

Cubes and the individual investor

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Abstract

We investigate issues of importance to individual investors concerning Cubes, the NASDAQ-100 Index Tracking Stock. Individual investors are the major long-term holders of Cubes and they hold and trade proportionately more Cubes than Standard & Poors Depository Receipts. Nevertheless, individuals account for less than 50% of the daily trading volume in Cubes. Individuals investing in Cubes are protected from return dilution resulting from market timing and late trading devices like those possible with open-end mutual funds. Cubes do demonstrate large, but rare, short-lived intraday deviations from net asset values, which appear not to present a significant problem except, possibly, for high frequency traders. © 2004 Academy of Financial Services. All rights reserved.

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1. Introduction

The NASDAQ-100 Index Tracking Stock, an exchange traded fund (ETF) with the stock symbol, QQQ, is well on its way to becoming one of the most successful equity financial products of all time. QQQ shares, commonly referred to as “Cubes,” have become, in an amazingly short time since their inception, the most actively traded equity securities on the stock exchanges.¹

First listed on March 10, 1999 on the American Stock Exchange (AMEX), Cubes now

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trade additionally on the New York Stock Exchange, the Chicago Stock Exchange, the NASDAQ Inter-Market (an electronic order-execution system encompassing various alternative trading platforms), the Island Electronic Communications Network (Island ECN), and other exchanges and ECNs. Even the derivative products of the Cubes have very high trading volume. For example, the QQQ options that trade on the Chicago Board Options Exchange (CBOE) and the AMEX have become one of the most actively traded option products on those exchanges.

Our research endeavors to answer two questions that are important to individual investors. First, we attempt to determine what accounts for the explosive volume of the Cubes? In particular, does this high trading volume come mainly from individual investors, institutions or both? Given the evidence in Barber and Odean (2000) that individual investors who trade frequently perform poorly, the high daily trading volume in Cubes, if it is primarily coming from individual investors, could indicate that substantial individual wealth is being destroyed through the extensive trading in this security. Our results indicate that while individuals, more so than institutions, are the long-term holders of QQQs, institutions account for over 50% of the daily trading volume in the QQQs. Despite this finding of relatively heavy institutional trading in QQQs, we also find that individuals comprise a larger proportion of both long holdings and trading in QQQs than in another popular ETF, the Standard & Poors Depository Receipts (SPYs or SPDRs), commonly referred to as Spiders.

The second question we address in this research is: To what extent does the market price of Cubes closely track its net asset value, which is based on the value of the underlying index? Close tracking is a key benefit touted by the promoters of Cubes and other ETFs. This question is particularly important to individual investors for at least two reasons. First, the typical individual investor does not have access to instantaneous index values and thus could be vulnerable to losses if significant deviations occur. Second, as we discuss in more detail below, ETFs may provide a way for individual investors to avoid the return dilution because of late trading and market timing that has been documented for open-end mutual funds. However, if intraday deviations from net asset value are significant and common for ETFs, this problem could more than offset the advantages of less dilution. Our results indicate that most of the time the prices of Cubes are very close to their net asset values. However, the trading activity in the Cubes appears to be producing relatively rare, but economically significant intraday mispricings between the QQQs and the underlying index. Our results further suggest that these mispricings are very short-lived.

We conduct our analysis by first comparing Cubes with SPDRs. SPDRs track the S&P 500 composite index and began trading on the AMEX, symbol SPY, on January 22, 1993. SPDRs, perhaps because of their relatively long history, are the most intensely studied ETFs in the academic literature. We then examine intraday trading activity. Most previous studies of ETFs draw inferences without considering intraday data. Our results indicate that it is necessary to consider intraday activity to gain an understanding of trading activity.

2. ETFs: an overview

ETFs are potentially important financial products for the individual investor since they combine the advantages of indexing with the advantages of stock trading. Legally, ETFs

represent shares of ownership in either fund, depository receipts or unit investment trusts that hold pools of common stocks chosen to track the performance of specific indexes. The indexes may be broad market, sector, investment style, or international. Broad market ETFs track a diverse portfolio of stocks from different industries and market sectors, whereas sector ETFs track groups of companies represented in related industries such as the health-care sector or energy sector. While most currently offered ETFs invest in equity markets, there are a few that invest in bonds.

A potentially large benefit of ETFs over open-end index mutual funds is that they avoid the potential for return dilution because of late trading and market timing. This issue has recently become the focus of legal and regulatory authorities, and at the time of this writing the full extent of the problem in the open-end mutual fund industry is unknown. However, academic studies indicate that the cost could be as high as 2% per year for some mutual funds (Greene & Hodges, 2002; and Zitzewitz, 2003). The feature of open-end mutual funds that allows these problems to occur is once a day pricing for purposes of issuing or redeeming shares. ETFs do not have this feature. Instead, ETFs trade continuously when the market is open at prices that are set by market conditions. The creation and redemption of ETF shares is through an in-kind process, by large investors and institutions in block size “Creation Units.” For the QQQs, this is 50,000 shares or multiples of 50,000 shares. Investors, with enough ETF shares to equal a “Creation Unit” may redeem them from the fund at net asset value and receive a “Redemption Basket” of the underlying securities. Alternatively, investors may exchange the appropriate number of underlying securities in the “Portfolio Deposit” for a “Creation Unit” of ETF shares. Given the continuous trading and in-kind creation and redemption, ETFs do not appear to be subject to the late trading and market timing problems of open-end funds.²

However, the continuous trading of the shares of ETFs creates the possibility of another problem—deviations between the market price and the net asset value of the fund. The in-kind creation/redemption mechanism is claimed by ETF promoters to insure that the ETF shares trade at a price close to their net asset value, not only at closing but intraday as well. If so, then ETFs may indeed represent a viable alternative for individual investors concerned with dilution because of late trading and market timing. It would also allow ETFs to avoid a major pitfall of closed-end mutual funds, which typically trade at significant discounts to their net asset values. As noted above, one of the goals of this research is to evaluate the validity of this claim.

ETF advocates list several other benefits of investing in or trading ETFs:

1. ETF investors can also use all the order and portfolio management strategies associated with stocks: market orders, limit orders, stop orders, short sales, and margin buying.
2. ETFs are not only eligible for short sales, but specific exchange traded products are exempt from the “uptick” rule that requires shares to be sold short only when the last sale price is higher than that of a security’s preceding last sale.
3. ETF shares can be a very cost-effective way to construct a portfolio or achieve targeted exposure to a specific sector, or investment style. ETFs have no sales loads, but brokerage commissions do apply. Expense ratios for ETFs vary between 0.08% and

0.84% of the value of the fund, which is not too dissimilar from many open-end index mutual funds (Scott & Henrich, 2003).

4. ETFs may be tax efficient. Both open-end mutual funds and ETFs are obligated to distribute realized capital gains to shareholders by year-end, which is a taxable event for nonretirement accounts. ETFs, however, may have a tax advantage over open-end funds because of the in-kind creation and redemption process. By transferring out high tax basis securities to redeeming shareholders they may be able to minimize capital gains. However, some researchers question the general claim of greater tax efficiency of ETFs over mutual funds. In a recent study on the tax efficiency of ETFs, Poterba and Shoven (2002) find that, over the period 1994–2000, the after-tax and pretax returns of the Vanguard Index 500 equity index fund were slightly greater than those on SPDRs.

For a more comprehensive explanation of the history and characteristics of ETFs, refer to Gastineau (2001, 2002).

3. Previous literature

Most of the previous research on ETFs has focused on the SPDRs, probably because they have the longest history for study. Both of the studies that are most relevant to our research focus on SPDRs. Aekert and Tian (2000) study SPDRs and MidCap SPDRs (an ETF whose underlying portfolio is the Standard & Poor's MidCap 400 index). They find that, in contrast to closed-end mutual funds, the difference between SPDRs and their net asset value is economically insignificant. The difference is somewhat larger for MidCap SPDRs, but still substantially less than the typical closed-end fund. They conclude that the mechanisms to create and destroy shares act to limit deviations from net asset value. Based on institutional ownership data, they conclude that individuals rather than institutions invest in SPDRs. They also find that the returns of SPDRs are not excessively volatile relative to the underlying index. Again this finding is in contrast to studies of closed-end mutual funds.

Elton et al. (2002) find that SPDRs underperform the Vanguard 500 Index open-end mutual fund. They attribute this underperformance to a peculiarity in the way that dividends are reinvested in SPDRs. Most relevant to our study, Elton et al. test the determinants of daily volume of SPDRs and find that volume is positively related to both intraday volatility of the S&P 500 index and the previous day's deviation of the SPDRs' closing price from net asset value.

Another thread of the ETF literature examines the relationship between ETFs and index derivatives. Switzer, Varson, and Zghidi (2000) find that the introduction of SPDRs acted to reduce the amount of mispricing in the S&P 500 Index futures contracts. Hasbrouek (2003) uses intraday data for several markets to examine in which market price discovery occurs. For SPDRs and QQQs, he finds that price discovery typically occurs in the E-mini futures market and not in the ETFs. However, for ETFs based on indices with less developed derivative alternatives (MidCap SPDRs and sector ETFs), he finds that the ETFs play a role in price discovery. Hasbrouek's study is also notable in that it is the only study of which we are aware that considers QQQs in its tests.³

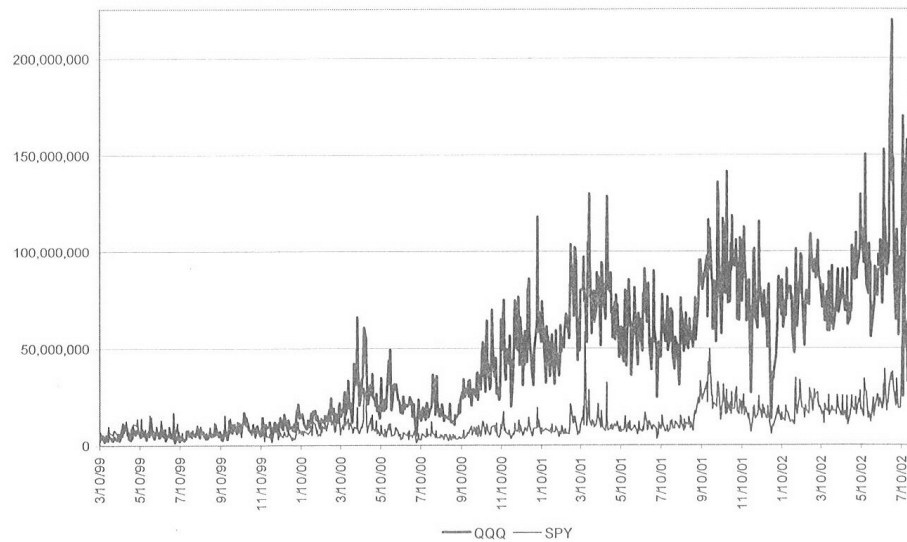


Fig. 1. Comparison of daily trading volume.

4. Data

The data for most of our study come from Internet sources. Daily price and volume data for QQQs and SPDRs, as well as the values of their underlying indexes, are from <http://finance.yahoo.com>. Daily net asset values, as well as short interest data, are from <http://amextrader.com>. Betas for QQQs and SPDRs are from <http://quotes.nasdaq.com>.

In one section of the study, we examine intraday pricing of the QQQ. These data come from the TAQ database for the month of July 2001, which we purchased from the New York Stock Exchange. Although issued by the New York Stock Exchange, this database covers trading on all of the major exchanges and over-the-counter markets in the United States. We obtained the technical data we needed to construct minute-by-minute values for the NASDAQ-100 index from three Internet sources: <http://www.marketdata.nasdaq.com/mr4a.html>; <http://ftp.amextrader.com/Nasdaq100>; and <http://www.nasdaqtrader.com/static/tdhome2.stm#Nas100>.

5. Results

5.1. History of QQQ trading volume

Fig. 1 shows the daily trading volume in QQQs and SPDRs since the inception of the QQQs. The volume in QQQs was similar to that in SPDRs during the early life of the QQQs. There was a large increase in activity in March through April 2000, which corresponds to the initial drop of the NASDAQ-100 Index from its peak. However, after a relatively brief flurry of activity, trading volume dropped back to a level only slightly higher than before the flurry. Then, in the fall of 2000, trading volume increased dramatically and then trended to

Table 1
Descriptive statistics for the QQQ versus the SPY

	QQQ	SPDR
Inception date	3/10/99	1/29/93
Expense ratio	0.18%	0.12%
Dividend yield	0.00%	1.07%
Average number of shares outstanding (July 2001)	539,723,000	216,607,000
Share creation and destruction (FY 2001)		
Shares sold	820,600,000	194,600,000
Shares redeemed	337,450,000	125,050,000
Average daily trading volume		
Full sample period (March 10, 1999–August 16, 2001)	29,972,033	8,205,805
Before November 2000	15,274,005	7,346,508
Since November 2000	60,634,681	10,000,236
Beta	2.12	0.99
Standard deviation of daily returns		
Full sample period	3.82%	1.35%
Before November 2000	3.82%	1.31%
Since November 2000	3.82%	1.43%
Institutional ownership		
% of average monthly volume	21.07%	57.06%
% of shares outstanding as of 06/30/01	23.67%	40.09%
Short interest (July 2001)		
Short interest	110,372,355	19,007,277
Days to cover	1.86	1.98
Percent of July average		
Shares outstanding	20.45%	8.77%

ever-higher levels. It is this high level and positive trend in trading volume in the QQQs that serves as a motivation for our study.⁴

5.2. Comparison of QQQ with SPDRS

One goal in this research is to determine the reasons for the very high trading volume in QQQs, and whether it is individual investors or institutions that contribute most heavily to this volume. We begin by comparing and contrasting QQQs with SPDRs. SPDRs have the longest history and have been studied more intensely than other ETFs.

Table 1 provides an array of descriptive statistics for QQQs compared to SPDRs. One difference that stands out between the two ETFs is that QQQs are substantially more risky than SPDRs, whether risk is measured by the standard deviation of daily returns or by beta. We assume that speculators are attracted to volatile investments. If so, QQQs would appear to be the superior speculative vehicle, at least when compared to SPDRs. It should be noted, however, that the standard deviation of returns for the QQQs was just as high before the large increase in trading volume as after. Thus, the large increase in trading volume in the fall of 2000 cannot be attributed to an increase in return volatility. Perhaps investors were just slow to discover the trading benefits of the QQQs.

The institutional ownership data in Table 1 is our first attempt to determine whether the

trading in QQQs is by individuals or institutions. Based on institutional ownership, it appears that individuals, not institutions are the primary owners of QQQs. The institutional ownership in QQQs is much lower than in SPDRs. As discussed in Ackert and Tian (2000) the institutional ownership level for SPDRs is low relative to large stocks in general. Thus, the very low level of institutional ownership in QQQs would seem to indicate that individuals dominate the trading in QQQs. However, as we demonstrate later, there is substantial difference between institutional ownership and institutional trading.

Table 1 also provides data on the short interest in QQQs and SPDRs in July 2001. The conclusion one reaches concerning the relative importance of short positions depends on the metric considered. In terms of number of shares sold short and in terms of short sales as a percentage of outstanding shares, the short position in QQQs is much higher than for SPDRs. However, because of the very high trading volume, the common short position metric—days to cover—is similar for the two securities. These data raise the possibility that investors are using QQQs for hedging or portfolio insurance. Investors with a portfolio heavily weighted toward technology stocks could use a short position in the QQQs as a hedge against a decline in the sector. Based on the reported short position, we conclude that portfolio insurance or hedging activity may be a contributing factor to the high trading volume, but we consider it unlikely that this is the primary factor. Therefore, we conclude from Table 1 that the most likely cause for the high trading volume in QQQs is speculative trading.

We next examine data similar to that used in previous studies of ETFs in an attempt to determine whether arbitrage plays an important role in the high trading volume of QQQs. Table 2 provides data on the deviations from net asset value for QQQs and SPDRs based on closing prices for the period April through July 2001. Panel A provides data on actual deviations, while Panel B provides data on the absolute value of the deviations. In both panels the deviations are expressed both in dollars and as a percentage of net asset value. Clearly the average size of the deviations is very small for both securities. However, the range of the deviations for the QQQs is somewhat larger than the range of deviations for the SPDRs. For QQQs the maximum absolute value of the deviation from net asset value was a little more than 2%, while for SPDRs the maximum absolute value of the deviation was less than 1%.

As discussed above, a potential major advantage of ETFs over traditional open-end mutual funds is that they are not subject to dilution because of market timing and late trading. However, ETFs do have the potential for deviations from net asset value. The extreme deviations documented in Table 2 could adversely affect the returns of an investor unlucky enough to buy or sell at the wrong time; however, the average deviations seem to indicate that the probability of the deviations having a significant impact on returns is relatively small.

One major caveat is in order concerning the analysis in Table 2. The deviations are calculated as of the close of trading each day. Thus this table is based only on deviations at market close. These data shed no light on deviations from net asset value that occur during the trading day. Despite this concern, Ackert and Tian (2000) and Elton et al. (2002) use similar end of day data to conclude that SPDRs do not deviate significantly from net asset value. As we show below, one reaches somewhat different conclusions from intraday data than from end of day data.

Table 2
 Analysis of premiums and discounts from NAV using daily closing prices during the period 3/4/01–3/25/02

	<i>Panel A.</i> Actual Deviations from NAV		<i>Panel B.</i> Absolute Deviations from NAV	
	QQQ	SPDR	QQQ	SPDR
Mean				
\$	−0.0129	−0.0152	0.1225	0.1884
% of NAV	−0.0402	−0.0169	0.3093	0.16319
Standard deviation				
\$	0.0116	0.0154	0.0086	0.0095
% of NAV	0.0291	0.0133	0.0213	0.0083
Minimum				
\$	−0.8800	−0.8200	0.0000	0.0000
% of NAV	−2.1400	−0.7200	0.0000	0.0000
1st quartile				
\$	−0.0800	−0.1500	0.0300	0.0800
% of NAV	−0.2100	−0.1400	0.0802	0.0688
Median				
\$	0.0000	0.0000	0.0900	0.1500
% of NAV	0.0000	0.0000	0.2266	0.1338
3rd quartile				
\$	0.09000	0.1575	0.15	0.2575
% of NAV	0.2400	0.1300	0.4059	0.2244
Maximum				
\$	0.5000	0.6300	0.8800	0.8200
% of NAV	1.2000	0.5100	2.1396	0.7127

5.3. Determinants of daily trading volume

We next perform a regression analysis of daily trading volume in the QQQs in an attempt to provide more direct evidence of speculative trading. Table 3 presents three specifications of an OLS regression model that relates daily trading volume for the QQQs to various independent variables. In Panel A, the models are estimated using a time series from inception of the QQQs through July 2001. Panels B and C split the sample period into before and after the explosion in trading volume. Preliminary tests indicate significant positive serial correlation in error terms. We use the Ljung-Box Q-statistics to examine the nature of the serial correlation in residuals and find that the correlation is of higher order. Thus, we use the Box-Jenkins approach to determine the structure of residuals. In our models, we consider up to ten lags and choose the reported autoregressive specifications. We use a Marquardt nonlinear least squares algorithm to estimate the models. The t-statistics shown beneath each coefficient estimate are based on standard errors derived from the Newey-West procedure.

Specification (1) is similar to the model used by Elton et al. (2002) in their analysis of SPDRs. The independent variables in Specification (1) are a measure of intraday volatility and a lagged measure of deviation from net asset value. The intraday volatility measure is calculated using values of the NASDAQ-100 Index. It is the daily high minus the daily low divided by the closing value. The deviation from net asset value measure is the closing price

Table 3
Regression analysis of the determinants of daily trading volume

Model specification:	(1)	(2)	(3)
Panel A: estimation period 3/10/99–3/25/02			
Intercept	0.0373 1.9693**	0.0373 1.9569*	−0.0062 −0.2452
Intraday volatility of the underlying index	0.3715 10.2069***	0.3705 9.7916***	
Lagged deviation from NAV	0.1155 1.5544	0.1173 1.5825	0.1133 1.4639
Down day dummy		0.0002 0.2240	
Implied volatility (VXN)			0.0011 1.4639***
Residual specification ^b			
ρ_{t-1}	0.2231 3.1127***	0.2226 3.1044***	0.2729 4.5728***
ρ_{t-3}	0.1384 3.0705***	0.1387 3.0852***	0.1263 3.0514***
ρ_{t-4}	0.1293 2.1614**	0.1288 2.1575**	
ρ_{t-6}	0.2659 4.4855***	0.2656 4.4718***	0.2355 4.4153***
ρ_{t-9}			0.1604 2.9510***
ρ_{t-10}	0.2051 3.1293***	0.2062 3.1472***	0.1687 2.5723**
Adjusted R ²	0.7639	0.7635	0.7478
F-statistic	343.8668***	300.5092***	315.2970***
Durbin-Watson statistic	2.0289	2.0288	2.0693
Observations	761	761	761
Panel B: Estimation period 3/10/99–8/30/00			
Intercept	0.0091 ^a 5.8174***	0.0095 4.6268***	−0.0143 −3.1255***
Intraday volatility of the underlying index	0.3012 14.1216***	0.3040 18.1508***	
Lagged deviation from NAV	0.0813 1.1351	0.0669 0.9567	0.0840 1.1436
Down day dummy		0.0002 0.3849	
Implied volatility (VXN)			0.0007 6.9248***
Residual specification ^b			
ρ_{t-1}	0.3555 7.3838***	0.3147 6.3377***	0.4893 10.2168***
ρ_{t-2}	0.2883 4.9959***	0.2645 4.5991***	
ρ_{t-3}			0.1849 3.4689***
ρ_{t-5}	0.2089 3.7929***		
ρ_{t-9}		0.1648 3.1943***	

(continued on next page)

Table 3
(Continued)

Model specification:	(1)	(2)	(3)
ρ_{t-10}		0.1339 2.5518**	
Adjusted R ²	0.7836	0.7865	0.6635
F-statistic	267.5066***	192.0237***	183.4025***
Durbin-Watson statistic	2.0920	2.0628	2.1111
Observations	374	374	374
Panel C: Estimation period 8/00–3/25/02			
Intercept	0.0481 ^a 8.6137***	0.0485 7.7411***	0.0051 0.3221
Intraday volatility of the underlying index	0.3773 5.1348***	0.3883 5.6796***	
Lagged deviation from NAV	0.0676 0.6210	0.1182 1.0394	0.1180 1.0539
Down day dummy		0.0007 0.3340	
Implied volatility (VXN)			0.0011 6.1167***
Residual specification ^b			
ρ_{t-1}	0.2191 3.0588***	0.2007 2.7844***	0.2578 3.7800***
ρ_{t-3}	0.1230 2.4340**	0.1382 3.1290***	
ρ_{t-4}	0.1685 2.4009**		
ρ_{t-6}	0.2959 4.3375***	0.2597 4.1789***	0.2614 4.4168***
ρ_{t-9}			0.1888 3.4973***
ρ_{t-10}		0.2274 3.2039***	0.1735 2.4796**
Adjusted R ²	0.3684	0.3838	0.3647
F-statistic	37.9482***	34.7238***	37.3544***
Durbin-Watson statistic	2.0319	2.0269	2.0541
Observations	387	387	387

^a -t-statistics along with significance levels are reported under coefficient estimates.

^b -Residual specification is based on Q-test of residuals.

*** Significant at the .01 level.

** Significant at the .05 level.

* Significant at the .10 level.

for the QQQ minus the net asset value divided by the net asset value. Following Elton et al. (2002) this variable is lagged by one day.² For the full sample period and both subperiods the results of Specification (1) with regard to the volatility variable are very similar to the results of Elton et al. There is a positive and significant relationship between intraday volatility and trading volume. However, our results are somewhat different from those of Elton et al. with regard to the lagged deviation from net asset value. They find a positive and statistically significant relationship between trading volume and this variable. In our study the sign of the coefficient is positive, but not statistically significant in the full sample and both subperiods.

Table 4
Trade size and volume for QQQ and SPDR

Trade size in shares: t	QQQ Volume		SPDR Volume	
	Percent	Cumulative percent	Percent	Cumulative percent
$t < 1,000$	13.46	13.46	6.22	6.22
$1,000 \leq t < 5,000$	23.48	36.94	15.74	21.96
$5,000 \leq t < 10,000$	8.66	45.60	9.72	31.67
$10,000 \leq t < 15,000$	4.85	50.45	8.75	40.42
$15,000 \leq t < 25,000$	5.66	56.11	7.72	48.14
$25,000 \leq t < 50,000$	8.99	65.10	13.16	61.30
$50,000 \leq t < 75,000$	7.88	72.97	10.18	71.48
$75,000 \leq t < 100,000$	2.07	75.01	5.07	76.55
$100,000 \leq t < 250,000$	15.24	90.21	14.78	91.23
$250,000 \leq t < 500,000$	4.35	94.57	4.90	96.13
$500,000 \leq t$	5.43	100.00	3.87	100.00

We include Specification (2) to further investigate the hedging explanation. In Specification (2) we add a dummy variable that equals one if the NASDAQ-100 Index declined on that day and zero otherwise. If investors are using QQQs for hedging purposes, particularly for some type of portfolio insurance, trading activity should increase during market declines. The results of Specification (2) do not support the hedging explanation. The coefficient on the down day dummy variable is insignificant for the full sample period and both subperiods.

We include Specification (3) to further test the relationship between volatility and trading volume. The intraday volatility measure in Specification (1) is contemporaneous. In Specification (3) we substitute a forward-looking measure, the implied volatility derived from pricing of options on the NASDAQ-100 Index. The results of this specification are consistent with Specification (1). In the full sample period and both subperiods there is a positive and significant relationship between implied volatility and daily trading volume.

It is noteworthy that the explanatory power of the models for the whole sample and for the first subsample is high (around 80%), and about two times greater than the explanatory power of the models in the second subsample (around 37%). Thus, there must be new factors, which cause the high trading volume in the second subsample.

5.4. Analysis of trading based on intraday data

Based on our analysis to this point, which is consistent with the type of analysis done in earlier studies of SPDRs, it appears that the large trading volume in QQQs due primarily to speculative activity. Further, based on the institutional ownership data shown in Table 1, it appears that individuals, not institutions, are the source of this activity. In this section we show that this picture is too simplistic. The data for this section is taken from the TAQ Database provided by the New York Stock Exchange for the month of July 2001. We conduct our analysis by examining trade sizes during the month to help us to differentiate individual investor trades from institutional trades. Table 4 shows the percentage of trading volume in QQQs and SPYs, respectively, accounted for by trades of different sizes. Con-

sistent with industry practice, we assume that large block trades (10,000 shares or more) are institutional trades, whereas smaller trades could be transactions by individual investors. Using this categorization method, trading volume in the QQQs is almost evenly divided between institution and individual trades. Institutions play an important role in QQQ trading, and they contribute significantly to the very high trading volume. This is a very different picture than we inferred from the institutional ownership data in Table 1, which seemed to indicate that institutions played a minor role in QQQ trading. Despite the relatively heavy trading by institutions in the QQQs, Table 4 also indicates that institutions play an even greater role in the trading of SPYs than in QQQs. Thus based on both the ownership data in Table 1 and on the trading data in Table 4, it appears that individual investors play a larger role in QQQs than in SPYs.

5.5. Intraday pricing of QQQs

One goal of our study is to evaluate the claims of ETF promoters that the prices of ETFs closely track their underlying indices throughout the trading day. To do this we examine intraday deviations from net asset value for the QQQs. Each minute during the trading day we take the most recent trade price for each stock in the NASDAQ-100 Index.⁶ We then compute an index value using the weights in effect during the period under consideration. Finally, we calculate the deviation between our calculated value of the index and the most recent trade price of the QQQs.

Table 5 presents a statistical analysis of our calculations of minute-by-minute deviations from index value for the QQQs during the period July 18 through July 31, 2001. A comparison of Table 5 with the closing data for QQQs in Table 2 indicates similar measures of central tendencies; however, the extreme values are larger using intraday data than using only closing prices. This indicates the presence of relatively rare, but large, deviations from index value during the trading day. The largest deviation during our sample period was almost 3% of net asset value. Such large mispricings between QQQ and its underlying NASDAQ-100 Index portfolio could be a problem for individual investors if they should conduct a trade during one of the large deviations.

Fig. 2 shows the intraday deviations from index value of the QQQs and large block (10,000 shares or greater) trading volume on a minute-by-minute basis during the trading day for the period July 18 through July 31, 2001. In this figure, the deviations are calculated at each minute and the volumes are for the succeeding one-minute period. Our first observation is that large deviations from value do occur throughout our sample, but they are relatively rare and very short-lived. Generally, large deviations disappear within one minute. Our second observation is that large deviations from index value are typically followed in a very short time by a surge in large block trading volume. We believe that this pattern is evidence of intraday arbitrage activity by institutions in the QQQs.⁷

We conclude that the large, but relatively rare, intraday deviations from net asset value, which we document in Table 5 and Fig. 2, probably do not represent a significant problem for most individual investors. Although the deviations are large enough to be economically significant, they are rare and the price returns rapidly to a narrow band around the net asset value. We note however, that the possibility of experiencing a large deviation rises with the

Table 5
 Analysis of intraday deviations of QQQ price from QQQ NAV during the period 7/8/01–7/31/01

	Absolute value of negative deviations	Positive deviations	Absolute value of deviations
Mean			
\$	0.0253	0.0186	0.0229
% of NAV	0.0610	0.0449	0.0554
Standard deviation			
\$	0.0397	0.0321	0.0374
% of NAV	0.0951	0.0769	0.0895
Minimum			
\$	0.0000	0.0000	0.0000
% of NAV	0.0001	0.0000	0.0000
1st quartile			
\$	0.0109	0.0063	0.0087
% of NAV	0.0262	0.0151	0.0213
Median			
\$	0.0215	0.0135	0.0184
% of NAV	0.0518	0.0328	0.0445
3rd quartile			
\$	0.0332	0.0242	0.0301
% of NAV	0.0795	0.0592	0.0726
Maximum			
\$	1.2161	0.6219	1.2161
% of NAV	2.9357	1.4907	2.9357

frequency of trading. Thus someone attempting to day trade in the QQQ should be aware of the problem.

Ideally, we would like to compare the magnitude of the deviations from net asset value problem inherent in the QQQ with the magnitude of the dilution problem from market timing

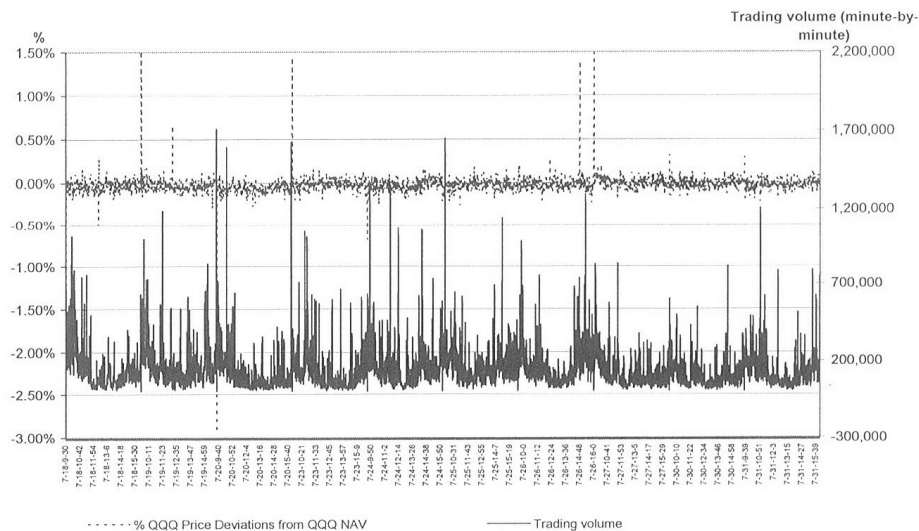


Fig. 2. QQQ price deviations from NAV and trading volume.

and late trading inherent in open-end funds. Unfortunately, a full answer to that question must await further research. The most comprehensive study of the open-end fund dilution problem to date, Zitzewitz (2003), documents potential dilution from market timing of up to 1.6% per year in international open-end funds. He does not, however, provide an estimate of the dilution potential for funds that invest in the large-cap technology companies that dominate the index underlying QQQs. More importantly we are not aware of any estimates in the literature of the potential dilution from late trading, which we believe would be a much larger potential problem than market timing for open-end funds that invest in large-cap technology companies.

6. Summary and conclusions

This research examines the meteoric rise in trading volume of the QQQ shares, or Cubes, representing the NASDAQ-100 Index Tracking Stock. Since their inception in March 1999, Cubes have become the most actively traded securities on the stock exchanges, generating share volume several times that of its prominent index ETF competitor and predecessor, SPYs, which track the S&P 500 composite index. First listed on the AMEX, Cubes now trade on numerous stock exchanges and BCNs. Even the derivative products of the Cubes, such as the QQQ options are among the most actively traded option products on the CBOE and AMEX.

Our investigation examines two questions of importance to individual investors. First, we seek to account for the explosive volume in the Cubes; and, in particular, to determine the involvement of individual investors versus institutions in the demand for QQQ shares. Second, we evaluate the claims of ETF promoters that these securities trade very close to net asset value throughout the trading day. This latter question is important to individual investors in light of the recent revelations of significant losses because of return dilution in some open-end mutual funds resulting from late trading and market timing. Some observers suggest ETFs as a way to avoid the dilution problem. However, the potential benefit of dilution avoidance could be offset if the deviation from net asset value problem in ETFs is significant.

The results indicate that individual investors are the major long-term holders of Cubes and that they, proportionately, hold and trade more Cubes than they do SPDRs. This conclusion arises out of the analysis of institutional ownership data. Nevertheless, when intraday data are evaluated, the results reveal that institutions account for at least 50% of the daily trading volume in QQQs.

We also find evidence of relatively rare, but large, intraday deviations from net asset values in the prices of QQQs. These mispricings are economically significant, but at least for the QQQs, the intraday mispricings are very short-lived. We conclude that the individual investor should generally be confident that the market prices of QQQs are, for the most part, close to their net asset values. However, albeit small, there is a chance of a significant mispricing. It is important to note that it may not be appropriate to generalize this conclusion for QQQs to other ETFs. QQQs are by far the most actively traded ETFs. We leave for further research the question of how closely the intraday prices of less actively traded ETFs

track their net asset values. Overall though, it would appear from the preceding discussion and these results that individuals investing in QQQs are quite well protected from the potential for exploitation and return dilution through market timing and late trading devices that characterize open end mutual funds.

Our study also demonstrates the importance of considering intraday data in examining the characteristics of ETFs. Because most previous academic studies of ETFs use only daily data, this finding indicates that caution is necessary in interpreting the results of earlier studies.

Notes

1. The measure of trading volume we use in this study is average daily share volume. Dollar volume, which is calculated as price times share volume, is not evaluated.
2. This is the conclusion in the popular business press. See, for example, Damato (2003).
3. For studies that consider other issues related to ETFs, see Solodar and Seiler (2001), Gastineau (2001, 2002), Poterba and Shoven (2002), Boehmer and Boehmer (2003), Hegde and McDermott (2004), Khorana, Nelling, and Trester (1998), Patro (2001), Pennathur, Delcours, and Anderson (2002), and Hendershott and Jones (2004).
4. In 2002, the QQQ average daily share volume not only greatly exceeded that of SPY, but also surged past that of Cisco Systems (CSCO on the NASDAQ exchange) that, according to an expert spokesperson on CNBC, had been the most actively traded individual equity security on the stock exchanges during the past few years. Per data from *S&P Comstock*, 30-day average volume figures ending July 31, 2002 were: 120,009,000 shares for QQQ, 45,731,000 shares for SPY, and 72,949,000 shares for CSCO. Thus, at the time of the first draft of this paper, QQQ shares were the most actively traded equity securities, ETFs or otherwise, on the stock exchanges.
5. We report results using the lagged variable to be consistent with the specification in Elton et al. (2002). We also ran our tests using the current day's deviation. The results were similar to the reported results.
6. Because the NASDAQ-100 Index consists of the largest stocks traded on the NASDAQ, we do not believe that stale trades should be a significant problem in this study.
7. In unreported analysis we examine trading in five-minute windows around the 11 largest deviations during our sample period and find evidence of higher than average large block trading during around the time of the deviations.

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