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EXCHANGE TRADED FUNDS: U.S. FINANCIAL MARKET CASE STUDY

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Exchange traded funds: U.S. Financial Market case study

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Abstract: The presence of exchange traded funds (ETFs) is well recognise in many financial markets on the word since their inception in the 1990's. The widespread interest in those are due to many advantages and confirms that it is worth investigating. The main advantages include its flexibility, and a large window of investment opportunities for retail investors and even become popular with institutional investors as well. However were introduced to the markets the main point was to provide cheaper access to passive indexed funds to individual investors. In this paper we provide the comprehensive knowledge on those funds in one particular market: the United States financial market. The aim of this research is to analyse and discuss the presence of ETFs in the financial markets. We analyse four ETFs and three indices, the results show that three out of the four ETFs are not cointegrated with the index that they track. On the other hand, correlation tests show that ETFs and its underlying index are highly correlated. The main methods of study used are integration orders of variables, cointegration vector and tests, error correction model – when it applies – all performed in R Studio. The data collection ranges between 2010 – 2019.

Keywords: stock exchange, exchange traded funds, U.S. financial market

JEL codes: G23, C12

1. Introduction

Since their inception in the 1990's, exchange traded funds (ETFs) have been a largely popular financial instrument. The widespread interest in this type of fund stems from many advantages of ETFs and confirms that it is worth investigating. The main advantages include the flexibility of these funds as well as a large window of investment opportunities for retail investors; however now they have also become very popular with institutional investors as well. The main point of ETFs when they were introduced to the markets was to provide cheaper access to passive indexed funds to individual investors. The additional benefits included more trading possibilities as well as portfolio diversification and arbitrage opportunities. ETF flexibility and exposure to different areas of the financial markets attracts many types of investors. The characteristics of ETFs resemble and are based on various other instruments, which will be discussed later on. The interesting aspects around ETFs are also volatility and liquidity, which will be the focus of the quantitative analysis. Moreover, we will look at the relationship between ETFs and their underlying indices.

In our paper we aim to analyze the presence of ETFs in the financial markets. The data collection ranges between 2010 - 2019. This period was selected because it allows the exclusion of the bias of the 2007 - 2008 financial crisis and stock market crash. Moreover, a 10-year period of daily frequency data allows for a sufficient amount of data for analysis. We enriched the analyzes with an overview of four exchange traded funds and three indices that the funds follow. The four ETFs are: SPDR S&P 500 Trust ETF (SPY), iShares S&P 500 ETF (IVV), Invesco QQQ Trust (QQQ), and SPDR Down Jones Industrial Average ETF (DIA). The three indices that the funds track are the following: S&P 500 for SPY and IVV; Nasdaq 100 for QQQ, and Dow Jones Industrial Average.

The main hypothesis is: the correlation between the ETFs and their tracked indices in the U.S. financial markets is strong. In order to focus on this problem we will present a few supplementary elements. First of all, the specifics of ETFs are analyzed in order to understand them as a financial mechanism and construct. For the selected period, daily close price and daily volume data is collected and compared with the same data concerning tracked indices. Secondly, the case study of cointegration and correlation between the ETFs and their underlying indices is performed in order to finish with conclusions on the relationship between the two variables. The research focuses not on global ETF presence, but on the specific ETFs in the United States of America only.

The research methods used are integration orders of variables, cointegration vector and tests, error correction model – when it applies – all performed in R Studio. Furthermore, this study was based on detailed description of ETFs and their background. Those methods were used primarily because they were adopted to the work and led to obtain the answer to the main research question.

The research paper is structured as follows: in Section 2 the relevant theoretical background on financial markets and ETFs is presented. The structure and specifics of ETFs are also discussed. Further, the literature and research questions are discussed in Section 3. The literature review presents studies concerning various ETFs. Moreover, the findings of the studies are presented. Based on these, the research questions and important points of focus are identified for this papers. Section 4 presents the data and method as well as the results and discussion. The data collection is described as well as the conclusions reached from the data analysis. A comparison of the findings and the initial research question is also looked at. In the final part the conclusions are provided.

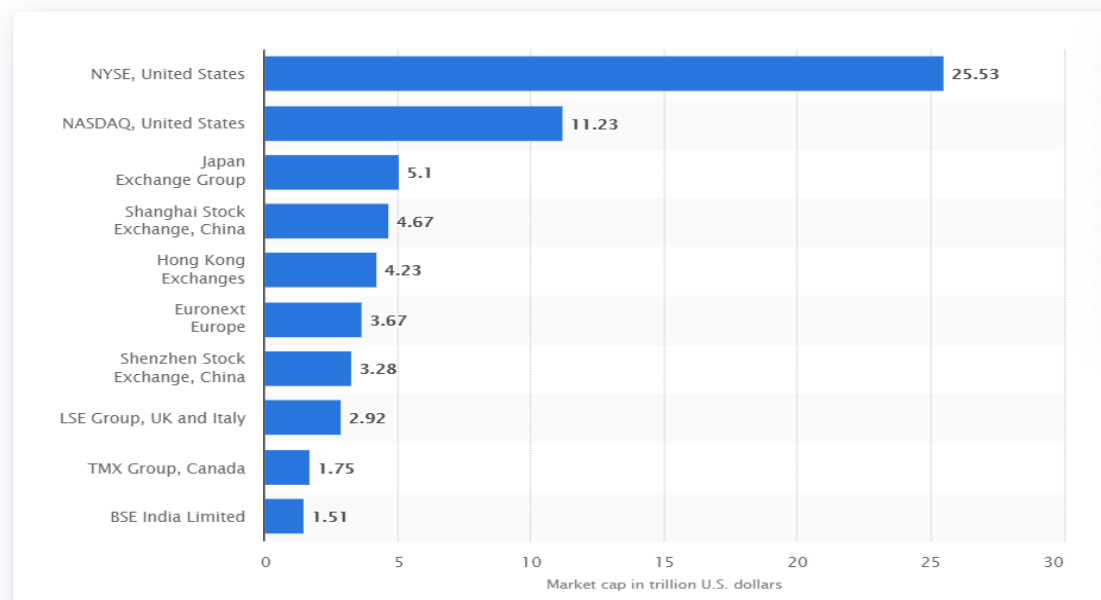
2. Financial markets and exchange traded funds

2.1. Background of stock exchange

The financial market is an important part of the economy. A proper starting point for considering the financial market is to understand its core issues. Currently, it is impossible to imagine the functioning of the economy without an efficient financial system, which is its main element. This system enables the financial needs of individual participants to be met, and it also enables financial transactions between them. The key institution of this system is stock exchange. With time and new technology exchanges became possible internationally and digitally, among many countries and time zones at once. Currently, there are about 144 stock exchanges around the world, where international and domestic companies may be listed ("List of Exchanges" 2020). Appendices I and II show the number of companies listed on stock exchanges per country in 2019. Appendix II specifically concerns data from the U.S., as data from the World Bank excludes it. Below, Table 1 as well as Graph 1 show the largest stock exchanges worldwide ranked by market capitalization for 2020. Both sources show NYSE, Nasdaq, and Japan Exchange Group as the 3 largest stock exchanges. Graph 2 depicts the largest stock markets as a statistical distribution

in 2020. Finally, Graph 3 shows the number of stocks traded worldwide as a percentage of GDP, from 2000 to 2019.

Graph 1: Largest stock exchange operators worldwide as of March 2020, by market capitalization of listed companies (in trillion U.S. dollars)



Source: https://www.statista.com/statistics/270126/largest-stock-exchange-operators-by-market-capitalization-of-listed-companies/

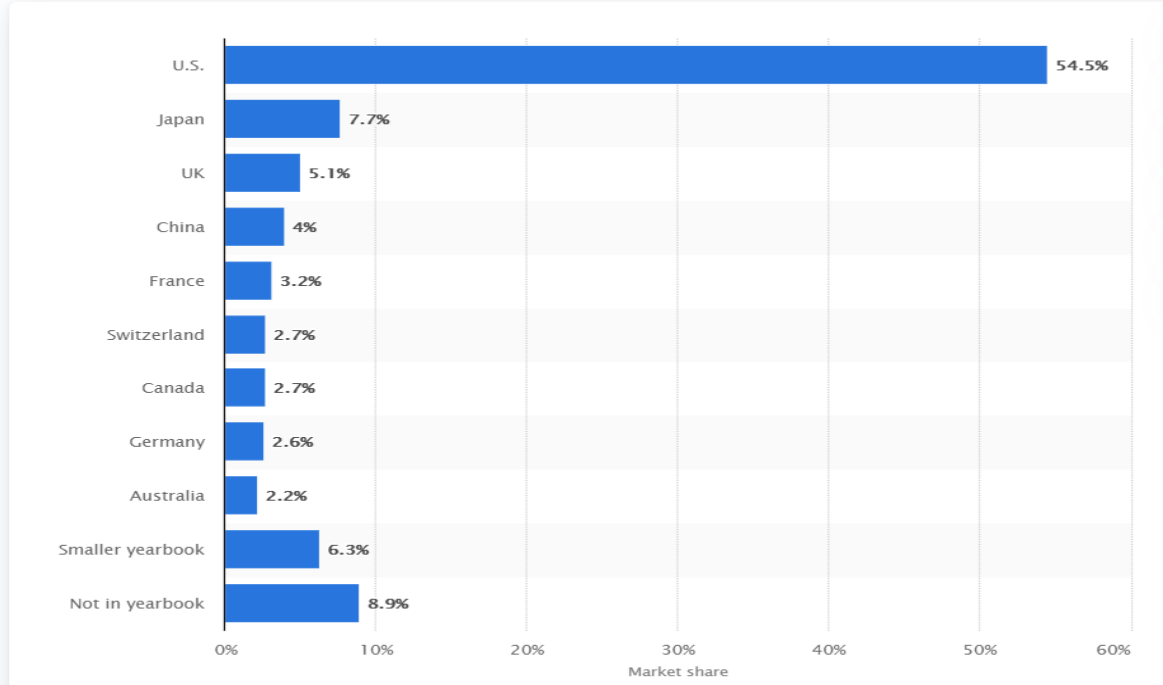
Table 1: Largest stock exchange operators worldwide as of April 2020, by market capitalization of listed companies

Rank	Exchange	Market Value
#1	NYSE	$28.19T
#2	Nasdaq	$12.98T
#3	Japan Exchange Group	$5.37T
#4	Shanghai Stock Exchange	$4.92T
#5	Hong Kong Exchanges	$4.48T
#6	Euronext	$3.85T
#7	Shenzhen Stock Exchange	$3.49T
#8	London Stock Exchange	$3.13T
#9	Saudi Stock Exchange	$2.15T
#10	TMX Group	$1.97T

Market capitalizations as of April 2020

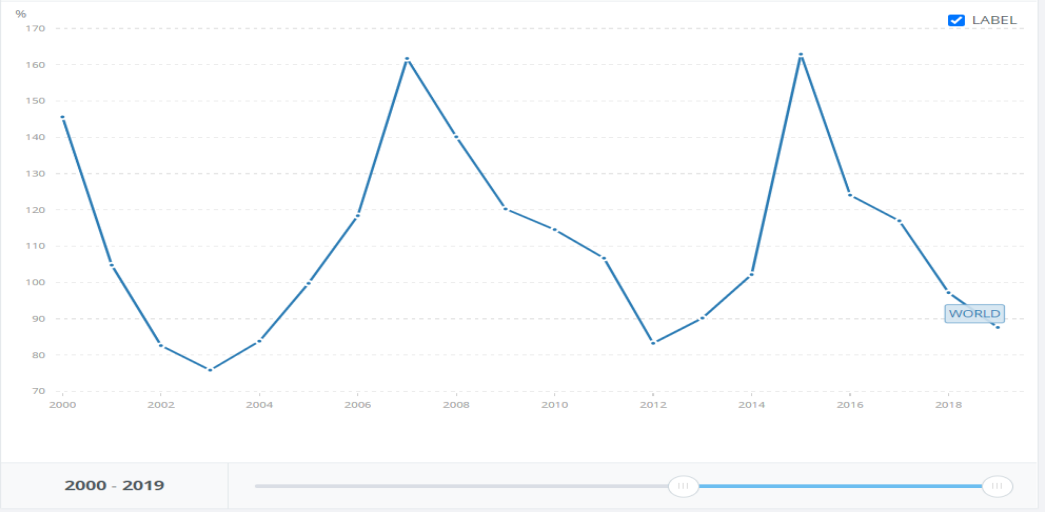
Source: https://www.visualcapitalist.com/the-worlds-10-largest-stock-markets/

Graph 2: Distribution of countries with largest stock markets worldwide as of January 2020



Source: https://www.statista.com/statistics/710680/global-stock-markets-by-country/

Graph 3: Stocks traded, total value (% of GDP)



Source:
https://data.worldbank.org/indicator/CM.MKT.TRAD.GD.ZS?end=2019&start=2000&view=chart

2.2. Exchange traded funds: overview

Besides many instruments being traded on exchanges, there are also investment structures that may be listed on an exchange, and these are known as exchange traded products (ETP). Exchange traded

products include exchange traded funds (ETFs), exchange traded commodities (ETC), and exchange traded notes, to list a few of the main instruments. They are built to track underlying securities such as indices or any chosen instrument. The prices of ETPs are derived from the tracked underlying assets while at the same time being subjected to price fluctuations from trades on exchanges.

Now for the available investment securities that exist, there are a number of ways that one may invest in them. Investing is the willingness and ability to allocate capital (in this case cash) with the purpose of achieving profits (return on the investment). Investing usually amounts to purchasing financial instruments, however there are also multiple investment vehicles where one can allocate their money. The most common investment vehicles are funds, which operate as businesses. Within a fund, the fund manager allocates the capital that is pooled together for investments. Within a fund there may be multiple sub-funds, umbrella funds, asset classes, etc. or other fund structures. A fund may follow any number of investment strategies, where usually each sub-fund is dedicated to a specific strategy. Usually, the main aim of the fund manager is to use the most profitable strategy. However, there are different investment styles. These include growth investing, value investing, market capitalization, active, passive, buy & hold, indexing.

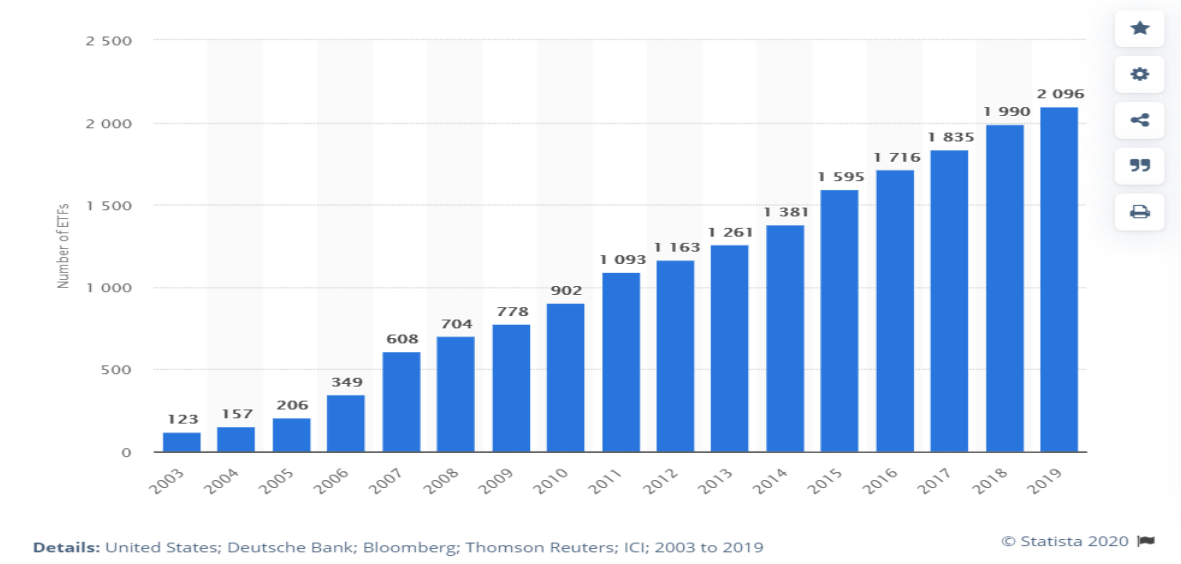
The first mutual fund to be created in modern day investing was the Massachusetts Investors Trust, started in March 1924. The fund went public in 1928 and became known as MFS Investment Management ("The History of Mutual Funds.", 2019). Mutual funds are the most common type of actively investing investment funds. They pool capital together and a fund manager allocates the capital as according to a chosen or constructed investment strategy. Other types of investment funds are hedge funds, index funds, money market funds, and exchange traded funds. Hedge funds are much riskier funds than mutual funds and are not as widely available. They are usually only available for institutional investors and are known for using leverage in order to increase returns and profits. Index funds share quite a few similarities with ETFs and will be discussed in more depth later on. Money market funds are usually short-term funds that focus on money market securities – as explained earlier – mainly government issued debt. Finally, exchange traded funds will be the focus of this paper and will be discussed in detail.

Exchange traded funds were chosen as the focus for this research as they are a prominently growing security on the U.S. exchange markets. Since 2010 to 2019, the number of ETFs has grown by 1,194 in the U.S. alone (which is around 133% growth). Worldwide however, ETFs have grown

by ~ 180% from 2010 to 2019. Assets under management have also grown by spectacular amounts. However, year-to-year growth shows ~ 371% worldwide and ~ 343% for U.S. ETFs (Statista, 2020). Compared to mutual funds, ETF growth is spectacular, however this is also due to the fact that it is a much newer concept than mutual funds. Assets under management of mutual funds in the U.S. grew by ~ 79.97% and the number of mutual funds grew by only 5.28% since 2010 until 2019 (Statista, 2020). It should also be noted that the number of mutual funds varies year-to-year in the U.S. and is not constantly growing.

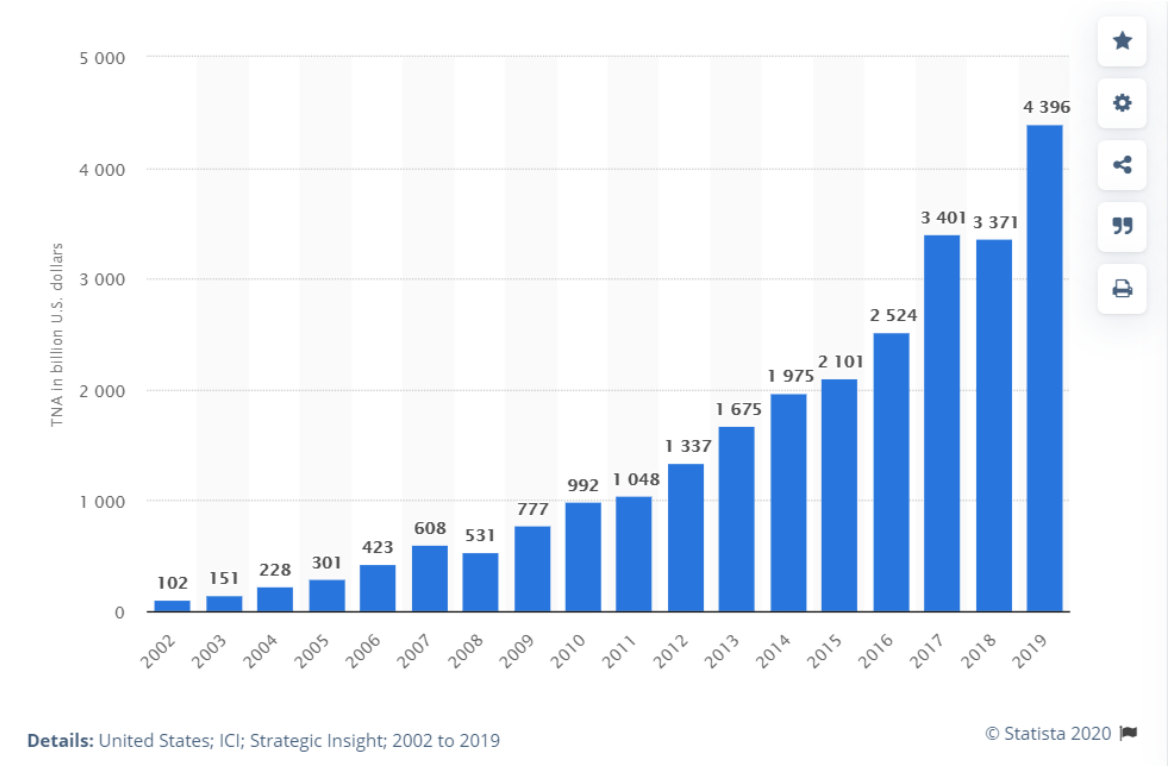
The first ETF was founded in 1993, the SPDR S&P 500 ETF (SPY); it will also be looked at in the data analysis chapter. The ETF was successful in launching as the Securities and Exchange Commission (SEC) allowed it exemptive relief from a number of provisions of the Investment Company Act of 1940 (1940 Act) that otherwise prohibited the ETF structure (Investment Company Institute, 2020). Two almost-ETFs tried to launch in 1989 and 1990, in the U.S. and in Canada, respectively, however were denied due to being ruled as too similar to futures contracts ("The 26-Year History of ETFs, in One Infographic.", 2020). Until 2008, the SEC granted approval for index-tracking ETFs, and since then, began to allow actively managed ETFs. There were around 320 active managed ETFs approved under the 1940 Act as of the end of 2019. Moreover, as of the end of 2019 there were around 1,708 index-based ETFs (in the U.S.). The growth in ETFs in the U.S. can be seen in Graph 4 below. Graph 5 shows the total assets under management for ETFs in the U.S. from 2002 until 2019.

Graph 4: Number of ETFs in the U.S. from 2003 to 2019



Source: Statista

Graph 5: Total net assets of ETFs in the U.S. from 2002 to 2019



Source: Statista

Exchange traded funds, from their inception in the 1990s, have grown significantly over the last few decades. ETFs were introduced in the United States in 1993, with the first ETF being Standard & Poore's Depositary Receipts (SPDR, with the ticker SPY), which tracks the S&P 500 index. Their popularity can be credited to many factors, however ones that stand out include low costs of management and high diversification opportunities. Lower costs are due to ETFs following a chosen number of securities, thus differentiating ETFs from highly active managed funds. The base idea is to follow a construct, such as an index, that already exists and to allow investors the ability to invest, for example, in one basket of goods as buying a share in the ETF. This is also the reason why an ETF is highly diversified. It invests by buying shares of a number of securities intending to follow an index, and in turn its portfolio has a high number of different securities that instantly gives access to any one investor in the ETF to those underlying assets. The diversification is greater than for other funds since it is most usually passively managed, and specific securities

are not hand-picked, but are already based on some existing construct. Additional characteristics of ETFs are the ability to sell short[1] as well as use leverage[2].

At this point, it would be worth mentioning that ETFs exist on both capital and money markets, although there are many more of them on the capital market, where the primary and secondary market for them exists, as will be explained further on. For the money market, ETFs are a source of safety and preservation of capital in case of a turbulent market.

Further, exchange traded funds, similarly to mutual funds, are ones that are a collection of capital deposited by investors – to be precise, a gathering of liquid assets (i.e. cash) to be invested. A large aspect that differs most ETFs from mutual funds is the formers' largely passive investment style – ETFs typically seek to follow a given index. However, ETFs may focus their investments on many different areas, and moreover, may choose any given index to follow, they may invest in equities, bonds (fixed income), derivatives, and/or any other instruments. In order to make the investments more significant for investors, leverage is often used. The outline and specific investment objectives as well as restrictions are described in the (statutory) prospectus[3] of an ETF (U.S. Securities and Exchange Commission, 2017). Some U.S. ETFs may also publish summary prospectuses, that would be a much shorter document and serve as an outline of the statutory prospectus. U.S. ETFs that are on European Union (EU) or European Economic Area (EEA) exchange markets must also publish the second best official document, that is the Key Information Document (KID) or the Key Investor Information Document (KIID). It is a two-page document summarizing the most important information contained in the prospectus required by the Undertakings for Collective Investment in Transferable Securities Directive (UCITS) EU law (*COMMISSION REGULATION (EU) No 583/2010,* 2010). However, it is definitely not the document to rely on when making investment decisions because of its cursory nature.

In order to understand how ETFs function, the structure of these investment vehicles should be discussed. First of all, an exchange traded fund is a type of investment fund. It is often compared

[1] Selling short occurs when a drop in prices is anticipated, and is the act of borrowing securities with the purpose of selling them and then buying them back at a lower price (gaining profits and returning securities to the owner)
[2] Leverage is the act of increasing the value of an investment through borrowing funds and investing funds that are not owned with the objective of a larger profit (and the return of the borrowed funds after the investment closes)
[3] The prospectus is an official fund document that specifies the type of the fund, the investment objectives, the investment restrictions, fee tables, financial highlights information, the currency of the fund, the approach to various types of calculations with regards to the investments of the fund, and many more. It is the most specific document available to the investor (and oftentimes to the public as well). It is usually published at the inception of a fund and re-published (updated) when new sub-funds within a fund begin their activity.

or presented as similar to traditional stocks and shares; however, it is not one piece of stock or share as a traditional one is, but a collection of various stocks and shares. The comparison has some reason as to the characteristics of both stocks and ETFs, however at the core they are very different. There are also many other funds that ETFs resemble, and these will be discussed here. First of all, an ETFs most specific characteristic is that it may be traded on stock exchanges throughout the day. This fact makes it similar to closed-ended funds. The characteristic that they carry from mutual funds is that the valuation is done at the end of a trading day, and the price that the ETF is traded at is usually quite close to its net asset value (NAV)[4]. In contrast, the price of a closed-ended fund may be at a significant premium[5] or discount[6] from its NAV. This solely depends on the market perception and market mechanisms. Nevertheless, as an ETFs price may be slightly deviated from its NAV, it will usually be a much smaller deviation than that of a closed-ended fund. This is due to the fact that ETF shares may be redeemed in exchange for a basket of the funds underlying assets, therefore its NAV is closely related to its market/trading price. Due to this difference in price, and the fact that ETFs stock may be purchased on an exchange, there may appear opportunities for arbitrage. In a frictionless market, an ETF would be priced at its NAV. If the ETF price would differ from its NAV, riskless and obvious arbitrage opportunities would exist. How ETF arbitrage works and how the opportunities appear exactly will be discussed further on in sub-chapter 2.4.2. Market Efficiency.

Considering the various investment fund types that exist, ETFs mostly behave as both closed- and open-ended investment funds. What makes exchange traded funds resemble closed-ended funds (CEFs) is that they may be bought and sold throughout a trading day as normal stock on any stock exchange. They are treated as listed securities. Closed-ended funds are ones where shares are sold to investors, also called subscriptions, and are only made at the inception of the fund, similar to stock issuances at initial public offerings (IPOs). Once purchased, shares may be traded on a given stock exchange, however they are not repurchased by the closed-ended fund. They may be resold and available on a secondary market. In contrast, open-ended funds (which are most mutual funds), may be subscribed to during the lifetime of the fund; there is no prohibition on additional subscriptions, however there may be restrictions. This allows investors “additional”

[4] The NAV is most popularly calculated as the net liabilities subtracted from the net assets.
[5] A security is said to be trading at a premium when its NAV is less than its price
[6] A security is said to be trading at a discount when its NAV is higher than its price

access to open-ended funds; i.e. opportunity to invest or withdraw at any chosen point in time. The operation of closed-ended funds is simply the opposite.

Besides ETFs resembling other fund types, there are also various ETF types that should be discussed. These are branches or spans of ETFs that possess most of the same characteristics, but then have a specific focus or investment purpose that differs from a "traditional" ETF. These constructs will be discussed next.

Additional characteristics of ETFs are the ability to use leverage. Moreover, besides ETFs being able to use this financial instrument, there are also specific exchange traded fund types within the ETF scope that exist. Two of these are leveraged ETFs and inverse ETFs. A leveraged ETF would use derivative instruments, such as swaps, forwards, futures, and more (such as exotic and more complex options, swaptions, etc. that are not the subject of this paper however it is noted that they exist in the market and may be used by certain ETFs) in order to gain multiplied profits (which could also turn into multiplied losses). It relies on multiplying ETF movements, which in turn increases the volatility, and in turn the respective gains or losses. An inverse ETF relies on investing oppositely to the movement of an underlying asset. Therefore, it avoids selling short and profits inversely to the performance of the index, that is, when that performance is declining. Various derivatives are used to reach the desired results and build the appropriate trading mechanisms. This type of ETF serves as an alternative to short selling securities and is also called a "Short ETF".

2.3. ETF structures

Presenting the ETF structure, it is necessary to go more deeply into master-feeders and asset classes. Master-feeder fund structures are not specific to ETFs; however, it should be mentioned that they can also be utilized by ETFs. The master-feeder structure is characterized by the main fund (master) and an umbrella of sub-funds, or "feeder" funds. Usually, the feeder funds invest all of their assets into the master. However, it may be that there is a specified percentage of the NAV that must be invested into the master-fund, and the rest may serve for other investment purposes, however this is quite rare. The point of this structure is that a larger amount of liquid assets is pooled together and transferred to the master. This allows for advantages such as economies of scale[7], favorable tax treatment, as well as reduced operation and trading costs. The main

[7] Saving costs due to increased level/size of operation

disadvantage is the "universal" investment strategy, that is all pooled funds face the same risks and opportunities for profits or losses (*U.S. Securities and Exchange Commission*, 2019).

There are a number of asset classes that ETFs may choose to focus on and invest in. The main asset classes are cash, equities, bonds/fixed income, property (real estate), commodities, alternatives, currencies, multi asset (diversified portfolio), volatility. Just as there are numerous asset classes, there are also many different investment focuses. Securities, including ETFs, may also be subdivided into industry sectors, regions, and size. Furthermore, ETFs may also focus on targeting different types of investing styles. These include value investing, growth investing, income investing, to list a few.

As per U.S. law, ETFs may also be registered as unit investment trusts (UIT). Therefore, a short explanation follows. A UIT usually will make a single public offering for a specified and fixed amount of units. The date of dissolution and termination of the UIT is decided upon its creation. Despite this, long term UIT's exist, some spanning even over 50 years after creation. The main characteristic of UITs is that they do not actively trade their investment portfolios (U.S. Securities and Exchange Commission, 2017). The main goal is to provide either capital appreciation or dividend income.

Commodity ETFs are funds that focus on investing in commodities. Commodities include physical goods such as gold, oil, metals, agricultural goods (livestock), to list a few. They may specialize in one good or many goods. However, it is more common to specialize in one good and moreover, hold this good in storage. Furthermore, commodity ETFs may also specialize in investing in futures (or other derivative instruments) on commodities. Finally, there are also commodity ETFs that track commodity indices (or one index more commonly) and intend to replicate a given index. Commodity markets are in general difficult to access, and commodity ETFs make this easier and accessible.

In fact, there are also exchange traded commodities, or ETCs. These stem from commodity exchange traded funds, except they do not specialize in derivatives, only commodities (goods) as well as tracking commodities or commodity baskets. An important characteristic of an ETC is that it is a debt instrument that a bank underwrites. Physical commodities are used as collateral for the given debt security. The physical commodities are bought using cash from within the ETC. Using assets as collateral allows the ETC to have lower risk if the debt security defaults. An exchange traded note (ETN) behaves similarly, which will be mentioned next. An ETC is a mix between an

ETF and an ETN. As opposed to an ETC, an ETN does not have physical collateral holdings. However, it has the same note structure, therefore it is susceptible to defaulting. It is in fact commonly compared to a bond type security. The ETN usually tracks an index, and at maturity will pay the return of that index.

2.4. Differences between ETFs and index funds

What is worth discussing is also the difference between ETFs and index funds. This is another type of fund that is attached/connected to the overall description and definition of an ETF. While at first glance the two may seem similar, they do have significant differences. In essence index funds follow a chosen index, while ETFs as a whole may choose to follow or replicate any traded financial construct of choice, such as funds, commodities, but also indices.

To reiterate, index following ETFs are built directly to replicate a benchmark index. There are synthetic replication and full replication ETFs. Synthetic ETFs replicate the performance of an underlying index using derivatives, such as total return swaps. Full replication on the other hand directly follow an index using the securities that make up a chosen index. The structure of such an ETF relies on holding or investing in the same securities that make up a given index, which allows the ETF to follow the index. The ETF not only aims to follow the price movements of a chosen index, but also their performance and returns (before taxes and expenses). What differs between various funds that track indices is their NAV. Not every fund will have the same amount of funds (cash) to work with, therefore the exposure to the benchmark index will differ. This is part of the reason why closing prices of a chosen index and an ETF tracking that index will not be the same, they will differ quite significantly. In essence, the market value of the benchmark index will be much larger than the ETF that tracks it. The ETF owns only parts of given securities and tries to replicate the segmentation as closely as possible, while the index merely lists percentages of securities that it is made up of. It follows that the market value of the ETF will not equal that of the index. Additionally, not the same amount of funds will be invested in the securities of the chosen index across different ETFs, even if they follow the same index.

However, in contrast to the above, the percentage of the NAV (weight) invested in a given security off of the benchmark index should be very similar to the index percentage itself. In fact, a 1:1 replication is the aim of such an index ETF portfolio. This requires a proportionate amount of the NAV to be invested in the securities of a chosen index in order to mirror the percentage of that index. The main advantage and purpose of index ETFs is that they give access to multiple

securities in essentially a single transaction. Moreover, the portfolio should be made up of as many securities as the actual index contains. Therefore, investing individually in each security would be highly difficult. It is also important to note that despite index ETFs investment objective, it may not be possible to fully replicate an index at all times. This is due to transaction costs, securities being unavailable on secondary markets, rebalancing of index securities, as well as taxes. A significant characteristic of index ETFs is that they are completely passively managed, that is the asset allocation only changes when changes are made in the underlying index.

2.5. Liquidity and Market Efficiency

Liquidity

ETF liquidity is based on trading volume and regularity, similarly to individual stocks. However, ETF liquidity can also be investigated at a further level, which pinpoints another specific characteristic of ETFs. This important distinction to be discussed within ETFs is the issuance on the primary versus on the secondary markets. The secondary market is the more known market to retail investors. Here, investors trade the already existing ETF shares, and trading is based on a demand-and-supply basis. The liquidity at this stage is defined by the volume of trades, as well as other factors such as discounts, premiums, or the bid-ask spread[8]. For the purpose of this research, the focus will be on secondary market prices. On the other hand, at the primary market level, ETF shares may be created or redeemed. This is done through an authorized participant (AP). An AP is an entity that is essentially in charge of creating and redeeming ETF shares and maintaining the prices of an ETF and its underlying shares at the same level (in order to battle arbitrage opportunities, which still do appear as discussed previously). Moreover, they are able to identify whether shares may be created or redeemed, based on whether the NAV is at the same level as the value of the underlying basket of securities.

When the NAV of an ETF is lower than the price of underlying assets (trading at a discount), an AP will reduce the ETF shares available on the market. Conversely, if the NAV is higher than the price of underlying assets (trading at a premium), an AP may increase the number of ETF shares available on the market. Creation and redemption are usually done with (and as a result of) very large orders, that are not at a usual level of trading volume. In order to create shares, an AP would obtain the necessary underlying assets weighted by market capitalization and

[8] The bid-ask spread is the difference between the buy and sell prices of a stock (or in this case an ETF)

in line with the investment policy and objectives of a given ETF. The AP then "hands" these assets to the ETF sponsor and in return receives newly created and equally valued ETF shares. The AP is then able to sell these shares on the secondary market. In effect, there is downward pressure on the ETF price, a potential increase of the NAV, which reduces the premium. On the other hand, the redemption process intuitively works in the opposite way. An AP buys ETF shares and exchanges or redeems them for a basket of the underlying assets from the ETF sponsor. Following, the AP can sell the underlying securities on the market. In turn, positive pressure should be exerted on the ETF share price. A potential decrease of the NAV should also occur, which would reduce the discount. An AP is not paid or financially compensated in any other way for their contribution in this process. However, AP's are the ones who mostly benefit from price differences and arbitrage opportunities within ETFs. Therefore, there is a mutual payoff and benefit for both parties involved. Additionally, there may be more than one AP involved with the creation or redemption of shares for an ETF, depending on the ETF size, market focus, etc. Without the AP mechanism in place, ETFs would begin to resemble closed-ended funds, which were discussed previously (Voros, 2020).

One of the most important definitions in terms of specifications relevant to ETF's is the tracking error. The tracking error is the difference between the price of a given portfolio (in this case an ETF portfolio) and the price of a given benchmark (for the purposes of this paper, largely the S&P 500 index). The effect of such a difference would usually result in an unexpected profit or loss. In essence, the lower the tracking error, the better, the more consistent returns (in theory). However, in practice, as stated, unexpected profits may be realized. Although, the lower the tracking error, the closer a fund is to replicating or following a chosen index. Tracking error is often presented as the standard deviation in percentage terms, that is the difference between the return an investor receives and that of the chosen benchmark that was to be followed. Usually a high expense ratio may affect the tracking error negatively. More specifically, the management expense ratio (MER)[9] may cause a higher tracking error, due to higher management fees, especially in actively managed funds. However, because ETF fund fees are generally lower than actively managed funds, mutual funds, and such, these should not affect the tracking error too much. What may have an impact on ETF tracking error is whether an ETF is sector-focused or specializes in

[9] The management expense ratio is the ratio of total fund costs to total fund assets; the ratio is rather stable over time, and aims to measure how much of a fund's assets are used for operating expenses.

a specific chosen area. For example, sector, international, and dividend ETFs tend to have larger tracking errors because they hold more illiquid or thinly-traded securities. On the other hand, equity and bond ETFs tend to have lower tracking errors. Other tracking error deviations may be caused by diversification constraints, overaccumulation of cash (also known as cash drag[10]), changes in benchmark indices (updating a portfolio generates transactions costs). On the other hand, security lending (in order to hedge funds for short selling) may be used to decrease the tracking error by using the collected lending fees.

Market Efficiency

Firstly, market efficiency is largely based on the efficient market hypothesis, which states that prices of securities in the markets should fully reflect all available information (Mishkin, 2014). When this statement does not hold, opportunities to exploit the markets and make profits appear. These opportunities are caused by returns on securities being larger than what are justified by market information and the characteristics of those securities.

As a relevant aspect of market efficiency, ETF arbitrage opportunities should be explained in depth. First of all, arbitrage is defined as taking advantage of (and at the same time eliminating) unexploited profit opportunities (Mishkin, 2014). As mentioned previously, arbitrage opportunities exist throughout the trading day, specifically due to the differences in the ETF share price and its respective NAV. There may be both risk-free and risky arbitrage opportunities. Besides AP's who take advantage of this profit opportunity, hedge funds and high-frequency traders are two other market participants that are motivated to do so. In contrast to AP actions concerning arbitrage which are mostly done within the creation or redemption processes, the other two parties focus on the profit opportunities in the secondary market, on any relevant exchange. However, it should be mentioned that ETF arbitrage on an exchange is not arbitrage in a strict sense, since there is still some speculation and profit is not guaranteed. However, ETF sponsors publish NAV values at 15-second intervals, allowing various parties to take advantage of this information with regards to market data and prices of underlying assets. This intra-day NAV is also called an intraday indicative value (IIV) or intraday operative value (IOPV), which are both unique to ETFs (The Office of Investor Education and Advocacy, 2012).

[10] Cash drag happens when a fund holds too much cash at once. It is caused by overnight balances, trading activity, early maturing securities, creations of shares, dividend payouts, and lags between receiving and reinvesting cash.

To continue, in these cases an interested party would purchase the cheaper security and short sell the more expensive one and hold positions until the prices meet. At this point the positions are closed, and any potential profit may be realized. An exception to the described creation and redemption mechanisms is for synthetic ETFs. These ETFs handle redemptions and creations with cash. However, arbitrage in the secondary market (on a given exchange) occurs as normally. Itzhak, Franzoni, and Moussawi (2018) also discuss the reason for the frequency of 15-second NAV values, which concerns the smooth functioning of arbitrage, and is what allows ETFs to have low tracking error. This will also be discussed further in the literature review.

2.6. Regulations

Related to ETF market efficiency are ETF and overall financial regulations, which allow for regulatory parties to regulate or supervise the activity of financial institutions, funds, actors (individuals), and any other parties participating in the financial markets. Generally, each country or nation has its own regulatory body, however unions or groups of nations, such as the EU, also have their own regulatory organization that all member states must abide by. Non-governmental organizations may also be in charge of this. The aim of such measures should be quite obvious, however the main goals are to manage the stability and integrity of markets and the financial system, as well as pose guidelines, requirements and restrictions for all to follow, creating an ideally fair and symmetrically informed environment. Asymmetry of information[11] plays a great role here and is usually part of the reason why regulations exist (due to misuse of "powerful" information and knowledge, which lead to unfavorable situations, crises, such as the 2008 financial crisis, and more). For the purposes of this paper, applicable U.S. Regulations will be focused on.

The three main acts that U.S. ETFs are under the jurisdiction of are the Investment Company Act of 1940, the Securities Act of 1933, as well as the Securities Exchange Act of 1934. However, these Acts provide exceptions to the rule for commodity- or currency- related ETFs. Neither of these two types are regulated by the aforementioned Acts, as these ETFs are commonly not registered investment companies. All three Acts are general forms of law regarding the U.S. financial market, not ETFs specifically. Besides these Acts, ETFs are largely unregulated (The Financial Industry Regulatory Authority, 2020). However, up until December 23, 2019, ETFs that

[11] Asymmetry of information is also called information failure; it is divided into two areas: adverse selection, which exists before a potentially risky transaction occurs, and moral hazard, which concerns potential risk factors after a transaction occurs

wanted to enter the U.S. financial market had to apply for an exemptive order under the Investment Company Act. In September 2019, the SEC issued Rule 6c-11, which allows ETFs to enter the market immediately, without the previous exemptive order process. Again, the rule is applicable to ETFs structured as open-end funds. The main point of this new rule was to provide lower barriers to entry for ETFs. Not only does this include lower costs of entering the U.S. market but also saves time (*U.S. Securities and Exchange Commission*, 2019). Furthermore, as demand for ETFs largely exists, regulators implemented this rule to allow for regulatory modernization and higher competitiveness between ETFs. In turn, investors will have more investment options. Despite the many advantages of this Rule 6c-11, there are still many previous restrictions that apply. As mentioned earlier, "ETFs organized as unit investment trusts (UITs), leveraged or inverse ETFs, ETFs structured as a share class of a multi-class fund, and non-transparent ETFs will not be able to rely on the rule" (*U.S. Securities and Exchange Commission*, 2019). Additionally, the Master-Feeder structure is also rescinded by the new rule, with the exception of existing structures. Moreover, amendments to forms are made in order to consolidate the process and allow for more unity and clarity of information. Fund of funds structures are allowed by the new rule as before. There are three main conditions outlined by the SEC with regards to the new rule. The first is portfolio transparency on a given ETFs website. The next condition states that an ETF may adopt custom baskets of securities through clear policies and procedures (listed in the ETF prospectus). Finally, the last requirement states that ETFs must disclose information regarding premiums, discounts, and the bid-ask spread. These should allow investors to familiarize themselves with the cost of investing.

In the described context, taxes and dividends play important roles. ETFs usually pay out dividends every quarter, however there are also funds that immediately reinvest issued dividends. Depending on the type of ETF, tax requirements differ. Because ETF taxation is such a dense topic, it will not be discussed in depth here, however merely it is enough to mention that taxes are primarily and most importantly collected on profits from ETF investing, similarly as with other investment structures. ETFs are generally more tax efficient than other investment funds because they can create and redeem shares without being taxed for this. In essence, they have lower capital

gains[12], because they have less turnover[13], and are therefore more tax efficient (Voros, "Why Are ETFs So Tax Efficient?").

3. Literature review and research question

3.1. Literature review

First of all, there has been significant empirical research published on this topic, from time series analysis to panel data models. The data is studied from different angles – looking at returns internationally as well as by region, in different types of markets, for example both emerging and developed. The literature on this topic is quite recent, yet very thorough. Despite this, there are always different ways to approach a given topic. Here, the new aspect will be examining this complex relationship with data from the United States. Through studying the various literature on exchange traded funds, it will be possible to form a hypothesis based on the relevant research.

Despite this, literature on ETFs is still rather scarce. There are many aspects of ETFs studied, however many are robust just in single areas or are limited in depth. The focus of this paper is the liquidity and volatility of ETFs. Therefore, the literature reviewed also covers this topic. However, not all research covers the same securities, the same timeframes, or the same concepts regarding ETFs. Despite this, a lot of research on ETFs is used as a framework to form the hypothesis and research question for this paper. Therefore, many different aspects of ETFs are in fact relevant.

Itzhak, Franzoni, and Moussawi (2018) are perhaps the most crucial piece of research that this paper relies on. Itzhak et al. discuss whether ETFs increase volatility, along with other theories and observations of second importance. They point out how ETFs have become a sort of financial instrument that may be compared to futures and futures markets. The comparison is that there is an ongoing "debate on the effect of derivatives on the quality of the underlying securities' prices", with conflicting views. A similar conclusion can be drawn about ETFs and the underlying securities' prices. However, this study supports the theory that ETF ownership does affect underlying stock price volatility. The study concludes that "a normal shock to ETF ownership shifts the volatility of the median stock in the S&P 500 to a place that is between the 55th and 64th percentiles". Further it discusses the effect of arbitrage on the (low) tracking error of ETFs and

[12] Capital gains tax is the tax on profit realized on the sale of a non-inventory asset
[13] Turnover is also known simply as revenue

high trading volume. From the conducted analysis, they find that about 93% of trading volume is accounted for by secondary market volume, including primary market creations and redemptions.

The data they use in their research comes from the Center for Research in Security Prices (CRSP). The focus remains on U.S. and U.S.-traded ETFs. Only full replication index funds are explored, whereas synthetic (derivative focused), leveraged, inverse-leveraged ETFs are not included in the data. The final data set contains 454 equity ETFs, from January 2000 to December 2015, which cover around 97,1% of all U.S. equity ETFs during the sample period. To compute daily market capitalization and to calculate daily creations and redemptions they use total shares outstanding at day-end. Daily volatility of stocks (underlying of ETFs) at a monthly frequency is calculated using the standard deviation of daily returns over a month. For some analyses they also use intraday data to calculate volatility at a daily frequency. The main hypothesis states that ETFs are a catalyst for liquidity trading, and that the change in ETF prices transfers to the underlying stocks prices through arbitrage. Therefore, as has been said before, stocks with higher ETF ownership should have higher volatility, which has been named "the liquidity trading hypothesis". There are two other hypothesis that contradict the first one. Finally, the study concludes that demand shocks caused by ETFs affect the market, which causes higher volatility for the underlying stocks. More specifically, the research shows that stocks with higher ETF ownership have higher volatility than otherwise similar securities. In turn, this creates a type of systematic risk that is partly non-diversifiable. In order to diversify it, one should consider buying ETF shares. In effect, this means that ETF ownership creates a risk premium and actually produces high alphas, shown by analyzing portfolios with stocks with high ETF ownership.

In relation to the above, Andrei and Hasler (2015) discuss the effect of investor attention to stock market volatility. Investor attention here may also be defined as where an investor chooses to allocate his money. The model that they build shows that volatility and risk premium increase with attention and uncertainty. They also find that "risk-premium volatility, risk-free rate volatility, and volatility of return volatility are larger in the dividend-driven attention case than in the consumption-driven attention case" because volatility of consumption surprises are two times smaller than those of dividends.

Similarly, Wang, Huand, and Padmanabhan (2016) study the U.S. ETF markets, and more specifically the effects of volatility divided into two parts: transitory and permanent. Permanent volatility is defined as the long-term trend volatility, while transitory is one that deviates (appears

above or below) from the trend. They focus on trading volumes and variance (as the volatility measure) for five chosen exchange traded funds. They select ETFs with different investment focuses, including equites, bonds, and commodities. The five ETFs include SPY, GLD, XOP, DBA, BLV[14]. The data used is daily returns for the time period from October 2007 to May 2012. The results of the research show that expected and unexpected volumes both impact permanent (long term) volatilities more significantly than they impact transitory (short term) volatilities. Although the data set was meant to provide a deeper insight into the differences between transitory and permanent volatilities for ETFs with different investment types and focuses, in fact the results were similar for all. Despite this, the impact of transitory volatility lasted the shortest for the equity ETF. Following, the higher effects in order were on agricultural, oil, gold, and bond ETFs (with the highest impact). In contrast, permanent volatility seems to have the highest impact on commodity ETFs. Therefore, a possible trading strategy could be constructed based on these results. Further, unanticipated information flows (that is, the unexpected volume variable) show to be more severe on permanent volatility than on transitory. In all, they also find that investors may make profits ranging from 0.5% to 18.64%, using the information on transitory and permanent volatility differences.

The study is relevant because it provides insight into two types of volatility effects. Moreover, it also looks at a small number of ETFs, and shows that relevant conclusion may be made even from a smaller data sample. They also study the effects of volume, which is significant here as well. They distinguish expected and unexpected trading volumes as normal trading volume for the latter and as a representation of unanticipated information flowing to the market for the former. However, many articles that study the volume and volatility relationship and effects provide mixed results. There is a lot of research that supports the findings of Wang et al., but also a lot that opposes them. This is due to different data analysis models used, as well as different variables and relationships that were examined.

Hughen and Mathew (2009) study the returns of ETFs and CEFs in comparison to the returns of the underlying portfolios. They use 19 ETFs and 19 CEFs that invest in non-U.S. equities. For funds with investments in multiple countries, only the ones with at least 10% of the NAV were

[14] Standard and Poor's Depositary Receipt and Standard and Poor's 500 ETF Trust (SPY), Standard and Poor's Depositary Receipt Gold Shares (GLD), Standard and Poor's Depositary Receipt Standard and Poor's Oil and Gas Exploration and Production ETF (XOP), Powershares DB Agriculture Fund (DBA), Vanguard Long-Term Bond ETF (BLV)

looked at. Panel data was used in order to find which factors influence each other, looking at underlying country (UC) index, exchange rate, NAV, S&P 500 index, and close price. A VAR regression was run to find the forecast error variance caused by the different variables. The variables are run exactly in the order as listed above, in line with previous research and models that are discussed in the literature review. Most of the variables turn out to be exogenous, as above 90% for each one explains its own variance. The results show that ETFs are priced more efficiently than CEFs, which is shown by the results of innovations in the NAV. For the ETFs, 78% of the forecast error variance is explained by innovations in the NAV, while for CEFs only 54% is explained. Furthermore, results from impulse response functions showed how fund share prices are affected by shocks in the variables listed previously (over the next 5 days following the shock). For CEFs, data showed that "CEFs that invest in foreign equities do not quickly process information on their underlying value". On the other hand, ETFs showed a quick response to the shocks, with a maximum adjustment period of two days (depending on which variable has caused the shock).

There have been many aspects of exchange traded funds studied and researched. Since ETFs have become vastly popular among investors, their strategies, returns, leverage effects, and many more have been studied. For one, Corbet (2012) studied both ETFs and CFDs, a derivative instrument, in an analysis of exchange volatility, efficiency, and liquidity. She finds that large ETF investments are associated with higher volatility, which supports regulatory views that some ETFs have dominant effects on the markets in which they exist. Corbet (2012) concludes that regulation on ETF investments should be more intense based on the conducted research.

Piccotti (2018) discusses the liquidity of ETFs. He recognizes ETFs as a means for investors to have access to a cash flow stream through certain stocks indirectly, while accessing them in another manner would be more costly. The results show that liquidity segmentation can explain why ETFs tend to trade at a premium. Moreover, a trend in premiums is shown and explained, indicating that newly created ETFs trade at a higher premium than older ones. For the data set, Piccotti uses monthly closing ETF share prices and monthly NAV values for 224 iShares ETFs to find that most (89%) of the sample trade at a premium (the mean ETF share prices were higher than the mean ETF NAVs). The period is from March 1996 to December 2011. Data is collected from CRSP and iShares. However, he also postulates that since ETFs provide such a wide access to the market and cash flows (through diversified investing), investors should be willing to buy ETF shares at a premium, "as long as the cost of the premium is less than the liquidity benefits

received". Therefore, the primary hypothesis states that the liquidity benefits of ETFs may explain why ETFs tend to trade at a premium to their NAV. Liquidity segmentation is defined as the NAV tracking error standard deviation (TESD), which is the standard deviation of the difference between NAV returns and returns on the underlying assets, as was explained earlier. More segmented markets have higher barriers to entry and higher illiquidity costs, hence why these ETFs are expected to have a higher tracking error. To conclude, Piccotti finds that investors are indeed willing to pay a premium in order to gain from ETF liquidity benefits, as well as to have indirect access to the underlying assets.

Harper, Madura, Schnusenberg (2006), study the performance of internationally available exchange traded funds versus closed-end funds for 14 countries. The data used is monthly prices (not NAV) for 22 closed-ended country funds, and correspondingly 29 ETFs. The sample period ranges from April 1996 to December 2001. The performance measures that are used as comparison metrics are mean returns and risk-adjusted returns (i.e. Sharpe Ratios). Harper et al. find that ETFs have a higher mean return and higher Sharpe ratios for their data sample. Additionally, CEFs showed negative alphas[15]. The findings indicate that a passive investment strategy in ETFs may outperform an active investment strategy in CEFs. More specifically in regard to the data sample, these results may point to higher risk-adjusted returns in terms of investing in ETFs within an internationally concentrated portfolio.

Similarly on ETF performance, Levy and Lieberman (2013) offer research on U.S. market prices and ETF returns. They study the effects of multiple variables, including NAVs, exchange rates, premiums, discounts, and the S&P 500 Index on the pricing of ETFs. Moreover, they look at the difference between synchronized and non-synchronized trading hours, as well as an intraday versus overnight price updating mechanism. The findings show that there is a difference with regards to the synchronization of trading hours. When trading hours are synchronized, the NAV returns are the leading factor of ETF pricing. However, during non-synchronized trading hours, the S&P 500 index dominates ETF prices.

[15] The alpha describes the ability of an investment strategy to beat the market (perform better than the market) over a given period of time. It is known as the excess or abnormal return – since markets are in theory efficient, as according to the Efficient Market Hypothesis defined by Fama in 1970, Fama (1970). Alpha is calculated as the excess return of an investment relative to the return of a benchmark index, however both must have reciprocal relevance; i.e. an equity fund may not be compared to a fixed income index. The value of alpha may be positive (meaning the strategy beat the market) or negative (where the strategy performed worse than the market). The calculation may be simplified to $R_m - R_f$, where R_m is the return on the market and R_f is the return on a risk free security, such as a U.S. Treasury Bill.

Levy and Lieberman (2013) also partly tie their research to looking at the effects of pricing during synchronized/non-synchronized[16] trading in the U.S. versus internationally. Results show that ETF prices are more sensitive to U.S. market returns when foreign markets are closed, as well as that the S&P 500 index effect on underlying foreign indices is less relevant at that time. This may be in turn related to further research on international effects, as discussed below.

Although this will not be studied in this research paper, it is worthy to mention that an aspect that creates arbitrage opportunities and misses the overlap in markets are the time zones that financial markets exist in. Jares and Lavin (2004) discuss this issue focusing on the US versus Japan and Hong Kong financial markets' trading hours. They find that indeed profit opportunities do exist when looking at the deviations in ETF prices and the value of the underlying securities. In turn, they test a simple trading strategy that utilizes this shortcoming of the internationality of markets.

Hilliard (2014) supports this with her research on ETF pricing with respect to premiums and discounts in ETF prices. The research is also a comparison on U.S. versus international ETF prices. She concludes that national (U.S.) ETFs actually have a very low possibility of arbitrage. Results show that ETFs pricing mechanism is highly accurate. However, internationally, equity and bond ETFs face higher barriers to arbitrage, which ultimately leads to higher long-term premiums in pricing and a longer time of price adjustment.

Further, Krause and Tse (2013) study the effects of volatility in ETF pricing in a comparison of Canada and the U.S. The data focused on is equity ETFs. An interesting aspect is that the findings may be of interest to Canadian market regulators, as Canadian circuit-breakers[17] are affected by U.S. market conditions.

Many researchers discuss the similarity of ETFs to futures contracts. However, another similar security to ETFs are American Depository Receipts (ADRs). ADRs are issued by U.S. depositary banks and are essentially shares of foreign companies. They are an investment opportunity for U.S. citizens to invest in overseas companies that they would not be able to invest in otherwise. However, a main difference between the two instruments is that ADRs are focused

[16] Synchronized trading is when two parties place a buy and sell order at the same time for the same security and same quantity. Circular trades are identified when brokers synchronize trading in order to influence (increase) the price of a security. Reversal trading in effect is when the buyer of the security sells it back to the original seller.

[17] Circuit-breakers in trading are regulatory measures to stop the trading on an exchange. This mechanism exists in order to prevent panic-selling of securities. Given price thresholds are put in place and they detect abnormal trading behavior automatically in order to be able to halt it in a correct period of time.

on the U.S. market, and only provide foreign shares to American citizens, while ETFs circulate worldwide and do not have these restrictions. The main similarity is that there are underlying assets within both instruments. Both are also traded on stock markets.

For one, the relationship between liquidity and the effects of volatility on stock returns has been studied by Ma et al. (2018) on a worldwide scale. Ma et al. studied the interaction between market volatility, liquidity shocks and common stock returns in 41 countries over the period from January 1990 to April 2015. There were 25 developed markets and 16 emerging markets and a total of 37,677 stocks. The developed markets included two are American markets, seven Asia-Pacific, 16 European and Middle Eastern markets. The emerging markets included four Latin American, seven Asia-Pacific, five European, Middle Eastern, and African markets. They find that the effect of liquidity is stronger in markets with higher market volatility, lower trading volume, countries with better governance, no short-selling constraints, more high-frequency trading, and during crisis periods. Stock data is collected in U.S. dollars from Thomson Reuters Datastream. Ma et al. control for stock and market determinants of stock returns, such as idiosyncratic volatility, trading volume, past stock returns, market returns, and market liquidity to find that returns are lower for stocks with higher liquidity sensitivity to market volatility. In fact, many studies find the same results as will be discussed further.

The next theoretical and empirical research comes from Amihud et al. (2005). The focus is on liquidity and asset prices, and includes controlling for different variables, one of which is risk (volatility). Amihud et al. find that liquidity-based asset pricing helps explain a number of phenomena in finance. For the purposes of this paper, the most important insights include the explanation of cross-section of stock returns, how a decrease in stock liquidity results in a decrease in stock prices and a rise in expected stock returns, yield spreads on corporate bonds, and possibly the low prices of securities that are difficult to trade compared to more liquid counterparts with the same cash flows, i.e. restricted stocks or illiquid derivatives. In their research, Amihud et al. address the difficulty of measuring liquidity, and use both daily and high frequency data to measure liquidity. They underline that high frequency data depicts liquidity of a stock more accurately, however this data at that point in time was not available for most assets; mainly only for U.S. assets. Therefore, they realize that the liquidity measures are limited and require more precision.

Amihud and Mendelson (1986) state two main theoretical hypotheses. One is that the expected stock return is an increasing function of illiquidity costs, and the other is that liquid assets

with no equilibrium are allocated to investors with longer holding periods. Amihud and Mendelson use stock return data from 1961 to 1980 and bid-ask spreads data from 1960 to 1979. For each year, they group stocks into 49 portfolios for which a monthly return is calculated. The model used is a pooled time-series and cross-section GLS regression, with an estimation of the variance-covariance matrix of the 49 portfolios. The results of the model regressions find that indeed the portfolio returns increase with the bid-ask spread, and the return-spread slope decreases in the bid-ask spread, which supports that fewer liquid assets are allocated to investors with longer holding periods. The article provides an overview of past research and reaches conclusions based on comparing and examining the empirical research that already exists. Amihud et al. do not conduct their own empirical research.

Pastor and Stambaugh (2003) also examine how stock returns are affected. Their research focuses on whether market wide liquidity is relevant to asset pricing. Liquidity is defined as a measure of the cross-sectional average of individual stock liquidity. The results of the research show that expected stock returns are cross-sectionally related to the sensitivities of returns to changes in liquidity. That is, the average return on assets with high sensitivity to liquidity was higher than for assets with low sensitivity to liquidity. The study controls variables such as momentum, market, size, and value, of which the last three come from the Fama and French (1993) Three Factor Model. The timeframe of the data collection is from 1966 to 1999.

The basis of their claims come from Campbell, Grossman, and Wang (1993), who found that returns with a high volume tend to be reversed more strongly. Campbell et al. found this to be consistent with a model where investors are compensated for accepting the liquidity demands of others. In other words, agreeing to liquidity constraints should provide higher returns. Based on this, Pastor and Stambaugh define liquidity betas – a stock's sensitivity to innovations in aggregate liquidity. They find that betas are relevant to asset pricing, in that stocks with higher betas show higher expected returns. Moreover, this study also focuses on whether expected returns are related to systematic liquidity risk, as opposed to just the level of liquidity. In all, Pastor and Stambaugh find that market wide liquidity is a significant variable for asset (stock) pricing. According to their findings, smaller stocks are less liquid, and the smallest stocks have high sensitivities to aggregate liquidity.

Pastor and Stambaugh define a direction for future research: to explore whether liquidity risk plays a role in various pricing anomalies in financial markets. This study shows that the

momentum strategy of buying recent winning stocks and selling recent losing stocks becomes less attractive from an investment perspective when portfolio spreads based on liquidity risk are also available for investment. Future research could investigate whether expected returns are related to stocks' sensitivities to fluctuations in other aspects of aggregate liquidity. Also explore whether some form of systematic liquidity risk is priced in other financial markets, such as fixed income markets or international equity markets.

For another perspective on this topic, Cao and Petrasek (2014) focus on an event-study context of the performance of stocks during liquidity crises. Their findings are especially insightful for understanding liquidity risk in equity portfolios. The results of the study show that beta, which represents the market risk, i.e. volatility, is not a good measure of expected stock returns during liquidity crises. Instead, they find that abnormal stock returns are negatively related to liquidity risk during liquidity crises. Factors unrelated to risk and volatility, such as ownership structure and asymmetry of information also affect abnormal returns during liquidity crises. This research is useful for this paper because it expands on the relationship between liquidity, volatility, and returns and explains this complex relationship from a case study perspective, where the behaviors of the three factors can be looked at more specifically. At the same time, the research also identifies other factors that are crucial to determining the expected performance of stocks during liquidity crises.

The research focuses on various measures of market liquidity to define "liquidity crises". They use the most common measure of stock market liquidity, which are the quoted bid-ask spread, the effective bid-ask spread, and the Amihud (2002) measure of liquidity, similarly to other researchers. For each measure of market liquidity, the liquidity crises are assumed to occur in the left tail of the distributions, for a defined period of 48 days, which is 1% of sample days, or 24 days, which is 0.5% of sample days. The study looks at these specifically defined crises days that occurred from 1993 to 2011. The data is divided by different risk measures and characteristics into quintile portfolios. Further, the research looks at two types of betas – the standard market risk beta (also used in the capital asset pricing model) and an estimated liquidity beta, which is a measure of liquidity risk. The analysis of crisis days shows that the liquidity beta explains around 52% of the cross-sectional variation in stock returns, while the market beta is found to not be statistically related to stock returns. Another important conclusion from the research is that there may be a possibility to estimate future abnormal stock performance. More specifically, looking at past

stock returns and other factors, such as firm ownership or asymmetric information, it may be possible to construct portfolios that foresee ways to outperform the market during liquidity crises.

3.2. Research questions

Based on the vast research discussed above, it is possible to form several research questions for the development, results, and conclusions of this paper. The main objective of this paper is to focus on exchange traded funds and their role in the financial markets, which to some extent has already been "explained" in Chapter I. Further, what is to be studied is whether ETFs have an effect on U.S. market volatility. In effect, a cause and effect relationship between ETFs and the U.S. financial market (represented by the S&P 500 index as a benchmark, as well as 8 stocks that are prominent in both the S&P 500 index as well as the chosen exchange traded funds). One of the crucial findings will be whether there is a statistically significant relationship between the variables just mentioned, as well as what that relationship is. Looking at the findings reached by previous researchers, there is significant empirical support for the assertion that exchange traded funds have a statistically significant effect on not only U.S. markets, but also internationally.

There are many various topics regarding ETFs and their structure, their uniqueness in the financial markets, and the demand and supply that exists for them. In fact, many of these topics are intertwined, as the mechanisms of ETFs largely work together when explaining relevant occurrences.

The limitations of this research question include the study of the issue on an international scale, however the data collection and access to data is largely restrained. In contrast, data on U.S. stocks, ETFs, and indices is much more widely available and easily accessible. This is an area of improvement that could be expanded on in further research. It is significant to study how the U.S. markets differ from other international markets; however, the scope of this paper does not cover these areas. It is a significant interest because the financial markets are a complex international structure and currently they are constantly intertwined through exchanges, trades, and prices. Moreover, the study and comparison of various countries' stock markets, ETFs, and equity holdings would require much more complex data analysis tools in order to reach relevant conclusions.

In fact, various aspects of ETFs are of interest and are peculiar to study. There are many aspects to be considered, given the vastness of financial markets, participants (players) of the markets, and financial instruments themselves. ETFs themselves are complexly structured

"products", without exploring the number of ways they may be transformed or manipulated. Therefore, determining how these funds affect the market in their simplest form is a primary reason for academic and professional interest in this topic. The fact that they were created in order to give access to a wider range of market participants, as well as provide ease of trading securities, heightens the interest of many researchers, as was shown in the literature review.

Following the established research questions and literature review, the next chapter discusses the data and method used. Firstly, in the next chapter, the data collection and databases will be explained. Secondly, the raw data analysis will be presented and discussed. Next, the analysis methods that were used will be disclosed in order to determine the significance of the independent variables. Finally, the results will be interpreted and discussed in relation to the findings in the literature review.

4. Exchange traded funds: U.S. Financial Market case study

4.1. Data Collection

Data was collected using various data sources necessary to obtain all relevant data. Sources containing data on ETFs prices, returns, holdings, trading volumes that were used were ETF.com, ETFdatabase, and Statista. Close prices for ETFs as well as the underlying stocks were downloaded from yahoo.finance, which is a reliable source of daily financial data. Information on ETF holdings and baskets of underlying assets were taken from Fidelity.com using a free trial account.

The data used in this research is daily close prices. The frequency of this data allows it to be more specific and accurate than weekly data. However, intraday trading prices are lost in this data. The data set comes from yahoo.finance and various other reliable financial data sources mentioned above.

The time period for the data set is the same for all of the studied exchange traded funds and selected stocks. The time period is a 10-year period and ranges from the January 4, 2010 until the December 31, 2019. This time period allows for the data collection to be relatively new. It also tries to eliminate the bias of the 2007-08 financial crisis, which affected the U.S. stock market greatly. Although the effects of the crisis did follow for many years after, even as stated by Mishkin, "*(...) starting in 2009, the stock market recovered quickly, rising by more than 50% by 2011*" (2014), it can be said that 2010 is a fair year as the base year for data collection and analysis. What will be discussed further on, and what can be seen immediately, is that the data increases

significantly beginning from the first year of data collection, that is 2010. This will be discussed further in detail.

Data was collected in daily intervals. This frequency was chosen as obtaining intraday data for ETFs is not openly accessible and would incur costs. Moreover, the data analysis is more relevant over a longer period of time. In order to see the effects of ETF ownership on stock price volatility, a longer period of time is necessary. Moreover, larger effects, such as large volume ETF trades will be seen clearly in daily data. It is rare for ETFs to have large volume trades throughout one day, or enough so that intraday data would be as transparent as daily data. As was discussed earlier, this is a part of ETF liquidity, which is measured by the bid-ask spread. This can also be monitored on a daily or even weekly basis, to see how liquid an ETF is. In order to recognize the liquidity of ETFs within this paper, the bid-ask spread will also be taken into account.

In order to test the volatility in underlying stocks as per ETF ownership, the 7 stocks with highest ETF ownership will be studied. On the other hand, stocks with the lowest ETF ownership will be looked at in comparison. The aim is to test whether the volatility of prices of stocks that have a high percentage of ETF ownership is influenced by that ownership or not. For contrast, the 10 other stocks that have either low ETF ownership or are not ETF-owned at all will be used as a comparison and benchmark measure. In particular, the volatility of close prices of stocks will be looked at and compared. As a next step of data analysis, the volatility of selected ETFs will be compared to the volatility of the underlying index. This will also be compared through close prices of both variables.

The data collection does not require many variables, specifically because the research depends on finding relationships between the specific mechanisms and counterparties.

The exchange traded funds included are:

1) iShares Core S&P 500 ETF (IVV)
2) SPDR S&P 500 ETF Trust (SPY)
3) Invesco QQQ Trust (QQQ)
4) SPDR Down Jones Industrial Average ETF (DIA)

The tracked underlying indices are:

1) S&P 500 index (GSPC)
2) NASDAQ 100 (NDX)
3) Dow Jones Industrial Index (DJI)

As well as the same data for the below 8 stocks that are in the S&P 500 index:

1) AAPL – Apple
2) MSFT – Microsoft
3) AMZN – Amazon
4) XOM – Exxon Mobil
5) JPM – JP Morgan
6) GOOG – Google (Alphabet)
7) JNJ - Johnson & Johnson

Descriptive statistics are presented as below:

Table 2: Descriptive Statistics for chosen ETFs

ETF	Inception Date	Index Tracked		Number of Holdings	Issuer	Legal Structure
DIA	14.01.1998	Dow Jones Industrial Average		31	State Street Global Advisors	Unit Investment Trust
SPY	22.01.1993	S&P 500		506	State Street Global Advisors	Unit Investment Trust
IVV	15.05.2000	S&P 500		507	Blackrock	Open-Ended Fund
QQQ	10.03.1999	NASDAQ-100		104	Invesco	Unit Investment Trust

Source: own calculations

Table 3: AUM for chosen ETFs

ETF	**Assets Under Management**	**Expense Ratio[18]**
DIA	$25.68B	0.16%
SPY	$302.79B	0.09%
IVV	$219.45B	0.03%
QQQ	$138.24B	0.20%

Source: own calculations

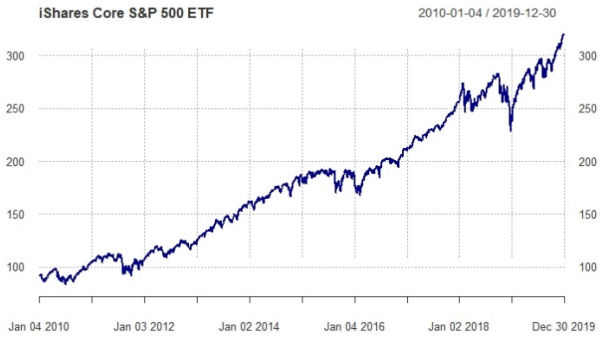
[18] The expense ratio is the annual fee percentage that funds charge shareholders

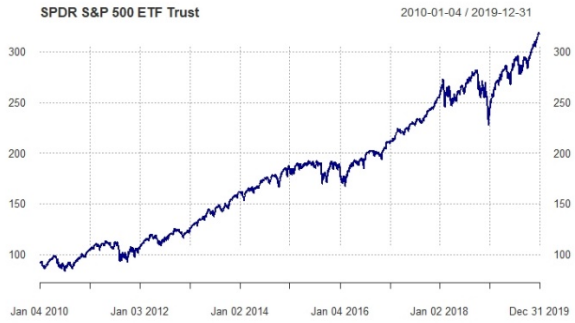
Table 4: Descriptive statistics for underlying 8 stocks in the S&P 500 index

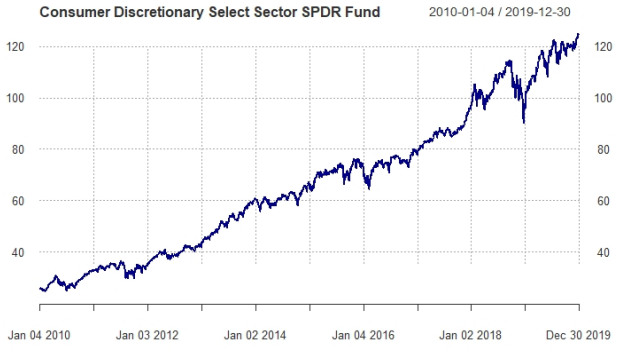
Index	IVV Close	AAPL Close	MSFT Close	XOM Close	JPM Close	JNJ Close	GOOG Close
Min.	83.53	23.75	18.18	40.13	22.16	42.33	217.2
1st Qu	117.90	56.82	24.27	63.11	34.30	53.82	316.3
Median	178.06	91.69	39.97	68.64	50.74	86.85	563.0
Mean	179.21	103.46	52.15	66.72	59.41	87.04	643.6
3rd Qu	229.83	144.94	67.47	73.10	82.87	116.47	929.2
Max.	320.97	290.04	158.09	82.04	135.51	144.51	1361.2

Source: own calculations

Graphs 3 – 7: graphs of initial data sets: January 2010 – December 2019







4.2. Method of analysis

The two main strategies that can be distinguished are fundamental and technical analysis. In short, fundamental analysis focuses on the fundamental valuation of, for example, an equity. It takes into account the financial results, including financial statements, financial ratios, and more. There are many trading strategies that can be implemented from the aforementioned techniques. In this paper, the technical analysis indicators will be focused on. Technical analysis is the study of the price movement of a security on an exchange. It bases on historical prices in order to make an informed idea of what the price movements may be in the future. Technical analysis may be based on a wide or narrow time span. However, since price movements vary constantly, this analysis is usually most useful over a smaller period of time. This is due to the fact that price volatility changes over time, and the price of a security that existed a number of years ago will most probably not repeat itself in the near future, for example due to inflation. The two main ideas in technical analysis are trend following and mean reverting trends. The first one focuses on the idea that the prices of a security follow a trend and will, for example, continue to rise or follow some sort of a given trend. The latter, however, focuses on the principle that the prices of a security tend to revert, or return, to some sort of "mean" price.

At first, the stationarity of each of the ETFs and indices will be tested for using the augmented Dicky-Fuller test (ADF). The null hypothesis of the ADF test states that there is no stationarity in the tested data. The alternative hypothesis states that the data is stationary. Therefore, we want to reject the null hypothesis and accept the alternative, that the data is stationary. For this, the p-value must be less than the desired significance level of 5%. Next, the integration order will be found, using the ADF and the Breusch-Godfrey test for autocorrelation in the residuals. The null hypothesis of the Breusch-Godfrey states that there is no autocorrelation in the residuals. The alternative states that there is autocorrelation in the residuals. We want to not be able to reject the null hypothesis, that is the p-value of the test should be above the significance level of 5%. Both of these tests will help in establishing the integration order of each data set. Finding the integration order is relevant in that it is the basis for a long-run relationship – if the integration order is the same, the long-run relationship between two variables may be tested.

An alternative to the ADF test is the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test. The KPSS test null hypothesis states that the tested data is stationary. Therefore, one wants to fail to

reject the null hypothesis, and instead fail to accept the alternative hypothesis. The desired p-value is higher than 0.05. In this case, both tests were run, and the results showed the same conclusions. Therefore, only the ADF test results are shown in the tables provided.

Further, once the integration order is established, cointegration between two variables may be tested. The cointegration test shows whether a long-term relationship exists. The first step is to create the cointegrating vector with both variables. The tests to confirm or deny the long-run relationship are again based on ADF and on Breusch-Godfrey tests, this time for the results of the cointegration model. Once again, we want the data to be stationary and no autocorrelation in the residuals. The cointegrating vector is created from the coefficients of the test results. It also defines the relationship between the two variables.

After successful establishment of the cointegrating vector, the error correction model (ECM) may be created. The ECM looks at how the lags of residuals behave in terms of trend following between two variables. The coefficients of the ECM test results define two things. The first, whether there is a short-term relationship, and what that relationship is. Specifically, as one variable increases by 1 unit, the second variable will increase by the amount of the coefficient, in the short run. The second is the adjustment coefficient, of which the purpose is to show how much of the unexpected error (or increase in gap between the two variables) will be corrected in the next period, as well as how many periods it would take for the unexpected deviation to be corrected. The adjustment coefficient should be negative, as it means that the data is converging, and may "reunite", as opposed to diverging and going in different directions.

4.3. Results and discussion

First of all, a test for correlation was run. Correlation confirms the statistical relationship between any two given variables, though it does not necessarily specify causality. It may refer to the degree that the variables are linearly related, however it is not the case here. As can be seen in the results, both IVV and S&P 500 close prices and returns are highly correlated (correlation values of 0.999 and 0.997, respectively).

The next analysis tests the cointegration between IVV and S&P 500. The summary of the cointegration model shows that the null hypothesis of non-stationarity of residuals cannot be rejected, as per the ADF test. Therefore, there is no purpose to test for the error correction mechanism (ECM), since the two variables do not converge, they are diverging based on these

results. However, it can be said that there is a long-run cointegration relationship between S&P 500 and IVV. So, if IVV increases by 1 in the long run, S&P 500 will increase by 9.250478. As can be seen by the results of the granger test, for lags of order 3, 4, and 5, there is bi-directional feedback between IVV and S&P 500. Moreover, it can be said that when IVV Granger-causes S&P 500, the patterns in IVV are approximately repeated in S&P 500 after these time lags. Further, past values of IVV can be used for the prediction of future values of S&P 500. IVV granger-causes another evolving variable S&P 500 if prediction of S&P 500 based on its own past values and on the past values of IVV are better than of S&P 500 based on S&P 500's own past values.

Similarly to IVV and S&P 500, SPY and S&P 500 are also not cointegrated. As per the ADF test for stationarity of residuals, the null hypothesis of non-stationarity cannot be rejected. Therefore, there is no purpose to conduct the ECM, because the two variables do not converge. However, what can be said about the relationship between SPY and S&P 500 is that the correlation is very high, similarly as previously. Moreover, it can also be said that the SPY granger causes the S&P 500. Given that both ETFs (IVV and SPY) are very similar in terms of their close prices as well as the make-up of the fund itself, the results with regards to the S&P 500, the index that both ETFs follow, are quite similar.

In contrast to the two previous pairs, the QQQ and Nasdaq 100 (NDX) are cointegrated. The ADF test showed that the residuals are stationary, that is the null hypothesis of non-stationary residuals was rejected at the 0.05% level of significance. In turn, the alternative hypothesis of stationary residuals was accepted. The results of the cointegration model show that as QQQ increases by 1 in the long run, NDX will increase by 40.24109. In effect, the error correction model (ECM) was also run in order to find whether the two variables converge. Indeed, the ECM shows that it takes about ~ 200 periods (1 / -0.005061) for the model to "correct" or revert back to equilibrium. However, this result is quite questionable. Despite the results of stationary residuals, the graphs of the ADF tests depict that the residuals are not quite stationary. Further, the granger test shows that there is bi-directional feedback between the index and the ETF. Similar to the other two pairs, the two variables are highly correlated.

Finally, the last pair of variables is the DIA and the Dow Jones Industrial Index (DJI). Again, the two data sets are highly correlated, with a correlation coefficient of 0.9992. Similar to the last pair (QQQ and NDX), the DIA and the DJI are cointegrated. The ADF test showed that the residuals are stationary at the first degree of augmentation (first lag, first difference). As the DIA

increases by 1, the DJI increases by 91.13923. In turn, the ECM was run, and the results show that it takes about ~ 861 periods (1 / -0.001161) for the model to correct itself to its equilibrium. Again, as earlier, this result is quite questionable. It maybe be seen on the graphs of the data sets that the residuals are not stationary. Moreover, it may be seen that the two data sets do not have a common equilibrium to revert to. Finally, the last test ran, the granger test, shows that there is bi-directional feedback between the index and the ETF.

The results showed that for the four different pairs the same conclusions cannot be expected. This is surprising, however, because all four pairs concern the same time period of data and the same shocks from the economy affect the underlying indices. However, one must remember that the four indices do not have the same underlying equities, therefore this seems to be a point of difference that could affect the outcome.

5. Conclusion

The existing issue that motivates us to this research paper was the rapid growth and development of the ETF presence in the U.S. financial markets. Ever since their inception in 1993, ETFs have been a very popular investment vehicle due to their advantageous characteristics. Some of these included higher liquidity, flexibility, access to a diversified portfolio, transparency in terms of positions in the portfolio, low costs, operational efficiency, and tax efficiency. Many investors chose to exploit these benefits, which is why ETFs have grown significantly more than their second-best alternative – mutual funds.

The research question posed in this paper was based on findings from previous researchers as well as statistical observations on the growth of ETF presence. The main focus was to explore the impact ETFs have on the market and how prominent their presence is. The hypothesis was that the correlation between the ETFs and their tracked indices in the U.S. financial markets is strong. To confirm it or deny the cointegration relationship between a given ETF and its underlying index was analysis. For the four of the selected ETFs, the results showed that there is no cointegration relationship with the underlying index. However, these results are questionable and would need much more data analysis. Moreover, the literature review included research on various topics on ETF impacts on the markets. Topics that were covered by the literature included liquidity, volatility, tracking error, and investment possibilities, to name a few.

The paper finds that ETFs are in fact very relevant in the U.S. financial markets. Moreover, the new regulation of the Investment Company Act of 1940 under Rule 6c-11 allows much more flexibility for ETFs to be created and sustained in the market. Lower barriers to entry are provided which also means competition may be higher.

For further research, the more complex relationship between ETFs and their underlying index may be studied. Here, it is merely an "introduction" into the complicated connections. Moreover, explanations for the relations may be studied, as here they are discussed as possible reasons. The complexity of ETFs and their characteristics poses many research questions and phenomena to be analyzed.

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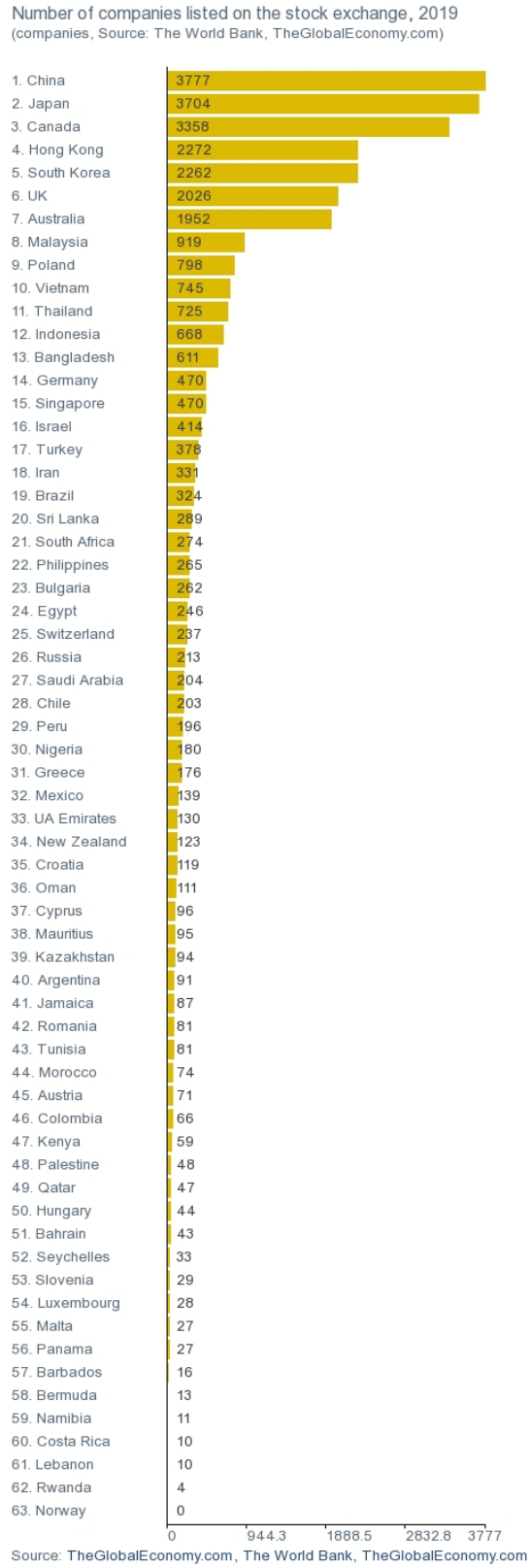
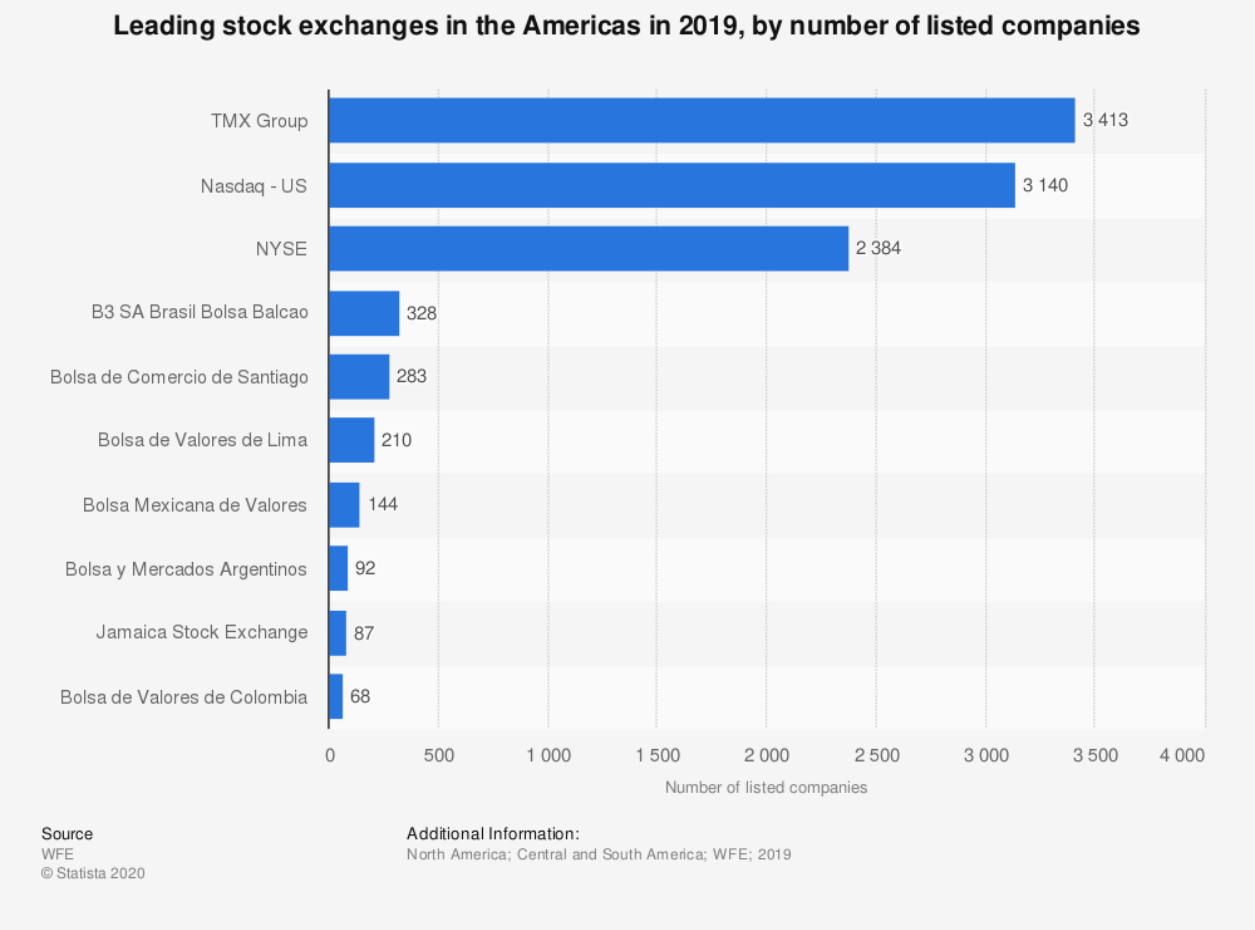
Appendix I: Number of companies listed on stock exchanges per country, 2019



Source: https://www.theglobaleconomy.com/rankings/listed_companies/

Appendix II: Number of companies listed on stock exchanges in the Americas, 2019



Source: Statista 2020

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