## Executive Summary

Contrary to a common belief in the industry, Exchange-Traded Funds (ETFs) are not perfect providers of index performance. Their performance in terms of returns can deviate significantly from the performance of the index they aim to replicate, creating a so-called tracking difference. There are many factors that can give rise to this difference in performance but we will regroup them in two categories. First, index methodologies cannot be readily used as investment guidelines because of practical implementations. The manager has hence a discretionary freedom to choose the best investment strategy to replicate closely the value of its underlying index. Secondly, ETFs have enjoyed a great trading convenience and an efficient pricing because of their unique structure. But we will see that this pricing can be challenged when the market is stressed, and will hence create a disparity between the share price of the ETF and its Net-Asset Value (NAV), which will be a further source of miss-performance over time. These two sources of inefficiencies are usually examined separately in the academic literature and in the industry, but this thesis will consider them altogether, as they both represent a source of miss-performance.

To have a comprehensive picture of the quality of the entire industry of ETFs, we use a unique subset of 2,000 funds which spans over a timeline of 10 years, from 2005 to 2015. This is twice as much as other studies in both terms of number of funds and length of the timeframe analysed. Moreover, whereas most studies solely compute aggregates descriptive statistics over their whole timeline, we will analyse the change in tracking performance of ETFs over time and on different frequencies. This will allow us to see how their performance is evolving over time and also whether their performance is resistant and/or resilient to different market regimes.

We first look at the tracking difference in performance as a whole for one of the most popular ETF, the SPDR S&P 500. We will see that it accumulates a difference in performance of -60 bps, which is in line with previous studies on its performance. But more interestingly, our time analysis will show that not only this cumulative (miss)-performance is itself very volatile - especially in times of market stress - but can also be steadily diverging when markets are more stable. These two caveats have a great importance as the first means that ETF's tracking performance is greatly dependent on market conditions. Not only can it bring an additional volatility in a portfolio's valuation when

it's the least desired, but also induces a market timing component novel to these so-called passive investments in potential redemptions as the cumulated tracking performance can differs greatly from one day to another. Moreover, the second implies that even with the optimal conditions, the most popular ETF is failing to keep track of its index performance.

Secondly, we will go on comparing the tracking performance across ETFs to see that it can vary across the industry. A distributional analysis will show that 50% of ETFs experience a cumulative tracking difference greater than 1% per annum (p.a.), with the existence of outliers greater than 10% p.a. This heterogeneity of the industry will show that ETFs should not be considered equally despite their similar trading convenience, and an usual due diligence of the fund is to be thoroughly conducted as for any other investments.

The third part will cover the difference in performance between the change in values of the share price and the NAV. This decomposition will show that most of the tracking difference can be explained by shortcomings in the replicating strategy. But the pricing inefficiencies of the product can also be responsible for as much as 50% of the volatility of the tracking performance in times of market stress. We will see that this additional volatility in the pricing will cause an additional miss-performance for any investments spanning over these troubles times, and that this disparity is similarly heterogeneous across ETFs. This distinction is important as it is not only specific to ETFs and will lead to a product differentiation from classical mutual funds, but it also expresses what proportion of the miss-performance is attributable to flaws in the product design or shortcoming in the replicating strategy chosen by the manager.

Finally, we will see that this pricing inefficiency can even be more emphasised on an intra-day frequency. On the 24th of August 2015, the Dow Jones opened with a $1000 drop in value, which quickly spread into trading halts and financial contagion. This led the associated and still-trading ETF's share price to greatly deviate from its NAV - more than 33% - which in turns triggered unintended fire sales and stop orders, crystallising a tracking difference on the books despite a valuation of the fund still in line with the index performance. This led to a wealth transfer from potential panicking institutional investors to active traders seeking arbitrage opportunities, amounting to a total of $1.22 millions just because of this pricing glitch.

This study thus draws a more comprehensive picture of ETFs from which investors can better judge the quality of these investment products. These problems are primordial for investors using ETFs to access the performance of the underlying index, as any discrepancy in replication will imply a miss-performance for their passive investment mandate. Understanding and assessing these potential caveats might improve the soundness of their investment decisions.