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THE MYSTERIOUS GROWING VALUE OF S&P 500 MEMBERSHIP

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ABSTRACT

The efficient markets hypothesis implies that passive indexing should generate as high a return as active fund management. Indexing has been a very successful strategy. We document a large value premium in the average *q* ratios of firms in the S&P 500 index relative to the *q* ratios of other similar firms that appears in the mid 1980s and grows in step with the growth of indexing. Passive investment strategies that require the purchase of the particular 500 stocks in this index increase demand for those stocks and so push up their prices. In short, indexing induces downward sloping demand curves for stocks in the index. For reasons that are not fully clear, arbitrageurs apparently do not correct this overvaluation.

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1. Introduction

When asked for investment advice at cocktail parties, most finance professors hesitantly recommend a well-diversified index fund, such as one that tracks the Standard and Poor's (S&P) 500 Index of blue chip shares. This advice may have been far sounder than its propagators ever imagined.

The view that investors should entrust their savings to a well-diversified index fund follows from the semi-strong form of the efficient markets hypothesis (EMH), which states that no publicly available information is useful in predicting stock returns. Despite a large literature on market anomalies, behavioral studies of investors, and the like, the hypothesis that the market is semi-strong form efficient retains its place of prominence in introductory finance textbooks, for studies critical of it have yet to coalesce into a coherent alternative framework.

If the semi-strong form of the EMH is valid, and it is impossible to pick stocks that will perform better than average on a risk adjusted basis, the optimal investment strategy is to keep transactions costs low and remain widely diversified. Index funds generally accomplish these two goals better than other investment channels available to typical cocktail party guests.

Increasingly, even big institutional investors 'index' large and growing fractions of their portfolios. That is, they relegate large and growing pools of money to 'passive' investment strategies, such as buying and holding the stocks in the S&P 500 Index. The growing importance of indexing makes an understanding of its economic consequences an important question.

There is now considerable evidence that the demand curves of stocks in important indexes, such as the S&P 500, slope down. Shleifer (1986) finds that a company's stock price rises significantly on the news that it will be added to the S&P 500, and argues that this value increase is permanent. Shleifer concludes that stocks, like ordinary economic goods, have downward sloping demand curves and that share purchases by index funds constitute outward shifts in these demand that generate the price increases he observes.

Although Shleifer contends that the price increases he detects are permanent, the power of long-term abnormal return tests is weak and subsequent evidence on this point has been mixed. In this paper, we argue that if the increased value associated with inclusion in the S&P index is indeed permanent, it should be detectable in average Tobin's q ratios.

We find that membership in the S&P 500 index is associated with significantly higher valuation, measured by average Tobin's q ratios, even after controlling for standard variables known to affect q ratios. This finding is highly robust, and the S&P 500 membership value premium rises steadily from 1978 to 1997 in step with the growth of indexing. Granger causality tests suggest that being in the index causes the value premium; and that, while it cannot be rejected in some specifications, reverse causation is less statistically important.

One interpretation of this finding is that there is a presently unknown intangible asset associated with membership in the S&P 500 that has grow steadily more valuable over time and that assets manifests in share value premiums when (or after) the shares are included in the index.

Another interpretation is that the demand curves of stocks in the S&P 500 index slope do slope downward, and that the increased demand associated with increased 'passive' investment has had the fortuitous effect of pushing up the prices of S&P 500 stocks relative to those of other similar firms, justifying that investment strategy.

We argue that the second explanation may be the more plausible one, and that the cocktail party advice, which adherents to the efficient markets hypothesis have promulgated, may have had the perverse effect of undermining the efficiency of the stock market. Nonetheless, it turned out to be very good advice.

1.1 Share Value Effects Associated with Index Membership

The basic finding of Shleifer (1986) is that, when a firm is added to the S&P 500 index between 1976 and 1983, its stock price rises by 2.79 percent. Shleifer argues that this increase is both permanent and unrelated to any change in the fundamental value of the stock. Consequently, Shleifer (1986, 2000) argues that this finding implies that the demand curves for stocks in the index slope downward.

This interpretation is illustrated in Figure 1. When a stock is added to a widely tracked index, the added demand by passive investors shifts its demand curve to shift out, from D to D_1. This causes its price to rise from P to P_1, generating the abnormal return Shleifer (1985) documents.

[Figure 1 about here]

As Scholes (1972) and Shleifer (2000) point out, the demand curve for any good is flat if it has perfect substitutes that are in unlimited totally elastic supply. The assumption that financial assets have infinitely many such perfect substitutes underlies most asset pricing models, in that they assume the demand for an asset to depend only on its expected return and risk. Any other asset, or combination of assets, with the same expected return and risk is a perfect substitute that can be arbitraged infinitely against the asset in question. It is therefore not surprising that Shleifer's (1986) interpretation of his findings has been controversial.

Harris and Gurel (1986) challenge Shleifer's first contention that the effect is permanent. They argue that purchases by index funds create only a temporary spike in demand for the newly included stock because potential sellers do not respond immediately. In their view, this delay causes a temporary price increase that is soon reversed. They use index inclusions from 1978 through 1983 to demonstrate an announcement date abnormal return of 3.13 percent and, critically, an offsetting -2.49 percent cumulative abnormal return of over the subsequent 29 trading days. They thus cannot reject a complete reversal. In contrast, Beneish and Whaley (1996) and Lynch and Mendenhall (1997) find only partial reversals in the event windows they study.

However, Jain (1987) and Dhillon and Johnson (1991) replicate Shleifer's (1986) finding rejecting a complete reversal. Dhillon and Johnson (1991) also show that the prices of call options on newly included stocks increase on the announcement date. Since corresponding put prices do not rise, these increases are not caused by increased implied volatility. Taken together, these findings indicate options markets expect the stock price increase to last - at least past the maturity of the options.

Kaul et al. (2000) study a rejigging of the weights of companies in the Toronto Stock Exchange (TSE) 300 index, which is tracked by Canadian index funds. The index weights of some companies rose, while those of others fell, and their share prices rose or fell in proportion when the rejigging was implemented. Kaul *et al.* reject a complete reversal until long after trading volume and spreads have returned to normal. Their tests lose power over very long horizons, but their point estimates suggest that the abnormal returns are not reversed.

In summary, Shleifer's (1986) inference that the abnormal returns he detects are largely permanent remains subject to debate, though more recent evidence tends to support his initial view. In this study, we test for a statistically significant value premium in the abnormal average Tobin's q ratios of S&P 500 firms relative to those of other similar firms. We argue that the effect detected by Shleifer and others is indeed permanent because we detect an unambiguous q ratio premium in S&P 500 firms in cross-sectional regressions.

Shleifer's (1986) second contention that inclusion in the S&P index is unrelated to any revision in investors' estimate of the stocks' fundamental values is also controversial. Dhillon and Johnson (1991) show that included firms' bond prices rise in step with their stock prices, and Jain (1987) finds abnormal returns for inclusions into industry indexes that are not used as passive investment benchmarks. These authors suggest that inclusion in the index amounts to a "certification of quality", and that this is the ultimate cause of the value increase. Since Standard and Poor's rates bonds as its core business, such a certification effect would seem plausible.

However, more recent studies support Shleifer's original interpretation. First, Wurgler and Zhuravskaya (2000) find that the abnormal returns associated with inclusion in the S&P 500 are larger for stocks that are less likely to have close substitutes. Second, the Kaul *et al.* (2000) result is clearly not due to a certification effect as the event studied is a mechanical rearrangement of the weights of stocks already in a widely followed index. Since no new stocks were added to the index, a certification effect can be ruled out categorically.

Thus, Shleifer's (1986) second contention, that the effect is unrelated to any change in the included stock's fundamental value, is also controversial, but again, more recent studies tend to confirm his interpretation of his finding. In this study, we argue that Shleifer's contention of an outward shift in demand caused by index funds holdings is plausible because the q ratio premium for S&P 500 member firms rises over time, in step with the rising popularity of indexing.

2. Empirical Framework

Our empirical analysis compares the actual market value of firm j in year t, $V_{t,j}$, with an estimate of that value based on a vector of reported financial data, $\mathbf{x}_{j,t}$. Thus, we consider

[1] $$V_{t,j} = f_t(\mathbf{x}_{t,j}) + \varepsilon_{t,j} \; .$$

If we find that firms in the S&P Index consistently have market values higher than those we predict, we can conclude that S&P membership is associated with higher market value. That is, we interpret a positive $\varepsilon_{t,j}$ as indicating a high market value. We postulate that $\mathbf{x}_{t,j}$ should include a variable representing membership in the S&P 500 index

As a first approximation, we assume the functional form

[2] $$f_t(\mathbf{x}_{t,j}) = \beta_{0,t}A_{t,j} + \beta_{1,t}rd_{t,j} + \beta_{2,t}adv_{t,j} + \beta_{3,t}debt_{t,j} + \beta_{4,t}n(A_{t,j}) \; .$$

That is, we assume firm j's market value to be proportional to the replacement cost of its tangible assets, $A_{t,j}$, plus an additional effect associated with possession of proprietary technology, which we assume proportional to research and development spending, $rd_{t,j}$, and another effect associated with the possession of brand names and the like, which we take to be proportional to advertising spending, $adv_{t,j}$. We allow for a possible effect on value of leverage, $debt_{t,j}$, and also allow for a nonlinear relationship of market value to tangible assets replacement cost by including an effect proportional to some function $n(A_{t,j})$.

We thus consider

[3] $$V_{t,j} = \beta_{0,t} A_{t,j} + \beta_{1,t} rd_{t,j} + \beta_{2,t} adv_{t,j} + \beta_{3,t} debt_{t,j} + \beta_{4,t} n(A_{t,j}) + \varepsilon_{t,j} .$$

It is plausible that the value of $\beta_{0,t}$ might differ across industries. Typical firms in industries where certain sorts of intangible assets are important, such as newspapers, where subscriber lists are a key asset, might have a much higher market value per dollar of tangible replacement cost than would firms in industries such as cement manufacturing, where tangible assets account for most of firms' market values. This line of reasoning suggests that we replace $\beta_{0,t}A_{t,j}$ in [3] with $\sum_{i=1}^{I} \gamma_{i,t} \delta_{t,i,j} A_{t,j}$ where

[4] $$\delta_{t,i,j} \equiv \begin{cases} 0 & \textit{if firm j is not in industry i in year t} \\ 1 & \textit{if firm j is in industry i in year t} \end{cases}$$

and the $\gamma_{i,t}$ are a vector of 3-digit SIC code industry-specific estimated coefficients.

Heteroskedasticity problems make the estimation of [3] by least squares problematic because both positive and negative valuation errors are likely to be larger for larger firms. That is, $\varepsilon_{t,j}$ is likely to be proportional to measures of firm size, such as $A_{t,j}$. Since least squares estimation techniques place greater weight on more extreme observations, direct estimation of [3] risks ignoring smaller firms. To remedy this, we divide through [3] by $A_{t,j}$ to get

[5] $$\frac{V_{t,j}}{A_{t,j}} = \sum_{i=1}^{I} \gamma_{i,t} \delta_{t,i,j} + \beta_{1,t} \frac{rd_{t,j}}{A_{t,j}} + \beta_{2,t} \frac{adv_{t,j}}{A_{t,j}} + \beta_{3,t} \frac{debt_{t,j}}{A_{t,j}} + \beta_{4,t} n'(A_{t,j}) + \zeta_{t,j} ,$$

where the transformed error term,

[6] $$\zeta_{t,j} \equiv \frac{\varepsilon_{t,j}}{A_{t,j}},$$

is plausibly independently and identically distributed (iid) across firms within each time period. Note that the dependent variable in [5] is equal to firm *j*'s average q ratio in year *t*.

Our objective is to test for a valuation effect associated with S&P 500 index membership in each year. We therefore expect $\zeta_{t,j}$ to be larger for firms that are in the index. That is, we expect that

[7] $$\zeta_{t,j} = \beta_{5,t}\eta_{t,j} + u_{t,j},$$

where

[8] $$\eta_{t,j} \equiv \begin{cases} 0 & \textit{if firm j is not in the index in year t} \\ 1 & \textit{if firm j is in the index in year t} \end{cases}$$

and $u_{t,j}$ is an iid error.

Our empirical framework is thus to estimate the regression

[9] $$\frac{V_{t,j}}{A_{t,j}} = \sum_{i=1}^{I}\gamma_{i,t}\delta_{t,i,j} + \beta_{1,t}\frac{rd_{t,j}}{A_{t,j}} + \beta_{2,t}\frac{adv_{t,j}}{A_{t,j}} + \beta_{3,t}\frac{debt_{t,j}}{A_{t,j}} + \beta_{4,t}\ln(A_{t,j}) + \beta_{5,t}\eta_{t,j} + u_{t,j}$$

cross-sectionally in each time period t. We test directly for a valuation effect by testing the statistical and economic significance of $\beta_{5,t}$ and observing how the value and significance of this coefficient change over time.

The S&P 500 index is value-weighted, so some firms make up greater parts of the index portfolio than others. We measure the importance of a firm in the index by its value weight,

$$[10] \qquad w_{t,j} \equiv \frac{\eta_{t,j} V_{cs,t,j}}{\sum_{k \in S\&P500} V_{cs,t,k}}$$

Our second empirical test is therefore to run the regression

$$[11] \qquad \frac{V_{t,j}}{A_{t,j}} = \sum_{i=1}^{I} \gamma_{i,t} \delta_{t,i,j} + \beta_{1,t} \frac{rd_{t,j}}{A_{t,j}} + \beta_{2,t} \frac{adv_{t,j}}{A_{t,j}} + \beta_{3,t} \frac{debt_{t,j}}{A_{t,j}} + \beta_{4,t} \ln(A_{t,j}) + \beta_{5,t} w_{t,j} + u_{t,j}$$

cross-sectionally in each time period t and again to note the statistical and economic significance of $\beta_{5,t}$.

To test whether index membership causes higher firm values or higher firm value causes index membership, we supplement this regression analysis with some simple Granger causality tests (see Granger, 1969; Sims, 1972). We detrend the coefficient from (9) and (11) by taking either first differences or first differences of logarithms (rates of growth). Durbin-Watson statistics reject the hypotheses that the detrended series are autocorrelated.

To test the hypothesis that indexing 'causes' a valuation premium for stocks in the index, we then regress

[12] $$\beta_{5,t} = \gamma_0 + \sum_{z=1}^{L} \lambda_z \beta_{5,t-z} + \sum_{z=0}^{L} \kappa_z x_{t-z} + z_t$$

where $\beta_{5,\tau}$ now represents the detrended coefficient from either (9) or (11), x_t is now the detrended amount of money indexes to the S&P 500 Index in year *t*, and z_t is a roughly *iid* error. That is, we regress the measures of the detrended S&P500 value premium on lagged values of itself and on current and on the detrended value of funds indexed to the S&P500.

We then run the restricted regression

[13] $$\beta_{5,t} = \theta_0 + \sum_{z=1}^{L} \vartheta_z \beta_{5,t-z} + \upsilon_t$$

without current and past values of x_t.

We test the joint significance of $\{\kappa_1, \ldots \kappa_L\}$ by testing whether the sum of squared residuals of the restricted regression is significantly larger than that of the corresponding unrestricted regression. If the difference in sums of squared residuals is statistically significant, we concluded that indexing 'Granger-causes' the valuation premium (or, changes in indexing Granger-cause changes in the valuation premium).

To compare the sum of squared errors of the restricted regression [13], denoted *SSE*(*u*) with that of the unrestricted regression [12], denoted *SSE*(*r*), we employ the statistic

[14] $$s_1 \equiv \frac{[SSE(r) - SSE(u)]/L}{SSE(u)/(n-2L-1)},$$

which has an *F* distribution with one and $n - 2L - 1$ degrees of freedom, where *L* is the number of lags and *n* the number of observations. An alternative approach is to use the statistic

[15] $$s_2 \equiv \frac{SSE(r) - SSE(u)}{SSE(u)/n},$$

which has a χ^2 distribution with *n* degrees of freedom.

We then test for reverse causality by switching the dependent and independent variables in [12] and [13], and repeating the whole procedure.

We find that β_5 grows steadily in magnitude through our sample period from 1978 to 1997, and that this growth roughly tracks the growth in S&P 500 indexing. Our Granger causality tests are more consistent with the view that growth in the amount of money indexed to the S&P 500 index causes the increased valuation effect associated with index membership or index weight than with the reverse.

3. Construction of Data Sample and Key Variables

This section is a technical explanation of the construction of our data sample and key variables.

3.1 Data Sample

Our basic sample begins with all firms listed in Compustat in the twenty-year panel from 1978 to 1997. We do not include firms in banking and financial industries - Standard Industrial Classification (S.I.C.) codes 6,000 through 6,999 – as accounting information for these firms is not comparable to that of other firms. We delete observations in which sales, the share price, the number of shares outstanding, inventories, or property plant and equipment (PPE) are missing or negative. Where these variables are present, but entries for research and development spending, advertising spending, short term debt, long term debt, or non-inventory short-term assets are missing, the missing variables are assumed to be nil. We call the resulting firm-year observations our *basic sample*.

We define a company as being in the S&P 500 Index in year *t* if it is in the index on December 31 of that year. To construct the list of S&P 500 members for each year, we begin with the current year's list of members and work backwards, adjusting the list for firms dropped from and added to the index each year.[1] We double-check the resulting sequence of lists by purchasing from Standard and Poor's Corporation its S&P 500 membership list for 1982, the earliest year for which such data are available. Where discrepancies were found, they were corrected using newspaper records. This procedure generates our *index firms sample* for each year.

The first column in Table 1 lists the number of S&P500 index firms we use each year. The number is less than 500 because some firms in the index are financial firms, and so are excluded from our basic sample. We refer to this *index subsample* as I_1.

We wish to contrast S&P 500 index member firms against other comparable firms. We do this in two ways: by using a multiple regression framework across a broad sample of non-S&P500 firms and by constructing subsamples of matched pair firms.

The second column of Table one lists the number of firms in the basic sample each year that are not members of the S&P 500 index and that are at least as large as the smallest S&P 500 firm that year. Size is measured as estimated replacement cost, the construction of which variable is described below. This subsample, denoted *C*, we call our *control subsample*. We do not include firms smaller than the smallest S&P500 index firm for a specific year on the grounds that very small firms may not be valued by investors in the same way as larger firms. This subsample contains some extreme observations, which probably reflect coding errors by

[1] We are grateful to Jeff Wurgler for providing us with index additions and deletions data.

Compustat.[2] We therefore winsorize the data at the first and 99th percentiles for all important variables.

The third and fourth columns in Table 1 list the number of S&P firms for which industry and size matched pair firms are available. We select matching firms for each index firm as follows. We define our match *candidate sample* as our *basic sample* less S&P index firms. For each year, we first match each index firm with a list of all candidate sample firms having the same primary three-digit industry code. We then rank each potential match by the percentage difference between its replacement cost and that of the index firm in question. The potential matching firm closest to the index firm by this metric is then chosen as the industry and size matched firm corresponding to that index firm. If there are several index firms in the same industry, we match the smallest firm first, then delete its match from the candidate sample, and then match the next smallest firm. This process insures that each S&P index firm has a unique industry and size matching control firm. In some cases, the number of index firms in an industry exceeds the number of candidate firms. If this occurs, several S&P firms are paired with the same control firm. The control firm observation only appears once, so the *match index subsample*, denoted M_1, may be smaller than I in some years.

Some of the matched pairs of index and control firms in I and M_1 are not terribly close matches. We therefore delete match pairs where the difference in replacement cost between the index firm and its match is greater than half that of the index firm. The remaining samples or

[2] We checked a randomly selected ten extreme observations in the ratios displayed in Table 2 by comparing Compustat figures to printed annual reports. Of these, 7 observations or 70%, reflect coding errors by Compustat, such as misplaced decimal points. A similar check of ten observations from the central parts of the distributions characterized in Table 2 found no coding errors. We therefore correct the 7 erroneous observations and then winsorize the resulting sample at the first and 99th percentiles on the grounds that tail observations contain a disproportionately high fraction of coding errors.

S&P 500 firms and matched firms, denoted I_2 and M_2 respectively, we call our *close match index subsample* and *close match controls subsamples*.

We run our regressions first on the subsample of index firms and control firms at least as large as the smallest index firm that year. We then repeat our regressions on the matched pairs of index and control firms. Finally we re-estimate our regressions using the close match pairs only. union of our index firms sample and matched firms sample.

[Table 1 about here]

3.2 Construction of Key Variables

Our key variables are constructed from Compustat data. In using this data, it is necessary to adjust for Compustat's fiscal year-end convention. Compustat defines the data from fiscal years ending between June 1 of year *t*-1 and May 31 of year *t* as 'year *t* data'. We redefine the data so that year *t* data is the data from the fiscal year that ended during the calendar year *t*. This adjustment is necessary, since we wish to explain variables constructed from calendar year-end share prices with accounting data, and do not wish to use future information to predict the past. Unless otherwise indicated, all data are in current dollars.

Table 2 displays simple univariate statistics for these variables, whose construction we now describe in detail in the remainder of this section - which can be omitted by the reader without loss of continuity.

[Table 2 about here]

Market Value

The market value of a firm is essentially a marking to market of all the components of the liabilities and net worth side of it's balance sheet. We take the market value, $V_{t,j}$, of firm j at time t to be the market value of all outstanding equity plus the market value of all outstanding debts. This subsection describes in detail the construction of each of these components of $V_{t,j}$.

First, we take the market value of common stock, $V_{cs,t,j}$, to be the price per share on December 31 times the number of shares outstanding.[3] The market value of preferred shares, $V_{ps,t,j}$, is the net number of preferred shares outstanding in the event of involuntary liquidation multiplied by their per share involuntary liquidating value.[4] Data to construct both $V_{cs,t,j}$ and $V_{ps,t,j}$ are taken from Compustat.

Second, market value of net short-term debts, $V_{sd,t,j}$, is assumed equal to their book value. Since their short durations render the market and book values similar for short-term liabilities and most short-term assets, we take them at book value.[5]

Third, we estimate the market value of long-term debt as

$$[16] \qquad V_{ld,t,j} \cong B_{ld,t,j} \sum_{a=2}^{20} f_{a,t,j} \sum_{s=t}^{t-a} \left(\frac{\frac{r_{t-a}}{2}}{(1+\frac{r_t}{2})^{2*(s-t)}} + \frac{1}{(1+\frac{r_t}{2})^{2*a}} \right),$$

where $B_{ld,t,j}$ is the book value of the firm's long-term debts at the end of year t, $f_{a,t,j}$ is the fraction of firm j's long-term debt that is a years old as of year t, and r_t is average Moody's BAA bond

[3] Compustat *item 24* times *item 25*.
[4] Compustat *item 10*.
[5] Compustat *item 34*.

rate for year t.[6] We thus take the difference between the book value of the firm's long-term debts in year *t-a* and year *t-a*-1 to be the book value of it's *a*-year-old debt. The book value of vintage *a* debt is multiplied by the market value of BAA debt of that age per dollar of book value, estimated using the standard formula for the price of 20-year debt issued at par *a* years ago.

We are thus simplifying by assuming all debt to be 20-year BAA coupon bonds issued at par and that the current BAA rate is an appropriate discount rate for pricing future coupons and final debt payments. We are also ignoring call features, security, and other factors that can cause bond prices to deviate from the simple coupon bond formula. Thus, bond prices are year-specific, but not firm-specific.

Long-term debt with one year to maturity is treated as short-term debt. We take the fraction of the firm's debt that is *a* years old as

[17] $$f_{a,t,j} \cong \frac{B_{ld,t-a,j} - B_{ld,t-a-1,j}}{B_{ld,t,j}}.$$

In some cases, it is not possible to obtain precise values for the book values of long-term debt in all 19 previous years. We therefore use an estimated debt age structure based on the aggregate fractional debt age structure across all firms in Compustat in that year. To do this, we sum the book values of long-term debt outstanding for all Compustat firms in each year and then take differences between the sums for each pair of successive years to construct an aggregate long-term debt age profile. We divide the components of each 19-year-long age profile by the total long-term debt outstanding in the 20th year to get an average fractional age structure for long-term debt in each year. Thus, we take

[6] Compustat *item 9* is $B_{t,j}$.

$$[18] \quad f_{a,t} \cong \frac{\sum_j \left(B_{t-a,j} - B_{t-a-1,j} \right)}{\sum_j B_{t,j}} .$$

Thus, if the values of $f_{j,a,t}$ are missing for $a < a_0$, we renormalize the corresponding $f_{a,t}$ for the missing debt vintages to obtain approximations for the missing fractions using

$$[19] \quad \hat{f}_{a,t,j} \equiv f_{a,t} \left(\frac{1 - \sum_{a \geq a_0} f_{a,t,j}}{\sum_{a < a_0} f_{a,t}} \right).$$

Finally, we take the market value, $V_{t,j}$, of firm j at time t to be the sum of the market values of common and preferred equity, net short-term liabilities, and long-term debts,

$$[20] \quad V_{t,j} \equiv V_{cs,t,j} + V_{pf,t,j} + V_{sd,t,j} + V_{ld,t,j} .$$

Replacement Cost

The replacement cost of a firm's tangible assets is essentially a marking to market of all the entries on the assets side of its balance sheet. Ideally, we would estimate a firm's replacement cost by making a detailed list of all the firm's individual assets and obtaining a value for each from second-hand capital goods markets. In practice, this is not possible because firms' asset accounts are not sufficiently detailed and because appropriate second-hand capital goods markets prices are often not available. Moreover, many of the assets that make up a typical firm are industry-specific. Others, such as proprietary technology or reputation are intangible, and are missing from conventional accounting balance sheets. Because of these complications, we begin by estimating the part of replacement cost that can be estimated with a degree of confidence, and then consider a series of control variables that are plausibly related to these missing components of true replacement cost.

We begin by taking the replacement cost of firm *j*'s tangible assets at time *t*, $A_{t,j}$, to be the sum of the market values of its property, plant and equipment (PP&E), $A_{ppe,t,j}$, inventories, $A_{inv,t,j}$, 'other assets', $A_{oa,t,j}$ and net current asset $A_{nca,t,j}$. This subsection describes in detail the construction of each of these components of $A_{t,j}$.

To estimate $A_{ppe,t,j}$, we begin with the book value of firm *j*'s net PP&E in year *t*, denoted $B_{ppe,t,j}$.[7] The $A_{ppe,t,j}$ are estimated as

$$[21] \qquad A_{ppe,t,j} \cong B_{ppe,t,j} \frac{\hat{p}_t}{\hat{p}_{t-a_{t,j}}},$$

where $\hat{p}_t$ is a capital goods price index (the fixed non-residential investments GDP deflator) and $a_{t,j}$ is the average age of firm *j*'s PP&E in year *t*.

We estimate $a_{t,j}$ as

$$[22] \qquad a_{t,j} \cong \frac{B^G_{ppe,t,j} - B_{ppe,t,j}}{D_{t,j}},$$

[7] Compustat *item 8.*

where $B^G_{ppe,t,j}$ and $D_{t,j}$ are the 'gross value of PP&E' and 'income statement depreciation' of firm j as reported for the fiscal year ending in year t.[8] While $a_{t,j} \geq 19$, $a_{t,j} = 19$, and if $a_{t,j} \leq 0$, $a_{t,j} = 0$.

To estimate $A_{inv,t,j}$, the value of firm j's inventories in time t, we follow different procedures depending on the inventory accounting method used by the firm.[9] If the firm reports inventories using the 'first in first out' (FIFO) method, the book value of inventories is likely to be close to the market value, and no adjustment in necessary. If the firm uses 'last in first out' (LIFO) accounting, the book value of inventories is based on old prices, and may thus deviate from market value – especially during and after periods of high inflation.

Accordingly, the reported inventories value for firms using LIFO, $B_{inv,t,j}$, is adjusted recursively as

$$A_{inv,t,j} = \frac{p_t}{p_{t-1}} A_{inv,t-1,j} + (B_{inv,t,j} - B_{inv,t-1,j}) \qquad \text{for } B_{inv,t,j} \geq B_{inv,t-1,j}$$

[23]

$$A_{inv,t,j} = \frac{p_t}{p_{t-1}} A_{inv,t-1,j} * (B_{inv,t,j} / B_{inv,t-1,j}) \qquad \text{for } B_{inv,t,j} < B_{inv,t-1,j}$$

where p_t is PPI deflator for year t.[10] The market value of inventories is taken as equal to the book value in the first year in which the firms is listed in Compustat.

Some firms use several inventory accounting methods. For these firms, Compustat ranks the methods in order of importance. We use the rules of thumb described in Table 3 to apply [17] to fractions of these firms' inventories.

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[8] $B^G_{ppe,t,j}$ is Compustat *item 7*.

[9] Firms' inventory accounting methods are from Compustat *item 59*.

[Table 3 about here]

Thus, each year, we apply the recursive formula [17] to the fraction of the firm's inventories listed in the third column of Table 2, and assume the market value of the remainder of the firm's inventories to equal their book value.

To estimate $A_{oa,t,j}$, the market value of 'other assets', we consider reported 'investments in unconsolidated subsidiaries', 'other investments', and 'investments in intangibles'.[11] Since these assets are carried at historical cost, their book values may understate their true replacement costs. We therefore adjust these book values using a recursive procedure identical to that described for LIFO inventories in [17]. The only difference is that the deflator in calculating $A_{oa,t,j}$ is the fixed non-residential investment GDP deflator instead of PPI deflator in the $A_{inv,}$ formula.

The last component of tangible replacement cost is 'net current assets', $A_{nca,t,j}$, (net of inventories, which are adjusted to market above). Remaining current assets include 'cash & short term investments', 'receivables', and 'other current assets'. Since these assets are quite liquid, their book values are reasonable estimates of their market values. We thus value 'net current assets' at the total book value of current asset minus the total book value of inventories.[12]

Finally, we take the tangible assets replacement cost of firm *j* at time *t*, $A_{t,j}$, as the sum of the estimated replacement costs of PP&E, inventories and 'other assets',

$$[24] \quad A_{t,j} \equiv A_{ppe,t,j} + A_{inv,t,j} + A_{oa,t,j} + A_{nca,t,j}$$

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[10] $B_{inv,t,j}$ is Compustat *item 3.*
[11] Compustat *items 31*, *32* and *33* respectively.
[12] Compustat *item4 minus item 3.*

Note that $A_{t,j}$ is expressed in 1982 dollars.

Tobin's Average q Ratio

In this analysis, we are interested in the total market values of firms, not their investment opportunities. That is, we are concerned with whether or not S&P membership boosts the market value of a firm, not the value of its marginal capital investment. We therefore require an estimate of Tobin's average q, not Tobin's marginal q as estimated, for example, by Durnev et al. (2001). We take Tobin's average q as

[25] $$q_{t,j} \equiv \frac{V_{t,j}}{A_{t,j}}$$

Control variables

In this section, we describe the construction of the control variables introduced in the Empirical Framework section above.

We define industries dummies using three-digit Standard Industrial Classification (SIC) codes, as provided by Compustat. Each firm's industry code is defined as the industry code of the segment reporting the largest volume of sales in the relevant year.

We take advertising, $adv_{t,j}$, and research and development (R&D) expense, $rd_{j,t}$, as reported in Compustat.[13] If these variables are listed as 'negligible', they are set to zero. If they are coded as 'missing', we assume they were not disclosed and therefore were judged by the auditor to be negligible.

[13] Compustat *items 45* and *46*, respectively.

We estimate each firm's total debt in each year as the sum of the market values of long and short-term debts,

$$[25] \quad debt_{t,j} = V_{sd,t,j} + V_{ld,t,j}$$

Non-linear effects on market value associated with firm size are captured by the logarithm of the replacement cost of the firm.

We include industry fixed effects, either directly using three-digit SIC code dummies or indirectly by adjusting our average q ratios. The adjustment is

$$[26] \quad \hat{q}_{t,j} \equiv q_{t,j} - \left(\frac{n_{t,i(t,j)} q_{t,i(t,j)} - q_{t,j}}{n_{t,i(t,j)} - 1} \right)$$

where firm j is in industry $i(t,j)$ in period t, which industry contains $n_{t,i}$ firms and where $q_{t,i(t,j)}$ is the mean average q of all firms in industry $i(t,j)$. Thus, the adjusted average q is the original average q ratio minus the mean of the average q ratios of all *other* firms in the same industry (excluding the firm in question). If $n_{t,i} = 1$, the observation is dropped. This second approach is econometrically preferable to simple fixed effects if some industries contain very few firms.

S&P Membership

Our primary measure of S&P membership is an S&P 500 membership indicator variable

$$[27] \quad \eta_{t,j} \equiv \begin{cases} 0 & \textit{if firm } j \textit{ is not in the index in year } t \\ 1 & \textit{if firm } j \textit{ is in the index in year } t \end{cases}$$

The procedure for classifying firms as S&P member firms is discussed in detail above in the

We measure the importance of each firm in the index each year with an S&P 500 Index weight variable, defined as

[28] $$w_{t,j} \equiv \frac{\eta_{t,j} V_{cs,t,j}}{\sum_j \eta_{t,j} V_{cs,t,j}}$$

where $V_{cs,t,j}$ is the market value of firm j's common stock at the end of calendar year t. The variable $w_{t,j}$ thus measures the weight of firm j in the value-weighted S&P 500 index in year t. For firms not included in S&P500, this weight equals zero by construction.

Assets Indexed to the S&P 500

In the Granger-Sims causality tests below, we require an estimate of the amount of money invested in passively tracking the S&P 500 Index. Besides the numerous mutual funds indexed to S&P 500, a huge amount of money is informally indexed to the S&P 500 by corporate and public sector pension funds. In addition, many actively managed funds use the S&P 500 as a benchmark. This creates an incentive for their managers to invest money in the S&P index and then deviate from that strategy when they feel they have private information. The result is another tier of less formally indexed investment. These considerations make measuring the total value of assets indexed to S&P 500 a virtual impossibility.

We therefore must employ a proxy variable that is roughly proportional to the value of S&P indexed assets. Our primary proxy for funds indexed to S&P 500 index is the net market capitalization of Vanguard 500 index fund, the first index fund. The Vanguard 500 fund is the oldest and largest index fund. It was established in 1976, and its success led to the establishment of numerous other funds. Thus, in the first years of its existence, the Vanguard 500 is a good proxy for assets indexed to the S&P 500, but in later years, it captures a smaller share of the action. This measure is available from Vanguard Group for the years 1976 through 1997, the last year of our data.

As an alternative proxy, we employ the total market capitalization of the Vanguard index fund family, which includes not only the index funds that track the S&P 500, but also those that track other indices. The advantage of this proxy is that it is more likely to accurately reflect the full extent of the growth of indexing in the 1980s and 1990s. Its disadvantage is that it is not confined to S&P 500 funds. This measure is available from S&P 500 Net Advantage for 1978 through 1997.

Our final proxy for the value of funds indexed to the S&P 500 is the total market value of 53 selected index funds in United States. This measure is available from Grand Prix Research for 1978 through 1997.

4. Findings

Table 4 displays means of Tobin's average q ratios, defined as market value per dollar of replacement cost or V_{tj}/A_{tj}, for firms in the S&P 500 index and for various control firm subsamples. The left panel compares index firms with all control firms at least as large as the smallest index firm in the relevant year. The middle panel contrasts index firms with size and industry matched non-index firms for each year. The right panel repeats this, but only including matched pairs that are close to the same size. In all three panels, no value premium is evident in the early years of our sample window. In the first two panels, the premium is statistically insignificant., while in the rightmost panel, a significant value discount associated with index membership is apparent in some years. However, from 1986 on, a statistically significant positive value premium associated with membership in the S&P 500 index is evident. Moreover, this premium grows steadily with time.

[Table 4 about here]

The t-tests described in Table 4 are standard two-tail t-tests. Substituting Bonforoni t-tests, which control for difference in the size of the two subsamples being compared, yield a similar pattern of statistical significance.

4.1 Regression Results

We run OLS regression of average Tobin's average q on S&P 500 membership, controlling for three-digit industry fixed effects, R&D spending, advertising spending, leverage and firm size, as described in equation 9, for each year from 1978 to 1997. Table 5 presents representative regressions for 1978, 1988, and 1997 run on the same three subsamples used in Table 4. Consistent with typical average q regressions, we find significant positive coefficients on R&D spending, advertising spending, and leverage, and significant negative coefficients on firm size measures.

The coefficients of interest in Table 5 are those of the S&P 500 membership dummy, which are positive and significant in all three years and in all specifications. The economically important point from Table 5 is that this coefficient is low in 1978, higher in 1988, and much higher in 1997 in all specifications. This indicates an increasing valuation premium associated with S&P500 membership through our observation window.

[Tables 5 and 6 about here]

Table 6 repeats the regressions in Table 5, but substitutes each firm's weight in the S&P 500 index for the index membership dummy. Firms not in the index have an index weight of zero. The weight of a firm in the index is the market value of its equity divided by that of all 500 firms in the index. Table 6 thus tests for a relationship between average *q* and the *importance* of a firm in the index., rather than its mere presence in the index The coefficients of index weight are also positive and significant in all years and specifications, uniformly higher in 1988 than in 1978, and highest in 1997.

The differences in value associated with S&P inclusion are economically as well as statistically significant. For example, regression 5.3 shows that inclusion in the S&P 500 in 1997 is associated with a 46.6% premium in average *q,* - substantially larger than the 7.7% premium for 1978. Given a 1997 average replacement cost for S&P500 firms of $8 billion, this implies an addition to shareholder value of $3.8 billion for the typical index firm, and of about $1.9 trillion dollars for all S&P 500 index firms.

[Table 7 about here]

Table 7 displays the regression coefficients of S&P membership dummies and S&P weights in regressions analogous to those in Tables 5 and 6 for all years from 1978 to 1997. The coefficients of control variables are not shown to conserve space and enhance readability. There is a clear and near uniform upward trend in the addition to shareholder value associated with S&P index membership and weight. This is illustrated graphically in Figures 2 and 3.

[Figure 2 about here]

We conclude that a large value premium for S&P 500 member firms has developed over the past two decades, and that this premium is proportional to the weight of the firm in the S&P 500 index.

4.2 Regression Robustness Checks

Reasonable changes in the sample or specification of the regressions we run generate qualitatively similar results, by which we mean that the signs, relative magnitudes, and significance patterns of the coefficients on S&P membership or weight are similar to those shown in the Tables.

The results shown contrast index firms with non-index firms larger than the smallest S&P 500 firm that year. Using cutoffs of 50% or 25% the size of the smallest S&P 500 firm that year generates qualitatively similar results.

The regressions shown use data that is Winsorized at the first and 99th percentiles. Winsorizing at the 5th and 95th percentiles generates qualitatively similar results. Alternative ways of dealing with outliers include using Cook's D statistics to delete selected observations, deleting "obvious outliers" based on visual inspection of the distribution, and substituting ranks for all continuous variables in the regressions. All three alternative techniques produce qualitatively similar results to those shown.

The regression variables are normalized by estimated replacement cost. Any reasonable alternative measure of firm size that maintains a fixed proportion with replacement cost can also be used. Normalizing all variables by sales instead of replacement cost, and using sales to measure firm size, generates qualitatively similar results. Normalizing all variables by book value results in the same pattern of parameters and significance levels.

We use total debt to measure leverage. Substituting long-term debt generates qualitatively similar results. We use the logarithm of replacement cost to control for size in the regressions shown. Using the dollar value of replacement cost generates qualitatively similar findings.

Our replacement cost estimation technique yields, as a by-product, an estimate of the average age of a firm's physical capital. Adding the average age of physical capital or its logarithm generates qualitatively similar results.

We conclude that our finding of a value premium associated with S&P 500 membership is highly robust.

The Direction of Causality

The regression results described above demonstrate a statistically and economically meaningful relationship between membership in the S&P 500 index and an elevated average q ratio. They do not, however, allow us to conclude that index membership 'causes' higher average q ratios. Indeed, the causation might run the opposite way. Standard and Poor's might choose firms with high q ratios for inclusion in its index.

However, the event study evidence unambiguously indicates that inclusion in the index 'causes' an immediate share price increase. Shleifer (1985), Harris and Gurel (1986), Jain (1987), Beneish and Whaley (1996) and Lynch and Mendenhall (1997) Dhillon and Johnson

(1991), Wurgler and Zhuravskaya (2000), and Kaul *et al.* (2000) all indicate a substantial rise in share price upon inclusion in the index.

Moreover, the underlying economic story proposed by Shleifer (1985) allows a more direct test of causality. If growing demand for index member firms' stock is responsible for the elevated q ratios we detect, then increases in the amount of money passively tracking the S&P 500 index should 'cause' increases in the regression coefficient associated with index membership (or weight) in the sense of Granger (1969) and Sims (1972).

Table 9 presents causality tests of the form recommended by Granger and Sims, and described in equation [11] above. These are joint significance tests of the hypothesis that past values of x_t, the total amount of money invested in S&P 500 index funds, predict the current year's value of $\beta_{5,t}$, the coefficient of S&P membership (either the dummy or index weight), after controlling for past values of $\beta_{5,t}$. The significance of these F-tests and χ^2-tests can be interpreted as evidence that the magnitude of funds tracking the index 'causes' increased share values in index member firms.

These tests are run using the S&P value premiums from 1978 to 1997 shown in Table 7 and the proxies for the amount of money passively tracking the S&P 500 shown in Table 8. Note that the first index fund, the Vanguard 500 was founded in 1976. Our window thus stretches back almost to the beginning of indexing.

In general, the Granger-Sims tests are more consistent with indexing causing the value premium than with the converse. Nineteen of the thirty six tests of indexing causing the premium are statistically significant at 10% confidence levels; whereas, only five of the thirty six tests of reverse causality are significant. While the incidence of statistical significance in the direct causality tests (53%) is much higher than that expected through type two errors (10%), the incidence of significant reverse causality (14%) is only slightly higher.

Overall, our findings are consistent with the view that the increasing amount of money passively tracking the S&P 500 Index “causes” the valuation premium associated with index membership and with a member firm’s weight in the index

Causality Test Robustness Checks

The χ^2 and F tests in Table 9 are all run using S&P membership or index weight coefficients from regressions run on the sample of firms at least as large (in terms of replacement cost), as the smallest S&P 500 firm in each year in question. When using regression coefficients estimated either across all available data or across firms larger than half the size of the smallest S&P 500 firms, The tests in Table 9 are based on runs using two lags of the S&P membership or weight coefficient and two lags of the value of funds under indexing. When we allow the data to select the number of lags, the results are similar to those shown in Table 9.[14]

In summary, our finding that the amount of money passively tracking the S&P 500 Index ‘causes’ the valuation premium associated with S&P 500 membership in the sense of Granger (1969) and Sims (1972) appears to be quite robust.

[14] Reverse causation not evident in any specification when firms smaller than half the size of the smallest index firm are included. When the data selects the number of lags, reverse causation is rejected in all specifications involving the coefficient on the membership dummy. When the regression coefficient is that of the index weight, causality appears to run in both directions.

Conclusions

This paper documents a large value premium in the average q ratios of firms in the S&P 500 index relative to the q ratios of other similar firms. This premium appears a few years after the founding of the first S&P 500 index fund, and grows steadily and in step with the growth of indexing.

One interpretation of this finding is that a mysterious intangible asset is connected with membership in the S&P 500 index, and that the value of this asset has grown in synch with the growth of indexing.

A second interpretation is that the value premium is due to indexing directly. Because index fund managers are penalized for tracking error, they *must* hold the stocks in the index they are tracking. Indexing can also be accomplished with derivatives, but many institutional investors and mutual funds bind themselves from using derivatives, so they must hold the index stocks. Firms in the index thus do not have close substitutes insofar as far as these index fund managers are concerned. Consequently, index member firms' stocks may have downward sloping demand curves.

This is easy to see *in reductio ad absurdum*. If the amount of money indexed to the S&P 500 grows without bound, index funds will come to buy and hold virtually all the shares in the firms in the index. Obviously, if still more money is pumped into index funds, investors squatting on the last few shares of each index member firm can demand exorbitant prices. The downward sloping demand curves story is basically that this economic logic sets in when index funds' stakes are still moderate because arbitrageurs do not correct valuation gaps between index firms and non-index firms with similar risks and expected payouts. Shleifer (2000) attributes this to costly arbitrage.

Shleifer (1985) presents evidence that S&P 500 member firms' stocks have downward sloping demand curves, and a series of subsequent papers debated this conclusion. Recent studies, particularly Kaul et al. (2000) and Wurgler and Zhuravskaya (2000) strongly support Shleifer's original interpretation of his results. Demand curves for stocks, or more precisely, demand curves for stocks in indexes, do indeed appear to slope downwards.

Since the Efficient Markets Hypothesis holds that active managers cannot outperform indexes on a risk-adjusted basis, financial economists usually recommend investing in index funds to achieve a widely diversified portfolio while minimizing management fees and avoiding direct trading costs. This advice has proven itself, as managed investment funds have indeed largely failed to consistently beat the S&P500 benchmark return. Consequently, more investors adopt indexing.

The second interpretation of our findings suggests that this upward spiral in demand for index stocks itself pushed up their prices. This view is consistent with Masso and Goetzman (1999), who find that the S&P index return to be positively correlated with net inflows into index funds.

Ironically, if this interpretation of our findings is correct, the investment advice implied by the Efficient Markets Hypothesis may itself be undermining the efficiency of the stock market. In an "indexing bubble", index stock prices spiral upward due to rising demand from index funds due to the superior past performance of indexing, which is due to the upward spiral of index stock prices, which …. . This second interpretation of our findings is consistent with the view that such an indexing bubble occurred in US stock markets.

A possible response to this development is for firms whose stocks are included in widely followed indexes, and consequently overvalued, to issue additional shares and use the funds so raised to acquire productive assets or to acquire firms not in widely-followed indexes. In other words, indexing may cause economically inefficient over-investment by index member firms and economically inefficient M&A activity. In our view, this response is undesirable from a public policy perspective.

A second response is to encouraging indexing using derivative securities and to discourage indexing accomplished by actually buying the stocks in the index. Given recent scandals associated with derivative securities, and the consequent determination of many plan sponsors and investors to avoid them, this option may not be realistic.

A third response, which we advocate, is that passive investment benchmarks should be reevaluated. If a total market index, such as the CRSP value-weighted total return, were the benchmark against which passive funds were judged, there would be no disproportionate demand for the shares of the relatively few firms in a narrow and arbitrarily defined index like the S&P 500. Passive investment funds could buy and hold diversified portfolios of randomly selected stocks, rather than all investing in the same 500 stocks. This *holistic indexing* would have the salubrious effect of spreading passive demand for stocks across the market more evenly, thereby avoiding price distortions of the sort described above.

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Table 1
Subsamples and Full Sample Sizes

year	*S&P 500 index firms with complete data*	*control firms larger than the smallest index firm*	*S&P500 index firms with size & industry matches*	*size & industry matched control firms*	*S&P firms with size & industry close matches*	*size & industry close matches*	*Full sample*
sample	I	C	I_1 [a]	M_1	I_2	M_2	$I \cup C$
1978	419	1,585	419	415	224	224	2,004
1979	420	1,781	420	417	216	216	2,201
1980	416	2,323	416	411	210	210	2,739
1981	420	2,114	420	412	200	200	2,534
1982	420	1,282	420	410	190	190	1,702
1983	409	1,368	409	399	185	185	1,777
1984	411	2,043	411	403	199	199	2,454
1985	408	1,538	408	400	197	197	1,946
1986	407	1,705	407	399	220	220	2,112
1987	413	1,640	413	406	218	218	2,053
1988	404	3,603	404	398	216	216	4,007
1989	404	3,477	404	398	200	200	3,881
1990	401	3,041	401	391	209	209	3,442
1991	404	2,287	404	394	207	207	2,691
1992	407	1,924	407	400	218	218	2,331
1993	409	2,164	409	405	237	237	2,573
1994	405	1,485	405	405	236	236	1,890
1995	394	1,672	394	394	229	229	2,066
1996	391	1,904	391	391	229	229	2,295
1997	390	1,486	390	390	233	233	1,876

a. The index firm samples I and I_1 are identical.

Table 2
Univariate Statistics for Main Regression Variables
Firms are indexed by *j* and time by *t*. Average Tobin's q is estimated market value, $V_{t,j}$, over estimated replacement cost, $A_{t,j}$. Research and development (R&D) spending and advertising spending are expressed as fractions of replacement cost. Leverage is the estimated market value of short and long-term debt over replacement cost, and firm size is the logarithm of replacement cost.

		Mean	Standard Deviation	Minimum	First Percentile	Median	99th Percentile	Maximum
Dependent Variable								
Average Tobin's q	$\frac{V_{t,j}}{A_{t,j}}$	1.31	0.95	0.22	0.32	1.05	5.47	7.63
Control Variables								
R&D spending	$\frac{rd_{t,j}}{A_{t,j}}$	0.02	0.04	0.00	0.00	0.00	0.19	0.28
Advertising spending	$\frac{adv_{t,j}}{A_{t,j}}$	0.01	0.03	0.00	0.00	0.00	0.17	0.25
Leverage	$\frac{debt_{t,j}}{A_{t,j}}$	0.28	0.26	0.00	0.00	0.22	1.31	1.83
Firm size	$\ln(A_{t,j})$	6.04	1.74	1.97	2.31	5.86	10.18	10.84
Index Membership Variables								
S&P 500 Indicator	$\eta_{t,j}$	0.17	0.37	0.00	0.00	0.00	1.00	1.00
Weight in S&P 500	$w_{t,j}$	0.00	0.00	0.00	0.00	0.00	0.01	0.07

Sample is full sample described in Table 1 *(I U C)*, all years combined.

Table 3
Inventory Valuation
Conventions for marking inventories to market for firms that use more than one inventory accounting method

Number of inventory accounting methods used	Rank in importance of LIFO accounting	Assumed fraction of inventories subject to LIFO
2	1	66.7
2	2	33.3
3	1	50.0
3	2	33.3
3	3	16.7

Table 4.
The Value Premium Associated with Being in the S&P500 Index
Mean Tobin's average q ratios for firms in the S&P 500 index and various control firm subsamples.

	Firms as large as smallest S&P firm				**Size and Industry Matched Pairs Control Group**				**Very Close Matched Pairs Control Group**			
year	*S&P firms*	*other firms*	*Index premium*	*t-test p-value*	*S&P firms*	*other firms*	*Index premium*	*t-test p-value*	*S&P firms*	*other firms*	*Index premium*	*t-test p-value*
sample	I	C			I_1	M_1			I_2	M_2		
1978	0.777	0.776	0.001	0.97	0.786	0.737	0.049	0.07	0.821	0.718	0.103	0.01
1979	0.777	0.831	-0.054	0.02	0.787	0.757	0.030	0.28	0.808	0.737	0.071	0.08
1980	0.838	0.991	-0.153	0.00	0.842	0.884	-0.042	0.50	0.918	0.741	0.177	0.00
1981	0.736	0.831	-0.096	0.00	0.736	0.778	-0.042	0.26	0.780	0.688	0.093	0.04
1982	0.826	0.797	0.030	0.33	0.840	0.841	-0.001	0.99	0.914	0.789	0.125	0.06
1983	0.959	0.990	-0.031	0.39	0.967	1.015	-0.048	0.36	1.045	0.916	0.129	0.07
1984	0.979	1.040	-0.061	0.08	0.981	0.937	0.044	0.31	1.076	0.879	0.196	0.00
1985	1.168	1.141	0.027	0.47	1.176	1.144	0.032	0.55	1.290	1.011	0.280	0.00
1986	1.323	1.244	0.079	0.06	1.354	1.235	0.119	0.07	1.451	1.133	0.318	0.00
1987	1.320	1.174	0.146	0.00	1.331	1.226	0.104	0.09	1.376	1.197	0.180	0.05
1988	1.344	1.414	-0.070	0.07	1.344	1.207	0.137	0.00	1.413	1.195	0.218	0.00
1989	1.530	1.510	0.020	0.69	1.533	1.287	0.246	0.00	1.627	1.314	0.313	0.00
1990	1.379	1.262	0.117	0.01	1.383	1.199	0.185	0.00	1.465	1.246	0.219	0.01
1991	1.642	1.564	0.078	0.25	1.678	1.462	0.215	0.03	1.756	1.464	0.292	0.05
1992	1.654	1.601	0.052	0.37	1.663	1.450	0.213	0.01	1.693	1.336	0.357	0.00
1993	1.707	1.784	-0.078	0.16	1.728	1.632	0.096	0.24	1.765	1.599	0.166	0.14
1994	1.626	1.540	0.086	0.09	1.650	1.473	0.177	0.01	1.699	1.450	0.249	0.01
1995	1.899	1.704	0.195	0.00	1.938	1.629	0.309	0.00	2.023	1.588	0.435	0.00
1996	1.995	1.764	0.232	0.00	2.046	1.728	0.319	0.00	2.063	1.694	0.370	0.00
1997	2.297	1.806	0.491	0.00	2.350	1.822	0.527	0.00	2.323	1.714	0.610	0.00

Table 5
Regressions of Average Tobin's Q On a Dummy Indicating S&P 500 Membership

Controls are 3-digit industry fixed effects, R&D spending, advertising spending, leverage, and firm size. Data are for 1978, 1988, and 1997. Regressions 5.1, 5.4, and 5.7 use 1978 data, regressions; 5.2, 5.5, and 5.8 use 1988 data, and regressions 5.3, 5.6, and 5.9 use 1997 data. Average Tobin's q is estimated market value, $V_{t,j}$, over estimated replacement cost, $A_{t,j}$. Research and development (R&D) spending and advertising spending are expressed as fractions of replacement cost. Leverage is the estimated market value of short and long-term debt over replacement cost, and firm size is the logarithm of replacement cost. S&P membership dummy is one for firms in the index that year and zero otherwise.

		5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.8	5.9
		Index firms and control firms at least as large as smallest index firm			**Size and Industry Matched Pairs**			**Very Close Size and Industry Matched Pairs**		
Year		1978	1988	1997	1978	1988	1997	1978	1988	1997
S&P membership dummy	$\eta_{t,j}$	0.077 (0.00)	0.205 (0.00)	0.466 (0.00)	0.096 (0.00)	0.174 (0.00)	0.466 (0.00)	0.096 (0.00)	0.172 (0.00)	0.540 (0.00)
R&D spending	$\frac{rd_{t,j}}{A_{t,j}}$	6.261 (0.00)	3.725 (0.00)	8.266 (0.00)	7.679 (0.00)	4.604 (0.00)	9.227 (0.00)	5.743 (0.00)	4.695 (0.00)	5.164 (0.00)
Advertising spending	$\frac{adv_{t,j}}{A_{t,j}}$	1.276 (0.00)	2.253 (0.00)	2.918 (0.01)	1.083 0.01	3.520 (0.00)	3.055 (0.03)	2.179 (0.00)	5.618 (0.00)	2.731 (0.18)
Leverage	$\frac{debt_{t,j}}{A_{t,j}}$	0.307 (0.00)	0.590 (0.00)	0.373 (0.00)	0.199 0.04	0.381 (0.00)	0.319 (0.12)	0.343 (0.01)	0.252 (0.04)	0.339 (0.12)
Firm size	$\ln(A_{t,j})$	-0.043 (0.00)	-0.067 (0.00)	-0.117 (0.00)	-0.067 (0.00)	-0.081 (0.00)	-0.041 0.50	-0.090 (0.00)	-0.103 (0.01)	-0.014 (0.85)
Regression F statistic		5.7 (0.00)	5.7 (0.00)	5.1 (0.00)	4.3 (0.00)	3.9 (0.00)	3.2 (0.00)	3.4 (0.00)	3.1 (0.00)	3.3 (0.00)
R-squared		0.41	0.27	0.41	0.43	0.43	0.39	0.49	0.45	0.44
Sample[c]		$I \cup C$	$I \cup C$	$I \cup C$	$I_1 \cup M_1$	$I_1 \cup M_1$	$I_1 \cup M_1$	$I_2 \cup M_2$	$I_2 \cup M_2$	$I_2 \cup M_2$

a. Data are winsorized at the 1st and 99th percentiles.
b. Firm size is measured by replacement cost of assets, $A_{t,j}$.
c. Sample sizes are as described in Table 1

Table 6
Regressions of Average Tobin's Q On S&P 500 Index Weight

Controls are 3-digit industry fixed effects, R&D spending, advertising spending, leverage, and firm size. Data are for 1978, 1988, and 1997. Regressions 6.1, 6.4, and 6.7 use 1978 data, regressions; 6.2, 6.5, and 6.8 use 1988 data, and regressions 6.3, 6.6, and 6.9 use 1997 data. Average Tobin's q is estimated market value, $V_{t,j}$, over estimated replacement cost, $A_{t,j}$. Research and development (R&D) spending and advertising spending are expressed as fractions of replacement cost. Leverage is the estimated market value of short and long-term debt over replacement cost, and firm size is the logarithm of replacement cost. S&P index weight is the market value of the firm's equity divided by the total market value of the equity of all index firms, and is zero for non-index firms.

		6.1	6.2	6.3	6.4	6.5	6.6	6.7	6.8	6.9
		Index firms and control firms at least as large as smallest index firm			**Size and Industry Matched Pairs**			**Very Close Size and Industry Matched Pairs**		
Year		1978	1988	1997	1978	1988	1997	1978	1988	1997
S&P index weight	$w_{t,j}$	0.141 (0.00)	0.246 0.05	1.715 0.00	0.179 (0.00)	0.264 0.01	2.233 (0.00)	0.441 (0.00)	0.366 (0.05)	2.914 (0.00)
R&D spending	$\frac{rd_{t,j}}{A_{t,j}}$	6.156 (0.00)	3.787 (0.00)	8.512 0.00	7.446 (0.00)	5.082 (0.00)	9.279 (0.00)	5.675 (0.00)	5.159 (0.00)	5.438 (0.00)
Advertising spending	$\frac{adv_{t,j}}{A_{t,j}}$	1.399 (0.00)	2.306 (0.00)	1.926 0.08	1.215 (0.00)	3.663 (0.00)	2.180 0.09	2.184 (0.00)	5.657 (0.00)	0.789 (0.66)
Leverage	$\frac{debt_{t,j}}{A_{t,j}}$	0.308 (0.00)	0.580 (0.00)	0.341 0.00	0.200 0.03	0.335 (0.00)	0.185 0.34	0.353 (0.00)	0.189 (0.12)	0.229 (0.24)
Firm size	$\ln(A_{t,j})$	-0.038 (0.00)	-0.054 (0.00)	-0.141 0.00	-0.067 (0.00)	-0.071 (0.00)	-0.190 (0.00)	-0.104 (0.00)	-0.111 (0.01)	-0.336 (0.00)
Regression F statistic		5.8 (0.00)	5.7 (0.00)	5.8 (0.00)	4.00 0.00	3.8 (0.00)	4.2 (0.00)	3.5 (0.00)	3.0 (0.00)	5.3 (0.00)
R-squared		0.41	0.27	0.44	0.44	0.43	0.46	0.49	0.44	0.57
Sample size		$I \cup C$	$I \cup C$	$I \cup C$	$I_1 \cup M_1$	$I_1 \cup M_1$	$I_1 \cup M_1$	$I_2 \cup M_2$	$I_2 \cup M_2$	$I_2 \cup M_2$

a. Data are winsorized at the 1st and 99th percentiles.
b. Firm size is measured by replacement cost of assets, $A_{t,j}$.

Table 7
How Regression Coefficients on Dummy Indicating S&P 500 Membership or on Index Weight Changed Over Time

Dependent variable is average q ratio, estimated market value, $V_{t,j}$, over estimated replacement cost, $A_{t,j}$.. Controls include 3-digit industry fixed effects, R&D spending, advertising spending, leverage, and firm size. Research and development (R&D) spending and advertising spending are expressed as fractions of replacement cost. Leverage is the estimated market value of short and long-term debt over replacement cost, and firm size is the logarithm of replacement cost. S&P index weight is the market value of the firm's equity divided by the total market value of the equity of all index firms, and is zero for non-index firms. S&P membership dummy is one for firms in the index that year and zero otherwise.

	Coefficient on S&P 500 membership dummy						Coefficient on weight in S&P 500 Index					
sample	$I \cup C$		$I_1 \cup M_1$		$I_2 \cup M_2$		$I \cup C$		$I_1 \cup M_1$		$I_2 \cup M_2$	
Year	$\beta_{5,t}$	Prob. $\beta_{5,t} = 0$	$\beta_{5,t}$	Prob. $\beta_{5,t} = 0$	$\beta_{5,t}$	Prob. $\beta_{5,t} = 0$	$\beta_{5,t}$	Prob. $\beta_{5,t} = 0$	$\beta_{5,t}$	Prob. $\beta_{5,t} = 0$	$\beta_{5,t}$	Prob. $\beta_{5,t} = 0$
1978	0.077	0.00	0.096	0.00	0.096	0.00	0.141	0.00	0.179	0.00	0.441	0.00
1979	0.070	0.00	0.077	0.00	0.070	0.02	0.104	0.01	0.166	0.00	0.228	0.02
1980	0.131	0.00	0.269	0.00	0.172	0.00	0.192	0.02	0.509	0.00	0.367	0.00
1981	0.056	0.09	0.082	0.02	0.103	0.00	0.174	0.02	0.295	0.00	0.401	0.00
1982	0.099	0.00	0.168	0.00	0.144	0.01	0.206	0.00	0.301	0.00	0.690	0.00
1983	0.091	0.01	0.157	0.00	0.146	0.01	0.231	0.00	0.355	0.00	0.612	0.00
1984	0.151	0.00	0.170	0.00	0.186	0.00	0.163	0.01	0.192	0.00	0.539	0.01
1985	0.190	0.00	0.234	0.00	0.269	0.00	0.184	0.01	0.279	0.00	0.687	0.01
1986	0.223	0.00	0.309	0.00	0.345	0.00	0.275	0.00	0.440	0.00	0.816	0.00
1987	0.242	0.00	0.211	0.00	0.146	0.07	0.287	0.00	0.322	0.01	0.384	0.13
1988	0.205	0.00	0.174	0.00	0.172	0.00	0.246	0.05	0.264	0.01	0.366	0.05
1989	0.308	0.00	0.330	0.00	0.301	0.00	0.423	0.01	0.484	0.00	0.526	0.02
1990	0.222	0.00	0.233	0.00	0.185	0.02	0.455	0.00	0.521	0.00	0.659	0.00
1991	0.259	0.00	0.324	0.00	0.244	0.06	0.833	0.00	1.091	0.00	1.099	0.00
1992	0.242	0.00	0.367	0.00	0.393	0.00	0.865	0.00	1.178	0.00	1.206	0.00
1993	0.200	0.00	0.246	0.00	0.212	0.03	0.701	0.00	1.047	0.00	1.505	0.00
1994	0.233	0.00	0.263	0.00	0.237	0.00	0.809	0.00	1.016	0.00	1.400	0.00
1995	0.349	0.00	0.413	0.00	0.352	0.00	1.247	0.00	1.771	0.00	1.816	0.00
1996	0.295	0.00	0.322	0.00	0.261	0.02	1.315	0.00	2.068	0.00	2.264	0.00
1997	0.466	0.00	0.466	0.00	0.540	0.00	1.715	0.00	2.233	0.00	2.914	0.00

Samples for each year are as described in Table 1. Regressions are identical to those shown in full in Tables 5 and 6.

a. Data are winsorized at the 1st and 99th percentiles.
b. Firms at least half as large, in terms of replacement cost of assets, $A_{t,j}$, as the smallest S&P500 firm in the same year.
c. Firms at least as large, in terms of replacement cost of assets, $A_{t,j}$, as the smallest S&P500 firm in the same year.

Table 8
Total Value of S&P 500 Indexed Mutual Fund Assets
Data are for the United States from 1986 to 1996, and are deflated to billions of 1982 dollars using the GDP Price Index.

Year	Value of Vanguard 500 [a]	Vanguard Index Fund Family [a,b]	Value of 53 Index funds [c]	Year	Value of Vanguard 500 [a]	Vanguard Index Fund Family [a]	Value of 53 Index funds [b]
1978	0.09	0.09	8.32	1988	0.87	0.92	160.38
1979	0.10	0.10	8.84	1989	1.44	1.58	208.56
1980	0.11	0.11	10.31	1990	1.66	2.23	208.29
1981	0.10	0.10	n.a.	1991	3.22	4.38	265.85
1982	0.11	0.12	16.10	1992	4.75	6.70	294.26
1983	0.22	0.22	23.44	1993	5.84	9.57	322.73
1984	0.27	0.30	41.87	1994	6.47	10.63	297.25
1985	0.35	0.39	60.00	1995	11.77	19.56	407.36
1986	0.43	0.45	92.47	1996	20.17	33.86	550.97
1987	0.71	0.73	134.19	1997	32.29	55.53	726.98

Source: S&P Net Advantage, Vanguard and Grand Prix Fund Research

a. Vanguard Group and S&P net advantage.
b. We substitute the value of the Vanguard 500 for missing value in the first four years.
c. Fifty-three selected index funds.

TABLE 9
Granger's Causality Tests

Subsample used to estimate index premium		Index premium associated with	Measure of value of funds indexed	Assets in index funds 'cause' index premium		Index premium 'causes' assets in index funds	
				F test	χ^2 test	F test	χ^2 test
Index firms & large control firms	$I \cup C$	Index membership	Vanguard 500	1.51 (0.26)	4.28 (0.12)	0.07 (0.93)	0.20 (0.90)
Index firms & large control firms	$I \cup C$	Index weight	Vanguard 500	**5.62** **(0.02)**	**15.92** **(0.00)**	**2.94** **(0.09)**	**8.32** **(0.02)**
Index firms & large control firms	$I \cup C$	Index membership	Vanguard Index family	2.73 (0.11)	**7.74** **(0.02)**	0.98 (0.40)	2.77 (0.25)
Index firms & large control firms	$I \cup C$	Index weight	Vanguard Index family	**6.00** **(0.02)**	**17.0** **(0.00)**	**3.61** **(0.06)**	**10.2** **(0.01)**
Index firms & large control firms	$I \cup C$	Index membership	Value of 53 index funds	0.73 (0.51)	2.28 (0.32)	0.53 (0.61)	1.72 (0.42)
Index firms & large control firms	$I \cup C$	Index weight	Value of 53 index funds	**4.38** **(0.05)**	**13.6** **(0.00)**	1.31 (0.32)	4.26 (0.12)
Match pairs	$I_1 \cup M_1$	Index membership	Vanguard 500	0.94 (0.42)	2.67 (0.26)	0.66 (0.54)	1.86 (0.39)
Match pairs	$I_1 \cup M_1$	Index weight	Vanguard 500	1.36 (0.29)	3.86 (0.15)	1.47 (0.27)	4.17 (0.12)
Match pairs	$I_1 \cup M_1$	Index membership	Vanguard Index family	1.01 (0.39)	2.85 (0.24)	0.61 (0.56)	1.73 (0.42)
Match pairs	$I_1 \cup M_1$	Index weight	Vanguard Index family	1.79 (0.21)	**5.07** **(0.08)**	1.38 (0.29)	3.91 (0.14)
Match pairs	$I_1 \cup M_1$	Index membership	Value of 53 index funds	1.35 (0.31)	4.20 (0.12)	0.09 (0.92)	0.28 (0.87)
Match pairs	$I_1 \cup M_1$	Index weight	Value of 53 index funds	1.89 (0.21)	**5.87** **(0.05)**	0.96 (0.42)	3.11 (0.21)
Close match pairs	$I_2 \cup M_2$	Index membership	Vanguard 500	**3.09** **(0.08)**	**8.76** **(0.01)**	1.96 (0.18)	**5.34** **(0.06)**
Close match pairs	$I_2 \cup M_2$	Index weight	Vanguard 500	**3.16** **(0.08)**	**8.95** **(0.01)**	0.46 (0.64)	1.30 (0.52)
Close match pairs	$I_2 \cup M_2$	Index membership	Vanguard Index family	**3.12** **(0.08)**	**8.83** **(0.01)**	2.32 (0.14)	6.57 (0.04)
Close match pairs	$I_2 \cup M_2$	Index weight	Vanguard Index family	**3.12** **(0.08)**	**8.85** **(0.01)**	0.51 (0.61)	1.45 (0.49)
Close match pairs	$I_2 \cup M_2$	Index membership	Value of 53 index funds	2.33 (0.15)	**7.26** **(0.03)**	0.71 (0.52)	2.32 (0.31)
Close match pairs	$I_2 \cup M_2$	Index weight	Value of 53 index funds	1.62 (0.25)	**5.04** **(0.08)**	0.09 (0.92)	0.29 (0.87)

Figure 1
A Downward Sloping Demand Curve For a Stock

If stocks have downward sloping demand curves, their prices reflect the interplay of supply and demand, like the prices of other economic goods. If a stock is added to a widely-tracked index, this shifts its demand curve to the right, from D_0 to D_1, and thereby increases the stock's price from P_0 to P_1. For simplicity, and without loss of generality for the topic at hand, we represent the supply curve, S, for the stock as a vertical line. In practice, firms might issue more stock as their stock prices rise, causing their stocks' supply curves to slope upward.

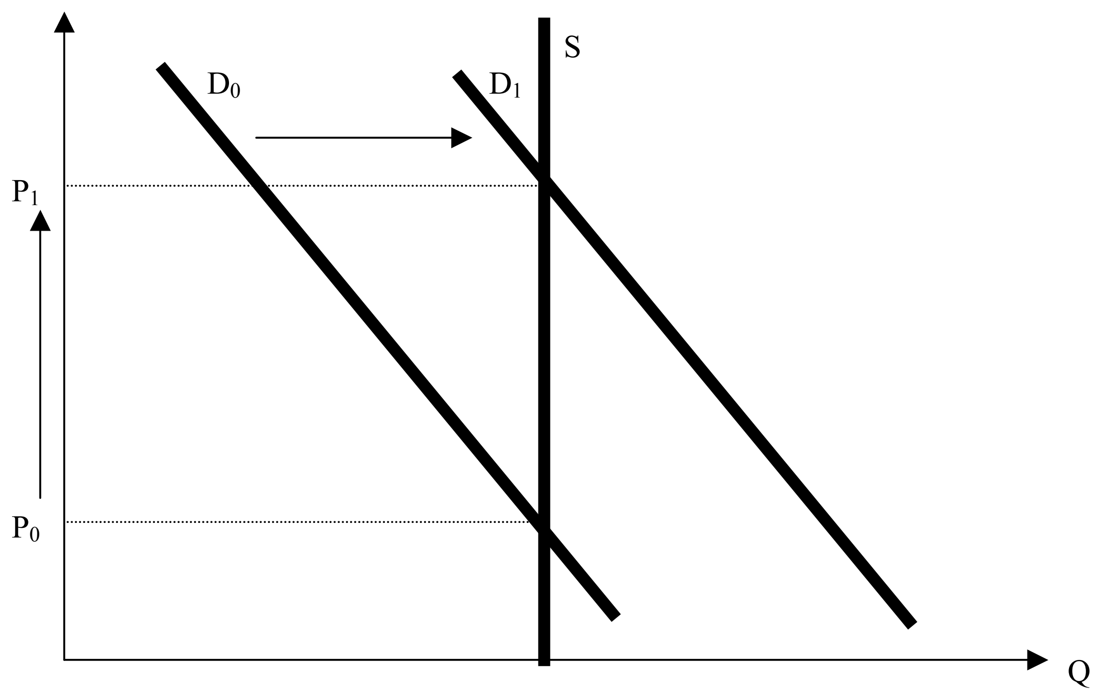
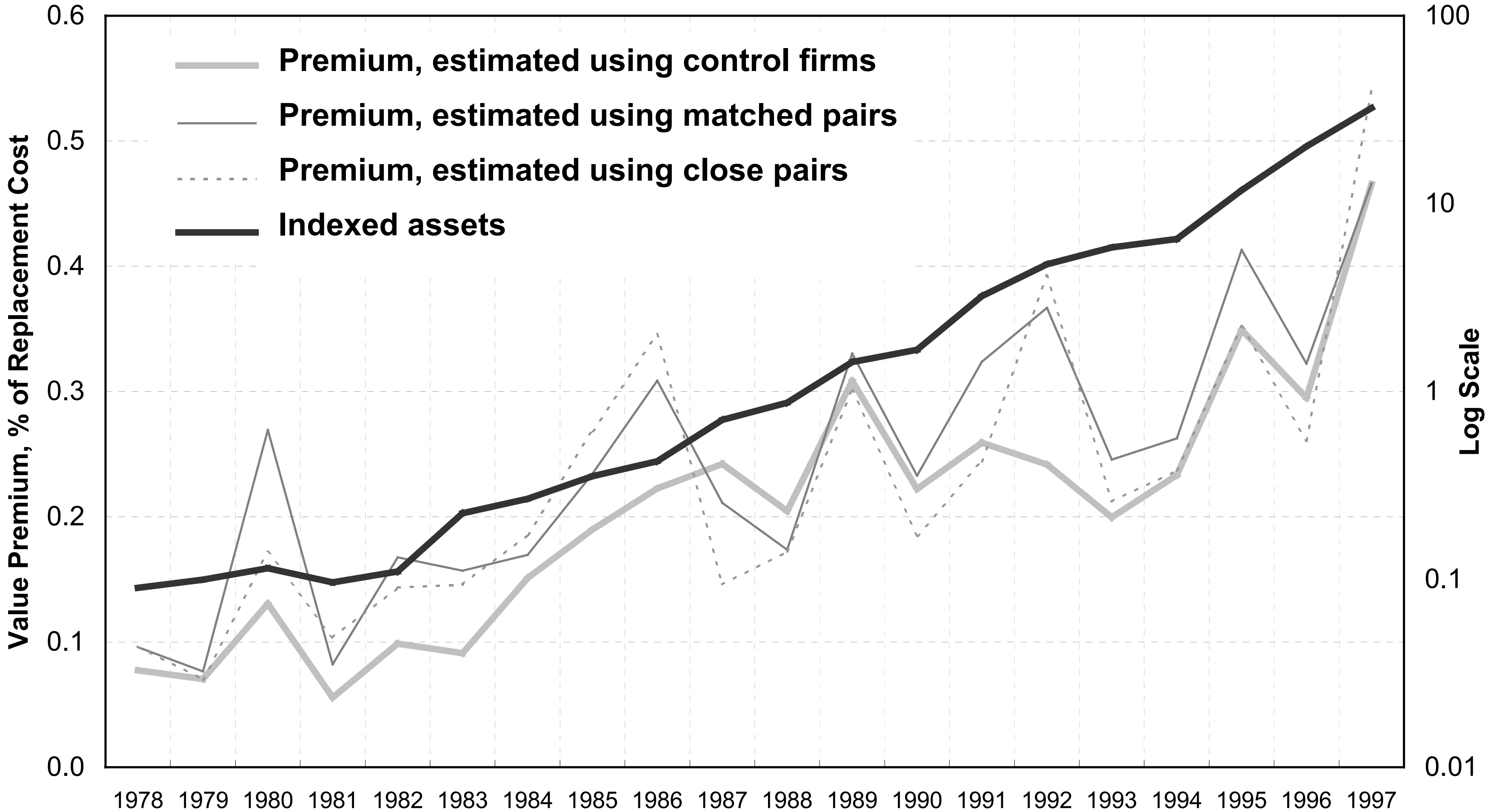
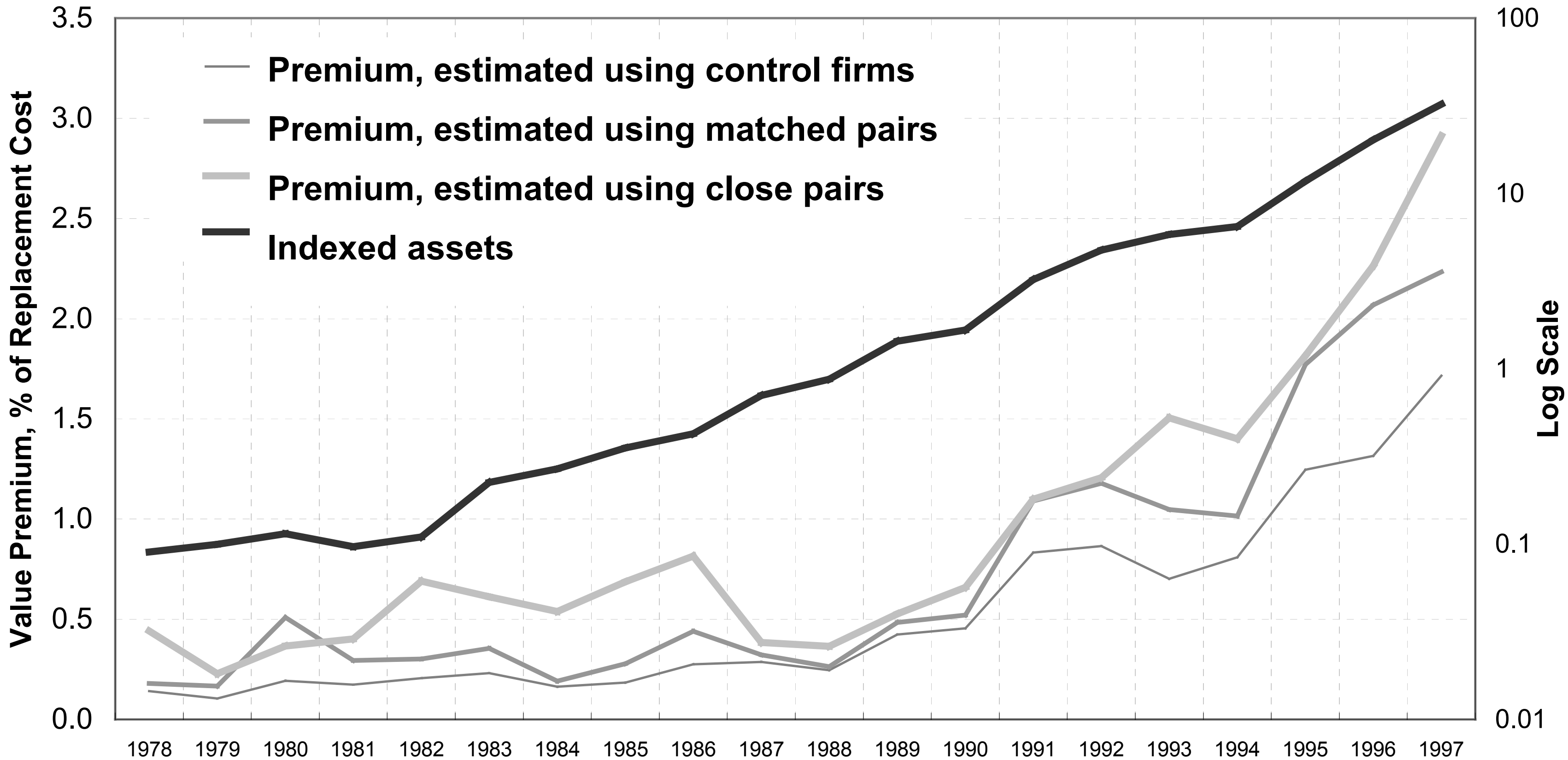


Figure 2
The Value of the Vanguard 500 Index Fund and the Tobin's Average Q Premium Associated with Membership in the S&P Index, 1978 through 1997



The value of the Vanguard 500 Fund is in billions of 1982 dollars on the left-hand scale, while the valuation effects (coefficients on S&P 500 membership dummies from table 7) are plotted against the right-hand scale. Samples used in estimating the valuation effects are as described in Table 1

Figure 3
The Value of the Vanguard 500 Index Fund and the Tobin's Average Q Premium Associated with Weight in the S&P Index, 1978 through 1997



The value of the Vanguard 500 Fund is in billions of 1982 dollars on the left-hand scale, while the valuation effects (coefficients on S&P 500 index weights from table 7) are plotted against the right-hand scale. Samples used in estimating the valuation effects are as described in Table 1. Firms not in the index are assigned a weight of zero.

Appendix Table 1
Assumed age structure of corporate debt in 1958

Age in years	Fraction of debt
19	0.020
18	0.038
17	0.038
16	0.039
15	0.047
14	0.038
13	0.038
12	0.044
11	0.060
10	0.056
9	0.058
8	0.058
7	0.063
6	0.079
5	0.076
4	0.033
3	0.059
2	0.067
1	0.086