Exchange-Traded Fund Introductions and Closed-End Fund Discounts and Volume

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Exchange-traded funds (ETFs), like closed-end funds (CEFs), are managed portfolios traded like individual stocks. We hypothesize that the introduction of an ETF in an asset class similar to an existing CEF results in a substitution effect that reduces the value of the CEF's shares relative to that of its underlying assets. Our event studies show that upon the introduction of a similar ETF, CEF discounts widen significantly and relative volume declines significantly. Single equation and systems estimation models show that the widening in discounts and reduction in volume are related to returns-based measures of the substitutability of ETFs for CEFs.

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1. Introduction

Until the advent of exchange-traded funds (ETFs) in 1993, closed-end funds (CEFs) were the only investment companies regulated by the 1940 Investment Company Act that could be traded throughout the trading-day and sold short like individual stocks. Consequently, they were the only professionally managed portfolios with stock-like trading characteristics that were generally available to lower net worth non-accredited retail investors. ETFs, also regulated by the 1940 Act, are professionally managed portfolios that can also be traded throughout the day and sold short by non-accredited investors. To date, ETFs are the only potential substitutes for CEFs with respect to these trading characteristics and also within certain narrow investment sectors.

In this paper, we formally test whether ETFs are viable substitutes for comparable CEFs. If a substitution effect exists, the introduction of a suitable substitute for a CEF should reduce its demand and hence, its price, relative to the value of its underlying assets (net asset value, NAV), ultimately resulting in a reduction in its premium or a widening of its discount. In addition, since the substitute ETF will be used as a trading vehicle for some investors who previously traded CEFs, the CEF's trading volume should eventually decline as well. Our objective in this paper is to determine whether CEF discounts widen and volumes decline after the introduction of ETFs in similar investment sectors. We expect that as CEF investors become familiar with the composition and behavior of ETFs, they would consider ETFs as potential substitutes in similar investment sectors.

Our contribution to the literature is threefold: First, we document the widening of discounts for CEFs upon the introduction of similar ETFs in three asset categories: U.S. domestic equity CEFs, international equity CEFs, and U.S. bond CEFs. Second, we examine the substitution effect using volume as well as discounts. Third, we explain these discount and volume substitution effects empirically using measures of how close a substitute an ETF is for a particular CEF, using both single-equation and systems estimations.

Our results indicate that in the year following the introduction of a similar ETF, the average discount widens significantly and volume falls significantly in all three investment categories of CEFs that we examine. Our regression analysis shows that both the widening of discounts and the reduction in relative volume following ETF introductions are significantly related to the degree of "relatedness" or substitutability of the ETF for the CEF, and that discounts and volume are simultaneously determined. We measure substitutability from an investors's viewpoint, as the correlation between CEF and ETF returns and as the regression coefficient of CEF returns on ETF returns. This evidence supports the hypothesis that a substitution effect exists and that a CEF loses some desirability when a substitute ETF becomes available.

2. ETFs as substitutes for CEFs

CEF and ETF shares are suitable for non-accredited investors because they are regulated under the 1940 Investment Company Act. Until the introduction of ETFs, CEFs were the only investment product featuring professionally managed portfolios and intra-day trading that were available to non-accredited small investors. It is natural, then, to expect that investors would consider ETFs as potential substitutes for CEFs in similar investment sectors. In addition, single-country ETFs are the only potential substitutes for many single-country CEFs, as there are few single-country open-end funds.

Although ETFs can be effective substitute investment vehicles for CEFs, there are a number of important differences between the two. Perhaps the most important in terms of structure is that CEFs shares often trade at values considerably higher or lower than their NAVs, while ETFs are designed to trade at values close to their underlying asset values (see Gastineau, 2001, U.S. Securities and Exchange Commission, 2008). Unlike traditional mutual funds and unit investment trusts, CEFs are not required to redeem their outstanding shares at NAV. CEFs issue a fixed number shares that trade continuously throughout the day at prices determined purely by supply and demand. As a result, the price of a CEF's shares has only an indirect link to NAV, and these shares can trade at a premium or, more often, a discount to NAV. ETFs, in contrast, can issue new shares as demand increases, resulting in greater liquidity for an ETF as its number of shares grow.

There are other differences between CEFs and ETFs that are more the result of management style than structure. For example, although most CEFs are actively managed, all ETFs introduced during our test period are passively managed indexes. As a result of passive management, ETFs have lower expenses than CEFs (see Del Guercio, Dann, and Partch, 2003, and Dellva, 2001) and perhaps lower total risk because they are more diversified.

Another difference between CEFs and ETFs is that CEFs commonly issue preferred stock, which is permitted for only CEFs under Section 18 of the 1940 Investment Company Act. The preferred issues are used to leverage returns of the common stock. In addition, all investment companies are permitted to have a debt load of up to one-third of their assets. While it is common for CEFs to use debt, almost all ETFs are index funds and make no use of leverage.[1]

CEF discounts have been widely studied because they appear to be a departure from efficient markets and because CEFs are one of the few securities that allow researchers to accurately measure the value of their underlying assets. In surveys of CEF research, Dimson and

[1] All of the ETFs in our 1993-2005 universe are index products.

Minio-Kozerski (1999) and Garay and Russel (1999) list 71 separate studies that explore a wide range of possible explanations for discounts. However, the substitution effect has heretofore been examined only in closed-end country funds (CECF).

Patro (2001) is the first to study the effect of ETF introductions on CEF discounts. In contrast to this study, Patro is limited to just CECFs. He investigates whether segmentation of international markets from the U.S. market was reduced by the introduction of World Equity Benchmark Shares (WEBS) ETFs. International financial markets are said to be segmented if assets with the same risk have different expected returns in different countries (see Bekaert and Harvey, 1995, p. 403-404). Patro finds that the announcement of WEBS resulted in significantly positive country-specific market index returns, supporting his hypothesis. More germane to this study, Patro also finds that average CECF premia decline significantly, which he argues is further evidence of a reduction in market segmentation. However, Patro's results are also consistent with a substitution effect. Therefore, we wish to examine other asset classes in addition to international CEFs to see if these same effects are present in markets where segmentation is clearly not an issue.

3. Hypotheses

ETFs are the only alternatives for many CEF investors who require professionally-managed, ready-made portfolios that can be traded throughout the day. Thus, we believe that when an ETF is introduced that is similar to an existing CEF, some proportion of the CEF's investors will switch to the ETF. The availability of a substitute will result in a reduction in demand for the CEF, which at the margin, will cause a reduction in the CEF's share price, relative to the value of its underlying net assets. This leads to our first hypothesis:

Hypothesis 1: Upon the introduction of a similar ETF, a CEF's premium will decline (or its discount will widen) relative to its expected premium.

We also believe that some proportion of CEF investors choose them as intra-day trading vehicles. The introduction of an ETF as a potential trading substitute will result in a loss of monopoly status for CEFs as traders switch to ETFs. Thus, we expect that the presence of a competing ETF will, over time, result in a reduction in a CEF's trading volume, which leads to our second formal hypothesis:

Hypothesis 2: After the introduction of a similar ETF, a CEF's trading volume, relative to its shares outstanding, will decline compared with its expected relative volume.

We examine three asset classes of CEFs: international equity, US equity, and US bonds. We test two competing hypotheses: the market segmentation hypothesis advanced by Patro (2001) and others, and our substitution hypothesis. Market segmentation can clearly be present only in the international asset category, as viable substitutes for US equity and bond CEFs have long been available. The substitution hypothesis, advanced throughout the paper, is simply that given attractive alternative investments with comparable or superior features, investors will substitute the superior ETF for the CEF for at least some of their investments. As market segmentation is defined as a price (or expected return) effect, declines in abnormal volume in any of the three asset classes (including international) is support for the substitution hypothesis. This leads to our third hypothesis:

Hypothesis 3: Upon the introduction of a similar ETF, a decline in premiums for international CEFs is consistent with either or both the market segmentation hypothesis or the substitution hypothesis. However, a decline in premiums for other asset categories not subject to market segmentation, i.e., U.S. equity and bonds, is consistent only with the substitution hypothesis. In addition, a decline in abnormal volume in any of the asset classes (including international) is support for the substitution hypothesis.

After testing these hypotheses, we use regression analysis to explore whether reductions in premia and volume are related to how close a substitute an ETF is for a specific CEF. We assume that close substitutes have similar return behavior, which we measure in two ways: first, as the correlation of returns among pairs of CEFs and ETFs, and second, as the coefficient of a regression of CEF returns on ETF returns. This leads to our fourth hypothesis:

Hypothesis 4: Abnormal premia and volume will be inversely related to correlation coefficients between CEF and ETF returns and to the slope coefficient of a regression of CEF returns and ETF returns.

4. Empirical methods

Our empirical objective of investigating the substitution effect is to first examine abnormal discounts and abnormal relative volume of CEFs upon the introduction of similar ETFs. We then attempt to explain any abnormal discounts and volume using measures of the degree of CEF-ETF substitutability in regressions of abnormal discounts and relative volume. Our regression methods account for the potential simultaneous determination of abnormal discounts and volumes. The following sections describe our sample, event-study methods, and regression methods.

4.1. Sample

Our hypothesis is that CEF discounts will widen and relative volumes will decline when “similar” ETFs are introduced. Our working definition of “similar” for U.S. general equity funds is the same capitalization class, i.e., small, medium, and large. We define similar as the same narrow asset class for U.S. specialty equity funds (e.g., real estate, health care), the same region for multi-country international funds (e.g., world, Asia), and the same country for single-country funds. For bond ETFs, we define similar as either U.S. government or investment grade corporate, which were the only bond ETFs with data available through 2005. We use *Morningstar* and *Closed End Fund Association (CEFA)* fund objectives and portfolio composition data to categorize both CEFs and ETFs.

We require discount and volume data for one year before and after the introduction of an ETF. Our sampling period starts in 1993 with the introduction of the first ETF, the large-capitalization SPDRS (ticker SPY, an S&P 500 index fund), and ends in December, 2005 so we can obtain CEF discount data for funds introduced through December, 2004. Our discount data is obtained from the *Wall Street Journal (WSJ)* and *Bloomberg*, using the *WSJ*'s listings as our universe of CEFs.

We assume that the introduction of the first ETF of a particular asset class will have the greatest effect on a similar CEF's discount and volume. When the first ETF of a specific asset class is introduced, we check the *WSJ* list of CEFs for that week to determine if a similar CEF, not previously included in the sample, exists. We include in the sample all CEFs that match the asset class of the new ETF, which means that one ETF is often matched to several CEFs. For example, SPY was the first actively traded U.S. ETF. As of January 29, 1993, when SPY began trading, the *WSJ* listed 21 general equity CEFs. Of those 21, 15 were classified by *Morningstar* at that time as being large-capitalization general equity (non-specialty), and were also listed on *CRSP*. Of those 15, our sample includes 11 CEFs for which we could obtain discount and volume data for one year before and after the ETF start date. Additionally, when the Midcap SPDR Trust (ticker MDY) began trading on May 4, 1995, we added the three CEFs classified by Morningstar as U.S. mid-cap. A more narrowly focused example is the iShares MSCI Germany ETF (ticker EWG), introduced in March, 1996. Of more than fifty international equity CEFs listed at that time, only two were German single-country funds. Both were added to the sample.

Our final sample consists of 71 CEFs. The sample includes 27 U.S. equity funds, including 17 general equity and 10 specialty; 27 international funds, including 21 single-country funds and 6 regional or world funds; and 17 U.S. bond funds. ETF starting dates are taken from Yahoo! Finance and ETF Connect, and confirmed by checking the first date that the ETF price is listed in CRSP.[2]

4.2. Event-study methods

Our empirical objective is to determine if CEF discounts and volume decline significantly after the introduction of similar ETFs, using event-study methods for both discounts and volume. However, our event-study differs from a typical event-study such as an earnings surprise or takeover bid, which is postulated to contain information that, in an efficient market, would cause an immediate revaluation of the company's shares. By contrast, the introduction of an ETF contains no new information about the underlying NAV or market price of the CEFs we examine. The event is merely the introduction of a competing security that may or may not be a good substitute and which may or may not be successful. Thus, an immediate market reaction can occur, but it is just as likely that abnormal discounts will widen and volume will decline for our sample CEFs more gradually over time, as investors switch to ETFs.

The event-date is defined as the initiation of ETF trading. We discuss empirical methods for discounts separately from those for volume because of their substantial differences.

4.2.1. Discounts

For discounts, our event-study is similar to Patro (2001). We use weekly CEF premia or

[2]The complete final sample and a summary of event dates are available from the working paper version of this paper at www.ssrn.com.

discount data from the *WSJ* and *Bloomberg.* We use the mean-adjusted returns (or comparison-period) method (substituting CEF premia for returns) due to the lack of a suitable discount index.[3] We use a 48-week estimation period ending four weeks before the event-week. A 48-week estimation period allows sufficient discount data to obtain robust expected discount estimates, and a four-week test period avoids the possibility that weekly discounts affected by the event will be used in parameter estimation.

In discussing our results, we refer to "premia" rather than discounts so that economically negative reactions, i.e., reductions in premia or a widening discounts, will be reported as negative numbers. For each CEF, the premium is defined as the difference between the CEF price per share and the net asset value per share (NAV). A discount to NAV is denoted as a negative premium. The abnormal premium for CEF j over week t is defined as:

$$AP_{jt} = P_{jt} - P_j \, , \tag{1}$$

where P_{jt} is the premium for CEF j on week t, and P_j is the mean estimation period premium for CEF j.

The sample average abnormal premium over week t is defined as

$$AAP_t = \frac{\sum_{j=1}^{N} AP_{jt}}{N} \, , \tag{2}$$

where N is the number of firms in the sample or subsample. Similar to Patro (2001), we define

[3]A market-model type regression, using the time-series of an index of discounts to estimate expected discounts, would control for the possibility that the event-dates occur during high or low discount periods. Unfortunately, such an index is unavailable. We believe that there are a sufficient number of event-dates over different calendar years and months within years to minimize the possibility.

the cumulative average abnormal premium as

$$CAAP_{t1,t2} = \sum_{t=t1}^{t2} AAP_t \qquad t1 \le t \le t2, \tag{3}$$

where t1 and t2 define the interval over which the abnormal premium is cumulated relative to the event (e.g., t1=-1, t2=0 for the interval including the week before the event and the event). The CAAP is useful for statistical testing over intervals, although unlike event studies using abnormal returns the CAAP has no economic meaning. For example, if the AAP is -10% in week one and remains at -10% in week two, the CAAP would be -20% although there has been no additional decline in discount or value in week 2. When CAAP is divided by the number of weeks in a given period, we obtain an average weekly AAP.

As the distributional properties of CEF discounts are not known, we test abnormal premia for statistical significance using two parametric tests based on normality and two nonparametric tests. The first test based on normality is the standardized abnormal return Z-test developed by Patell (1976), which accounts for unequal variances across securities. For tests over intervals longer than one week, we account for potential serial correlation using the adjustment developed by Mikkelson and Partch (1988). As ETFs tend to be introduced in groups, resulting in event-clustering, we also present Brown and Warner's (1985) "crude dependence adjustment" (CDA) test, also based on normality. This statistic calculates a single variance estimate using the time-series and cross-section of discounts across the entire sample being tested.

Our nonparametric statistics include the sign test, which compares the proportion of positive AAP or CAAP to the proportion of positive premia in the estimation period, and the rank test developed by Corrado (1989). The rank test has the benefit of not assuming that the underlying distribution is symmetrical.

4.2.2. Volume

For volume, we use an OLS market model to estimate abnormal volume, with a 250 trading-day estimation period, ending twenty days before the event (equivalent to the four-week period used for discounts). Volume and abnormal volume are based on the percentage of outstanding shares of each security traded each day:

$$V_{jt} = \frac{100 n_{jt}}{S_{jt}}, \qquad (4)$$

where n_{jt} is the number of shares of security j traded on day t relative to the event, and S_{jt} is the number of shares outstanding on day t.

Ajinkya and Jain (1989), studying abnormal trading volume for NYSE securities, find that volume is non-normal, but that a log-transformation of raw volume data yields a distribution that is approximately normal. We perform a log-transformation on the percentage of outstanding shares traded measure, following Campbell and Wasley (1996).

Market model abnormal daily percentage relative volume for security j on day t is

$$AV_{jt} = V_{jt} - (\alpha_j + \beta_j V_{mt}), \qquad (5)$$

where α_j and β_j are estimated market model parameters and V_{mt} is average percentage of outstanding shares traded on day t over each security in the *CRSP* equally-weighted market index.

We measure the average abnormal percentage volume as

$$AAV_t = \frac{\sum_{j=1}^{N} AV_{jt}}{N}, \qquad (6)$$

where N is the number of firms in the sample or subsample. The cumulative average abnormal percentage volume is

$$CAAV_{t1,t2} = \sum_{t=t1}^{t2} AAV_t \qquad t1 \le t \le t2, \tag{7}$$

where t1 and t2 are trading days relative to the event, defined in a similar manner as for abnormal premia, except here we use daily data. As in the discount study, dividing the CAAV by the number of days in an interval yields a daily average AAV.

We test for abnormal volume using the same test statistics as in the discount event study, accounting for serial correlation with the Patell (1976) statistic. Campbell and Wasley (1996), examining the properties of volume tests using Nasdaq securities in addition to NYSE securities, compare the Patell (1976) statistic to Corrado's (1989) rank statistic. They find that both the parametric and rank statistics are well-specified, but the rank statistic is more powerful with all their models and for all sample sizes.

5. Empirical results

5.1. Abnormal discounts

We present abnormal CEF discounts and test statistics in Table 1 for the three individual weeks -1,0,1, and then cumulated over various intervals. Week 0 is the week containing the first day of trading in a similar ETF. We report significance levels using one-tailed tests, consistent with our hypotheses. Results for the full sample (n=71) are in panel A, showing that weekly average abnormal premia (AAP) and cumulative average abnormal premia (CAAP) are negative over every interval that we examine. The AAP on weeks -1 and 0 are approximately -1.4%, statistically significant at the 0.10 level in both weeks using the nonparametric sign test and the two tests based on normality. The AAP on week one is -2.3%, with 51 of the 71 funds having a negative AAP, significant at the 0.01 level with both the nonparametric binomial test and the Patell Z, and at the 0.05 level with the crude dependence adjustment statistic (CDA) statistic.

[Table 1 about here.]

For intervals longer than one week, we present both the CAAP and the average weekly AAP, which is the CAAP divided by the number of weeks in the interval. The average weekly AAP decreases consistently as the test periods lengthen, to -2.80% over the entire 48 week post-event period, indicating that abnormal discounts widen as the event-year progresses. In addition, the weekly AAP are at least -3% over each week from 45 to 48 (not presented in the table) and are statistically significant at the 0.01 level using all four test statistics. For all windows, the first three statistics indicate that the CAAP is significantly negative at the 10% level or better. Over the (1,24) and (1,48) windows, all four tests are significantly negative at the 1% level.

Hypothesis 3 states that an examination of abnormal premia of asset categories beyond international CEFs in response to similar ETF introductions allows a differentiation between the segmentation and substitution hypotheses. Therefore, we examine abnormal premia for each of the three categories individually, i.e, international, U.S. equity, and U.S. taxable bonds, in table 1, panels B-D. The international category in panel B, which includes 21 single-country portfolios, displays negative abnormal premia over every week and period. Abnormal premia on weeks -1,0, and 1 are -2% or more, and two out of the four test statistics are significant (one nonparametric and one based on normality) at the 0.05 level or better, while three out of four are statistically significant at the 0.10 level in week +1. As in panel A, in all cumulative windows the first three tests indicate statistical significance at the 10% level or better. Abnormal CAAP widens to -3% or more over intervals (1,8), (1,24), and (1,48), statistically significant at the 0.10 level with all four tests. We speculate that this strong result for international funds is due to the fact that until the introduction of single-country ETFs, CEFs were the only way to invest in many of these countries individually, resulting in a strong substitution effect. These results are also consistent with the market segmentation hypothesis advocated by Patro (2001), or a combination of both the market segmentation and substitution hypotheses. We next look at other asset classes that can shed light on the market segmentation versus substitution hypothesis.

Abnormal premia for the U.S. equity category are reported in panel C of Table 1. The AAP is -2.22% in week 1, significant at the 0.05 level or better with all but the rank Z test. The average weekly AP over the (1,8) period is -1.69%, also significant at the 0.05 level with all but the Rank Z test. The average weekly AP is -2.55% over the (1,24) period and -2.96% over the (1,48) period, statistically significant at the 0.10 level or better using all four tests.

Table 1, panel D displays the empirical results for the taxable bond category. Abnormal premia are negative in every period, but the AAP declines substantially only after the eighth week (the AAP first exceed -1% in week 13) and is statistically significant at the 0.05 level or better using all four tests over period (1,24) and in three tests, including the nonparametric rank Z, over the (1,48) period.

To summarize, abnormal premia are significantly negative for the entire sample over most of the intervals we present. The magnitude of the discount changes are largest for the international and U.S. equity funds, but are significantly negative for all three asset categories over the (1,24) and (1,48) week intervals at the 0.10 level or better or better for 23 out of 24 test statistics. Although our results for international equity are consistent with both the market segmentation or substitution hypotheses, the results for U.S. equity and taxable bonds cannot be due to market segmentation, as other investment vehicles have been available in those segments for many years. Therefore, our results support the substitution hypotheses, H1 and H3.

5.2. Abnormal volume

We present daily abnormal volume results in table 2. As we have daily data for volume as opposed to weekly for discounts, we report results for days -1,0,1 as well as for cumulative daily periods that correspond to the weekly periods reported for discounts. We believe that even if a new ETF is a preferred substitute for a particular CEF, abnormal volume around the introduction date would be positive as investors trade out of the CEF. However, volume should decline over time as investors use ETFs as substitute trading vehicles. In addition, hypothesis 3 states that as segmentation theory is a pricing or return issue, a decline in abnormal volume in *any* asset category is support for the substitution hypothesis. Panel A shows that for the entire sample, abnormal volume is negative for all periods during and after the event week. The mean cumulative average daily relative volume (CAAV) is significantly negative at the 0.05 level or better for the Patell Z, CDA, and nonparametric rank Z test starting with the (5,20) period, and significant with all four tests at the 0.10 level or better over the (5,120) and (5,240) periods. The average daily AAV over those periods is below -6.58%.

[Table 2 about here.]

Results from the three categories are shown in panels B-D of table 2. These results indicate that the magnitude of abnormal volume is driven primarily by international CEFs, in which the AAV is greater than -12.0% over each of trading days -1 through +1, and declines quickly to at least -17.0% over the post-event period. For international funds, 23 out of a possible 24 test outcomes from the four test statistics are significant at the 0.10 level or better for all intervals beginning with (-5,0) and beyond.

Results for the U.S. equity category in panel C is mixed and of much smaller magnitude. The CAAV for U.S. equity funds are largely positive over most of the earlier post-event intervals.[4] However, the CAAV turns negative, with magnitudes of approximately -0.5% over the (1,120) and (1,240) periods. Two test statistics, including the nonparametric rank Z test, are significant at the 0.10 level or better. The results for taxable bonds in panel D are similar to U.S. equity surrounding the event, where CAAVs are positive and insignificant. However, beginning with the (5,20) window, 23 of 24 test outcomes are significantly negative at the 0.10 level or better using all four test statistics.

Overall, the abnormal volume results are driven by international equity. However, U.S. equity and U.S. bonds are significantly negative over the longer periods as well. Significance in the latter asset categories is further support for the substitution hypothesis, as they cannot be subject to segmentation, and declines in volume indicate substitution.

5.3. Regression analysis

5.3.1. Variables

In the previous section we find that abnormal discounts widen and abnormal volume declines, indicating lower demand for CEFs when a similar ETF is introduced. Our third hypothesis is that the decrease in demand for the CEF is a function of how close a substitute an ETF is for a CEF.

We measure the degree of substitutability of an ETF for a CEF in two ways, both measuring how closely investor returns from substitute funds track each other. The first measure

[4]As our hypotheses are one-tailed, large positive values of the test statistics do not denote statistical significance.

is the correlation coefficient between daily returns of the CEF and the ETF (Corr). The second measure (RegCoeff) is the slope coefficient from the following regression:

$$CefR_{it} = \alpha + RegCoeff * ETFR_{it} + \varepsilon_t \quad , \qquad (8)$$

where $CefR_{it}$ is the daily return of CEF i on day t, $ETFR_{it}$ is the daily return of the corresponding ETF on day t, α_i is the intercept, and ε_{it} is a random error term. The slope coefficient, $RegCoeff_i$, is similar to a market-model beta coefficient, particularly if the ETF is a country or sector index.

Pontiff (1997) shows that U.S. CEF fund returns and discounts are related to the Fama-French (FF, 1993) factors. Therefore, we include as exogenous control variables the three FF factors–market (MktRf), book-market (Hml), and firm size (Smb) in our regression equations.

5.3.2. Regression methods

While single-equation models with either abnormal discounts or abnormal volume as the dependent variable are appropriate specifications for testing the substitution hypothesis, this specification is likely to be subject to simultaneity bias. We address this issue in two ways: using an instrumental variables (IV) approach in our single-equation models, and then to verify the robustness of our results, estimating a simultaneous system using two-stage least squares (2SLS). Both IV and 2SLS provide consistent estimators. In the absence of a formal theoretical model, we do not use three-stage least squares (3SLS). Its major shortcoming is that mis-specification of one equation can negatively affect the other, and specification error will outweigh the modest efficiency improvement inherent in 3SLS. For example, Pindyck and Rubinfeld (1991) state that the gain in efficiency associated with 3SLS is approximately 5% (p. 313).

We create instruments by lagging our independent variables by one six-month period. That is, we divide the approximate one-year test period following the ETF introducation into two semiannual periods, taking the dependent variables from the second half of the test period and the independent variables (other than the exogenous FF factors) from the first half of the test period. This procedure yields lagged variables that are highly correlated with their contemporaneous counterparts, but which are theoretically uncorrelated with the error term.[5]

We divide the cumulative abnormal premium for each fund by the number of weeks in the test period (24 weeks) to obtain an average weekly abnormal premium over the period (AbPremium). Similarly, we divide the cumulative abnormal relative volume for each fund by the number of days in the test period (120 days) to obtain an average daily relative abnormal volume (ABVOL). Both variables are measured in percent. Single-equation regressions are of the form:

$$AbPerf_{it} = \alpha + \beta(Sub_{i,t-1}) + \sum_{k=1}^{3}\gamma_k (FF_{i,k,t}) + \varepsilon_{it} , \qquad (9)$$

where AbPerf is either AbPremium or AbVolume; Sub are the substitution measures Corr or RegCoeff; FF are the Fama-French factors MktRf, Hml, and Smb; α, β, and γ are regression parameters; ε is a random error term; i denotes a specific CEF, t is the second half of the one-year test period, and t-1 is the first half of the test period. We present descriptive statistics for the regression variables in table 3. The mean average abnormal premium (AbPremium) is -2.945% and the mean average relative abnormal volume (AbVolume) is -6.809%. The mean regression coefficient of daily returns on the CEF relative to the ETF (RegCoeff) is 0.337, with a range of

[5]Correlation coefficients for the lagged-contemporaneous variables are between 0.71 and 0.95.

-0.494 to 0.901. The mean correlation coefficient of returns on the CEF relative to the ETF (Corr) is 0.271, with a range of -0.269 to 0.771, demonstrating a wide distribution of substitutability measures between sample CEFs and ETFs.

[Table 3 about here.]

5.3.3. Single-equation abnormal premium regressions

The abnormal premium regressions are shown in table 4. We present both standard and White's (1980) heteroskedasticity-corrected t-statistics. In regression 1, the coefficient for RegCoeff from equation 8 is -5.328, significant at the 0.05 level or better based on White's (1980) t-statistic, which shows that a one-unit increase in RegCoeff (e.g., from 0 to 1.0, or from no relationship to a linear relationship with unit slope) would result in a greater than 5% widening of the discount. Of the control variables, only the market factor is significant. The regression explains 32% of the variation in abnormal premia.

[Table 4 about here.]

Regression 2 substitutes the correlation (Corr) of returns between the CEF and ETF for RegCoeff. The regression coefficient on Corr is -6.660, significant at the 0.05 level, indicating a 6.66% widening of the discount for a CEF that is perfectly correlated with the corresponding ETF than for one that is uncorrelated. As in regression 1, the market factor is statistically significant at the 0.01 level, and the two regressions have virtually identical explanatory power.

These regressions indicate that the CEFs which have daily returns that are highly correlated with those of a corresponding ETF experience significant widening in abnormal discounts relative to those with low correlations. This evidence supports the substitution hypothesis.

5.3.4. Single-equation abnormal volume regressions

The abnormal volume regressions are presented in the last two columns of table 4. Again, we present both standard and White's (1980) heteroskedasticity-corrected t-statistics. In regression 3, the coefficient on RegCoeff is -23.98, significant at the 0.05 level using both t-statistics. The coefficient indicates that a one unit increase in the regression coefficient from equation (8) (e.g., from 0 to 1.0, or from no relationship to a linear relationship with unit slope) is associated with abnormal relative volume of almost -24%. In regression 4, we substitute Corr for RegCoeff. The coefficient on Corr is -24.53, significant at the 0.05 level. The two regressions indicate that the variables RegCoeff and Corr have very similar effects on abnormal relative volume.

The regressions reported in table 5 indicate that the CEFs which have daily returns that are highly correlated with those of a corresponding ETF experience a significant decline in abnormal relative volume. Similar to the abnormal discount regressions, this evidence supports the substitution hypothesis.

5.3.5. Two-stage least squares regression results

We estimate a simultaneous system in this section to examine the robustness of our estimates and to determine if significant feedback exists between abnormal premia and abnormal relative volume. The equations we estimate are similar to equation (9), but here the AbPremium (AbVolume) equation now includes the contemporaneous AbVolume (AbPremium) as an explanatory variable, with both variables measured over the second half of the one-year test period. To ensure identification, a predetermined variable included in one equation is omitted from the other equation in the system. We report the results in table 5.

[Table 5 about here.]

In model 1, the coefficient on RegCoeff is significant at the 0.10 level in the abnormal premium equation (column a) and at the 0.05 level in the abnormal volume equation (column b). The signs are both negative, similar to those in the single-equation models. However, the magnitudes of the coefficients are smaller with 2SLS. The coefficient on AbVolume in the AbPremium equation is 0.0556, statistically significant at the 0.10 level, suggesting that a one percent decrease in the premium is associated with a 0.0556 percent reduction in volume. The coefficient on AbPremium in the AbVolume equation is 4.949, significant at the 0.05 level, suggesting that a one percent reduction in volume is associated with a five percent reduction in the premium. The signs of both coefficients are positive, as our previous results associate large abnormal discounts with large abnormal relative volume. Thus, there is significant contemporaneous feedback present. Our hypotheses make no claim on causality between AbVolume and AbPremium. We hypothesize that both are manifestations of substitution of ETFs for CEFs.

Model 2 substitutes Corr for RegCoeff. Again the magnitudes of the coefficients on Corr are smaller than in the single-equation models, and the coefficients on AbVolume and AbPremium are essentially unchanged from model 1.

Combined, the results in tables 3, 4, and 5 indicate that significant substitution effects are present when a competing ETF is introduced that covers the investment category of an existing CEF. In addition, our systems results in table 5 establish that abnormal CEF discounts and volume are simultaneously determined. Although market segmentation can explain some of these results for international funds, it is difficult to argue that segmentation exists in all three asset categories we examine.

6. Conclusions

We hypothesize that the introduction of an ETF covering a market segment similar to an existing CEF results in a substitution effect: the market price of a CEF will decline relative to the value of its underlying assets, causing the CEF discount to widen (or the premium to decline). We further hypothesize that the availability of a substitute will also cause a CEF's trading volume to decline over time. Finally, we expect that the closer a substitute a new ETF is for an existing CEF, the greater will be the decline in premium and the reduction in volume.

Our discount event study indicates that for a sample of 71 CEFs, average discounts widen significantly, by more than 2% in the week after the introduction of a similar ETF. This widening persists over the year after the event. In addition, we demonstrate that discounts widen in all three CEF asset categories that we examine: international equities, U.S. equities, and U.S. taxable bonds. The effect is strongest for international equity, but still significantly negative over the year for U.S. equity funds and U.S. taxable bond funds. Although market segmentation (Patro, 2001) may explain the widening of discounts for international CEFs, it is difficult to argue market segmentation is an issue for U.S. equity and taxable bonds, where alternative asset choices have long been available. Therefore, we conclude that substitution, in conjunction with market segmentation, is a likely explanation for widening discounts in international equity CEFs.

Our relative volume event study indicates that for the entire sample, relative daily volume declines, on average, by more than 6% after one month of the introduction of similar ETFs, and is statistically significant. This significant decline persists throughout the year. The magnitude of the decline is driven primarily by international CEFs, which have average abnormal relative volumes of more than -17%. The decline is smaller in the other categories, but is still significant for U.S. equity and taxable bonds. As market segmentation is a pricing or return issue, declines in volume indicate substitution.

Our regression analysis shows that abnormal discounts and relative volume are related to how close a substitute a new ETF is for an existing CEF. In single-equation instrumental variable estimation and in systems estimation using two-stage least squares, two measures of substitutability, the correlation coefficient of returns and the slope coefficient of a regression on CEF-ETF return, are significantly and negatively related to abnormal premia and abnormal relative volume. These results provide further evidence in favor of the substitution hypothesis.

Our study supports previous empirical work which finds that discounts widen among single-country CEFs upon the introduction of a similar ETF, and extends this work to domestic equity and bond funds. Our study also contributes to the literature by examining volume and by measuring the effect of the degree of substitutability between an ETF and CEF.

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Table 1

Event study of abnormal premia for a sample of 71 closed-end funds (CEFs) upon the introduction of a similar exchange-traded fund (ETF).

The event week (week 0) contains the first day of trading for an ETF that is similar with respect to the type of assets held to one or more CEFs. Weekly premia (discounts) are taken from the *Wall Street Journal (WSJ*). The premium is the percentage difference between the CEF price per share and the net asset value per CEF share. AAP is the average abnormal premium for the sample or subsample of CEFs for the event-week. CAAP is the cumulative average abnormal premium over the period specified. The average weekly abnormal premium is the CAAP divided by the number of weeks in the interval. (See equations 1-3.) The comparison period (or mean-adjusted) method is used to estimate abnormal premia. The estimation period is the 48 week period (-52,-5). Tests of the proportion of positive AAP or CAAP are relative to the proportion positive in the estimation period. The Patell Z test is based on Patell (1976); periods longer than one week are adjusted for serial correlation. CDA is Brown and Warner's (1980) crude dependence adjustment test. The rank test is based on Corrado (1989).

Panel A: Full sample, n=71

Week	AAP or CAAP	Avg. weekly AP	Positive: negative	Patell Z	CDA	Rank Z
-1	-1.36%	-1.36%	29:41*	-1.62*	-1.29*	0.49
0	-1.49%	-1.49%	28:43*	-2.33**	-1.42*	0.23
1	-2.30%	-2.30%	20:51***	-4.08***	-2.19**	-0.40
(-1,0)	-2.84%	-1.42%	28:43*	-2.81***	-1.91**	0.51
(-1,1)	-5.15%	-1.72%	25:46**	-4.63***	-2.83***	0.18
(1,4)	-7.32%	-1.83%	25:46**	-4.79***	-3.48***	0.24
(1,8)	-16.62%	-2.08%	21:50***	-8.30***	-5.59***	-0.24
(1,24)	-64.23%	-2.67%	19:52***	-19.49***	-12.47***	-3.55***
(1,48)	-134.40%	-2.80%	21:50***	-25.78***	-18.45***	-5.25***

Panel B: International equity, n=27

Week	AAP or CAAP	Avg. weekly AP	Positive: negative	Patell Z	CDA	Rank Z
-1	-2.19%	-2.19%	8:18**	-1.72**	-1.08	0.12
0	-2.52%	-2.52%	6:21***	-2.98***	-1.24	-0.54
1	-2.93%	-2.93%	6:21***	-2.52***	-1.44*	-0.14
(-1,0)	-4.71%	-2.36%	6:21***	-3.33***	-1.64*	-0.29
(-1,1)	-7.64%	-2.55%	6:21***	-4.14***	-2.17**	-0.32
(1,4)	-11.47%	-2.87%	6:21***	-4.66***	-2.83***	-0.39
(1,8)	-26.02%	-3.25%	5:22***	-8.37***	-4.53***	-1.63*
(1,24)	-83.80%	-3.49%	5:22***	-14.25***	-8.43***	-4.51***
(1,48)	-159.62%	-3.33%	5:22***	-14.29***	-11.35***	-4.78***

Table 1 continued

Panel C: U.S. equity, n=27

Week	AAP and CAAP	Avg. weekly AP	Positive: negative	Patell Z	CDA	Rank Z
-1	-1.15%	-1.15%	12:15	-1.15	-1.64*	0.36
0	-1.18%	-1.18%	11:16	-1.05	-1.68**	0.31
1	-2.22%	-2.22%	8:19**	-2.56***	-3.18***	-0.61
(-1,0)	-2.32%	-1.16%	11:16	-1.56*	-2.35***	0.47
(-1,1)	-4.54%	-1.51%	10:17*	-2.73***	-3.76***	0.04
(1,4)	-5.58%	-1.40%	11:16	-1.77**	-3.99***	0.23
(1,8)	-13.48%	-1.69%	9:18**	-3.46***	-6.83***	-0.62
(1,24)	-61.19%	-2.55%	9:18**	–9.80***	-17.88***	-1.94**
(1,48)	-141.91%	-2.96%	10:17*	-18.01***	-29.33***	-5.09***

Panel D: U.S. taxable bond, n=17

Week	AAP and CAAP	Avg. weekly AP	Positive: negative	Patell Z	CDA	Rank Z
-1	-0.34%	-0.34%	9:8	0.31	-0.34	-0.83
0	-0.34%	-0.34%	11:6	0.33	-0.34	-0.96
1	-1.43%	-1.43%	6:11	-1.94**	-1.40	-0.27
(-1,0)	-0.71%	-0.34%	11:6	0.43	-0.49	1.22
(-1,1)	-2.15%	-0.70%	9:8	-0.81	-1.20	0.87
(1,4)	-3.51%	-0.87%	8:9	-1.69**	-1.70**	0.87
(1,8)	-6.65%	-0.82%	7:10	-2.06**	-2.28**	1.35
(1,24)	-37.99%	-1.57%	5:12*	-9.52***	-7.53***	-2.17**
(1,48)	-81.39%	-1.70%	6:11	-12.00***	-11.54***	-3.26***

Statistical significance at the 0.10, 0.05, and 0.01 levels using a one-tailed test are denoted by *,**,and ***, respectively

Table 2

Relative volume event study results

The event date (day 0) is the first day of trading for a fund (ETF) that is similar with respect to asset class or sector to one or more CEFs. Daily volume is taken from *CRSP*. Relative volume of each CEF is the log-transformed percentage of outstanding shares traded each day. AAV is the average abnormal relative volume for the sample or subsample of CEFs for the trading day relative to the event. CAAV is the cumulative average abnormal relative volume over the period specified. The average daily abnormal relative volume is the CAAV divided by the number of days in the interval. (See equations 4-7.) The market model method is used to estimate abnormal relative volume. The estimation period is the 250 trading-day period (-270,-21). Tests of the proportion of positive AAV or CAAV are relative to the proportion positive in the estimation period. The Patell Z test is based on Patell (1976); periods longer than one week are adjusted for serial correlation. CDA is Brown and Warner's (1980) crude dependence adjustment test. The rank test is based on Corrado (1989).

Panel A: Full sample, n=71

Day	AAV and CAAV	Avg. daily AAV	Positive: negative	Patell Z	CDA	Rank Z
-1	6.03%	6.03%	22:49	1.92**	1.27	-0.86
0	-8.43%	-8.43%	23:48	-1.34*	-1.78**	-0.90
1	-3.46%	-3.46%	24:47	0.30	-0.73	0.51
(-5,0)	-22.84%	-3.81%	28:43	0.23	-1.96**	-0.65
(-5,5)	-42.57%	-3.87%	27:44	0.32	-2.70***	-0.19
(5,20)	-105.28%	-6.58%	25:46	-3.80***	-5.40***	-1.93**
(5,40)	-256.95%	-7.14%	22:49	-4.66***	-9.01***	-3.03***
(5,120)	-924.37%	-7.97%	19:52**	-9.40***	-18.06***	-9.44***
(5,240)	-1751.80%	-7.42%	20:51*	-7.00***	-24.00***	-10.76***

Panel B: International equity, n=27

Day	AAV and CAAV	Avg. daily AAV	Positive: negative	Patell Z	CDA	Rank Z
-1	-22.08%	-22.08%	2:25***	-2.53***	-1.98**	-1.47*
0	-18.40%	-18.40%	7:20	-1.42	-1.65**	-0.65
1	-12.13%	-12.13%	6:21*	-1.69**	-1.09	-0.42
(-5,0)	-96.98%	-16.09%	4:23**	-4.04***	-3.54***	-1.77**
(-5,5)	-157.06%	-13.90%	4:23**	-4.88***	-4.24***	-1.18
(5,20)	-267.55%	-16.72%	3:24***	-7.37***	-5.98***	-3.14***
(5,40)	-649.79%	-18.05%	4:23**	-10.23***	-9.69***	-5.67***
(5,120)	-2237.68%	-19.29%	3:24***	-16.63***	-18.59***	-10.27***
(5,240)	-4192.63%	-17.77%	4:23**	-17.41***	-24.42***	-11.85***

Table 2 continued

Panel C: U.S. equity, n=27						
Day	AAV and CAAV	Avg. daily AAV	Positive: negative	Patell Z	CDA	Rank Z
-1	36.03%	36.03%	11:16	4.57	9.65	-0.38
0	-3.32%	-3.32%	8:19	-0.84	-0.89	-1.49*
1	-0.70%	-0.70%	9:18	-0.20	-0.19	0.44
(-5,0)	26.96%	5.39%	12:15	0.97	2.95	-1.72**
(-5,5)	28.48%	2.59%	13:14	1.60	2.30	-1.44*
(5,20)	13.01%	0.81%	18:9	3.43	0.87	1.79
(5,40)	14.05%	0.39%	14:13	3.87	0.63	2.21
(5,120)	-61.15%	-0.53%	12:15	3.12	-1.42*	-2.24***
(5,240)	-141.85%	-0.60%	14:13	7.43	-2.40***	-1.90**

Panel D: U.S. taxable bond, n=17						
Day	AAV or CAAV	Avg. daily AAV	Positive: negative	Patell Z	CDA	Rank Z
-1	3.03%	3.03%	9:8	1.36	1.07	0.74
0	-0.72%	-0.72%	8:9	0.11	-0.26	0.61
1	5.94%	5.94%	9:8	2.98	2.11	1.37
(-5,0)	15.81%	2.64%	12:5	4.34	2.29	3.25
(-5,5)	26.39%	2.40%	10:7	4.79	2.82	3.11
(5,20)	-35.43%	-2.21%	4:13*	-1.93**	-3.14***	-1.64*
(5,40)	-63.46%	-1.76%	4:13*	-1.51*	-3.75***	-0.70
(5,120)	-209.53%	–1.81%	4:13*	-2.19**	-6.90***	-3.45***
(5,240)	-431.95%	-1.83%	2:15**	-1.74**	-9.97***	-4.45***

Statistical significance at the 0.10, 0.05, and 0.01 levels using a one-tailed test are denoted by *,**,and ***, respectively

Table 3

Regression variable statistics

The single-equation models use an instrumental variable method, and the simultaneous equations models use two-stage least squares, to ensure consistent estimation. The approximately one year test period is divided in half. The dependent variable, AbPremium, is the average weekly abnormal premium, in percent, over the second half of the test period. The dependent variable AbVolume, is the average daily abnormal relative volume, in percent, over the second half of the test period. The variables RegCoeff and Corr, are instruments for contemporaneous variables, measured over the first half of the test period to eliminate correlation with the error term in the single-equation models. RegCoeff is the coefficient of a regression of CEF daily returns on corresponding ETF daily returns. Corr is the correlation coefficient of daily CEF and corresponding ETF returns. MktRf, Smb, and Hml are the Fama-French (1993) market, size, and book-market variables, taken from Kenneth French's web site. They are exogenous to the models. Their values are the averages of daily values over the second half of the test period, contemporaneous with the dependent variables.

Variable	Mean	Std. dev.	Minimum	Maximum
AbPremium	-2.945%	5.472%	-19.708%	8.996%
AbVolume	-6.809%	18.647%	-110.750%	24.034%
RegCoeff	0.337	0.255	-0.494	0.901
Corr	0.271	0.215	-0.269	0.771
Mktrf	0.0003804	0.00108	-0.00292	0.00141
Smb	0.0002245	0.006496	-0.0008533	0.0009908
Hml	0.0001389	0.0009875	-0.00179	0.00238

Table 4

Abnormal premium and volume regressions

Single-equation models use an instrumental variable method to ensure consistent estimation. The approximately one year test period is divided in half. The dependent variable, AbPremium, is the average weekly abnormal premium, in percent, over the second half of the test period. The dependent variable, AbVolume, is the average daily abnormal relative volume, in percent, over the second half of the test period. RegCoeff and Corr are instruments for contemporaneous variables, measured over the first half of the test period to eliminate correlation with the error term. RegCoeff is the coefficient of a regression of CEF daily returns on corresponding ETF daily returns. Corr is the correlation coefficient of daily CEF and corresponding ETF returns. MktRf, Smb, and Hml are the Fama-French (1993) market, size, and book-market variables, taken from Kenneth French's web site. They are exogenous to the models. Their values are the averages of daily values over the second half of the test period, contemporaneous with the dependent variables. The traditional t-statistic is the first number in parentheses below each estimated coefficient, followed by the t-statistic using White's (1980) heteroskedasticity-corrected standard errors.

Regression	1	2	3	4
Dependent Variable	AbPremium	AbPremium	AbVolume	AbVolume
Intercept	-0.556 (-0.48) (-0.65)	-0.528 (-0.46) (-0.57)	1.900 (0.40) (0.56)	0.162 (0.04) (0.06)
RegCoeff	-5.328 (-2.23)** (-2.89)***	---	-23.984 (-2.65)** (-2.48)**	---
Corr	---	-6.660 (-2.31)** (-2.87)***	---	-24.530 (-2.21)** (-2.62)**
MktRf	-2419.2 (-3.81)*** (-5.95)***	-2546.8 (-3.94)*** (-6.08)***	-1732.8 (-0.72) (-0.96)	-1909.1 (-0.77) (-1.07)
Smb	1198.0 (1.28) (1.58)	1298.8 (1.42) (1.83)*	2632.2 (0.74) (1.08)	3585.3 (1.10) (1.56)
Hml	388.4 (0.58) (0.63)	459.2 (0.69) (0.73)	-3101.8 (-1.23) (-2.21)**	-2827.8 (-1.10) (-2.04)**
R^2	0.320	0.324	0.16	0.14
Adjusted R^2	0.280	0.284	0.11	0.09
F-stat	7.79	7.92	3.20	2.63
Prob > F-stat	<0.0001	<0.0001	0.019	0.042

Statistical significance at the 0.10, 0.05, and 0.01 levels using a two-tailed test are denoted by *,**,and ***, respectively.

Table 5

Two-stage least squares regressions.

The simultaneous equations models use two-stage least squares to ensure consistent estimation. The approximately one year test period is divided in half. The variables AbPremium, the average weekly abnormal premium, in percent, and AbVolume, the average daily abnormal relative volume, in percent, are both measured over the second half of the test period. RegCoeff and Corr are predetermined, as they are measured over the first half of the test period to eliminate correlation with the error term. RegCoeff is the coefficient of a regression of CEF daily returns on corresponding ETF daily returns. Corr is the correlation coefficient of daily CEF and corresponding ETF returns. MktRf, Smb, and Hml are the Fama-French (1993) market, size, and book-market variables, taken from Kenneth French's web site. They are exogenous to the models. Their values are the averages of daily values over the second half of the test period, contemporaneous with the dependent variables. One predetermined variable is eliminated from each equation to allow identification.

Model	1		2	
Regression	a	b	a	b
Dependent variable	AbPremium	AbVolume	AbPremium	AbVolume
Intercept	-0.0612 (-0.06)	4.032 (0.99)	0.0796 (0.08)	2.398 (0.60)
RegCoeff	-4.628 (-1.93)*	-19.969 (-2.30)**	---	---
Corr	---	---	-6.012 (-2.11)**	-19.188 (-1.85)*
AbVolume	0.0556 (1.95)*	---	0.0588 (2.12)**	---
AbPremium	---	4.949 (2.49)**	---	5.080 (2.52)**
MktRf	-2495.6 (-4.11)***	---	-2629.2 (-4.25)***	
Smb	---	3543.6 (0.14)	---	1327.0 (0.38)
Hml	448.4 (0.68)	-4219.6 (-1.85)*	515.2 (0.79)	-4020.8 (-1.71)*
R^2	0.34	0.22	0.35	0.20
Adjusted R^2	0.30	0.17	0.31	0.15
F-statistic	8.53	4.71	8.76	4.16
Prob>F-statistic	<0.0001	0.002	<0.0001	0.005