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Tracking Error and Pricing Efficiency of Exchange Traded Funds: A Systematic Literature Review

Ashima Gaba[1*] and Ravinder Kumar[2]

[1]Research Scholar, Department of Commerce and Business Studies, Jamia Millia Islamia-A Central University, New Delhi.
E-mail: ashimagaba27@gmail.com
[2]Professor, Department of Commerce and Business Studies, Jamia Millia Islamia-A Central University, New Delhi.
E-mail: rkumar4@jmi.ac.in
[*]Corresponding Author

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JEL Classification

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Abstract: Exchange Traded Funds (ETFs) are recently popularized financial instruments. Thus, lack systematic review of previously conducted studies on its two major strands i.e. Tracking Error and Pricing Efficiency. Therefore, this study has been undertaken to synthesize and summarise the findings of existing literature on these subtopics. There by providing concise view of the empirical work conducted over the years. For the purpose of study 57 articles have been reviewed, these articles are specific to the objectives of study and fulfill the quality assessment criteria. Through in-depth study of these articles it becomes comprehensible that ETFs underperform their benchmarks although mixed results have been obtained regarding factors affecting tracking error. Further, in regard to pricing efficiency of ETFs it has been observed that arbitrage opportunity does not last long in developed nations whereas significant persistence was observed in developing nations. It is believed that this systematic literature review (SLR) will be valuable to investors and other market participants specifically arbitrageurs and hedgers. Additionally, it will also pave the way for potential researchers by providing a concise view of available literature.

1. Introduction

ETFs are well diversified and passively managed instruments, designed to track underlying indices consequently providing exposure to various market segments. Primary objective of an ETF is to track its benchmark perfectly which they often fail to do thus leading to tracking error. Tracking error has been a matter of concern for fund managers as well investors from the time of inception of ETFs. Despite of tracking error, ETFs are increasingly gaining attention across the globe as their issuance has exponentially expanded every year since 2000 (Ferri, 2009). One of the reasons behind expanding market is being a hybrid form of investment. Similar as stocks ETFs are traded on exchange thereby

providing trading flexibility, greater transparency and liquidity to an investor. Simultaneously just as mutual funds, ETFs have an underlying Net Asset Value (NAV), are professionally managed and can be created/redeemed in primary market through Asset Management Companies (AMCs).

Along with the twin features of stocks and mutual funds ETFs are also accompanied with the unique feature of creation/redemption process through which they can be bought or sold directly from/to issuers in large lots at their NAV. Due to this distinct feature, ETFs have two prices i.e. market price which is determined as per the demand and supply on exchange and another is its NAV. If the market price of ETF is less than its NAV it is regarded to be trading on discount and if the market price goes above NAV then ETFs are said to be trading at premium. Any difference between these two prices leads to arbitrage opportunity which is exploited by large market players through creation/ redemption process. Investors start buying ETFs units if market price is lower than NAV and starts to sell if market price goes beyond NAV. This simultaneous buying and selling of ETFs units bring these two prices in lieu although this process may take several days.

It has been noted that over the years considerable amount of research has been carried out on Tracking Error and Pricing Efficiency of ETFs. Thus, present study is conducted with the purpose to systematically review and summarize the different viewpoints expressed through existing literature on Tracking Error and Pricing Efficiency of ETFs. Undertaking this study will bridge the research gap and develop sound understanding regarding these aspects of ETFs. This piece of work will enable arbitrageurs and hedgers to make an informed decision and also pave a way for future researchers as they can get access to available literature in a concise manner.

2. Objectives of the Study

ETFs came into existence in 1993 with the introduction of first successful ETF i.e. Standard and Poor Depository Receipts' (SPDRs) since then various studies have been conducted on two major strands of ETFs i.e. Tracking Error and Pricing Efficiency. Thus, in order to obtain the holistic view of the available literature on tracking error and pricing efficiency of ETFs an attempt has been made to synthesise and summarise the findings of prior contributions. The objectives of the present study can thus be described as follows:

- To synthesize and summarise the existing literature on tracking error of ETFs and factors affecting it.
- To extract and summarise the findings of existing literature on pricing efficiency aspect of ETFs.

3. Methodology

SLR is a strategy to review the previously conducted studies of any particular domain. Literature review can be conducted in different manners, for this study narrative review style has been adopted. In order to conduct SLR, researcher is required to adopt a procedure to extract and synthesise data so that the quality review is brought out. Similarly for this SLR, a definite search and filtering criteria along with appropriate quality assessment method has been used for which detailed explanation is provided in the following sections.

3.1. Search Strategy and Filtering Criteria

First step for conducting SLR is to search for literature. To extract literature two sources have been used which includes:

a) Search by means of electronic databases i.e. through Web of Science, Scopus, PRO-QUEST, EBSCOHOST, SSRN, Google Scholar and Research Gate.

b) Backward searching i.e. by referring to the references of already cited papers.

Search for articles through electronic databases was primarily was based on keywords. Initially, "Tracking Error of ETFs" was used as a keyword which resulted into 107 articles. Further, "Pricing Efficiency of ETFs" was used as a keyword which produced 53 articles. All these articles were between the period ranging from January 2000 to January 2020.

Upon obtaining the available literature, second step is to decide which article should be included for analysis and which should be excluded. For including/excluding articles initial screening was done through abstracts whereby those articles that do not surround the defined research objectives, were in language other than English or the ones that were in paid journals have been removed. After initial screen full text review was done to assess the quality of remaining articles which lead to the final selection of 57 relevant studies whereby 36 studies made estimations specifically regarding tracking error and factors affecting tracking error, 17 studies focused only on pricing efficiency of ETFs and remaining 4 studies covered both the aspects of ETFs thus forming a total of 57 studies. Table 1, describes the objective of the study along with the description of the search criteria.

Table 1: Objectives and Search Criteria

Objective	*Time Frame*	*Database/ Search Engine*	*Articles*	*Keywords Searched*	*Studies Included*
Objective-1: To synthesize and orderly arrange the existing literature on tracking error of ETFs and factors affecting it.	Jan 2000-Jan 2020	EBSCOHOST, PRO-QUEST, SSRN, Scopus, Google Scholar	Retrieved 107 articles out of which 36 articles specifically belong to objective 1. Other than this 4 studies are common to objective 1 & 2.	"Tracking Error of ETFs"	Empirical Studies
Objective-2 : To extract and arrange the existing literature on pricing efficiency aspect of ETFs	Jan 2000-Jan 2020	EBSCOHOST, PRO-QUEST, SSRN, Scopus, Google Scholar	Retrieved 54 articles out of which 17 articles specifically belong to objective 2. Other than this 4 studies are common to objective 1 & 2.	"Pricing Efficiency of ETFs"	Empirical Studies

Source: Authors' Own Compilation

Application of the above described search and filtering criteria has led to the final selection of 57 articles to be included in the SLR. A PRISMA chart in Figure 1 describes the step-by-step procedure applied to obtain the articles.

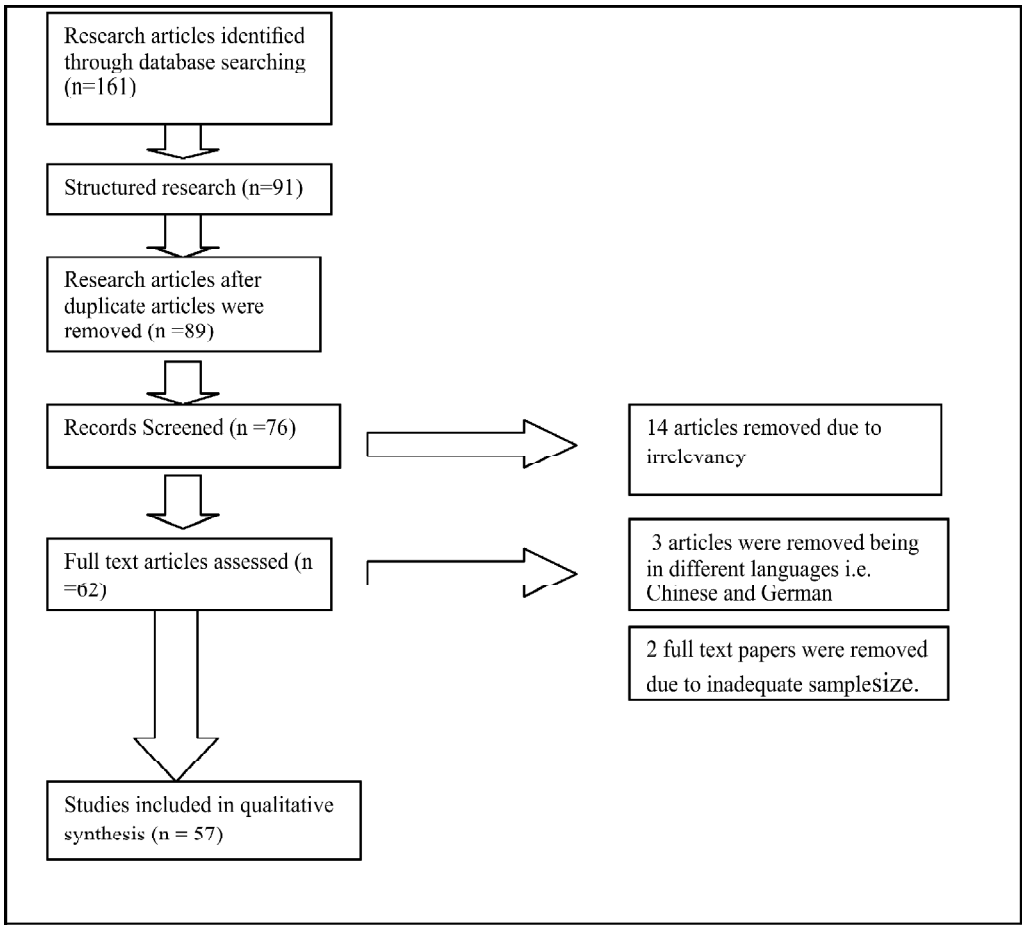

Figure 1: Prisma Flow Chart

Source: Authors' Own Compilation

3.2. Quality Assessment

Along with the full text review, quality of literature review is also assessed on the basis of publishing source. Table 2 provides the number of articles that have been obtained from various databases. Upon looking at Table 2 it becomes clear that these articles majorly belong to Elsevier, Emerald, Taylor & Francis, Sage, and other such publishing houses. Papers in the category of "others" are also a part of peer-reviewed journals. Out of 57 selected studies, all the studies are published except three papers

which belong to the "gray literature these studies are considered for review as they are found to be relevant on the basis of content. Selected papers cover research on two major aspects of ETFs i.e. Tracking Error and Pricing Efficiency. Additionally, it has been believed that the quality of papers is also satisfactory regarding contents.

Table 2: Qualitative Assessment of Selected Literature

Database	*Count*
Elsevier	7
Emerald	6
Sage	2
Taylor & Francis	7
Springer	5
Wiley Online Library	2
EBSCO	5
Pro-Quest	2
SSRN	5
Research Gate	3
Working Paper	1
Conference Papers	1
Dissertations	1
Others*	10
Total	57

Source: Authors' Own Calculation

Note: *Category of others include papers published in Scopus listed journals, DOAJ listed Journals, journals forming part of emerging source citation index or are peer-reviewed

4. Findings and Discussion

4.1. Tracking Error of ETFs

Tracking error can be understood as a proximity measure i.e. how closely an ETF track the pattern of return of its underlying index. It determines if performance of an ETF lags or exceeds its respective benchmark. Over the years number of studies have been undertaken to understand the tracking efficiency of ETFs. On scrutinizing the existing literature, it was observed that among the studies selected for review in 77% of the studies ETFs underperform their underlying benchmarks, 11% of the studies indicated outperformance of ETFs, and 12% of the studies brought out that ETFs perform at par with their benchmarks. Elton *et al.* (2002), Milonas& Rompotis (2006), Shin and Soydemir (2010), Chu (2011), Blitz and Huij (2012), Nazli and Serra (2015), Singh and Kaur (2016), Chen *et al.* (2017), Rompotis (2020) conclusively brought out that ETFs underperform in relation to their benchmarks whereas contrary to these results Wong and Shum (2010), Rompotis (2012) concluded that ETFs are able to

beat the market and thus investors are more inclined to invest in ETFs rather than their benchmarks. Other than these studies, Gallagher and Segara (2006), Harper *et al.* (2006), Pan and Li, (2016) observed that German ETFs, Barclays's shares, and gold ETFs traded in china provided equal average returns in comparison to their benchmarks. Additionally, this underperformance in ETFs was found to be more for emerging markets (Shin and Soydemir, 2010), (Blitz and Huij, 2012). Further, it was observed that leveraged tracker funds and inverse tracker funds exhibit greater underperformance than single equity tracker funds also ETFs with optimized portfolio were found to be performing better than those with full replication strategy (Pan and Li, 2016).

4.2. Factors Affecting Tracking Error of ETFs

Most prominent factors affecting tracking error identified through review of selected studies are as follows:

4.2.1. Expense Ratio and Tracking Error

Expense ratio of an ETF is defined as the annual charges deducted from the fund's investment value. It is calculated by dividing total cost of operating funds by total assets of fund. It has been observed that expense ratio is positively related to tracking error of ETFs i.e. any increase in expense ratio will increase the tracking error of ETFs (Frino and Gallagher, 2001), (Rompotis, 2011), (Chu, 2011), (Drenovak *et al.*, 2014). Although, studies conducted by Elia (2012) and Rompotis (2020) brought out contrasting results whereby expense ratio was found to be negatively related to tracking error of ETFs.

4.2.2. Volume Traded and Tracking Error

Average daily volume traded has been identified as one of the significant factors driving tracking error. Earlier studies as conducted by Rompotis (2012) & Osterhoff and Kaserer (2016) confirmed a positive impact of volume on tracking error for German ETFs i.e., any increase in volume traded of German ETFs will also increase the tracking error of German ETFs. Whereas, in the study conducted by Buetow and Henderson (2012), Qadan and Yagil (2012) negative relationship between volume and tracking error of the U.S listed ETFs was observed which was also confirmed by Singh and Kaur (2016) in respect to Indian Equity ETFs and by Rompotis (2020) for ETFs traded in Greece.

4.2.3. Volatility of Fund and Tracking Error

Price related volatility of fund was also found to be significant factor causing tracking error. It has been brought out through studies that daily price volatility of fund is positively related to tracking error i.e. any increase in volatility of fund will adversely impact the tracking efficiency of fund (Qadan and Yagil, 2012), (Paliwal, 2014), (Dorocáková, 2017).

4.2.4. Size of Fund and Tracking Error

Average Asset under Management (AAUM) has been used as a proxy for the size of the fund. An inverse relationship was depicted between AAUM and tracking error i.e. as AAUM of fund increase, tracking efficiency of ETFs also increase (Chu, 2011), (Drenovak *et al.* , 2014), (Dorocáková, 2017).

4.2.5. Risk of Fund and Tracking Error

Here, Risk of fund has been computed as standard deviations of returns of ETFs. It has been observed that risk of fund is positively related to the tracking ability of ETF i.e. as the risk of fund increase, it's tracking error also increase. This outcome is well supported in the studies conducted by Milonas and Rompotis (2006) & Rompotis (2012).

4.2.6. Age of Fund and Tracking Error

Another factor influencing tracking error as identified in available literature is age of the fund, that is, for how long the fund has been in market. It has been observed that age of fund is positively related in respect to U.S ETFs as per the study conducted by Rompotis (2011). Similar results were obtained in the study conducted in Indian context by Singh and Kaur (2016). Thus, it can be said that age of fund is positively related to tracking error.

Other than above described factors various other factors such as exchange rate, premium/discount, cash drag, tax optimisation, bid-ask spread and swap fees have also been identified as significant factors causing tracking error but no conclusive relationship could be established between them.

4.3. Pricing Efficiency of ETFs

ETFs have two quoted prices, NAV and market price. The price of an ETF is determined by the supply and demand from market participants whereas NAV represents the intrinsic value of ETFs or the value of the investments held by the fund. Due to this, the market price and NAV may not be the same. There can be a difference between the price of an ETF on the stock exchange and the NAV of the fund. If ETF trades at a price that is above its NAV there is a premium, if the price is less than NAV there is a discount. This divergence among price and NAV of ETFs represents an arbitrage opportunity for investors (Gallagher and Segara, 2005).On reviewing the available literature it has been observed that 84% of the studies reviewed reveal existence of arbitrage opportunity regardless of the different financial markets, different time zones and different sample size being considered in these studies. Some of the major studies that could be cited in this regard are Elton *et al.* (2002), Gallagher and Segara (2005), Engle and Sarkar (2006), Delcoure and Zhong (2007), Kayali (2007), Aber *et al.* (2009), Shin and Soydemir (2010).

Several studies such as (Engle and Sarkar, 2006), (Delcoure and Zhong, 2007) have documented in their studies that ETFs have notable and long-lasting arbitrage opportunities i.e. premium/discounts of ETFs are quite persistent even though the effect of persistence seems to fade away when moving away from day one. Further, in studies conducted by Ackert and Tian (2008), Shin and Soydemir (2010), Tripathi and Garg (2016) it has been brought out that emerging markets have greater price deviations and persistence. These results are also consistent with studies conducted in Indian set up by Aditya and Desai (2015), Tripathi and Garg (2016), Shanmugham and Zabiulla (2012). However, it has been noted that developed markets also fail to maintain this smooth arbitrage mechanism during the times of high volatility as highlighted by Madhavan (2012). Flash crash of May 6 2010, has been one such event where ETFs witnessed a sharp decline in its price due to the non-availability of accurate real-time data of underlying assets, and unprecedented increase in volume traded thus delinking it from its NAV (Abner, 2013).

Although, through the review of studies it can be conclusively said that price deviations are significant and last long in emerging markets when compared to developed nations. Thus, indicating inefficient arbitrage mechanism and unfamiliarity regarding ETFs in emerging markets.

5. Conclusion

This SLR attempts to conduct review of literature available on two major aspects of ETFs i.e. Tracking Error and Pricing Efficiency. On scrutinizing the existing literature underperformance of ETFs has been observed by the majority of authors while some of the studies support that ETFs tend to outperform their benchmark whereas a few state that ETFs perform at par with their benchmarks. (Elton *et al.*, 2002), (Milonas and Rompotis, 2006), (Shin and Soydemir, 2010), (Chu, 2011), (Blitz and Huij, 2012), (Singh and Kaur, 2016), and (Chen *et al.*, 2017) conclusively brought out that ETFs underperform in relation to their benchmarks contrary to these results (Wong and Shum, 2010), (Rompotis, 2012) concluded that ETFs are able to beat the market and thus investors are more inclined to invest in ETFs rather than its benchmark. Other than these studies, (Gallagher and Segara, 2006), (Harper *et al.*, 2006), (Pan and Li, 2016) observed that German ETFs, Barclays's shares, and gold ETFs traded in china provided equal average returns in comparison to their benchmarks respectively.

Further, this divergence in performance was found to be more for emerging markets than developed markets as documented by (Shin and Soydemir, 2010) and (Blitz and Huij, 2012). Beyond performance (Milonas and Rompotis, 2006), (Rompotis, 2012), (Chu, 2011), (Elia, 2012), (Drenovak *et al.*, 2014), (Osterhoff and Kaserer, 2016), (Sethi, 2016) made an attempt to provide evidence on factors affecting tracking ability. Their studies documented that tracking error of ETFs is positively related to Management fees, risk, age of fund, and market volatility. In addition to this (Chu, 2011), (Qadan and Yagil, 2012), (Drenovak *et al.*, 2014) brought out that there are other factors i.e. size of the fund, bid-ask spread and volume which are also among significant factors that cause tracking error but these factors are negatively related to tracking error. Other than these factors number of constituents and exchange rates were also highlighted as factors of significant importance in some studies. However, no consensus has been established over the factors affecting tracking error due to different financial markets being considered for the studies.

Moving on to the pricing efficiency aspect of ETFs, it has been established that in 84% of the studies reviewed, arbitrage opportunity do exist for ETFs as Price and NAV of ETFs do move together but are not close enough. However, Engle and Sarkar (2006), Shin and Soydemir (2010), Tripathi and Garg (2016) observed that deviations between price and NAV persist for longer time period in emerging markets rather than developed economies. Highlighting, the fact that arbitrage mechanism is much more efficient in developed markets due to which any opportunity that arise, disappear within a very short span of time. Some of the reasons that has been identified over the years for this mispricing between price and NAV of ETFs are inefficient arbitrage mechanism, liquidity of underlying securities, difference in time zones and transaction cost.

5.1. Implications and Future Scope for Research

This study will enable researchers to get a comprehensive view of available literature at one place thereby developing a sound understanding about these major two aspects of ETFs. Availability of this

review will facilitate future researchers to identify the research gap and explore new dimensions of ETFs. Along with researchers, retail investors and other market players can also be benefitted by the outcomes of this study as it provides an understanding on how ETFs behave across the globe.

Present study comprises of research papers till January 2020, thus it can be expanded by adding more studies to broaden the understanding regarding these strands of ETFs. Also papers in other languages can be included. Further, researchers can conduct empirical research to explore factors causing pricing inefficiencies in ETFs market which remain one of the less explored dimension. Also, authors can explore other empirical perspectives of ETFs.

References

Aber, J. W., Li, D., & Can, L. (2009). Price volatility and tracking ability of ETFs. *Journal of Asset Management*, *10*(4), 210–221. https://doi.org/10.1057/jam.2009.13.

Abner, D. J. (2013). Visual guide to ETFs (Vol. 580). *John Wiley & Sons*.

Ackert, L. F., & Tian, Y. S. (2008). Arbitrage, liquidity, and the valuation of exchange traded funds. *Financial markets, institutions & instruments*, 17(5), 331-362.

Aditya, G., & Desai, R. (2015). The journal of index investing Pricing Efficiency and Price Discovery of Indian Equity etfs.*The Journal Of Index Investing,*67-79.

Aroskar, R., & Ogden, W. A. (2012). An analysis of exchange traded notes tracking errors with their underlying indexes and indicative values. *Applied Financial Economics*, *22*(24), 2047–2062. https://doi.org/10.1080/09603107.2012.684787.

Badenhorst, W. M. (2017). Premiums and discounts of exchanged-traded funds. *South African Journal of Accounting Research*, *31*(3), 212–222. https://doi.org/10.1080/10291954.2016.1199145.

Blitz, D., & Huij, J. (2012). Evaluating the performance of global emerging markets equity exchange-traded funds. *Emerging Markets Review*.149-158. https://doi.org/10.1016/j.ememar.2012.01.004

Buetow, G. W., & Henderson, B. J. (2012). An Empirical Analysis of Exchange-Traded Funds. *Journal of Portfolio Management Summer*, *38*(4).

Charteris, A. (2013). The price efficiency of South African exchange traded funds. *Investment Analysts Journal*, , 1–11. https://doi.org/10.1080/10293523.2013.11082558.

Charupat, N., & Miu, P. (2013). The pricing efficiency of leveraged exchange-traded funds: Evidence from the U.S. markets. *Journal of Financial Research*, *XXXVI(2),* 253-277.https://doi.org/10.1111/j.1475-6803.2013.12010.x.

Chen, J., Chen, Y., & Frijns, B. (2017). Evaluating the tracking performance and tracking error of New Zealand exchange traded funds. *Pacific Accounting Review*, *29*(3), 443–462. https://doi.org/10.1108/par-10-2016-0089.

Chu, P. K. K. (2011). Study on the tracking errors and their determinants: Evidence from Hong Kong exchange traded funds. *Applied Financial Economics*,*21,*309-315. https://doi.org/10.1080/09603107.2010.530215.

Delcoure, N., & Zhong, M. (2007). On the premiums of iShares. *Journal of Empirical Finance*, *14*(2), 168–195. https://doi.org/10.1016/j.jempfin.2005.12.004.

Dorocáková, M. (2017). Comparison of ETF´s performance related to the tracking error. *Journal of International Studies,10*(4),154-165. https://doi.org/10.14254/2071-8330.2017/10-4/12.

Drenovak, M., Uroševiæ, B., & Jelic, R. (2014). European Bond ETFs: Tracking Errors and the Sovereign Debt Crisis. *European Financial Management,20*(5),958-994.https://doi.org/10.1111/j.1468-036X.2012.00649.x.

Elia, M. (2012). Tracking Error of Traditional and Synthetic European Exchange-Traded Funds. http://ssrn.com/abstract=2084929.

Elton, E. J., Gruber, M. J., Comer, G., & Li, K. (2002). Spiders: Where Are the Bugs? *Source: The Journal of Business*, *75*(3), 453–472. https://doi.org/10.1086/339891.

Engle, R., & Sarkar, D. (2006). Premiums-discounts & exchange traded funds. *Journal of Derivatives*, *13*(4), 27–45. https://doi.org/10.3905/jod.2006.635418.

Ferri, R. A. (2009). The ETF book: all you need to know about exchange-traded funds. *John Wiley & Sons*.

Frino, A., & Gallagher, D. R. (2001). Tracking S&P 500 index funds. *The Journal of Portfolio Management*, 28(1), 44-55.

Garg, S. (2015). The performance and trading characteristics of exchange traded funds in India: An empirical study. *The International Journal of Business & Management*,*2*(4).70-78.

Gallagher, D. R., & Segra, R. (2005). The performance and trading characteristics of exchange-traded funds. *Journal of Investment Strategy*, *1*(1), 47-58.

Harper *et.al.* (2006). Performance comparison between exchange-traded funds and closed-end country funds. *Journal of International Financial Markets, Institutions & Money, 16*,104–122.

Hilliard, J. (2014). Premiums and discounts in ETFs: An analysis of the arbitrage mechanism in domestic and international funds. *Global Finance Journal*, *25*(2), 90–107. https://doi.org/10.1016/j.gfj.2014.06.001

Jiang, Y., Guo, F., & Lan, T. (2010). Pricing efficiency of China's exchange-traded fund market. *Chinese Economy*, *43*(5), 32–49. https://doi.org/10.2753/CES1097-1475430503.

Nazli, K. B. & Serra, E. S. (2015). Tracking Ability and Pricing Efficiency of Exchange Traded Funds: Evidence from Borsa Istanbul, *Business and Economics Research Journal*, *6*(1), 19–33. www.berjournal.com.

Kaur, P., & Singh, J. (2018). Testing the tracking efficiency of commodity Exchange Traded Funds (ETFs) across the bearish and bullish market regimes: Evidence from Indian Gold ETFs. *Journal of Asia-Pacific Business*, *19*(3), 182-202. DOI: 10.1080/10599231.2018.1490593

Kayali, M. (2007). Pricing efficiency of exchange traded funds in Turkey: Early evidence from the Dow Jones Istanbul. *International Research Journal of Finance and Economics*, *10*(10), 14–23.

Kumar, P. (2018.). An Investigation Of Pricing Efficiency Of CPSE,*Journal of Commerce and Accounting Research,7*(2),28-33.

Kurian, B. C. (2017). Return-Risk Analysis Of – Bank Etfs. *Asia Pacific Journal of Research*,*1*(LII),51-58.

Li, Y. (2013). Performance Evaluation of Exchange-Traded Funds in Emerging Markets.

Lin, C.-C., Chan, S.-J., & Hsu, H. (2006). Pricing efficiency of exchange traded funds in Taiwan. *Journal of Asset Management*, *7*(1), 60–68. https://doi.org/10.1057/palgrave.jam.2240202.

Madhavan, A. (2012). Exchange-traded funds, market structure, and the flash crash. *Financial Analysts Journal*, *68*(4), 20-35.

Milonas, N. T., & Rompotis, G. G. (2006). Investigating European ETFs: the case of the Swiss exchange traded funds. *The Annual Conference of HFAA*.

Mizio³ek, T., & Feder-sempach, E. (2019). Tracking ability of exchange-traded funds, *Evidence from Emerging Markets Equity ETFs. 50*(August 2018), 221–248.

Narend, S., Thenmozhi, M., & Thenmozhi-Professor, M. (2013). *Performance and Price Discovery of Gold ETFs*. http://ssrn.com/abstract=2370337

Nargunam, R., & Anuradha, N. (2017). Market efficiency of gold exchange-traded funds in India. *Financial Innovation*, *3*(1). https://doi.org/10.1186/s40854-017-0064-y

Osterhoff, F., & Kaserer, C. (2016). Determinants of tracking error in German ETFs – the role of market liquidity. *Managerial Finance*,*42*(5),417-437. https://doi.org/10.1108/MF-04-2015-0105

Paliwal, R. (2014). Digital Commons@SHU Tracking Errors of Exchange Traded Funds and Index Funds. http://digitalcommons.sacredheart.edu/wcob_wp

Pan, W.-F., & Li, T. (2016). The Measurement of Tracking Errors of Gold Etfs: Evidence from China,*Applied Finance Letters,5*(1).

Purohit, H., Choudhary, N., & Tyagi, P. (2014). An Evaluation of Tracking Error on World Indices ETFs Traded in India, *20*(3),41-52

Qadan, M., & Yagil, J. (2012). On the dynamics of tracking indices by exchange traded funds in the presence of high volatility. *Managerial Finance,38*(9),804-832.https://doi.org/10.1108/03074351211248162.

Reddy, Y. V, & Dhabolkar, P. (2020). Pricing Efficiency of Exchange Traded Funds in India. *Organisations and Markets in Emerging Economies.11*(1), 244–268.doi: 10.15388/omee.2020.11.33.

Rompotis, G. G. (2011).”Predictable patterns in ETFs’ return and tracking error”. *Studies in Economics and Finance*, *28*(1), 14-35.

Rompotis, G. G. (2012). “The German Exchange Traded Funds.” *The IUP Journal of Applied Finance*,*18*(4),62-82.

Rompotis, G. G. (2013). Recent developments in exchange-traded fund literature: Pricing efficiency, tracking ability, and effects on underlying securities,*Managerial Finance,28*(5).

Rompotis, G. G. (2014). On the trading behavior of emerging market ETFs. *The Journal of Trading*, *10*(1), 56-86.

Rompotis, G. G. (2020). *Actively versus passively managed equity ETFs/ : new empirical insights*. *Int. J. Banking, Accounting and Finance,11*(1).

Sethi, N. (2016). Examining the Performance of Indian Exchange Traded Funds (ETFs). *Eurasian Journal of Business and Economics*, *918*, 61–79. https://doi.org/10.17015/ejbe.2016.018.04.

Shanmugham, R., & Zabiulla. (2012). Pricing efficiency of nifty BeES in bullish and bearish markets. *Global Business Review*, *13*(1), 109-121. https://doi.org/10.1177/097215091101300107.

Shin, S., & Soydemir, G. (2010). Exchange-traded funds, persistence in tracking errors and information dissemination. *Journal of Multinational Financial Management*,*20*(2010),214-234.https://doi.org/10.1016/j.mulfin.2010.07.005.

Singh, J., & Kaur, P. (2016). Tracking Efficiency of Exchange Traded Funds (ETFs). *Paradigm*, *20*(2), 176–190. https://doi.org/10.1177/0971890716670722.

Steyn, J. (2019). The tracking efficiency of exchange-traded funds listed on the Johannesburg Stock Exchange. *Management Dyanimcs,28*(4).

Swathy, M. (2015). An Empirical Analysis on Pricing Efficiency of Exchange Traded Funds in India. *International Journal of Engineering and Management Sciences*, *6*(2), 68–72.

Tripathi, V., & Garg, S. (2012.). A Cross-Country Analysis of Pricing Efficiency of Exchange Traded Funds.*The IUP Journal of Applied Finance,20*(3),41-63.

Wong, K. H., & Shum, W. C. (2010). Exchange-traded funds in bullish and bearish markets. *Applied Economics Letters*, 17(16), 1615-1624.

Appendix – A
Findings of Studies on Tracking Error and Factors Affecting Tracking Error

S. No	*Author (Year)*	*Country*	*Citations*	*Sample*	*Major Findings*
1.	(Elton et al., 2002)	USA	340	1ETF i.e. SPIDERS	SPIDER was found to be underperforming its benchmark index
2.	(Gallagher and Segara 2005)	Australia	93	6 ETFs listed on Australian Stock Exchange	All six ETFs provided same return as of its benchmark.
3.	(Harper 2006)	14 Countries	133	29 Close Ended Funds for14 countries	Tracking errors for all the funds were negative but this tracking error was insignificant.
4.	(Milonas & Rompotis, 2006)	Switzerland	46	36 Swiss ETFs	Selected ETFs underperformed the respective underlying benchmark. Management Fee and Risk were positively related to tracking error whereas expense ratio was found to be negatively related.
5.	(Jhonson 2009)	USA	55	20 Foreign Country ETFs	ETFs were underperforming its foreign country benchmark and this difference in performance was positively related to overlap between operational hours of foreign stock exchange with that of U.S.
6.	(Shin & Soydemir, 2010)	USA	144	26 U.S ETFs	ETFs were underperforming its benchmark and exchange rate was identified as the only factor causing tracking error.
7.	(Wong & Shum, 2010)	7 Countries	44	15 ETFs of USA, UK, Hong Kong, Japan, Amsterdam, Belgium	ETFs provide higher return than its benchmark in bullish as well as bearish phase of market.
8.	(Rompotis 2011)	USA	53	50 Barclay's Ishares	ETFs were found to be providing superior returns than its benchmark at short term level. Age of Fund, Risk of Fund and Expense Ratio were positively related with tracking error.
9.	(Chu, 2011)	Hong Kong	59	18 ETFs traded on Hong Kong Stock Exchange.	High tracking error was witnessed for the ETFs traded in Hong Kong. Size of fund was negatively related to tracking error whereas Expense Ratio was positively related to tracking error.
10.	(Aroskar & Ogden, 2012)	USA	14	25ipath ETNs	A near to perfect tracking was witnessed for Exchange Traded Notes (ETNs).
11.	(Blitz & Huij, 2012)	USA and Europe	86	All ETFs listed in the U.S and Europe	It was observed that ETFs underperform its benchmark. This underperformance is more in emerging market than developed market.

S. No	*Author (Year)*	*Country*	*Citations*	*Sample*	*Major Findings*
12.	(Buetow &Henderson, 2012)	USA	8	845 unique ETFs of various categories	ETFs that tracking less liquid securities tend to exhibit large absolute tracking error than those ETFs that track grade credit and government sectors.
13.	(Elia, 2012)	Europe	20	48 ETFs created before September 2007.	It was observed that traditional as well as synthetic ETFs underperform benchmark. Fund Expenses, High Dividend withholding, Synthetic replication method were negatively related to tracking error whereas Asset Under Management (AUM) positively affected tracking error.
14.	(Rompotis, 2012)	Germany	18	43 German ETFs traded on XTRA market.	It was observed that on an average ETFs and benchmark provided equal returns. Any difference that exist in return is positively affected by Premium/Discounts of ETFs and Bid-ask spread.
15.	(Shanmugham & Zabiulla, 2012)	India	1	13 Gold ETFs listed on NSE	Selected sample of Gold ETFs do not outperform market.
16.	(Qadan & Yagil, 2012)	USA	19	42 US ETFs	In this study, significant tracking error was witnessed. Daily Volatility was positively related with tracking error where as trading volume was negatively related.
17.	(Charupat & Miu, 2013)	Canada	2	8 ETFs listed on Toronto Stock Exchange.	ETFs were categorized into bull and bear funds. Bull ETFs traded at discount whereas bear ETFs trade at premium. Leveraged ETFs provide promised performance
18.	(Jhonson et. al. 2013)	Europe	21	65 ETFs of European Countries	ETFs with physical replication had high tracking error than ETFs that have synthetic replication. Total Expense Ratio, Swap Fees, Cash drag, Tax optimization are some of the factors that significantly impact tracking error.
19.	(Narend, Thenmozhi, 2013)	USA & India	4	6 Gold ETFs	Gold ETFs were closely tracking its underlying index. Even the small tracking error was found to be significant.
20.	(Li 2013)	China	0	6 ETFs traded in China	All the selected ETFs were not perfectly tracking their underlying benchmark.
21.	(Drenovak et al., 2014)	Europe	33	31 Eurozone Sovereign Debt ETFs	Underperformance of ETFs was witnessed. Size of fund and Bid-ask spread was negatively related to tracking error whereas Duration, Expense Ratio and Number of Constituents positively impacted tracking error.

S. No	*Author (Year)*	*Country*	*Citations*	*Sample*	*Major Findings*
22.	(Purohit, Choudhary, and Tyagi 2014)	India	3	2 ETFs tacking world Indices	ETFs provided lower return than that of its benchmark. This difference in return of ETF was found to be significant.
23.	(Garg 2014)	India		7 Equity ETFs and 5 Gold ETFs listed on NSE.	ETFs underperformed their underlying benchmark. This underperformance was also found to be significant.
24.	(Paliwal, 2014)	USA	3	12 ETFs and their matched index funds.	A comparison was made between ETFs and mutual funds tracking same indices. ETFs performed better in respect of Mid-Cap and Small-Cap Indices. Market Volatility positively impacted tracking error.
25.	(Valle *et. al.* 2014)	UK	4	7198 ETFs actively traded in markets.	Inverse trackers as well as leverage trackers witnessed a great underperformance than single equity trackers.
26.	(Rompotis 2014)	USA	7	40 US listed ETFs exposed to Emerging Markets.	A significant negative tracking error was observed for ETFs. Although day time underperformance was more than overnight returns.
27.	(Yiannaki 2015)	Luxemborg and Ireland	12	12 ETFs listed on LSE, Euronext and Frankfurt Stock Exchange	Tracking Error for Luxemborg ETFs was 5% whereas for Irish ETFs it was 4%.Correlation Analysis indicated that index volatility and tracking error are positively correlated.
28.	(Nazli and Serra ,2015)	Istanbul	15	16 ETFs traded on Borsa Istanbul.	Return as well as risk of ETFs was below its benchmark index.
29.	(Sethi, 2016)	India	1	10 ETFs listed on NSE.	All the ETFs showed underperformance.
30.	(Osterhoff & Kaserer, 2016)	Germany	17	8 ETFs that fully replicate.	ETFs underperform benchmark on maximum days. Liquidity of underlying stocks, cash distribution, daily net creation redemption process, and portfolio adjustment impacted tracking error.
31.	(Pan & Li, 2016)	China	2	All Gold ETFs traded in China.	ETFs were not perfectly tracking its benchmark. Though, optimized portfolio performed better than ETFs that adopted full replication.
32.	(Singh & Kaur, 2016)	India	9	12 Equity ETFs listed on NSE.	All equity ETFs were underperforming their benchmark. Volume traded positively related to tracking error whereas Intraday Volatility and AUM was negatively related to tracking error.
33.	(Kurian, 2017)	India	0	9 Bank ETFs listed on NSE.	Bank ETFs were found to be aggressively outperforming industry average.

S. No	*Author (Year)*	*Country*	*Citations*	*Sample*	*Major Findings*
34.	(Dorocáková, 2017)	USA	8	All ETFs tracking world Indices.	Tracking Error of ETFs became quite close when quarterly return was used. Volatility as well as fund size positively was positively related to tracking error.
35.	(Chen et al., 2017)	New Zealand	3	3 ETFs traded in New Zealand.	ETFs were underperforming their respective benchmark.
36.	(Kaur & Singh ,2018)	India	12	12 Gold ETFs listed on National Stock Exchange of India.	Gold ETFs are less sensitive to gold prices during bear phase. Volume was found to be positively related to tracking error whereas volatility and pricing deviation were found to be negatively impacting tracking error.
37.	(Miziołek & Federsempach, 2019)	Europe	14	14 ETFs listed on European Exchanged trying to mimic emerging market index.	Tracking Error was found to be lower than that obtained in literature. Moreover, daily tracking errors were found to be higher than weekly tracking errors.
38.	(Steyn, 2019)	South Africa	76	ETFs listed on Johannesburg Stock Exchange.	Perfect tracking was not observed for any of the ETFs. It was also observed that ETFs tracking international indices had larger tracking errors.
39.	(Rompotis, 2020)	Greece	37	37 active as well passive ETFs pairs.	Passive ETFs performed better than active ETFs .Expenses and volume traded negatively impacted the performance of ETFs whereas underlying assets positively impacted performance.
40.	(Zawadzki, 2020)	Poland	18	ETFs issued by ishares belonging to Asia, America and Europe.	ETFs were underperforming their respective benchmark and this deviation in performance was more in emerging market ETFs than developed countries.

Source: Authors' Own Calculation

Appendix – B
Findings of Studies on Pricing Efficiency of ETFs

S. No	*Author (Year)*	*Country*	*Citations*	*Sample*	*Major Finding*
1.	(Elton et al., 2002)	USA	340	1 ETF i.e. SPIDERS	Difference between NAV and Price was found to be less than 1.8 basis point on an average. This difference between price and NAV disappear within a day
2.	(Gallagher and Segara 2005)	Australia	93	6 ETFs listed on Australian Stock Exchange	Deviation between price and NAV disappear within a day.
3.	(Engle & Sarkar, 2006)	USA	235	21 domestic and 16 international ETFs.	Price and NAV of domestic ETFs were near to each other, whereas, price and NAV of international ETFs were away from each other.
4.	(Lin et al., 2006)	Taiwan	61	Taiwan Top 50 Tracker Fund (TTT).	TTT was trading at premium although this premium was insignificant.
5.	(Delcoure & Zhong, 2007)	USA	103	20 ishares traded on AMEX.	All the ETFs were trading at premium accept ishares Malaysia that traded at discount. Institutional ownership, bid-ask spread, trading volume, exchange rate volatility were some of the factors causing deviations in price and NAV.
6.	(Kayali, 2007)	Turkey	47	Dow Jones Instabul 20.	Difference between price and NAV was significant. These premium/discounts persisted on the day following their occurrence.
7.	(Aber et al., 2009)	USA	94	3 domestic and 1 international ETF	ETFs trades at discount on maximum days accept one ETF that traded on premium on most days.
8.	(Jiang et al., 2010)	China	23	Shanghai 50 ETF	Premium/Discounts do persist but these deviations disappear within 3 days. Unidirectional Causality was witnessed where price was causing NAV.
9.	(Shin & Soydemir, 2010)	USA	144	26 ETFs traded in USA.	It was brought out that ASIAN markets have greater persistence of deviations of price and NAV.
10.	(Shanmugham & Zabiulla, 2012)	India	16	NiftyBees	The average premium is higher in bearish markets whereas, average discount is higher in bullish markets. The price divergence disappears within three days. .
11.	(Charteris, 2013)	South Africa	19	7 South African ETFs.	Domestic ETFs were trading at discount whereas international ETFs were trading at premium. Also the Arbitrage opportunity disappear on following day.

S. No	*Author (Year)*	*Country*	*Citations*	*Sample*	*Major Finding*
12.	(Hilliard, 2014)		16	801 domestic ETFs	Domestic Equity ETFs were narrowly trading around their NAV. Whereas, premium for international equity and taxable bond ETFs were more than that of domestic ETFs.
13.	(Swathy, 2015)	India	3	5 Equity ETFs traded on NSE.	ETFs were found perfectly tracking its benchmark. The discrepancy between price and NAV did not persist on following days thus proving markets efficient.
14.	(Aditya and Desai 2015)	India	4	17 Equity ETFs traded on NSE.	All the selected ETFs were trading at discount. Any difference took 10 days to disappear. No long term relationship between price and NAV was observed in long run.
15.	(Nazli and Serra 2015)	Turkey	15	16 ETFs traded on Borsa Istanbul.	ETFs were perfectly priced and no arbitrage opportunity was available in Turkish capital markets.
16.	(Tripathi and Garg 2016)	USA, UK, Japan, Australia and India	11	17 ETFs and 11 different Indices.	It was observed that average daily deviation between price and NAV of ETF was lowest for US and highest for India.Deviations for USA disappear on following day whereas these persisted long for India.
17.	(Badenhorst, 2017)	USA	2	ETFs traded on Johannesberg.	Deviations do exist between price and NAV of ETFs. These deviations are positively affected by Investment portfolio and Expense ratio.
18.	(Nargunam & Anuradha, 2017)	India	6	5 Gold ETFs.	Market for Gold ETF was found to be inefficient as past prices were affecting future prices.
19.	(Kumar 2018)	India	2	CPSE ETFs traded on NSE.	This ETF trades at discount but this discount is insignificant.
20.	(Reddy & Dhabolkar, 2020)	India	1	39 ETFs listed on NSE	Pricing Deviation was observed for minimum one day to maximum four days.

Source: Authors' Own Calculation