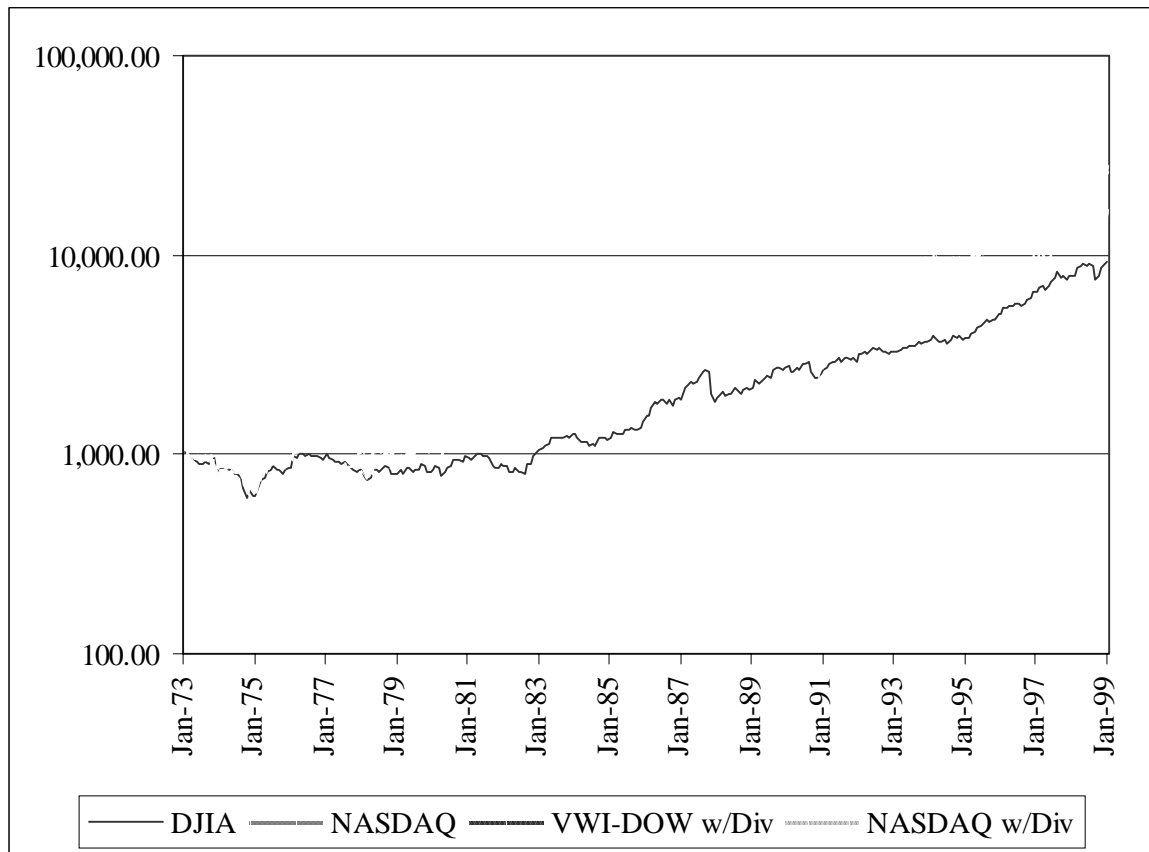
Index	Index Value 12/31/98 (10/1/28 = 239.43)	Mean Monthly Return (%)	Monthly Standard Deviation (%)	Correlation Coefficient with DJIA
DJIA (no Dividends)	9,181	0.5885	5.5490	1
VW-Dow with Dividends	233,060	0.9730	5.5664	0.9730
EW-Dow with Dividends	347,439	1.0493	6.0884	0.9661
VW-Big 30 with Dividends	225,780	0.9495	5.1639	0.9516
EW-Big 30 with Dividends	225,635	0.9579	5.3239	0.9504
S&P 500 with Dividends	294,683	1.0098	5.7205	0.9710
VW-TMI with Dividends	224,073	0.9691	5.5640	0.9652
EW-TMI with Dividends	1,147,728	1.2854	7.6349	0.8467
Treasury-Bills	3,272	0.3110	0.2662	-0.0170
Consumer Prices	2,274	0.2688	0.5447	-0.0105

An additional correction of the indices would be to measure the value of stock portfolios relative to consumer prices. Consumer prices increased during this period almost ten-fold and the real levels of all the indices would therefore be approximately one-tenth of their 1998 nominal values.

## 7. DJIA vs. NASDAQ

During 1999 the DJIA increased by 25.2 percent from 9,181.40 to 11,497.12 points. The Nasdaq-Composite Index rose during the same period by 85.6 percent from 2,192.69 to 4,069.39 points. This section discusses whether the Nasdaq outperformed the DJIA over a longer time horizon if dividends are included. The Nasdaq Composite Index measures all domestic and non-U.S. based common stocks listed on the Nasdaq stock market and is market-value weighted. Today the Nasdaq Composite includes over 5,000 companies.<sup>7</sup> Trading on The Nasdaq Stock Market—the world’s first electronic stock market—began in 1971. In this section we compare the long-run performance of the Nasdaq Composite Index and the DJIA with and without dividends.

Figure 7.1: The DJIA vs. the Nasdaq Composite Index With and Without Dividends (Month-End Data from Jan-1973 until Dec-1998)



Data for the Nasdaq index were taken from CRSP. CRSP has not yet released the data for 1999. Therefore our analysis concerns the period 1973-98.<sup>8</sup>

<sup>7</sup> See the Nasdaq-website for additional information (<http://www.nasdaq.com>).

<sup>8</sup> The CRSP-Nasdaq index used here differs slightly from the ‘official’ Nasdaq Composite Index. The CRSP index was used because CRSP computes as well an index including dividends, whereas there is no

The DJIA includes larger, better-established companies that tend to pay higher dividends than the smaller and younger companies in the Nasdaq index. The average annual dividend yield of the DJIA between 1973 and 1998 amounted to 4.86 percent, whereas the Nasdaq Index yielded only 2.23 percent. Figure 7.1 shows the performance of the two indices with and without dividends. All indices start at the level of the DJIA in December 1972 (1020.02 points). The Nasdaq-Index without dividends would have closed at a level of 16,544 points in December 1998, whereas the DJIA closed at a level of 9,181.43 points. If we include dividend payments, then the DJIA would have closed at 25,574 points and the Nasdaq at 27,657 points. The largest portion of the over-performance of the Nasdaq until 1998 disappears after the inclusion of dividends.

Table 7.1 summarizes the mean returns and the standard deviations of the two indices over the period from 1973-1998. The Nasdaq index has a much higher standard deviation than the DJIA. A statistical test of the equality of the mean of the returns of the two indices cannot be rejected for the indices with dividends (the t-value is 0.5101) or for the indices without dividends (the t-value is 1.3940).

Table 7.1: Performance of the DJIA compared to the Nasdaq (January 1973-December 1998)

Index	Index Value 12/31/98 (1/1/73= 1,020.02)	Mean Monthly Return ( %)	Monthly Standard Deviation (%)	Correlation Coefficient with DJIA
DJIA	9,181	0.8106	4.5337	1
Nasdaq	16,544	1.0600	5.5664	0.8301
VW-Dow with Dividends	25,574	1.1282	4.2474	0.9630
Nasdaq with Dividends	27,657	1.2260	5.6586	0.8284

Our interpretation of these results is that the superior performance of the Nasdaq over the DJIA for the period 1973-98 is greatly diminished once dividends are considered. In fact, taking account of the noticeably higher monthly standard deviation in the Nasdaq Composite's total returns, a case could be made that the Dow actually outperformed the Nasdaq over this time interval. This simply emphasizes the point that stock price indices are very poor measures of the total return to investors over lengthy periods of time.

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corresponding official Nasdaq Composite Index including dividends. There are many factors that cause the indices to differ. First are differences in the constitution between the two indices (CRSP exclude foreign and preferred stocks, rights, and warrants). Moreover, Nasdaq reweights their index on an intraday basis. The monthly returns of CRSP are only reweighted monthly. The two indices do not differ much despite those differences. The official Nasdaq index outperformed the CRSP index by only 1.08 percent cumulatively over the period from 1973-1998. The correlation coefficient between the monthly returns of the two indices was 0.9993.

## 8. Conclusions

The Dow Jones Industrial Index was originally designed in the late nineteenth century. Keeping the computational mechanics as simple as possible was essential. Therefore, the index was constructed using price weights. Computing it simply involved adding up the prices of the component stocks and dividing the result by a number, originally the number of stocks. This weighting system has little going for it now that computation is infinitely faster and cheaper. Nonetheless, we find that a value weighted DJIA would have performed very similarly to the actual Dow index. The price weighting scheme, while crude, has not by itself caused the index to be misleading.

Similarly, the inclusion of only thirty firms in the DJIA is difficult to justify today. Perhaps in 1928 a case could have been made that there were only thirty stocks whose trading was sufficiently thick to justify including them in a daily index. Clearly there are several thousand such companies today. The thirty stocks of the DJIA are chosen somewhat arbitrarily. We computed a price index of the thirty companies with the largest market capitalizations in the country. We also compared the Dow with the Standard and Poors 500 and a total market index. While the December 1998 value of the DJIA trailed the value of the broader indices, the differences were not dramatic. In fact, we could not reject the hypothesis that the mean monthly return of the DJIA was the same as mean return for the other value-weighted indices. Again, the limited and somewhat arbitrary inclusion of firms in the DJIA does not seem to have caused it to be misleading.

The third and final flaw of the DJIA, shared with all other leading stock market indices, is serious and quantitatively important. As a stock price index, changes in the DJIA understate the returns earned by market participants. The failure to account for dividends means that the index is less and less useful over longer and longer time horizons. We found that a value weighted total return index of the Dow companies would be over 250,000 points today. We also found that most of the superior performance of the Nasdaq Composite over the DJIA in the 1973-98 period disappears once dividends are considered.

Our work suggests that publicizing a value weighted, broadly defined, total return index that includes dividend payments of stocks would be useful for gauging the returns offered by U.S. equity markets. Such an index could be continuously computed and might aid people in making their own portfolio decisions.

## References

Banz, Rolf W. (1981). "The Relationship between Return and Market Value of Common Stocks," *Journal of Financial Economics*, 9 (1), 3-18.

Dickson Joel M., John B. Shoven, and Clemens Sialm (1999). "Tax Externalities of Equity Mutual Funds," Stanford Institute for Economic Policy Research: SIEPR Discussion Paper No. 99-9.

Ibbotson Associates (1999). "Stocks, Bonds, Bills, and Inflation," Chicago: Ibbotson Associates.

Pierce, Phyllis S. (Editor) (1996). "The Dow Jones Averages 1885-1995," Chicago: Irwin.

Siegel, Jeremy J. (1998). "Stocks for the Long Run," New York: McGraw-Hill (2<sup>nd</sup> edition),

## Appendix

Table A.1 shows the composition of the Dow Jones Industrial Average on January 28, 2000 according to Dow Jones & Co. The divisor was 0.20145268. The market capitalizations are taken from Market Guide.

Table A.1: The Composition of the DJIA (January 28, 2000)

Company Name	Price	Market Capitalization (\$Billions)	Price-Weight	Market-Weight
Alcoa Inc.	69.5000	25.5	3.21%	0.66%
American Express	158.2500	70.8	7.31%	1.83%
AT&T	48.6250	156.2	2.25%	4.04%
Boeing	44.6250	41.7	2.06%	1.08%
Caterpillar	43.5000	15.4	2.01%	0.40%
Citigroup	56.1250	189.2	2.59%	4.90%
Coca-Cola	57.0625	140.6	2.64%	3.64%
DuPont	59.4375	61.9	2.75%	1.60%
Eastman Kodak	61.7500	19.5	2.85%	0.50%
Exxon Mobil	78.8750	272.4	3.65%	7.05%
General Electric	134.0000	439.2	6.19%	11.37%
General Motors	78.9375	50.6	3.65%	1.31%
Home Depot	55.6250	128.1	2.57%	3.32%
Honeywell International	45.1875	35.8	2.09%	0.93%
Hewlett-Packard	108.9375	108.9	5.04%	2.82%
International Business Machines	111.5625	201.1	5.16%	5.20%
Intel	94.0000	314.1	4.35%	8.13%
International Paper	47.8750	19.8	2.21%	0.51%
J.P. Morgan & Co.	117.5000	20.4	5.43%	0.53%
Johnson & Johnson	84.5000	117.5	3.91%	3.04%
McDonald's	36.7500	49.8	1.70%	1.29%
Merck	76.3750	178.5	3.53%	4.62%
Microsoft	98.2500	508.4	4.54%	13.16%
Minnesota Mining & Manufacturing	92.2500	37.0	4.26%	0.96%
Philip Morris	20.7500	49.1	0.96%	1.27%
Procter & Gamble	100.3125	132.0	4.64%	3.42%
SBC Communications	39.2500	133.9	1.81%	3.47%
United Technologies	52.2500	25.0	2.42%	0.65%
Wal-Mart Stores	54.5625	245.5	2.52%	6.35%
Walt Disney	36.7500	75.8	1.70%	1.96%
Sum	2163.3750	3863.7	100.00%	100.00%

Source: Dow Jones & Co., Market Guide