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The Performance and Trading Characteristics of Exchange Traded Funds in India: An Empirical Study

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Abstract:

This study empirically examines the performance and trading characteristics of Exchange Traded Funds (ETFs) in India. A sample of twelve ETFs listed on the National Stock Exchange of India has been analyzed in this study over a period ranging from January 2002 to December 2009. The study finds evidence of significant daily tracking errors for ETFs, however no significant bias in performance is found over long term investment horizon. Moreover, ETFs were found to follow nearly full portfolio replication strategy as promised by them. However, significant pricing deviations (premiums and discounts) were found to exist in the trading of these instruments. Also, such deviations were found to persist over a number of days indicating gross pricing inefficiencies and the presence of unexploited arbitrage opportunities in the Indian ETF market which commands immediate attention of the market players. To the best of our knowledge there has been no previous published research study which empirically examines the performance and trading characteristics of Exchange Traded Funds in India.

JEL Classification: G23

Key words: Exchange Traded Funds, Performance, Pricing Efficiency, Tracking Error

1. Introduction

One of the most dynamic, new investment vehicles in the market today is an Exchange Traded Fund (ETF), a security that tracks a stock index, a commodity or a basket of assets like an index fund, but trades on a securities exchange like a stock. ETFs have a unique trading mechanism characterized by a dual structure with a primary market open to authorized participants for the 'in-kind' creation and redemption of ETF shares in lots directly from the fund, and a secondary market open to all investors, where ETF shares can be traded on a real time basis, with no limitation on order size. Since an ETF is negotiated on two markets, it has two prices: the NAV of the shares on the basis of which creation and redemption takes place in the primary market and the price in the secondary market which depends on the supply and demand for ETF shares on the exchange. If buying or selling pressure is high, these two prices may deviate from one another. However, the possibility of 'in-kind' creation and redemption facilitates an arbitrage mechanism which ensures that such departures are not too large.

These innovative financial products were first introduced on the U.S. and Canadian exchanges in the early 90s. Today ETFs have proliferated across global financial markets both in terms of their number and the market value of total assets under management.

2. Literature Review

Research on ETFs has basically focused on analysis of ETFs as a performing alternative to conventional index mutual funds, testing of its pricing efficiency, and on studying their impact on the trading of index component stocks and index derivatives. A brief review of such studies is as follows:

- **Frino and Gallagher (2001)** examine the performance of S&P500 index funds between March 1994 and February 1999. Their study highlights the reasons why tracking error is inherent in index funds performance and examines both the magnitude and variation of tracking error over time, for a sample of S&P500 index funds. The results show that the sample index funds experience difficulties in replicating the returns of the target index and the tracking error of index funds averages between 0.039% and 0.110% per month before cost.
- **Elton et al (2002)** examine the characteristics and performance of SPDRs, the first official ETF launched in 1993 which tracks the performance of S&P 500 Index. They show an average of 0.28% annual underperformance for spiders relative to the S&P 500 Index over the period from 1993-1998. Examining the extent of deviation of price from NAV, they find that on average price lies below NAV by 1.4 cents or 0.018%. Moreover, these small deviations do not persist, and disappear in a day due to arbitrage mechanism. Regarding the trading volume they report that, in 1998 over 10% of the outstanding shares of SPDR were traded each day, which indicates that short term traders are active participants in the market.

- **Engle and Sarkar (2006)** examine the end-of-day and intra-daily premiums for a collection of 21 domestic and 16 international ETFs and measures both the magnitude and the persistence of the premiums. The overall findings of the study suggests that once mismatches in timing are accounted for, the premiums (discounts) for the domestic ETFs are generally small and highly transient, typically lasting only several minutes.
- **Gallagher and Segara (2004)** examine the performance of Australian ETFs between January 2002 and December 2003. The study finds evidence of significant tracking errors for ETFs while there is no significant bias in performance over majority of half yearly intervals examined. They also document small dollar and percentage differences in price and NAV that do not persist over time, but rather disappear within a day, indicating the pricing efficiency of Australian ETF market. However, an analysis of the trading profile of ETFs reveals lack of trading activity for ETFs in Australia, since the average trading volume of ETFs as a percentage of total issues outstanding was found to be below 0.5% over most of the time periods analyzed.
- **Rompotis (2006)** empirically examine the performance of 73 equity ishares ETFs from 3/10/2005 to 29/9/2006 using daily data. The study finds that ishares returns move in line with the return of indices and follow relatively perfect replication of the index portfolio. Further, the study finds significant tracking errors for ishares. Examining the relation among performance and premium, the study finds that the lagged premium is negatively related to return and the concurrent premium influences it positively.
- **Svetina and Wahal (2008)** study a sample of 584 domestic equity, international equity, and fixed income Exchange Traded Funds from their inception to the end of 2007. The findings show that on average, ETFs underperforms their benchmark indices and are not immune from tracking error.
- **Agapova (2009)** empirically investigates the substitutability of conventional index funds and ETFs and evaluates the clientele effects created from their differing features, which extend competition beyond price. An analysis of tracking error and effectiveness of a comprehensive sample of U.S funds over the period 2000 to 2004 reveals that ETFs have smaller tracking errors and are more effective in returns after fees than the index funds.

A review of the aforementioned studies shows that tracking error is inherent in the performance of such funds though its magnitude has differed across studies. Regarding the pricing efficiency of ETFs researches shows that as per the expectations, the premium or discounts on ETFs are very small and disappear within a day due to effective arbitrage mechanism. Most of these studies however have concentrated on the U.S markets, with only a few of them focusing on the European, Australian or Asian markets. Moreover, no empirical research has yet focused on the Indian ETF market. This gap in literature is surprising, given the significant growth and size of assets invested in the ETFs market.

3. Rationale of the study

The limited evidence on the performance of ETFs internationally, and the absence of empirical research in India provides the rationale and motivation for the present study. The ETF industry in India is still young and relatively little is known about the extent of tracking error as well as the magnitude of premium or discount experienced by such funds since these are not explicitly reported by ETFs in India. Our study contributes to the literature by providing analysis of the performance and trading characteristics of ETFs in India.

4. Objectives of the study

The first objective of the study is to empirically examine the performance of Exchange Traded Funds (ETFs) in India in terms of their replication strategy, tracking ability and performance effectiveness.

The second objective is the examination of pricing efficiency of ETFs in India, i.e. whether significant premiums or discounts exist in the Indian ETF market, which could present profitable arbitrage opportunities to the market makers.

5. Research Hypotheses

The study attempts to test the following hypotheses concerning the performance and pricing efficiency of Exchange Traded Funds (ETFs) in India:

- ETFs in India are able to perfectly track the daily returns of their underlying indices and experience insignificant tracking errors.
- ETFs in India are effective in replicating the returns of their underlying indices, and do not experience significant net under-performance or out-performance over half yearly intervals.
- Indian ETF market is efficient in terms of pricing, i.e. no significant premium or discount exists, and if it does, it disappears within a day and does not persist for long.

6. Research Methodology

6.1. Performance of ETFs

The performance of an ETF is analyzed in terms of whether it has been able to achieve its investment objective of tracking or replicating the returns of its underlying benchmark index. The present study uses the methodology adopted by Frino and Gallagher (2002), Gallagher and Segara (2004) and Rompotis (2006). In particular, it uses the following performance measures, each of which analyses a different aspect of ETF performance.

6.1.1. Regression Analysis

The study uses the well known market model by regressing the daily returns of the ETF portfolio on the returns of the underlying market index. The beta estimate of this regression is used as an indicator of the portfolio replication strategy adopted by the ETF manager. A beta equal to unity reflects a full replication strategy, which implies that the fund invests in all the components of the underlying index in the same weightage as represented by the index.

6.1.2. Tracking Error Estimation

An important criterion for assessing a passive fund manager's performance is through an estimation of 'tracking error', which quantifies the difference in returns of the fund and its underlying index. The study uses two different measures of tracking error (TE). These are:

- the average of the absolute difference in returns between the fund and the index,
- the standard deviation of the return difference between the fund and the index, and

6.1.3. Performance Effectiveness

The study then measures the performance effectiveness (or bias), i.e. the net under-performance or out-performance of ETFs over a period of time, using the following measures:

- the average of the arithmetic difference in returns between the fund and the index,
- the alpha coefficient of regression of fund returns on underlying index returns, and

6.2. Trading Characteristics of ETFs

In order to analyze the trading characteristics of ETFs, the study firstly tests their pricing efficiency, i.e. whether they experience significant premiums or discounts during any given day, and how much time does it take for such premium/discount (if any) to disappear. Towards this purpose the study quantifies the daily deviations between ETF's trading price and NAV (Net Asset Value) in rupee as well as percentage terms, and reports their frequency distribution. The persistence of such deviations is then examined using a regression model whereby the rupee deviation on a day is regressed over its one-day lagged variable. A significant beta here indicates persistence of premium or discount over one day and in such case more lags are included until the beta of last lag becomes insignificant. The study also provides a trading profile of ETFs to analyze other trading characteristics of ETFs, such as their average daily trading turnover.

7. Data and Period of Study

Our study analyses all the equity and gold ETFs that are listed on NSE and started trading before 1st Jan 2009. In all we analyze 12 ETFs comprising of 7 equity and 5 gold ETFs. The time period under the study extends from January 2002 to December 2009. Each ETF has been analyzed over a time period beginning from the first full calendar year of its trading till 31st December 2009. The final sample of selected ETFs, along with their respective time periods under the study is presented below in Table 1. We use daily data in respect of the ETF's closing price and NAV as well as the closing values of the underlying indices.

ETF	Index Tracked	Date of Listing	Period under Study
NIFTYBEES	S&P CNX Nifty	8-Jan-2002	8Jan 02 - 31Dec 09
JUNIORBEES	CNX Nifty Junior	6-Mar-2003	1Jan 06 - 31Dec 09
BANKBEES	Bank Nifty	4-Jun-2004	1Jan 07 - 31Dec 09
GOLDBEES	Gold Prices	19-Mar-2007	1Jan 08 - 31Dec 09
GOLDSHARE	Gold Prices	17-Apr-2007	1Jan 08 - 31Dec 09
KOTAKGOLD	Gold Prices	8-Aug-2007	1Jan 08 - 31Dec 09
PSUBNKBEES	CNX PSU Bank	1-Nov-2007	1Jan 08 - 31Dec 09
KOTAKPSUBK	CNX PSU Bank	16-Nov-2007	1Jan 08 - 31Dec 09
RELGOLD	Gold Prices	26-Nov-2007	1Jan 08 - 31Dec 09
QGOLDHALF	Gold Prices	28-Feb-2008	1Jan 09 - 31Dec 09
RELBANK	CNX Bank Nifty	27-Jun-2008	1Jan 09 - 31Dec 09
QNIFTY	S&P CNX Nifty	18-Jul-2008	1Jan 09 - 31Dec 09

Table 1: ETFs selected for the study

8. Empirical Findings

8.1. Performance

Table 2 presents the results of the return regression of all the ETFs in terms of alpha, beta and R-square values using NAV based ETF returns. Though the study uses price based returns as well, they are not reported since NAV based ETF returns seem to be more appropriate for examining the replication strategy adopted by the ETF managers.

ETF	Index	Period		Alpha	Beta	R ² (adj)
Niftybees	S&P CNX Nifty	2002-09	Coefficient	0.00	1.00	0.99
			Prob-value	0.95	0.00	0.00
Juniorbees	CNX Nifty Junior	2006-09	Coefficient	0.00	1.00	0.99
			Prob-value	0.37	0.00	0.00
Bankbees	Bank Nifty	2007-09	Coefficient	0.00	0.99	1.00
			Prob-value	0.90	0.00	0.00
Goldbees	Gold Prices	2008-09	Coefficient	-0.01	1.09	0.88
			Prob-value	0.14	0.00	0.00
Goldshare	Gold Prices	2008-09	Coefficient	-0.01	1.09	0.88
			Prob-value	0.11	0.00	0.00
Kotakgold	Gold Prices	2008-09	Coefficient	-0.01	1.09	0.89
			Prob-value	0.13	0.00	0.00
Psubankbees	CNX PSU Bank	2008-09	Coefficient	0.00	0.98	1.00
			Prob-value	0.98	0.00	0.00
Relgold	Gold Prices	2008-09	Coefficient	-0.01	1.09	0.89
			Prob-value	0.02	0.00	0.00
Kotakpsubk	CNX PSU Bank	2008-09	Coefficient	0.01	1.00	1.00
			Prob-value	0.04	0.00	0.00
Qgoldhalf	Gold Prices	2009	Coefficient	-0.01	1.05	0.89
			Prob-value	0.14	0.00	0.00
Relbank	Bank Nifty	2009	Coefficient	0.01	0.99	1.00
			Prob-value	0.04	0.00	0.00
Qnifty	S&P CNX Nifty	2009	Coefficient	0.00	0.99	1.00
			Prob-value	0.57	0.00	0.00

Table 2: Results of ETF Return Regression

It can be observed from the table, that the beta coefficients of all the equity ETFs are statistically significant at any given level of significance and approximately equal unity, which indicates that the portfolio holdings of these funds move closely in line with the index portfolio stocks (as promised), and almost full replication strategy is being adopted by the ETF managers. For the gold ETFs, the beta coefficients are found to be slightly higher than unity indicating more aggressive management strategy and greater sensitivity of such ETFs returns to index movements. Moreover, the high values of R-square firstly confirm the high adequacy of the applied regression, and secondly the minor gap in index replication in NAV terms.

Table 3 reports the measure of tracking ability of ETFs in terms of TE₁ (i.e. mean absolute difference in returns of ETF and its underlying index) and TE₂ (i.e. standard deviation of the return difference between the fund and the index). It also reports the effectiveness of ETFs in terms of the average of the arithmetic difference in returns between the fund and the index, along with a number of other descriptive statistics. Since these measures are more important from investor's point of view, price based returns are used here.

ETF Name	Period	Absolute difference in returns				Arithmetic difference in returns				
		Mean(TE ₁)	p-val.	Min.	Max.	Mean	S.D(TE ₂)	p-val.	Min.	Max.
Niftybees	1 st Half,2002	0.38	0.00	0.00	1.51	0.00	0.50	0.93	-1.51	1.34
	2 nd Half,2002	0.36	0.00	0.00	1.31	0.01	0.46	0.77	-1.10	1.31
	1 st Half,2003	0.29	0.00	0.00	1.25	-0.01	0.39	0.85	-1.06	1.25
	2 nd Half,2003	0.72	0.00	0.03	2.67	0.00	0.90	0.95	-2.67	2.67
	1 st Half,2004	1.04	0.00	0.01	5.42	0.01	1.40	0.94	-5.42	4.38
	2 nd Half,2004	0.64	0.00	0.01	2.72	0.00	0.84	1.00	-2.72	2.11
	1 st Half,2005	0.61	0.00	0.00	3.40	-0.01	0.82	0.91	-3.03	3.40
	2 nd Half,2005	0.75	0.00	0.00	3.93	0.01	1.01	0.87	-3.93	3.53
	1 st Half,2006	0.81	0.00	0.01	6.10	0.00	1.27	1.00	-5.09	6.10
	2 nd Half,2006	0.49	0.00	0.01	4.34	0.01	0.71	0.84	-3.20	4.34
	1 st Half,2007	0.43	0.00	0.00	1.71	-0.02	0.54	0.74	-1.71	1.13
	2 nd Half,2007	0.36	0.00	0.00	1.61	0.00	0.48	0.94	-1.48	1.61
	1 st Half,2008	0.43	0.00	0.00	2.06	0.00	0.60	0.96	-1.99	2.06

	2 nd Half,2008	0.41	0.00	0.01	2.78	-0.01	0.63	0.82	-2.72	2.78
	1 st Half,2009	0.41	0.00	0.01	3.12	0.00	0.60	0.93	-3.12	1.66
	2 nd Half,2009	0.25	0.00	0.00	1.25	-0.01	0.32	0.72	-1.25	0.79
	All	0.53	0.00	0.00	6.10	0.00	0.78	0.99	-5.42	6.10
Juniorbees										
	1 st Half,2006	1.23	0.00	0.01	5.78	0.01	1.65	0.97	-4.54	5.78
	2 nd Half,2006	0.84	0.00	0.01	4.20	0.00	1.11	0.97	-4.20	2.80
	1 st Half,2007	0.76	0.00	0.03	2.84	0.00	0.94	0.98	-2.14	2.84
	2 nd Half,2007	0.72	0.00	0.01	3.40	0.00	0.95	0.99	-2.96	3.40
	1 st Half,2008	0.82	0.00	0.01	11.03	0.00	1.65	0.99	-10.77	11.03
	2 nd Half,2008	0.76	0.00	0.00	10.68	0.01	1.47	0.96	-8.61	10.68
	1 st Half,2009	0.81	0.00	0.02	5.89	0.01	1.29	0.92	-5.89	5.57
	2 nd Half,2009	0.67	0.00	0.00	2.03	-0.03	0.87	0.74	-2.01	2.03
	All	0.82	0.00	0.00	11.03	0.00	1.27	1.00	-10.77	11.03
Bankbees										
	1 st Half,2007	1.12	0.00	0.02	2.91	0.01	1.40	0.96	-2.91	2.91
	2 nd Half,2007	0.85	0.00	0.02	6.35	0.00	1.27	1.00	-6.35	6.09
	1 st Half,2008	1.14	0.00	0.01	7.02	0.00	1.66	0.99	-7.02	5.81
	2 nd Half,2008	1.18	0.00	0.01	8.31	0.01	1.64	0.97	-5.14	8.31
	1 st Half,2009	0.81	0.00	0.01	2.29	0.00	0.98	0.99	-2.05	2.29
	2 nd Half,2009	0.75	0.00	0.00	2.89	-0.02	0.96	0.81	-2.89	2.29
	All	0.97	0.00	0.00	8.31	0.00	1.34	0.98	-7.02	8.31
Goldbees										
	1 st Half,2008	0.59	0.00	0.00	2.32	0.03	0.72	0.67	-1.53	2.32
	2 nd Half,2008	0.80	0.00	0.01	4.20	-0.03	1.11	0.76	-3.52	4.20
	1 st Half,2009	0.42	0.00	0.00	2.83	0.01	0.62	0.89	-2.77	2.83
	2 nd Half,2009	0.26	0.00	0.00	1.49	0.00	0.38	0.96	-1.49	1.39
	All	0.52	0.00	0.00	4.20	0.00	0.75	0.99	-3.52	4.20

ETF Name	Period	Absolute difference in returns				Arithmetic difference in returns				
		Mean(TE ₁)	p-val	Min.	Max.	Mean	S.D(TE ₂)	p-val	Min.	Max.
Goldshare	1 st Half,2008	0.73	0.00	0.01	4.06	0.02	1.03	0.82	-4.00	4.06
	2 nd Half,2008	0.77	0.00	0.00	4.16	-0.03	1.11	0.76	-4.16	3.48
	1 st Half,2009	0.50	0.00	0.01	3.40	0.01	0.73	0.88	-3.40	3.35
	2 nd Half,2009	0.33	0.00	0.00	1.39	0.00	0.44	0.95	-1.39	1.25
	All	0.59	0.00	0.00	4.16	0.00	0.87	0.99	-4.16	4.06
Kotakgold	1 st Half,2008	0.60	0.00	0.00	2.35	0.01	0.76	0.84	-2.06	2.35
	2 nd Half,2008	0.84	0.00	0.00	5.46	-0.02	1.24	0.83	-3.90	5.46
	1 st Half,2009	0.57	0.00	0.00	3.61	0.01	0.81	0.92	-3.61	3.58
	2 nd Half,2009	0.31	0.00	0.00	1.49	-0.01	0.41	0.88	-1.49	1.19
	All	0.58	0.00	0.00	5.46	0.00	0.85	0.95	-3.90	5.46
Psubankbees	1 st Half,2008	1.22	0.00	0.01	5.57	0.04	1.60	0.76	-5.57	5.45
	2 nd Half,2008	1.93	0.00	0.01	8.09	-0.01	2.61	0.96	-6.62	8.09
	1 st Half,2009	1.44	0.00	0.01	11.64	-0.02	2.28	0.94	-9.61	11.64
	2 nd Half,2009	0.88	0.00	0.00	3.18	-0.02	1.14	0.86	-3.18	2.89

	All	1.36	0.00	0.00	11.64	0.00	1.97	1.00	-9.61	11.64
Relgold	1 st Half,2008	0.74	0.00	0.03	3.96	0.03	1.02	0.78	-3.51	3.96
	2 nd Half,2008	0.82	0.00	0.00	4.32	-0.05	1.15	0.65	-3.38	4.32
	1 st Half,2009	0.49	0.00	0.00	2.25	0.01	0.67	0.89	-2.25	1.79
	2 nd Half,2009	0.34	0.00	0.01	1.59	0.00	0.45	0.94	-1.52	1.59
	All	0.60	0.00	0.00	4.32	0.00	0.87	0.91	-3.51	4.32
Kotakpsbk	1 st Half,2008	1.94	0.00	0.00	14.44	0.07	2.70	0.77	-14.44	8.20
	2 nd Half,2008	2.44	0.00	0.07	8.72	0.00	3.13	0.99	-8.49	8.72
	1 st Half,2009	3.06	0.00	0.00	16.36	0.04	4.48	0.93	-16.36	15.11
	2 nd Half,2009	1.42	0.00	0.00	9.20	0.01	1.96	0.96	-6.64	9.20
	All	2.17	0.00	0.00	16.36	0.03	3.12	0.84	-16.36	15.11
Qgoldhalf	1 st Half,2009	0.57	0.00	0.00	2.36	0.01	0.75	0.85	-2.28	2.36
	2 nd Half,2009	0.34	0.00	0.00	1.62	-0.01	0.46	0.85	-1.62	1.17
	All	0.45	0.00	0.00	2.36	0.00	0.62	0.96	-2.28	2.36
Relbank	1 st Half,2009	2.79	0.00	0.05	10.46	0.01	3.65	0.97	-10.46	9.86
	2 nd Half,2009	1.40	0.00	0.02	9.13	0.02	1.99	0.89	-5.84	9.13
	All	2.07	0.00	0.02	10.46	0.02	2.90	0.92	-10.46	9.86
Qnifty	1 st Half,2009	1.58	0.00	0.01	7.03	0.03	2.09	0.88	-5.90	7.03
	2 nd Half,2009	0.67	0.00	0.00	2.90	-0.01	0.88	0.90	-2.62	2.90
	All	1.09	0.00	0.00	7.03	0.01	1.57	0.93	-5.90	7.03

Table 3: Tracking Errors(TE) and Effectiveness of ETFs

On examination of TE_1 , the magnitude of average daily tracking error ranges from 0.25% to 3.06% across all ETFs over half yearly intervals, which seems to be quite substantial and are found to be statistically significant at all levels. As shown by the table, the second measure of tracking error (TE_2), which measures the variability in daily return differences are even higher than TE_1 for all the ETFs over the entire study period. These facts indicate the presence of market frictions which are preventing the ETFs in India from perfectly replicating the daily returns of their underlying indices.

After finding evidence of significant daily tracking errors in the Indian ETFs, we now examine the effectiveness or bias in the performance of such funds over a period of time. It can be observed from table that the mean arithmetic difference in returns between ETFs and their underlying indices over half-yearly intervals are negligible, and are not statistically significant based on standard t-test (since p-values are high). Though the daily return difference are high and volatile (as evident from the range between minimum and maximum values as well as the high standard deviations), there is no significant bias in performance (i.e. no net under-performance or out-performance) over a period of six months as well as for the overall period for any of the ETFs. For the overall sample period, the absence of any significant performance bias is also confirmed by the regression analysis, whereby the alpha coefficients are found to be close to zero, indicating the absence of any excess returns for the ETFs. An implication of these findings is that ETF investors with a long term investment horizon can achieve investment returns that are similar to the underlying index returns.

8.2. Trading Characteristics

Table 4 report the frequency distribution of the difference between price and NAV of ETFs and the in percentage terms. The tables show that on average, price lies below NAV for nine out of twelve ETFs analyzed. The mean percentage difference between price and NAV ranges from -0.97% to 0.23% for all the ETFs (except Relbank), and equals -5.28% for Relbank.

ETFs →	Niftybees		Juniorbees		Bankbees		Goldbees		Goldshare		Kotakgold	
	Freq.	Prop. of obs.	Freq.	Prop. of obs.	Freq.	Prop. of obs.	Freq.	Prop. of obs.	Freq.	Prop. of obs.	Freq.	Prop. of obs.
<= -4.0	0	0.00	0	0.00	0	0.00	6	1.24	10	2.06	4	0.84
-4.0 to -3.5	0	0.00	1	0.10	0	0.00	3	0.62	4	0.82	3	0.63
-3.5 to -3.0	0	0.00	0	0.00	1	0.14	5	1.03	6	1.24	5	1.05
-3.0 to -2.5	1	0.05	0	0.00	0	0.00	8	1.65	15	3.09	18	3.77
-2.5 to -2.0	7	0.35	3	0.31	4	0.57	16	3.30	22	4.54	20	4.18
-2.0 to -1.5	19	0.96	8	0.84	14	1.98	23	4.74	33	6.80	26	5.44
-1.5 to -1.0	60	3.04	31	3.24	42	5.95	29	5.98	32	6.60	39	8.16
-1.0 to -0.5	399	20.19	106	11.06	132	18.70	38	7.84	45	9.28	44	9.21
-0.5 to 0	703	35.58	224	23.38	106	15.01	96	19.79	75	15.46	111	23.22
0 to 0.5	558	28.24	267	27.87	128	18.13	153	31.55	115	23.71	133	27.82
0.5 to 1.0	180	9.11	216	22.55	159	22.52	65	13.40	74	15.26	45	9.41
1.0 to 1.5	23	1.16	59	6.16	80	11.33	21	4.33	26	5.36	15	3.14
1.5 to 2.0	11	0.56	19	1.98	19	2.69	11	2.27	9	1.86	4	0.84
2.0 to 2.5	7	0.35	14	1.46	9	1.27	2	0.41	8	1.65	3	0.63
2.5 to 3.0	2	0.10	2	0.21	5	0.71	1	0.21	2	0.41	3	0.63
3.0 to 3.5	1	0.05	3	0.31	4	0.57	1	0.21	1	0.21	2	0.42
3.5 to 4.0	1	0.05	0	0.00	0	0.00	4	0.82	1	0.21	0	0.00
>4.0	3	0.15	5	0.52	3	0.42	3	0.62	7	1.44	3	0.63
Total	1975	100	958	100	706	100	485	100	485	100	478	100
Mean		-0.11		0.23		0.18		-0.15		-0.25		-0.35
Median		-0.13		0.21		0.25		0.04		0.00		-0.12
Maximum		6.32		15.89		5.57		7.01		7.02		6.74
Minimum		-2.73		-3.73		-3.09		-6.72		-6.96		-6.69
Std. Dev.		0.63		0.95		0.96		1.31		1.55		1.27

ETFs →	Psubankbees		Relgold		Kotakpsubk		Qgoldhalf		Relbank		Qnifty	
	Freq.	Prop. of obs.	Freq.	Prop. of obs.	Freq.	Prop. of obs.	Freq.	Prop. of obs.	Freq.	Prop. of obs.	Freq.	Prop. of obs.
<= -4.0	1	0.21	4	0.83	16	3.53	0	0.00	164	68.33	9	3.83
-4.0 to -3.5	1	0.21	4	0.83	4	0.88	3	1.24	6	2.50	6	2.55
-3.5 to -3.0	5	1.05	7	1.45	8	1.77	3	1.24	5	2.08	4	1.70
-3.0 to -2.5	3	0.63	10	2.07	10	2.21	10	4.15	15	6.25	7	2.98
-2.5 to -2.0	11	2.31	27	5.58	19	4.19	9	3.73	6	2.50	8	3.40
-2.0 to -1.5	19	3.98	18	3.72	36	7.95	13	5.39	3	1.25	22	9.36
-1.5 to -1.0	37	7.76	36	7.44	50	11.04	13	5.39	4	1.67	36	15.32
-1.0 to -0.5	69	14.47	55	11.36	58	12.80	12	4.98	7	2.92	48	20.43
-0.5 to 0	64	13.42	102	21.07	47	10.38	61	25.31	4	1.67	48	20.43
0 to 0.5	75	15.72	100	20.66	48	10.60	77	31.95	3	1.25	30	12.77
0.5 to 1.0	87	18.24	49	10.12	52	11.48	38	15.77	3	1.25	8	3.40
1.0 to 1.5	46	9.64	26	5.37	34	7.51	1	0.41	3	1.25	4	1.70
1.5 to 2.0	26	5.45	17	3.51	24	5.30	1	0.41	3	1.25	2	0.85

2.0 to 2.5	12	2.52	8	1.65	14	3.09	0	0.00	2	0.83	3	1.28
2.5 to 3.0	8	1.68	6	1.24	6	1.32	0	0.00	0	0.00	0	0.00
3.0 to 3.5	5	1.05	4	0.83	7	1.55	0	0.00	1	0.42	0	0.00
3.5 to 4.0	1	0.21	0	0.00	2	0.44	0	0.00	1	0.42	0	0.00
>4.0	7	1.47	11	2.27	18	3.97	0	0.00	10	4.17	0	0.00
Total	477	100	484	100	453	100	241	100	240	100	235	100
Mean		0.18		-0.10		-0.10		-0.33		-5.28		-0.97
Median		0.20		-0.12		-0.21		-0.02		-6.14		-0.81
Maximum		8.06		9.51		15.69		1.82		15.80		2.39
Minimum		-7.87		-6.34		-10.66		-3.70		-17.96		-7.79
Std. Dev.		1.44		1.62		2.28		1.04		4.50		1.46

Table 4: Frequency distribution of percentage difference between price and NAV of ETFs

While the mean deviations between price and NAV are quite high, there exists still higher variability in the deviations within each ETF. For nine out of twelve ETFs analyzed in this study, more than 10% of the time, the percentage difference lies above 2%. For the other three ETFs it lies above 2% for less than 4% cases. However, for Relbank, such deviations exceed 2% in approximately 87% cases. When compared to the Australian ETFs (Gallagher and Segara (2004)) and the US ETF named Spiders (Elton et al. (2002)), none of them experienced deviations above 2% on any day. This comparison clearly reveals greater pricing inefficiency of the Indian ETF market.

An issue that needs to be examined further is whether there is persistence or lack of it in such deviations. Table 5 reports the results of regression model employed to test the persistence in price deviations. It shows the slope of regression coefficients (β) to be significant upto three lags for most of the ETFs, indicating the persistence of price deviations upto three days for Indian ETFs. These findings are again in contrast with the US and Australian findings which documents that not only the deviations between price and NAV of ETFs are small, but also disappears within a day due to the effective arbitrage mechanism facilitated by ETF's unique trading system.

ETF Name	Variable	Intercept (α)	D_{t-1}	D_{t-2}	D_{t-3}	D_{t-4}	Adj R^2	Persistence
Niftybees	Coefficient	-0.16	0.21	0.15	0.06		0.09	3 days
	Prob-value	0.00	0.00	0.00	0.01			
Juniobees	Coefficient	0.13	0.17	0.07			0.04	2 days
	Prob-value	0.00	0.00	0.03				
Bankbees	Coefficient	0.72	0.14	-0.02	0.24	0.12	0.11	4 days
	Prob-value	0.01	0.00	0.58	0.00	0.00		
Goldbees	Coefficient	-0.30	0.53	0.13	0.18		0.61	3 days
	Prob-value	0.54	0.00	0.01	0.00			
Goldshare	Coefficient	-0.44	0.57	0.14	0.15		0.64	3 days
	Prob-value	0.43	0.00	0.01	0.00			
Kotakgold	Coefficient	-0.79	0.52	0.14	0.18		0.59	3 days
	Prob-value	0.14	0.00	0.01	0.00			
Psubankbees	Coefficient	0.31	0.14	-0.15	0.10		0.04	3 days
	Prob-value	0.04	0.00	0.00	0.03			
Relgold	Coefficient	-0.23	0.65	0.12	0.10		0.69	3 days
	Prob-value	0.66	0.00	0.03	0.02			
Kotakpsbk	Coefficient	-0.27	0.03				0.00	Nil
	Prob-value	0.27	0.57					
Qgoldhalf	Coefficient	-0.19	0.39	0.22	0.12	0.14	0.61	2-4 days
	Prob-value	0.55	0.00	0.00	0.08	0.03		
Relbank	Coefficient	-5.24	0.70	0.17			0.72	2 days
	Prob-value	0.00	0.00	0.01				
Qnifty	Coefficient	-2.11	0.33	0.14	-0.06		0.15	2 days
	Prob-value	0.00	0.00	0.04	0.37			

Table 5: Persistence of premium/ discount in ETFs ($D_t = \alpha + \beta_1 D_{t-1} + \beta_2 D_{t-2} + \dots$)

The findings of this study thus highlight the pricing inefficiency of the Indian ETFs market, where not only significant pricing deviations exist but they also persist over a number of days. This clearly indicates the presence of ample arbitrage opportunities in the Indian ETFs market which have not yet been fully exploited by the market players.

Finally, we analyze the trading activity in the Indian ETF market in terms of average daily turnover as a percentage of fund's AUM and find that over most time intervals, less than 1% of the outstanding shares have been traded on each day. This indicates the low level of trading activity in the Indian ETF market which might be one of the possible reasons for the presence of and persistence in pricing inefficiency of ETFs in India.

9. Summary and Conclusion

This study examines the performance and trading characteristics of Exchange Traded Funds (ETFs) in India and reports a number of important results. Firstly, an evaluation of the performance of ETF managers in terms of the replication strategy adopted by them reveal that, most of them have been able to achieve their stated objective of nearly replicating the underlying index composition. Secondly, the study shows that Indian ETFs do exhibit significant daily tracking error in their performance which reflects the difficulties facing fund managers in exactly replicating the daily performance of frictionless indices. However, there is little evidence of the bias in fund performance over half yearly intervals. This implies that investors who engage the services of ETF managers with long term investment horizons ultimately achieve returns that are commensurate with those of their target index.

Finally, an analysis of trading characteristics of ETFs provides evidence of significant premiums and discounts, which persist over a number of days indicating gross pricing inefficiency and the presence of unexploited arbitrage opportunities in the Indian ETF market. Moreover, there is also evidence of low daily trading activity in such funds indicating the shallowness of Indian ETF market which could possibly be due to lack of investor awareness about this relatively new investment product available to them. This represents an important area for further research, as a means of better understanding the factors responsible for this.

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