A Cross-Country Analysis of Pricing Efficiency of Exchange Traded Funds

Abstract

This study empirically compares the pricing efficiency of Exchange Traded Funds (ETFs) across countries in terms of the deviations of trading price from Net Asset Value (NAV) as well as the persistence of such deviations. A sample of seventeen ETFs tracking popular equity indices of five dominant countries namely U.S., U.K., Japan, Australia and India have been analyzed in this study over a period ranging from 1st April 2000 to 31st March 2012. We find evidence of varying level of pricing efficiency across countries whereby the U.S. ETFs emerges to be the most price-efficient, with minimum daily deviations between price and NAV averaging less than 0.15% which disappears within a day due to effective arbitrage mechanism. Indian ETFs on the other hand are found to be the most price-inefficient, experiencing not only exceptionally high daily deviations averaging from 0.52% to 1.40% but also persist for three days for most ETFs. These findings indicate 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 compares the pricing efficiency of Exchange Traded Funds across countries and this is the first such attempt in this direction.

Keywords: *Exchange Traded Funds, Persistence, Pricing Efficiency, Premiums and Discounts, Trading Activity.*

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1. Introduction

One of the most innovative, new investment vehicles that have emerged in the financial markets over the last two decades is 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 stock exchange like an ordinary corporate stock. ETFs are hybrid investment instruments combining the advantages of both open-end mutual funds and closed-end funds. They combine the creation and redemption process of the former with the continuous stock market tradability of the latter. This is made possible by the unique trading mechanism of ETFs characterized by a dual structure, with a primary market open to institutional investors (known as Fund Authorized Participants or APs) and a secondary market open to all investors. In the primary market, "in-kind" creation and redemption of ETF shares takes place in lots (called creation units) directly from the fund in return for a pre-specified stock basket consisting of shares comprising the underlying stock index in the same weightage as represented in the index. Whereas in the secondary market, such ETF shares created in the primary market can be bought and sold in cash on real time basis, with no limitation on order size, can be short sold or bought on margin in the same way like an ordinary corporate stock is traded.

Since an ETF is traded in two markets, it has two prices: the 'NAV' of the shares, which forms the basis for creation and redemption in the primary market and the 'trading price' of the ETF shares which is determined by the market forces of demand and supply on the stock exchange. If the buying or selling pressure is high these two prices may deviate from each other leading to

significant premium or discount on such funds. However, through the possibility of 'in-kind' creation and redemption, market markers (APs) could absorb any such liquidity shock in the secondary market and arbitrage any significant deviation between price and NAV of ETFs either by redeeming outstanding shares or creating new shares in the primary market. For example, if the market price of ETF falls below its NAV (i.e. ETF is trading at discount in secondary market), APs can buy enough ETFs shares in the secondary market to form a creation unit and at the same time take a short position in the underlying index stocks. The APs can then redeem the ETF shares for the stock basket and close the short position at a profit (Deville, 2008). This buying pressure on ETF shares and selling pressure on underlying index stocks in the secondary market will thus correct the discounts on ETF shares. A reverse process may apply if an ETF is trading at a premium.

Though theoretically ETFs are expected to trade at prices that closely fit their NAVs, in practice this might not always be the case. There is an emerging literature examining the pricing efficiency of ETFs being traded in different parts of the world. However, most of these studies have concentrated on the U.S markets, with only a few of them focusing on the European, Australian or Asian markets. Also, these researches done on various countries have at times used different methodologies and no empirical study has yet compared the pricing efficiency of ETFs across countries using uniform performance criterion. This gap in literature provides rationale for the present study which makes a cross-country comparison of pricing efficiency of ETFs. More specifically, the study examines the presence as well as the persistence of premiums and discounts on ETFs traded in five dominant countries including India. The remainder of this paper is organized as follows. Section 2 offers a brief review of literature on the pricing efficiency of ETFs being traded in different parts of the world. The data and methodology are described in

Section 3. Section 4 presents the empirical findings of the study. Section 5 summarizes and concludes the paper.

2. Literature Review

In this section we review the literature on the pricing efficiency of Exchange Traded Funds being traded around the globe.

Ackert and Tian (2000) studies the pricing efficiency of SPDRs (the first official ETF in the world) and examines the impact of arbitrage costs on the pricing of these instruments. They find that SPDRs do not trade at economically significant discounts and also the SPDRs and MidCap SPDRs returns are not excessively volatile. The study however reports a larger, economically significant discount for MidCap SPDRs which are likely due to their higher arbitrage costs.

Elton et al (2002) examines the pricing efficiency and volume determinants of SPDR over the period 1993-1998. They find that on average price lies below NAV by 1.4 cents or 0.018%. Moreover, these 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.

Gallagher and Segara (2004) examine the trading characteristics of Australian ETFs. They document small dollar and percentage differences in price and NAV that do not persist over time. However, an analysis of the trading profile of ETFs reveals lack of trading activity for ETFs in Australia, since it was found to be below 0.5% of the outstanding shares over most of the time periods analyzed.

Lin, Chan and Hsu (2006) investigate the pricing efficiency of TTT, Taiwan's first ETF. The findings of the study suggest that the TTT sells at a premium, though at 0.041% the premium is not statistically significant. The authors conclude that the TTT is price efficient.

Engle and Sarkar (2006) examine the pricing efficiency of both domestic and international ETFs. They report smaller premiums and discounts for the domestic ETFs which last only several minutes. For international ETFs, they find much larger and more persistent deviations, frequently lasting several days.

Rompotis (2006) examine the pricing efficiency of a sample of 30 American ETFs by regressing trading values of ETFs and its NAVs. The author finds that the average premium or discount does not exceed 10 basis points, a fact that indicates efficient execution of arbitrage strategies by institutional investors.

Kayali (2007) investigates the pricing efficiency of Dow Jones Istanbul 20 (DJIST), the first ETF in Turkey. The author documents a statistically significant but small discount on average, which, considering the transaction costs associated with arbitrage, seem to be economically insignificant. Further, the results show that the premium or discount do not persist over time and disappear within two days.

Ackert and Tian (2008) examine the pricing of a sample of 28 U.S and country ETFs in relation to their fundamental values. They find that while the U.S. funds are priced closely to their net asset values, the country funds are not and can exhibit large, positive autocorrelations in fund premium which is related to momentum, illiquidity, and size effects.

Rompotis (2010) examines the deviations between price and NAV of ETFs using a sample of 50 Barclay's iShares from the period 2001–2007. The results indicate that on average, ETFs trade at

a slight daily premium to their NAV in both dollar and percentage terms, amounting to $0.018 and 0.059 per cent respectively which do not persist due to effective arbitrage mechanism and disappears within two successive days.

DeFusco, **Ivanov and Karels (2011)** examine the pricing deviations of the three most liquid Exchange Traded Funds namely, Spider, Diamonds, and Cubes over the period 1999 to 2007. The study finds that the deviation in price of these ETFs is predictable and nonzero. The study attributes the predictability of the pricing deviation to its stationarity. Moreover, the specific price discovery processes of ETFs and their dividend accumulation and distribution are found to be the reasons for the pricing deviation being nonzero.

Singh and Garg (2012) examine the pricing efficiency of ETFs in India by analyzing a sample of twelve ETFs listed on the National Stock Exchange of India over a period 2002 to 2009. The study finds evidence of significant pricing deviations for all the ETFs under study which also persists over a number of days for most ETFs. The study points out gross pricing inefficiencies and unexploited arbitrage opportunities in the Indian ETF market.

3. Data and Research Methodology

Data

The present study analyses the pricing efficiency of all the domestic ETFs that track the popular equity indices of five dominant countries across various continents, namely U.S., U.K., Japan, Australia and India. These indices are the broad-based equity indices which represent the performance of the respective markets. In all we study 11 popular indices and 17 ETFs that track such indices. Each selected ETF has been analyzed over a time period beginning from the first full financial year (1st April- 31st March) of its trading till 31st March 2012. The study uses daily

data in respect of closing trading prices and Net Asset Values (NAVs) of ETFs. For any ETF, the time period for which either its price or NAV was not available has not been included in the study. The time period actually covered under the study extends from 1st April 2000 till 31st March 2012. Moreover, two Indian ETFs namely UTI SUNDER and ICICI SPICE were found to have very poor trading history with more than 40% of daily price data missing over their life. These ETFs have therefore been excluded from the study. The final sample of selected ETFs, along with their respective time periods under the study is presented in Table 1. The study uses several sources for data collection. In particular, the list of all existing ETFs around the world has been taken from ETF Landscape Global Handbook (Q1 2011), Blackrock. The daily trading prices of ETFs have been taken from Google finance and Yahoo finance whereas the daily NAVs of the ETFs have been extracted from the respective fund sites. Finally, the Assets under Management (AUM) and Average Daily Volume (ADV) of selected ETFs for the years 2011 and 2012 have been taken from the ETF Landscape (Q1 2011) and ETF Landscape (2012) respectively.

Research Methodology

For analyzing the pricing efficiency of ETFs, we first examine the extent of deviation of ETFs trading price from NAV, which represents both a cost to investors and an arbitrage opportunity for the market makers. The lesser the extent of such deviation, more efficient would be the pricing of ETFs. To undertake this analysis, we follow the methodology adopted by Gallagher and Segara (2004) and Elton et al (2002). Accordingly, the study reports the frequency distribution and statistical characteristics of the percentage difference between price and NAV of ETFs over their trading history. A positive difference between price and NAV indicates that the ETF trades at premium, whereas the reverse holds true for a discount. A cross-country analysis

of the magnitude of pricing deviations experienced by ETFs has been made by comparing the absolute mean percentage deviations of ETFs as well as the proportion of absolute deviations lying at the extreme ends of the distribution for each ETF.

After examining the presence of deviation of ETFs trading price from NAV, the next issue to be examined is the persistence or lack thereof in these deviations, i.e. whether the premium/discount (if any) disappear within a day, or persists over a number of days. To investigate this issue, a regression model is employed whereby the monetary difference between price and NAV of an ETF at the close of day 't' (D_t) is regressed with a constant (α) and its one day lagged variable (D_{t-1}). This can be expressed as model (1).

$$D_t = \alpha + \beta_1 D_{t-1} \quad \ldots\ldots\ldots\ldots\ldots (1)$$

Here, an insignificant β_1 would indicate no persistence in deviations (as the lagged deviation do not explain present deviation), indicating that the premium/discount disappears within a day. However, if β_1 is found to be significant, it would indicate the persistence of premium/discount, and in such case more lags in the form of $\beta_2 D_{t-2}$, $\beta_3 D_{t-3}$ and so on will be included in model (1), until the beta coefficient of the last lag becomes insignificant. An ETF for which beta coefficients are found to be significant upto 'n' number of lags would indicate the persistence of premium/discount over n number of days. Persistence in price deviation over a long period of time would indicate the inefficiency of arbitrage mechanism in the ETF marketplace. Additionally, in order to examine the trading activity in the ETF market, we report the average daily trading volume as a percentage of fund's Asset under Management (AUM) over the last two years of the study period for each of the selected ETFs.

4. Empirical Findings

The study estimates the magnitude of deviations between price and NAV of ETFs (premium and discount) in monetary terms as well as in percentage terms. The monetary estimates of deviations however are not suitable for comparing the pricing efficiency of various ETFs, firstly due to the different currency denominations and secondly due to difference in the scale of investment (NAV values) for each ETF. Table 2 therefore presents only the frequency distribution and related descriptive statistics of the daily percentage deviations between price and NAV of ETFs (measured as monetary deviations divided by the fund's NAV) for the overall period of study. Among the descriptive statistics of such deviations, the table reports two types of mean. The simple mean quantifies the net premium /discount experienced by an ETF on a daily basis, whereas the absolute mean quantifies the pure deviation between price and NAV of an ETF, irrespective of whether it is a premium or a discount to NAV.

The Table shows that the average absolute daily deviation between price and NAV for the overall period of study ranges from 0.04% to 1.40% across all the selected ETFs. As indicated by the wide range, the magnitude of deviation differs significantly across ETFs and across countries. For instance, U.S ETFs have the lowest average deviations ranging from 0.04% to 0.15%, followed by Japanese ETFs having deviations in the range of 0.14% to 0.16%. U.K and Australian funds comes next with average deviations ranging from 0.19% to 0.34% and 0.14% to 0.67% respectively. Lastly, Indian ETFs emerges to be the one having the highest average daily deviations ranging from 0.52% to 1.40%.

While the mean deviation in price and NAV varies widely across ETFs, there exists even higher variability in the daily deviations around the mean for each of the ETFs as evident from the spread of the frequency distribution, standard deviation and the minimum- maximum range. For

instance, one of the Indian ETFs named KOTSS shows the highest daily deviation averaging 1.40% which ranges from -10.62% to 16.03% over the period of study.

Through Table 3 an attempt is made to briefly summarize the findings of the frequency distribution of percentage deviations in price and NAV of ETFs. Specifically, the table reports the proportion (%) of absolute daily deviations lying in the two extreme ranges namely, the lower range of "Below 0.1%" and the higher range of "Above 1%" for various ETFs over the entire period of study. Moreover, in order to analyze the possible impact of the US sub-prime crisis on the pricing efficiency of various countries' ETFs, the study divides the entire time period into three sub-periods, taking the period of crisis (August 2007 – December 2009) as the basis of division and reports the summary findings of the frequency distribution of deviations over such periods as well. Table 3 also reports the mean absolute deviation for each of the ETFs for the overall period of study and finally provides a ranking of various countries based on the pricing efficiency of their ETFs in terms of the magnitude of deviations experienced by them.

The table shows that for most of the ETFs under study, majority of daily deviations (more than 50%) for the overall period of study lies below 0.1% and only a few deviation (less than 2%) crosses 1%. All the Indian ETFs and one of the Australian ETFs (named SFY) however stands exception to this, as the deviations in these funds are mostly on the higher side.

A sub-period analysis of the daily deviations reveals that in general the magnitude of pricing deviations is decreasing over time (i.e. pricing efficiency is improving) as the proportion of deviations in the 'Below 0.1%' range has been increasing and the proportion of deviations in the 'Above 1%' range has been gradually decreasing over time for majority of the selected ETFs. This indicates that the US sub-prime crisis has no significant impact on the pricing efficiency of

majority of the ETFs except in case of two of the U.S ETFs namely SPY and DIA, which have witnessed considerable increase in the magnitude of deviations between price and NAV during the crisis period, which could possibly be an impact of the crisis.

In terms of the relative performance, U.S ETFs emerges to be the most price efficient, experiencing minimum deviations between price and NAV on most of the trading days. They are followed by the Japanese, U.K and Australian ETFs in that order. Indian ETFs however emerges to be the most price inefficient, having not only the highest mean deviations but also the daily deviations lying above 0.1% on majority of days and even crossing the upper mark of 1% on more than 10% trading days. The worst performance among all the ETFs has been shown by the Indian ETF named KOTSS which has experienced a daily pricing deviation of more than 1% on 46.8% of the trading days over the period of study.

These results in general suggest varying degree of deviations in price and NAV experienced by different ETFs across countries. An issue that needs to be examined further is whether there is persistence or lack of it in such deviations, i.e. whether such premiums/discounts experienced by ETFs on any particular day persist over a number of days or disappears quickly due to the arbitrage mechanism facilitated by the unique trading structure of ETFs.

Table 4 reports the results of regression model employed to test the persistence in such price deviations. The table shows the slope of regression coefficients (β) to be significant upto zero to four lags across various ETFs, indicating the persistence of price deviations upto such number of days. Least amount of persistence is found in case of U.S ETFs where any premium or discount either do not persist or disappear within a day due to the effective arbitrage mechanism facilitated by ETFs unique trading system. This is however not true for other ETF markets

especially the Indian, U.K and Australian markets where deviations were not only high, but persist over a number of days for most ETFs indicating the presence of ample arbitrage opportunities in such ETFs markets which have not yet been fully exploited by the market players.

A possible reason for the existence of such unexploited arbitrage opportunities in the market could be the lack of active participation by the traders in such markets. Table 5 provides a trading profile of the selected ETFs for the last two years of the study period. More specifically, it reports the Assets under Management (AUM) and Average Daily Volume (ADV) in US $ mn for the year 2011 and 2012. Trading activity, defined as the average daily volume as a percentage of fund's AUM has been shown in the last column for the two years.

An analysis of the size of ETFs (in terms of Assets under Management) shows the first official ETF namely SPY of U.S to be the largest ETF with AUM crossing US$100bn by 2012. Other US ETFs also emerges to be the largest among all the ETFs analyzed. Indian ETFs however proves to be the smallest among all the selected ETFs, showing lack of popularity of these instruments among the investors. An analysis of the trading activity shows that, for majority of the ETFs under study, less than 1% of the outstanding shares have been traded each day. U.S ETFs stands exception to this and shows significant trading activity, the highest being for SPY, crossing 10% for both the years. This indicates low level of trading activity in all the selected ETF markets other than U.S, namely India, U.K, Japan and Australia, which seems to be one of the reasons for the presence and persistence in pricing deviations of ETFs in such markets.

5. Summary and Conclusions

Theoretically, ETFs are considered to be price efficient due to their unique dual trading system which ensures that any significant deviation between price and NAV of an ETF is easily arbitrage away by the market players. In this paper we empirically analyze this pricing efficiency of ETFs across five countries by firstly quantifying the deviation between price and NAV of ETFs, and then testing the persistence of such deviations.

As per the findings of the study U.S ETFs emerges to be the most actively traded and price efficient ETFs, experiencing not only very little pricing deviations of below 0.1% on most trading days, but also such deviations do not persist and disappear within a day due to effective arbitrage mechanism in place. The Japanese ETFs also experience a low average daily deviation of around 0.15% which takes one or two days to disappear, possibly due to low trading activity in the ETF market. The U.K and Australian ETFs also have shallow ETF markets and shows a little higher average daily deviation in the range of 0.14% to 0.67% which persists for upto four days for some of the ETFs. Indian ETFs however show an alarming pricing inefficiency with not only very high average daily deviation in the range of 0.5% to 1.4%, but also the persistence of such large deviations for upto three days for most ETFs. This possibly indicates lack of active market participation and consequently the presence of unexploited arbitrage opportunities in the Indian ETF market.

Overall, the study points out exceptionally high pricing inefficiency and unexploited arbitrage opportunities in the Indian ETF market which command immediate attention of the market players. Though the present study does not attempt to quantify the profitability of such arbitrage opportunities, many of the price deviations appear to be too large to be accounted for solely by transaction cost. There is also a need to examine the causes of the lack of trading activity and the

resulting pricing inefficiency in the Indian ETF market, towards which future researches may be focused.

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Appendix

Table 1: ETFs Sample Under Study

INDICES	ETF Name	ETF tickers	Fund House	Exchange Listed on	Listing Date	Study Period
INDIA						
NIFTY	Nifty BeES	**NBEES IN**	Benchmark AM	NSE	8-Jan-02	Apr 02-Mar2012
	Quantum Nifty ETF	**QINDEX IN**	Quantum AM	NSE	18-Jul-08	Apr 09-Mar2012
	Kotak Nifty	**KONIFTY IN**	Kotak Mahindra AM	NSE	11-Feb-10	Apr 10-Mar2012
SENSEX	Kotak Sensex	**KOTSS IN**	Kotak Mahindra AM	BSE	16-Jun-08	Apr 09-Mar2012
U.K.						
FTSE 100	ishares FTSE 100	**ISF LN**	ishares	LSE	28-Apr-00	Apr 03-Mar2012
	Lyxor ETF FTSE 100	**LYUK LN**	Lyxor AM	LSE	9-Nov-09	Apr 10-Mar2012
	dbx-trackers FTSE 100 ETF	**XUKX LN**	dbx-trackers	LSE	7-Sep-07	Apr 08-Mar2012
JAPAN						
NIKKEI 225	Listed index fund 225	**1330 JP**	Nikko AM	TSE	9-Jul-01	Apr 02-Mar2012
TOPIX	Listed index fund Topix	**1308 JP**	Nikko AM	TSE	20-Dec-01	Apr 02-Mar2012
AUSTRALIA						
S&P/ASX 200	SPDR S&P/ASX 200	**STW AU**	SSgA	ASX	27-Aug-01	Apr 02-Mar2012
S&P/ASX 50	SPDR S&P/ASX 50	**SFY AU**	SSgA	ASX	27-Aug-01	Apr 02-Mar2012
S&P/ASX 300	Vanguard Australian Shares Index ETF	**VAS AU**	Vanguard	ASX	6-May-09	Apr 10-Mar2012
U.S.						
S&P 500	ishares S&P 500 Index fund	**IVV US**	ishares	NYSE Arca	15-May-00	Apr 01-Mar2012
	SPDR S&P 500	**SPY US**	SSgA	NYSE Arca	29-Jan-93	Apr 04-Mar2012
	Vanguard S&P 500 ETF	**VOO US**	Vanguard	NYSE Arca	9-Sep-10	Apr 11-Mar2012
NASDAQ	Power shares QQQ trust	**QQQ US**	PowerShares	NASDAQ	10-Mar-99	Apr 00-Mar2012
DOW	SPDR Dow Jones Industrial Average ETF	**DIA US**	SSgA	NYSE Arca	20-Jan-98	Apr 04-Mar2012

Table 2: Frequency Distribution of Percentage Difference between Price and NAV of ETFs (i.e. [(Price-NAV)/NAV]*100)

INDIA								
ETFs →	**NBEES**		**QINDEX**		**KONIFTY**		**KOTSS**	
Difference between price and NAV (%)	***Freq.***	***Proportion of observations***	***Freq.***	***Proportion of observations***	***Freq.***	***Proportion of observations***	***Freq.***	***Proportion of observations***
<= -2.00	12	0.47	50	5.92	4	0.80	113	12.39
-2.00 to -1.00	149	5.89	140	16.59	61	12.15	155	17.00
-1.00 to -0.5	491	19.41	157	18.60	80	15.94	123	13.49
-0.5 to -0.4	129	5.10	45	5.33	20	3.98	20	2.19
-0.4 to -0.3	161	6.37	49	5.81	25	4.98	23	2.52
-0.3 to -0.2	160	6.33	31	3.67	23	4.58	26	2.85
-0.2 to -0.1	161	6.37	43	5.09	23	4.58	31	3.40
-0.1 to 0	186	7.35	34	4.03	36	7.17	35	3.84
0 to 0.1	163	6.45	40	4.74	21	4.18	30	3.29
0.1 to 0.2	178	7.04	36	4.27	24	4.78	16	1.75
0.2 to 0.3	133	5.26	23	2.73	26	5.18	42	4.61
0.3 to 0.4	126	4.98	33	3.91	21	4.18	24	2.63
0.4 to 0.5	124	4.90	27	3.20	24	4.78	20	2.19
0.5 to 1.00	249	9.85	63	7.46	77	15.34	95	10.42
1.00 to 2.00	78	3.08	51	6.04	32	6.37	92	10.09
>= 2.00	29	1.15	22	2.61	5	1.00	67	7.35
Total	**2529**	**100**	**844**	**100**	**502**	**100**	**912**	**100**
Mean (absolute)		0.52		0.94		0.65		1.40
Mean		-0.08		-0.36		-0.04		-0.35
Maximum		11.69		13.82		7.68		16.03
Minimum		-4.79		-9.98		-5.00		-10.62
Std. Dev.		0.77		1.48		0.94		2.13
C.V		-936.65		-408.26		-2315.07		-614.27
Skewness		3.25		0.68		1.95		0.20
Kurtosis		44.06		22.30		21.04		12.34
Jarque-Bera		182092.80		13167.43		7125.82		3321.44
Probability		0.00		0.00		0.00		0.00

	U.K						JAPAN			
ETFs →	**ISF**		**LYUK**		**XUKX**		**1330**		**1308**	
Difference between price and NAV (%)	***Freq.***	***Proportion of observations***	***Freq.***	***Proportion of observations***	***Freq.***	***Proportion of observations***	***Freq.***	***Proportion of observations***	***Freq.***	***Proportion of observations***
<= -2.00	4	0.18	4	0.86	4	0.41	3	0.12	6	0.24
-2.00 to -1.00	2	0.09	12	2.58	4	0.41	8	0.33	18	0.73
-1.00 to -0.5	9	0.40	32	6.88	12	1.22	21	0.86	38	1.55
-0.5 to -0.4	4	0.18	9	1.94	16	1.62	24	0.98	30	1.22
-0.4 to -0.3	9	0.40	33	7.10	25	2.53	66	2.69	80	3.26
-0.3 to -0.2	13	0.57	13	2.80	64	6.48	152	6.20	182	7.42
-0.2 to -0.1	53	2.34	79	16.99	159	16.11	313	12.76	451	18.39
-0.1 to 0	236	10.42	228	49.03	287	29.08	584	23.81	546	22.26
0 to 0.1	280	12.37	26	5.59	213	21.58	667	27.19	535	21.81
0.1 to 0.2	237	10.47	5	1.08	104	10.54	359	14.64	337	13.74
0.2 to 0.3	229	10.11	3	0.65	44	4.46	141	5.75	126	5.14
0.3 to 0.4	246	10.87	3	0.65	21	2.13	60	2.45	58	2.36
0.4 to 0.5	369	16.30	3	0.65	13	1.32	23	0.94	14	0.57
0.5 to 1.00	548	24.20	7	1.51	13	1.32	29	1.18	25	1.02
1.00 to 2.00	24	1.06	6	1.29	4	0.41	3	0.12	6	0.24
>= 2.00	1	0.04	2	0.43	4	0.41	0	0.00	1	0.04
Total	**2264**	**100**	**465**	**100**	**987**	**100**	**2453**	**100**	**2453**	**100**
Mean (absolute)		0.34		0.23		0.19		0.14		0.16
Mean		0.30		-0.13		-0.02		0.00		-0.03
Maximum		2.04		4.13		14.56		1.27		3.19
Minimum		-3.53		-3.05		-6.94		-2.32		-2.90
Std. Dev.		0.31		0.46		0.64		0.22		0.27
C.V		103.89		-353.33		-4068.18		-13963.68		-803.98
Skewness		-1.64		1.15		9.91		-2.00		-2.28
Kurtosis		23.67		28.86		297.05		23.48		37.90
Jarque-Bera		41314.94		13062.15		3572105.00		44497.56		126579.50
Probability		0.00		0.00		0.00		0.00		0.00

AUSTRALIA						
ETFs →	**STW**		**SFY**		**VAS**	
Difference between price and NAV (%)	***Freq.***	***Proportion of observations***	***Freq.***	***Proportion of observations***	***Freq.***	***Proportion of observations***
<= -2.00	2	0.08	172	6.88	0	0.00
-2.00 to -1.00	6	0.24	94	3.76	0	0.00
-1.00 to -0.5	42	1.67	144	5.76	5	0.99
-0.5 to -0.4	26	1.03	65	2.60	3	0.60
-0.4 to -0.3	53	2.11	118	4.72	7	1.39
-0.3 to -0.2	138	5.48	190	7.60	25	4.96
-0.2 to -0.1	288	11.45	307	12.28	49	9.72
-0.1 to 0	788	31.32	353	14.12	102	20.24
0 to 0.1	586	23.29	262	10.48	154	30.56
0.1 to 0.2	330	13.12	269	10.76	80	15.87
0.2 to 0.3	127	5.05	183	7.32	41	8.13
0.3 to 0.4	60	2.38	92	3.68	24	4.76
0.4 to 0.5	28	1.11	62	2.48	7	1.39
0.5 to 1.00	29	1.15	137	5.48	6	1.19
1.00 to 2.00	7	0.28	39	1.56	0	0.00
>= 2.00	6	0.24	13	0.52	1	0.20
Total	**2516**	**100**	**2500**	**100**	**504**	**100**
Mean (absolute)		0.15		0.67		0.14
Mean		0.01		-0.40		0.05
Maximum		5.98		6.15		3.19
Minimum		-3.47		-12.50		-0.62
Std. Dev.		0.30		1.68		0.23
C.V		5513.90		-424.91		499.84
Skewness		5.75		-4.29		5.16
Kurtosis		127.85		25.40		74.54
Jarque-Bera		1647982.00		59919.70		109719.50
Probability		0.00		0.00		0.00

USA										
ETFs →	**IVV**		**SPY**		**VOO**		**QQQ**		**DIA**	
Difference between price and NAV (%)	***Freq.***	***Proportion of observations***	***Freq.***	***Proportion of observations***	***Freq.***	***Proportion of observations***	***Freq.***	***Proportion of observations***	***Freq.***	***Proportion of observations***
<= -2.00	0	0.00	0	0.00	0	0.00	4	0.13	0	0.00
-2.00 to -1.00	1	0.04	6	0.30	0	0.00	23	0.76	5	0.25
-1.00 to -0.5	9	0.33	17	0.84	0	0.00	67	2.22	5	0.25
-0.5 to -0.4	16	0.58	11	0.55	0	0.00	38	1.26	5	0.25
-0.4 to -0.3	37	1.34	19	0.94	0	0.00	67	2.22	23	1.14
-0.3 to -0.2	79	2.86	55	2.73	2	0.79	100	3.31	29	1.44
-0.2 to -0.1	260	9.40	211	10.47	10	3.97	265	8.78	167	8.29
-0.1 to 0	985	35.60	726	36.03	107	42.46	1133	37.54	766	38.01
0 to 0.1	881	31.84	697	34.59	121	48.02	769	25.48	755	37.47
0.1 to 0.2	343	12.40	190	9.43	10	3.97	230	7.62	183	9.08
0.2 to 0.3	106	3.83	45	2.23	1	0.40	117	3.88	40	1.99
0.3 to 0.4	34	1.23	17	0.84	1	0.40	76	2.52	22	1.09
0.4 to 0.5	8	0.29	7	0.35	0	0.00	39	1.29	5	0.25
0.5 to 1.00	6	0.22	13	0.65	0	0.00	66	2.19	6	0.30
1.00 to 2.00	2	0.07	1	0.05	0	0.00	20	0.66	4	0.20
>= 2.00	0	0.00	0	0.00	0	0.00	4	0.13	0	0.00
Total	**2767**	**100**	**2015**	**100**	**252**	**100**	**3018**	**100**	**2015**	**100**
Mean (absolute)		0.09		0.09		0.04		0.15		0.08
Mean		0.00		-0.01		0.01		0.00		0.00
Maximum		1.53		1.01		0.31		2.83		1.27
Minimum		-1.04		-1.61		-0.24		-5.84		-1.81
Std. Dev.		0.14		0.16		0.06		0.31		0.14
C.V		2896.92		-1953.49		557.87		-7395.77		13148.17
Skewness		0.56		-1.32		-0.19		-3.68		-1.21
Kurtosis		17.27		21.49		7.47		83.21		35.86
Jarque-Bera		23625.55		29294.85		211.63		815804.90		91172.71
Probability		0.00		0.00		0.00		0.00		0.00

Table 3: Cross-Country Comparison of Pricing Efficiency of ETFs in Terms of Absolute Percentage Deviation between Price and NAV

ETFs	Overall Mean	Proportion(%) of Absolute Deviations								Ranking
		Below 0.1%				Above 1 %				
		pre-crisis	during crisis	post crisis	Overall	pre-crisis	during crisis	post crisis	Overall	
INDIA										
NBEES	**0.52**	14	15	12	**14**	12	9	9	**11**	
QINDEX	**0.94**	n.a	6	11	**9**	n.a	49	20	**31**	
KONIFTY	**0.65**	n.a	n.a	11	**11**	n.a	n.a	21	**20**	
KOTSS	**1.4**	n.a	6	8	**7**	n.a	56	41	**47**	**V(Worst)**
U.K										
ISF	**0.34**	12	15	52	**23**	0	2	3	**1**	
LYUK	**0.23**	n.a	n.a	55	**55**	n.a	n.a	5	**5**	
XUKX	**0.19**	n.a	40	59	**51**	n.a	4	0	**2**	**III**
JAPAN										
1330	**0.14**	44	42	48	**51**	0	2	1	**1**	
1308	**0.16**	44	54	65	**44**	1	2	1	**1**	**II**
AUSTRALIA										
STW	**0.15**	45	51	81	**55**	1	2	0	**1**	
SFY	**0.67**	15	22	49	**25**	22	4	0	**13**	
VAS	**0.14**	n.a	n.a	51	**51**	n.a	n.a	0	**0**	**IV**
U.S.A										
IVV	**0.09**	57	68	95	**67**	0	0	0	**0**	
SPY	**0.09**	64	55	97	**71**	0	1	0	**0**	
VOO	**0.04**	n.a	n.a	90	**90**	n.a	n.a	0	**0**	
QQQ	**0.15**	50	70	97	**63**	2	0	0	**2**	
DIA	**0.08**	73	59	97	**75**	0	1	0	**0**	**I(Best)**

Table 4: Persistence of premium/ discount in ETFs ($D_t = \alpha + \beta_1 D_{t-1} + \beta_2 D_{t-2} + \ldots$)

Country	ETF	Variable	α	D_{t-1}	D_{t-2}	D_{t-3}	D_{t-4}	D_{t-5}	D_{t-6}	D_{t-7}	Adj R^2	Persistence
INDIA	**NBEES**	Coefficient	-0.08	0.23	0.12	0.08	0.05	0.09			0.15	3 days or more
		p-val	*0.12*	*0.00*	*0.00*	*0.00*	*0.01*	*0.00*				
	QINDEX	Coefficient	-0.54	0.22	0.13	0.15	0.08	0.08			0.21	3 days
		p-val	*0.00*	*0.00*	*0.00*	*0.00*	*0.02*	*0.02*				
	KONIFTY	Coefficient	-0.11	0.40	0.08	0.18					0.29	1 day
		p-val	*0.54*	*0.00*	*0.10*	*0.00*						
	KOTSS	Coefficient	-0.11	0.36	0.14	0.10	0.08	0.04			0.32	2 days or more
		p-val	*0.14*	*0.00*	*0.00*	*0.01*	*0.02*	*0.26*				
U.K	**ISF**	Coefficient	0.23	0.14	0.16	0.14	0.14	0.06	0.10	0.11	0.40	4 days
		p-val	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.01*	*0.00*	*0.00*		
	LYUK	Coefficient	-0.64	0.11							0.01	nil
		p-val	*0.00*	*0.02*								
	XUKX	Coefficient	-0.03	0.14	0.25	0.17	0.02				0.17	3 days
		p-val	*0.75*	*0.00*	*0.00*	*0.00*	*0.45*					
JAPAN	**1330**	Coefficient	-0.17	0.22	0.04						0.05	1 day
		p-val	*0.73*	*0.00*	*0.04*							
	1308	Coefficient	-0.21	0.33	0.14	-0.03					0.16	2 days
		p-val	*0.00*	*0.00*	*0.00*	*0.17*						
AUSTRALIA	**STW**	Coefficient	0.00	0.12	0.07	0.02					0.02	2 days
		p-val	*0.24*	*0.00*	*0.00*	*0.34*						
	SFY	Coefficient	-0.05	0.26	0.09	0.19	0.06	0.04			0.22	4 days
		p-val	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.03*				
	VAS	Coefficient	0.02	0.11							0.01	nil
		p-val	*0.00*	*0.02*								
USA	**IVV**	Coefficient	0.01	0.06	0.05						0.01	1 day
		p-val	*0.08*	*0.00*	*0.01*							
	SPY	Coefficient	-0.01	0.07	-0.03						0.01	1 day
		p-val	*0.03*	*0.00*	*0.13*							
	VOO	Coefficient	0.01	0.06							*0.00*	nil
		p-val	*0.01*	*0.33*								
	QQQ	Coefficient	0.00	-0.04							0.00	nil
		p-val	*0.54*	*0.02*								
	DIA	Coefficient	0.00	-0.04							0.00	nil
		p-val	*0.53*	*0.06*								

Table 5: Trading Profile of ETFs

ETFs	Listing Date	Exchange Listed on	Assets Under Management (US $ mn)		Average Daily Volume (US $ mn)		Trading Activity (ADV/AUM)*100	
			2011	2012	2011	2012	2011	2012
INDIA								
NBEES	8-Jan-02	NSE	125.92	104.80	1.89	0.90	**1.50**	**0.86**
QINDEX	18-Jul-08	NSE	0.31	0.40	0.00	0.00	**0.00**	**0.00**
KONIFTY	11-Feb-10	NSE	5.87	13.40	0.12	0.10	**2.04**	**0.75**
KOTSS	16-Jun-08	BSE	7.74	1.20	0.01	0.00	**0.13**	**0.00**
U.K								
ISF	28-Apr-00	LSE	6049.22	5599.00	52.36	55.40	**0.87**	**0.99**
LYUK	9-Nov-09	LSE	28.05	n.a	0.00	n.a	**0.00**	**n.a**
XUKX	7-Sep-07	LSE	777.23	452.20	2.60	1.90	**0.33**	**0.42**
JAPAN								
1330	9-Jul-01	TSE	3608.21	5726.30	39.58	19.20	**1.10**	**0.34**
1308	20-Dec-01	TSE	3196.38	4555.70	4.32	4.40	**0.14**	**0.10**
AUSTRALIA								
STW	27-Aug-01	ASX	2392.12	2140.60	25.41	9.30	**1.06**	**0.43**
SFY	27-Aug-01	ASX	279.71	247.30	0.59	0.50	**0.21**	**0.20**
VAS	6-May-09	ASX	226.90	270.90	1.58	0.40	**0.70**	**0.15**
U.S.								
IVV	15-May-00	NYSE Arca	28142.72	31766.40	388.03	478.30	**1.38**	**1.51**
SPY	29-Jan-93	NYSE Arca	94778.99	118359.00	20666.30	17115.00	**21.80**	**14.46**
VOO	9-Sep-10	NYSE Arca	909.95	5520.40	21.70	46.40	**2.38**	**0.84**
QQQ	10-Mar-99	NASDAQ	25435.18	34766.40	3586.10	2119.70	**14.10**	**6.10**
DIA	20-Jan-98	NYSE Arca	9841.76	11729.90	924.87	524.70	**9.40**	**4.47**