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EFFECTS OF THE ETF OWNERSHIP ON THE VOLATILITY AND RETURN CO-MOVEMENT OF EUROPEAN STOCKS

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Abstract

Exchange traded funds (ETFs) are financial products that allow for investors to track the performance of various bundles of stocks. ETFs are similar to mutual funds, but they can be traded throughout the day as any other equity. Existing literature argues that the structure of ETFs and the rapid growth of this market damages the pricing efficiency of the underlying stocks. However, most studies regarding ETFs are analyzing only the US market. Additionally, European Securities and Markets Authority introduced Markets in Financial Instruments Directive, which recognizes ETFs as an asset class, with extensive new set of reporting, which should promote ETF popularity among informed investors. My goal is to examine the impact of European ETF ownership induced stock co-movement and the subsequent development of systematic risk factor of constituent stocks. I used dynamic conditional correlation between a large set of European stocks and market returns as a proxy for European stock return co-movement to analyze its potential threat to increase the undiversifiable risk factor in underlying stocks and what factors are promoting it. I found that the prices of less liquid stocks included in the constituent list of an ETF have a significant chance to diverge from their fundamental values due to ETF trading activity. The stocks tracked by ETFs are also more likely to have large systematic risk factors integrated in their price movement.

Introduction

Exchange traded funds (ETFs) are investment vehicles traded on the largest stock exchanges around the world. ETFs are designed to track the performance of a basket of assets. Originally, exchange traded funds were only tracking the major stock indexes. The first ETF listed in the US (SPDR) was launched in 1993 and it was constructed to replicate the structure and returns of the S&P 500 index (Lettau & Madhavan, 2018). Currently, it is the largest ETF according to its net asset value. Since then the composition of the underlying asset of ETFs has evolved and now ETFs are constructed to track the performance of a great variety of assets – fixed-income securities, stocks, commodities, etc.

ETFs are similar to mutual funds; both of these instruments give investors an exposure to a portfolio of various securities. However, investors can deposit their funds to a mutual fund only once a day, while exchange traded funds, on the other hand, are traded throughout the day and rely on the arbitrage mechanisms to have their price in line with the net asset value. Aside from the opportunity to trade ETF shares on the stock exchanges during the trading hours, investors can also request the ETF to exchange their shares for the underlying basket of securities (Alexander & Barbosa, 2008). The trading can take place on the primary market (directly with the fund) or on the secondary market (stock exchanges). According to Lettau & Madhavan (2018), 75% of the ETF activity is recorded on the secondary market.

Recently the global ETF market reached 5 trillion dollars in assets under management (ETFGI, n.d.). Exchange traded funds have attracted an increased interest from investors due to their lucrative structural properties. ETFs offer very low fees and high liquidity. Consequently, investors gain the opportunity to execute various financial strategies with low market frictions (Ackert & Tian, 2008). ETFs grant this high level of liquidity through the flexible supply of shares. Authorized participants (APs) act as the market makers in the ETF trading, they facilitate the balance of demand and supply of the ETF shares in the market to eliminate any deviations from the underlying net asset value.

US ETF market is by far the most active and has almost reached its maturity (Authers, 2018). According to Staer & Sottile (2018), ETFs have become so popular that in 2012 the average trading dollar volume was almost the same for ETFs as for their underlying stocks. However, European market, which is the second biggest ETF market in the world (ETFGI, n.d.), has, according to Lee, Tseng, & Yang (2014), a substantially lower liquidity. Kyle (1985) reports that less liquid stocks experiences a stronger effect from trading related to 4 arbitrage opportunities. Consequently, European stocks that are included in actively traded ETFs experience a price pressure from arbitrage traders who seize the opportunity of ETF mispricing. The problematic element of the ETF construction is that the price pressure is exerted on all underlying stock simultaneously. A study by Lee et al. (2014) shows that during the nonsynchronous trading hours individual countries' ETFs are relatively more affected by the S&P 500 price movement, and though, the value of ETFs converge with their net asset value after the respective country's market opens, the consequent ETF rebalancing through the creation/redemption process leaves an impact on the price movement of the constituent stocks.

The European market has recently undergone a legislative change that directly affects the derivatives market. In the Markets in Financial Instruments Directive II (MiFID II) ETFs have been acknowledged as financial instruments and for the first time it is required to report ETF trades, which should affect their demand and liquidity (Deloitte, n.d.). Previously ETFs were not included in the MiFID regulations, so the reporting standards were lower compared to equity market. These new legal requirements have introduced a new level of transparency in the financial markets. The real effect of the MiFID II on the liquidity of the underlying financial instruments, while potentially profound, has not yet been widely studied. This has motivated me in this paper to examine how these new regulations have affected the level of systematic risk in European stocks that are included in portfolios of European ETFs[1] listed across the world. The research question I pose is:

- How passive investment vehicles like ETFs affect the non-diversifiable risk factor in European stock markets?

I am primarily basing my research on studies done by Da & Shive (2017) and Staer & Sottile (2017), which provide evidence of an excessive stock return co-movement among the stocks that are included in the largest ETFs listed in US.

[1] European ETFs are ETFs that have exposure to stocks that have their primary listing in European stock exchanges.

Literature Review

The main focus of the research is on the particular design of exchange traded products that can potentially cause an excessive co-movement and increased systematic risk of the European stocks, and what aspects of the MiFID II regulatory requirements bear an impact on ETF market. To review these developments, first, I provide an overview of the historical background of the evolution of ETFs and present findings from existing literature describing the structural elements of ETFs that might induce increased systematic risk for the constituent stocks. Second, I provide a rather in-depth analysis of the segments of MiFID II that are relevant to ETF trading in Europe and, therefore, also on the co-movement of constituent stocks. Lastly, I present the results of empirical studies that tie together the shortcomings of an efficient pricing mechanism with the liquidity, volatility and other transactional obstacles of individual equities and the market in general. These results directly back up the notion that ETFs have a significant impact on the overall pricing structure of the underlying stocks. It is important to note that most of the studies done so far focus mainly on the US market. Moreover, many empirical studies base their analysis on one of the biggest, most liquid and oldest ETFs – the SPY fund, which is tracking the S&P 500 index. To this end I present a theoretical background for why it has become important to counter this trend and investigate the impact of increased ETF activity European markets as well.

2.1. The evolution and structure of ETFs

In the mid 1950s, the computers designed to win World War II were put to use in various other sectors, one of such sectors was the financial service industry. In 1957 Standard & Poor's exploited the computing power and introduced the S&P 500 index, the first of its kind (Valetkevitch, 2013). The first financial product that somewhat resembled the modern version of exchange traded fund was conceived in 1973, when after an unsuccessful attempt to establish an index fund that would hold all stocks listed New York's stock exchange Wells Fargo decided to create a fund tracking the S&P 500 index. The indexing became popular throughout 1970s and 1980s with John C. Bogle founding Vanguard in 1975, the investment firm, which is considered to be the pioneer of passive investing (Vanguard, n.d.). After the infamous "Black Monday" market crash on October 19, 1987, the United States Securities and Exchange Commission speculated that if there had been a single financial instrument, which would allow to trade multiple assets at the same time, it would have mitigated the downfall. After the statement the first asset classified as exchange traded fund was listed for trading on the Toronto Stock Exchange in 1990 (Wigglesworth, 2018). Since the inception of the first ETF, the market for this type of financial instruments has grown to reach more than $5 trillion globally (Flood, 2018).

ETFs are designed to track the performance of a bundle of various assets - originally ETFs replicated the structure of the biggest stock indexes (Lettau & Madhavan, 2018). Since the inception of the first ETF, the structural diversity of the underlying components has developed significantly. Currently, an investor can purchase an ETF tracking the performance of almost any asset class in various compositions. Chacko, Das, & Fan (2016) categorized exchange traded funds into 4 structurally distinctive categories according to the method of replicating the performance of the underlying basket of securities: fully replicated, optimized, derivative, and blended. Fully replicated ETFs hold all of the stocks in their respective weights that correspond to the index (or any other set of assets) it is tracking. Optimized ETFs efficiently replicate the performance of an index without necessarily holding all the stocks, for example, excluding the stocks with the smallest weights in the index. Exchange traded funds that use only financial derivatives like swaps to track the returns of an index are called exchange traded notes and they do not hold the actual assets that they are tracking. Instruments like exchange traded notes, which do not have a direct impact on the underlying stocks will not be analyzed in this research. Combined ETFs are employing elaborate strategies of holding a mixture of assets and financial derivatives to track the returns of an index. For my empirical analysis I am focusing on the fully replicated and optimized ETFs, since the market for financial derivatives is less transparent than equity markets and thus the data availability is limited. However, Ben-David, Franzoni, & Moussawi (2018) argue that arbitrage mechanisms are comparable among all types of ETFs and, therefore, all have a similar impact on the basket of constituent assets.

ETFs are traded throughout the day like regular equities making them prone to the same level of volatility as the assets they are tracking. To guarantee an efficient pricing of ETFs they are rebalanced daily. The managers of exchange traded funds do not directly interact with the market selling and purchasing the underlying stocks. Instead, they enter a legal relationship with Authorized Participants (APs), who are commissioned to deposit a basket of shares that constitute the respective index that the ETF is tracking to the ETF asset manager and in return, APs receives a block of ETF shares. APs then trade these shares in the secondary market. This is called the creation process. Redemption process is executed in reverse order – APs executes a transaction with ETF asset manager exchanging the ETF shares for the shares of the underlying stocks that can be again traded in the secondary market. APs usually are large investment banks or other financial institutions, which have the necessary resources and access to the market for continuous mediation of transactions. ETF shares are redeemed and created in packages (creation units). One creation unit can vary in size from few thousand ETF shares to couple hundred thousand shares. Creation/ redemption process is executed at the end of the trading day. Broman (2016) describes that retail investors can access the creation and redemption process by requesting it to their broker, which could also act as one of the APs. If indeed the broker has entered a legal agreement with the ETF sponsor to act as an AP, then it is not in violation of the agreement to bundle the requests of its retail clients to exchange the underlying shares for ETF shares and vice versa, which at the end of the trading day are executed through the creation/ redemption process. This makes participation in arbitrage strategies more accessible for retail investors.

Authorized participants also can react to any mispricing of ETFs and exploit it through arbitrage and/ or the creation/ redemption mechanism, which is extremely important for efficient pricing of ETF shares (Elton, Gruber, Comer, & Li, 2002). When ETF price deviates from the net asset value of the basket of constituent stocks, any market participant can exploit the arbitrage opportunity. For example, if ETF share price falls below the net asset value of the constituent stocks and if the investor has access to the creation/ redemption process then to utilize the arbitrage opportunity the strategy would be as follows – at the moment when the mispricing is detected: purchase ETF shares, short the underlying basket of shares; at the end of the trading day: exchange ETF shares for the basket of constituent stocks and use those shares to close the short position. Investor would profit from the law of one price being breached, which dictates that the same assets should be equally priced. Regarding this arbitrage strategy - investors would exert a downwards price pressure on the constituent equities, and an upwards price pressure on the ETF shares, hence the prices of ETF and constituent stocks would converge. According to Petajisto (2017), the ETFs present a continuous opportunity for arbitrage, therefore the common price pressure on the underlying stocks is not causing only small temporary jumps, rather it implies systematic price co-movement. The redemption/creation process is one of the major components of the ETF pricing model (Lettau &Madhavan, 2018). It allows for ETFs to have a flexible number of outstanding shares and effectively manipulate the supply side of their shares to keep the pricing in line with the NAV of underlying stocks. According to Ackert & Tian (2008), if investors would have access to unlimited arbitrage opportunities (perfect information accessibility and no transactional frictions) the value of the ETF should perfectly track the value of the constituent assets. The APs are closely monitoring the market for any tracking errors where an arbitrage opportunity could be exploited. As the APs are the largest owners of the ETF shares, they have the easiest access to exploiting any mispricing that occurs.

2.2. ETF related factors that can affect stock co-movement

The major concern looking at the structural elements of the exchange traded funds is that arbitrage and creation/redemption process requires the AP or any other investor to purchase the underlying shares together in a bulk, which might cause the co-movement of stocks. For example, when investors spot a mispricing of an ETF (e.g. the price of the ETF exceeds its net asset value), they or APs have to purchase the whole basket of underlying stocks in their respective weights, therefore, the homogenous demand for all of the stocks that are included in the ETF exerts a common upward price pressure. The resulting price movement is a product of ETF pricing mechanism and it does not anymore represent exclusively the relevant information about the stock fundamentals, causing an excessive price co-movement (Staer & Sottile, 2018). Moreover, considering that even up to 80% of the total daily trading volume of the underlying stocks can be contributed to the turnover of the ETFs the stock belongs to (Staer & Sottile, 2018) it is certain that ETFs have a significant impact on the underlying stocks. Da & Shive (2018) and Staer & Sottile (2018) present a significant amount of proof that links ETF ownership and the related arbitrage activity to the co-movement of the underlying stocks in the US equity markets. Early studies by Shleifer (1986) show evidence of stock co-movement by studying the impact of a stock joining an index on its return path correlating with rest of the index. A later study by Greenwood & Sosner (2007) finds similar results for the Nikkei 225 index. According to Lee, Tseng, & Yang (2014) commonality in liquidity and impact of S&P 500 index movement has ramifications beyond the US market, as the ETFs tracking equity listed in other countries during the non-synchronized market hours experience liquidity spill-overs from the US market. During the hours when investors can trade country ETFs on the US markets, but the underlying stock is not available for to trade because its respective markets are closed, the price of these ETFs significantly diverges from their NAV and is mostly driven by the performance of the S&P 500 index (Levy & Lieberman, 2013). Liquidity spill-overs occur when the respective markets open for trading and the APs adjust the number of outstanding shares to correct for the mispricing.

Chen, Singal & Whitelaw (2016), on the other hand, do not find an excessive co-movement of underlying stocks for index tracked shares, however, they find that indexed winner stocks (stocks that experience positive growth and tend to outperform other stocks with similar characteristics) carry an increased beta factor. Moreover, Ben-David, Franzoni, and Moussawi (2018), empirically prove that stocks tracked by ETFs display higher volatility, which is covered by higher return premium that compensates for the increased systematic risk factor in these shares, which is consistent with the increased beta factor for indexed stocks. Overall, existing literature has proven that ETF activity has a significant effect on the pricing of underlying stocks.

The impact of increased ETF activity on the performance of the underlying stocks does not necessarily has to be negative. Winne, Gresse, & Platten (2014) examining the CAC 40 index found that ETFs decreased the spreads of the underlying stocks and increased their liquidity. Interestingly, they also find that declining trading related costs of the CAC 40 constituent stocks is due to the diminishing costs regarding order imbalances. Also, according to Xu & Yin (2017), ETF activity directly impacts the efficiency of the underlying index. They argue that ETFs are the first to react to the information because informed traders choose to execute their strategies using ETFs due to the high liquidity and low transaction costs. However, the low-cost structure seems to be peculiar – how can a fund that is fully replicating the underlying index be traded cheaper than the index itself? Chacko, Das & Fan (2016) empirically prove that fixed-income ETFs are incorporating liquidity risk because they are holding a short position in equity (selling ETF shares), which is very liquid, and holding a long position in fixed-income securities (buying bonds to create ETF shares) that do not have a liquid market to be traded in.

Lettau & Madhavan (2018) address a major concern that some investors have with equity ETFs – asset lending. ETFs are allowed to lend their assets to third parties for short selling purposes in return for collateral, which, in the majority of cases consists of fixed-income securities (e.g. iShares by BlackRock[2]). Accordingly, the low transaction costs could also be considered as a compensation for the liquidity risk – risk that ETF managers could have difficulty redeeming ETF share if a large sell-off would happen. Overall, the impact the ETFs have on the underlying stocks together with the risks they have integrated into their design can potentially pose threat for the financial stability, and for that reason it is important to study the effect ETFs have on the financial system.

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[2] iShares by BlackRock provides information for each of their ETFs about the structure of the collateral for their stock lending program https://www.ishares.com/uk/individual/en/products/etf-productlist?switchLocale=y&siteEntryPassthrough=true#!type=emeaIshares&tab=overview&view=list&fac=43511

2.3. Further factors that can exacerbate potential stock co-movement

Barberis, Shleifer, & Wurgler (2005) identify several types of stock return co-movements: investor habitat preferences, information diffusion, and style investing. Investors might prefer to invest in companies operating in a single industry hence creating the style investing co-movements. Exchange traded funds exacerbate the style investing stock return co-movements by constructing industry and style tailored portfolios with low transaction costs that allow for investors to park their money in a bundle of homogeneous stocks. However, the commonality of preferences is not the main source of stock co-movement that comes from ETF activity. Da & Shive (2018) and Staer & Sottile (2017) link the co-movement of constituent stocks with the arbitrage activity related to investors and APs exploiting ETF tracking errors. Co-movements related to arbitrage activity falls into the information diffusion co-movement category. According to Ben-David, Franzoni, & Moussawi (2018), ETFs indeed propagate a new layer of non-fundamental volatility that can be caused by the mismatch in the liquidity between the ETF and the constituent stocks. Bertone, Paeglis, & Ravi (2015) argue that illiquidity and volatility of stocks are directly related, mainly due to the decreased market depth for illiquid assets. Consequently, if the underlying stocks that have higher illiquidity (Amihud, 2002), and thus are more susceptible to volatility, are being influenced by a common price pressure they will experience a common volatility. Kyle (1985) analyses that liquidity of assets is significant when new information is incorporated into the price of an asset, which means that trading strategies are exerting stronger price pressure on less liquid assets. Therefore, the arbitrage trading related to ETF mispricing could potentially cause the price of constituent stocks to adjust to the movement of ETF and not the other way around if the underlying assets are less liquid than the ETFs tracking them.

According to Bertone et al. (2015) price efficiency is directly linked to the liquidity. Higher liquidity and lower market frictions give the opportunity for investors to engage in arbitrage activities and profit from the mispricing of ETFs. The trading costs related to market frictions has to be lower than the potential arbitrage profit in order to promote efficient pricing correction through arbitrage activity. Xu & Yin (2017) present a partially contradicting viewpoint – they empirically prove that increased liquidity indeed provides higher price efficiency but only when the liquidity is low to begin with; on the other hand, when liquidity already is high, the additional trading activity will attract more noise traders and consequently decrease price efficiency.

The existing studies create a contradiction between notions that a) higher ETF activity should increase pricing efficiency because ETFs have a flexible supply structure, which depends on the liquidity provision by large financial institutions (APs), and b) that ETF induced arbitrage and the liquidity mismatch (if underlying stocks are less liquid, they are more prone to volatility than the ETFs) create a stock return co-movement and, therefore, decreases pricing efficiency. In highly liquid markets like US this is less of a concern, but in European markets stocks have been proven to be less liquid (Bertone et al., 2015).

2.4. European markets

During the intraday trading, the main factor that keeps the ETF performance locked with the net asset value is the opportunity to earn profits by exploiting arbitrage. According to Ackert & Tian (2008), prices of stock should track the fundamentals and any divergence of the net asset value signals market inefficiency. Shin & Soydemir (2010) present evidence that European ETFs have higher tracking error than the US. Furthermore, according to Lee, Tseng, & Yang (2014), in a study about country ETFs traded in the US, they found that European stock markets and financial instruments listed in European exchanges are comparatively less liquid, which makes them more volatile. Hilliard (2014) established that European ETFs have higher premiums due to limited arbitrage opportunities. Overall, consensus emerges from the academic research that European markets are less efficient than US markets. However, the recently passed MiFID II regulation contains provisions that are expected to positively affect the transparency of the trading in Europe and improve efficient market transactions. However, the higher reporting costs might have also increased the transaction costs, which would exacerbate arbitrage limitations. The overall effect of MiFID II, as discussed in the next section, is yet uncertain and ambiguous. Considering that European markets are less efficient than US markets, it is necessary to examine the impact of the European ETFs listed in various markets worldwide on the underlying stocks that are listed in European stock exchanges, which currently is not a thoroughly explored topic.

European markets are periodically experiencing times of higher volatility due to regional and global factors. According to Shin & Soydemir (2010), during the periods of increased volatility the tracking error of stock indexes might increase if the initial shock is coming from a market in a different time zone. The timing difference allows for investors to execute arbitrage strategies with ETFs listed in US markets, which are tracking European stocks. However, the tracking error is corrected at the opening of local stock markets, which in turn cause an increase in stock co-movement due to indexed stocks being traded together.

Also, due to large trading activity during volatile periods, the consequent increase in ETF activity potentially can exacerbate stock co-movement.

2.5. MiFID II

In 2007 Markets in Financial Instruments Directive (MiFID I) was implemented to unite financial market across European Union (European Securities and Markets Authority, n.d.). It was designed to develop a standardized regulatory environment for market participants across the European Union. The legislators intended to set common operating and reporting requirements for investment firms and public companies to increase competition, efficiency and transparency of the European stock markets and to prevent market abuse (European Parliament, 2014). However, the financial crises showed multiple failings of MiFID I and during G20 summits in 2009 and 2011 it was decided that transparency and investor protection in European markets needed an improvement. Consequently, in 2014 European Securities and Markets Authority (ESMA) developed and published several papers to initiate discussion on the potential regulatory improvements. ESMA is an independent organization, which protects the investors and stability of financial system in EU. Over the next 3 years ESMA in collaboration with European Commission developed the Markets in Financial Instruments Directive II (MiFID II) and Markets in Financial Instruments Regulation (MiFIR). In January 3, 2018 MiFID II and MiFIR came into force for all EU member states and with over 1.4 million paragraphs describing the requirements for participating in and reporting market transactions has greatly increased the transparency of European financial markets (Stafford, 2017). In contrast to MiFID II, which had to be implemented by national authorities in every EU country separately taking more time to be enforced, MiFIR, on the other hand, was applied directly to all market participants.

The first Markets in Financial Instruments Directive focused mainly on equity trading and did not recognize ETFs as a separate asset class (Stafford, 2019). As a consequence, large segment of ETF trading was happening in over the counter (OTC) trading venues with brokers negotiating the price and executing the deal accordingly. About 70% of all ETF transactions were happening off the exchange platforms and therefore went unrecorded (Hadfield, 2019). Since the introduction of MiFID II, improved transparency regarding ETF transactions entice more retail investors to allocate their funds towards the cost-efficient ETF solutions. Moreover, the abundance of data covering European market activity has made the ETF market more automated, which improves the liquidity of European ETF market (Flood, 2018).

The key elements of MiFID II that have a direct impact on ETF trading activity in Europe are the improved reporting requirements for the financial derivatives, and the regulatory changes for trading venues that aim to prevent negotiated trading for liquid financial instruments. The negative experience during the subsequent financial crises after the introduction of MiFID I indicated major shortcomings of the directive. During the crises the liquidity in opaque derivative OTC markets dried up and exacerbated the financial downturn during the international credit crisis (ECB, 2019). Conversely, MiFID II recognizes ETFs and other financial derivatives as important investment vehicles that have as significant impact on the financial system as conventional equity products. Thus, MiFID II expands its regulatory scope to include various financial derivatives (PricewaterhouseCoopers, 2015).

MiFID II has defined 4 trading venues – regulated market, multilateral trading facility (MTF), organized trading facility (OTF) and systematic internaliser (SI) (European Parliament, 2014). Regulated market is a trading platform that allows third party traders to participate in market transactions. Regulated market is organized by a market operator. MTF is similarly defined as a regulated market, with the exception that market operator can be monetarily incentivized to manage efficient transactional services. Both regulated markets and MTFs are operating in accordance to non-discretionary rules[3] for execution of trades. Organized trading facility is operating as a marketplace for structured financial products and derivatives. OTFs are not obliged to operate under non-discretionary rules. All three previously described platforms are applicable to all of the trading requirements introduced by MiFID II. The only platform that is exempt from following MiFID II rules and requirements is systemic internaliser (SI). SIs are investment firms, which deliver financial products from their own accounts when executing orders. SIs are not allowed to bring together third-party market participants to settle an order. The scrupulous segmentation of various trading venues has been developed to minimize the off-exchange trading, which goes unreported and damages the price efficiency in financial markets.

In attempt to bring ETF and other financial derivative trading into more transparent environment MiFID II requires public records of pre-trade and post-trade information. Pre-trade transparency requirements dictate that market operators (except SIs) must report updated bid and offer prices and how many shares are offered for the advertised price. Pre-trade transparency requirements for systematic internalisers only apply when they are trading

[3] Non-discretionary rules dictate that the execution of the trade cannot be influenced by the organiser of the trade (e.g. RM or MTF), regardless of the organisers's relation to the investor.

financial instruments for which there is a liquid market (Fischer & Murphy, 2017). Post-trade transparency requirements dictate that market operators must report the price, volume and time of transaction, these rules are applicable to all market participants including systematic internalaisers. All information must be posted as close to real time as possible.

As already mentioned, ETFs were recognized as an asset class in European markets only after MiFID II. Large fraction of ETF trading before January 2018 went unreported as it was executed in OTC platforms through brokers negotiating the prices. According to (Olly, 2018), MiFID II and MiFIR have indeed been successful in eliminating many inefficiencies in European equity markets and providing a level of intelligence to ETF trading in Europe that was not available previously. Consequently, due to lower costs investors' interest is shifting from traditional funds towards ETFs. Increased informational efficiency of European ETF market allows for more accurate pricing mechanisms, therefore rational investors who prefer more to less (prefer higher returns to lower returns) should naturally drift towards ETFs that track the performance of indexes for fraction of the transaction costs (Flood, 2019).

Considering that ETF turnover, or the reported ETF turnover has increased since the introduction of MiFID II (Stafford, 2019) it is reasonable to conclude that ETF market in Europe has become more liquid. As discussed by Caginalp & DeSantis (2016), increased informational symmetry of all market participants increases trading activity and hence improves the liquidity of the financial system. In the case of ETFs, improved access to data about pricing formation and more liquid market with low level of transactional frictions incentivizes informed trader to more actively employ arbitrage strategies by exploiting any discrepancies between the price of ETFs and the fundamental NAV of the equities it is tracking (Bertone et al., 2015). Ergo, MiFID II is likely to be a double-edged sword because increased ETF trading could potentially escalate the information diffusion co-movement of European equities tracked ETFs.

According to Xu & Yin (2017), the creation and redemption of ETF shares generates a significant price pressure on the underlying stocks, which potentially causes common volatility and co-movement of the underlying asset prices. However, MiFID II has included a waiver in its transparency regulations for creation and redemption process of ETF shares. Creation/ redemption process is described by ESMA to have no possible links to market abuse and therefore does not require any transparency related reporting (ESMA, n.d.). As discussed earlier, it is allowed for APs to directly interact with their retail clients and exchange their ETF shares for the shares of underlying assets, in this scenario APs are acting as arbitrage mediators. Therefore, the creation/ redemption process could potentially bear a speculative aspect to it.

Coming back to the notion made by Kyle (1985), that arbitrage related trading has a higher impact on the less liquid asset, the increase of liquidity in ETF market due to MiFID II regulations and low-cost structure of ETFs could presumably exacerbate the volatility of constituent stocks. Less discussed source of price inefficiency caused by ETF trading is presented by Qin & Singal (2015), they conclude that passive investors trading indexes and other similar instruments demotivate informed traders to engage in arbitrage trading thus compromising efficient pricing mechanism.

ETFs market is currently experiencing a very intensive price competition (Box, Davis, & Fuller, 2016), which motivates ETF managers to decrease their costs and operate on very thin margins. Majority of ETFs use stock lending programs to cover their costs and provide lower fees for their investors (Mooney, 2018). Securities lending could potentially increase risk if the investment companies are undercollateralized in times of distress when investors seek to withdraw funds. In spite of this sensitive issue, MiFID II has included another waiver for transparency regulations, which excludes transfers of collateral from reporting standards. Consequently, investment companies have no responsibility of disclosing information about the ETF stock lending program and the level of collateral they are holding.

Overall, MiFID II has significantly increased transparency of the ETF trading in European trading venues. Consequently, the pricing and fund allocation has also become more efficient. As a result of all of the changes brought upon the European ETF market, the improvement of market liquidity is substantial. On the other hand, the worrying aspects of ETF market before MiFID II were, firstly, the liquidity mismatch between the underlying stocks and ETFs, which potentially could induce increased volatility of underlying shares due to amplified systematic risk factor (Olly, 2018). Second, the homogenous demand for underlying stocks generating excessive stock co-movement caused by arbitrage activity and creation/ redemption process. Lastly, the unregulated stock lending programs, which in times of financial distress could imperil the solvency of financial institutions that issue ETFs. The potential risk of MiFID II is that the increased popularity of ETFs could exacerbate the above-mentioned dangerous aspects of ETFs, which are currently not addressed by financial regulations in Europe.

2.6. Hypothesis

After reviewing the existing studies about the topics of ETF market development globally and in Europe, stock co-movement, and the details of MiFID II regarding ETF trading, the further research investigates 3 major themes. First, I have identified that, to best of my knowledge, current literature does not offer an analysis of the stock co-movement particularly for the stocks listed in European markets that are included in the major European indexes and tracked by the respective ETFs. Therefore, I examine the following *hypothesis*: stocks included in the largest Europe specific indexes are experiencing return co-movement.

As discussed earlier, liquidity mismatch between stocks and the ETFs tracking them is causing an excessive volatility and co-movement of the underlying stocks (Kyle, 1985; Bertone et al., 2015). Also, increased ETF activity is incentivizing additional arbitrage trading, which in turn adds to the excessive co-movement of underlying stock prices (Staer & Sottile, 2017). In the context of European markets, I include analysis of the following 2 *hypothesis*: decrease in relative liquidity of stocks listed in Europe (compared to the liquidity of ETFs, which are tracking them) is related to higher price co-movement; higher price co-movement is related to lower absolute liquidity measure in the stocks listed in Europe.

The recently adapted MiFID II regulations have transformed the derivatives market in Europe. The new reporting standards has recognized ETFs as an asset class, which was not the case before. However, to best of my knowledge, there have not yet been studies analyzing the development of liquidity, price co-movement, and systematic risk factor for stocks listed in European markets after the introduction of MiFID II regarding the increased ETF activity. To find out how the above-mentioned factors have changed since MiFID II came into force, I analyze the following 4 *hypothesis*: after the introduction of MiFID II, liquidity has improved for stocks included in the largest Europe specific index funds; the relative liquidity of stocks compared to the liquidity of ETFs tracking them has decreased after the introduction of MiFID II; after the introduction of MiFID II the systematic risk factor has increased for stocks included in the largest Europe specific index funds; after the introduction of MiFID II the co-movement of stocks included in the largest Europe specific index funds has increased.

Market wide stock return correlation makes stock prices more sensitive to systematic risks. In other words, the CAPM beta measurement increases if stock price correlates with the market. To address this issue, I test the following hypothesis: if stocks included in the largest Europe specific index funds have marginally higher price co-movement, they also experience increased systematic risk factor.

In summary, I am examining the following *hypothesis*:

1. Stocks included in the largest Europe specific indexes are experiencing market wide co-movement;
2. Decrease in relative liquidity of stocks listed in Europe (compared to the liquidity of ETFs, which are tracking them) is related to higher price co-movement;
3. Higher price co-movement is related to lower absolute liquidity measure in the stocks listed in Europe;
4. After the introduction of MiFID II liquidity has improved for the stocks included in the largest Europe specific index funds;
5. The relative liquidity of stocks compared to the liquidity ETFs tracking them has decreased after the introduction of MiFID II;
6. After the introduction of MiFID II, the systematic risk factor has increased for stocks included in the largest Europe specific index funds;
7. After the introduction of MiFID II, the co-movement of stocks included in the largest Europe specific index funds has increased;
8. If stocks included in the largest Europe specific index funds have marginally higher price co-movement, they also experience increased systematic risk factor.

Data description

Only stocks listed in, at least, one European market and tracked by, at least, one fully replicated ETF are considered eligible for the analysis. European markets are categorized as any financial asset markets operating in the continental Europe, which is in direct supervision of European Securities and Markets Authority (ESMA) or is adopting the regulations published by ESMA. Therefore, this sample set of countries also includes Switzerland and Norway. Interestingly, if Switzerland would choose not to conform to the MiFID II regulations ESMA would be authorized to revoke its access from servicing EU based professional clients and eligible counterparties (Eversheds, n.d.).

Taking into account that ETFs are not limited to tracking single region at a time, it is plausible that they include stocks from more than one economic region. Therefore, only ETFs tracking the largest Europe specific index funds are chosen for the analysis. I have to note that the list of ETFs tracking the major Europe specific index funds where extracted from the Thomson Reuters data base (n.d.) and the list consists of ETFs that are also not all fully replicated (ETFs holding all the same share as the index). However, according to Ben-David, Franzoni, & Moussawi (2018), exchange traded products, which use financial derivatives to replicate the performance of the underlying index also induces increased return co-movement for the constituent stocks. They argue that arbitrage activity exacerbates stock co-movement regardless of the what is the structure of the ETF.

The set of stocks observed for the empirical analysis was sampled using the stocks included in the following Europe specific indexes: Euro Stoxx 50, Stoxx Europe TMI, FTSE 100, S&P Euro, France CAC 40, DAX 30 Performance, OMX Stockholm 30 (OMXS30), OMX Copenhagen (OMXC20), OMX Helsinki (OMXH), Swiss Market (SMI), ATX - Austrian Traded Index, BEL 20, IBEX 35, FTSE 250, Warsaw General Index, AEX Index (AEX), FTSE All Share, Euro Stoxx, Euronext 100. Most popular European indexes were determined using the list published in The Wall Street Journal (The Wall Street Journal, n.d.). The constituent list was extracted as of 31.12.2018. The total sample includes 1624 unique stocks listed in at least one of the European stock exchanges. Data is also extracted for 272 ETFs tracking the above-mentioned indexes. Data was extracted for the period starting from 01.01.2014. up to 31.12.2018 with daily frequency. The starting period coincides with the time when negotiations for MiFID II began. For data extraction I rely on the Thomson Reuters data base (n.d.). The extracted data for the 1624 observed stocks and 272 ETFs included the following variables with daily frequency: average prices, number of outstanding shares, volume traded, market value. Also, daily price data for STOXX Total Market Index (TMI) was extracted.

After inspecting the individual distributions of the variables used in the final analysis for testing the proposed set of hypotheses, noticeable outliers impaired the distribution of observations. Therefore, all variables used in the final analysis, market (STOXX TMI) returns are winsorized at 10% cut-off, to support the normal distribution of the observations. The data is sorted as a panel according to individual stocks and time.

3.1.Estimation of stock co-movement

For estimating stock co-movement of stock prices, I use dynamic conditional correlation Engle (2002). Dynamic conditional correlation is estimated with Multivariate Generalized Autoregressive Conditional Heteroscedasticity (MGARCH) model with the dynamic conditional correlation (DCC) parameterization. In this model the conditional variances and covariances follow time varying autoregressive mean structure (StataCorp LLC, n.d.). According to Engle (2002), the MGARCH DCC produces superior estimates for time varying correlations between processes. Staer & Sottile (2017) employ this estimation model in their research to measure the excess co-movement between each separate stock and the ETF that is tracking it. In their paper, they condition ETF and stock returns on the value-weighted market returns and use the residuals vector to estimate the dynamic conditional correlation value, which effectively is the excess co-movement between the stock and the ETF. However, I am looking at a larger sample of ETFs and my goal is to estimate the stock co-movement on a larger scale across many European markets, therefore I have modified the model. I am not using any independent variables, instead I am conditioning stock returns (R_s) and market returns (R_m) only on the values of their past conditional variances and squared residual values by using the generalized autoregressive conditional heteroskedasticity term at each t.

$$R_{m,t} = \alpha_m + \varepsilon_{m,t}$$
$$R_{s,t} = \alpha_s + \varepsilon_{s,t}$$

The time varying residual correlation measurement generated by this model has incorporated the conditional variances (σ_t), which follow univariate GARCH process, of the stock and market returns separately and the dynamic conditional covariances($\sigma_{s,m,t}$). In other words, the model generates daily co-movement (ρt) between market returns and each individual stock returns taking into consideration the time varying conditional variances of both variables separately and time varying covariance between the two variables.

$$\sigma_{s,m,t} = \rho_{s,m,t} \times \sqrt{\sigma_{s,t} \times \sigma_{m,t}}$$

The common covariances between stock and the market most likely are market wide correction affecting majority of stocks similarly. The regression postestimation allows to export the values for the dynamic correlations, which I am then using for further analysis. Market returns are approximated by using the daily price data on the STOXX TMI index, which tracks the performance of European markets.

Using the model, I estimated *k* pairwise correlations for *k* stocks with the market returns. The results from estimating the dynamic correlation for large amount of stock returns using one common variable, should act as a good proxy for the co-movement among the group of stocks. Due to non-convergence issues caused by some stocks having a high price volatility, the model did not produce a result for all stocks. From the sample of 1624 stocks, the model reached convergence and estimated dynamic correlations (DCC) with market returns for 1131 stocks.

3.2. Estimation of liquidity measures

Staer & Sottile (2017), employs a variable called equivalent volume to measure the relative liquidity of stocks tracked by ETFs. They argue that the magnitude of an impact on the asset prices derived from an arbitrage trading depends on the liquidity of the respective assets. Meaning that less liquid assets experiences larger price movement when investors engage in arbitrage trading. Therefore, they construct a variable ($EqVol_{i,t}$) that measures how much of the stock daily volume traded is attributable to the ETF volume traded.

$$EqVol_{i,t} = \frac{w_{i,t} \times volume_{etf,t}}{volume_{i,t}}$$

If the $volume_{i,t}$ is large, comparatively larger than $volume_{etf,t}$, it means that the underlying stock is liquid since it is getting traded extensively during the day. However, if the opposite is true, then the underlying stock is being traded rarely, and arbitrage trading related to ETF mispricing significantly impacts the pricing of the stock more severly. The larger is the relative liquidity ($EqVol_{i,t}$) the less liquid is the underlying stock. The weight of the stock ($w_{i,t}$) in this equation correspond to the weight of the stock in the respective ETF. However, due to limitations in accessing data, it was not possible to acquire continuous information about the weights assigned to each stock for all of the observed ETFs. For the purpose of this study, an overarching fund was modeled, which consisted of all observed stocks and the weights were assigned according to the relative market capitalization.

$$mcap_{i\_adj,t} = mcap_{i,t} \times X_t$$

$$w_{i,t} = \frac{mcap_{i\_adj,t}}{\sum_{i=1}^{n} mcap_{i\_adj,t}}$$

The respective methodology for assigning weights to stocks is in line with the methodology used by indexes observed in this research. Many stocks are tracked by more than one index; accordingly, the stocks are assigned with a multiplier indicating how many indexes are tracking the respective stock. This way of approximating the weights of the stocks and, consequently, also the relative liquidity does not give precise information about each individual stock because this method assumes each euro invested is equally distributed among all ETFs. However, for the analysis it gives the approximation whether the value invested in ETFs grows proportionally to the amount invested in individual stocks and, therefore, is serving as a good proxy for relative liquidity.

Another liquidity measure employed to in the analysis is the ILLIQ measurement introduced by Amihud (2002). The ILLIQ variable captures the price sensitivity to transactional volume. ILLIQ is calculated as the absolute value of daily stock returns over the daily volume traded. The measure presents how sensitive is the price to the value traded. The higher the value of ILLIQ variable the lower the liquidity of stock.

3.3. Estimation of systematic risk factors

As discussed in the review of existing literature, stocks tracked by indexes and ETFs have displayed a trend to be traded at a premium. According to Olly (2018), the premium is a fair compensation for the added systematic risk factor due to increased stock co-movement. To generate a proxy the systematic risk factor in the observed shares, I use an autoregressive conditional heteroskedasticity (ARCH) model. ARCH model is configurated to estimate the variance of residual values on the squared values of its lagged values. Data used to generate the estimates for systematic risk factor in stocks tracked by Europe specific index funds are daily returns for the respective stocks ($\Delta lnP_{s,t}$) and for the market ($\Delta lnP_{m,t}$). Decision was made to use CAPM beta (β_1) as a proxy for systematic risk factor.

$$\Delta lnP_{s,t} = \beta_0 + \beta_1 \Delta lnP_{m,t} + u_t$$

$$\sigma_{u,t}^2 = \alpha_0 + \alpha_1 u_{t-1}^2$$

Since the returns exhibit conditional heteroskedasticity ARCH model would provide highly accurate results for CAPM beta. The ARCH_beta was generated for 14 quarterly periods for each of the 1131 stocks used in the co-movement analysis

Taking into consideration the small sample of systematic risk factors the validity of the systematic risk analysis is examined also using linear CAPM beta. For the further examination of systematic risk factor a sample of 60 observations was generated with a monthly frequency.

Table 1: Descriptive statistics

Variable	Obs	Mean	Std.Dev.	Min	Max
TIME	1030000	20909.1	369.39	20270	21549
t	1030000	457.5	263.849	1	914
n	1030000	727.854	472.282	1	1624
DCC	1030000	.391	.214	-.825	.961
EqVol	958000	.28	3.299	0	594.546
R_stock	1030000	0	.019	-.5	.697
Market_R	1030000	0	.01	-.07	.042
Group	1030000	.283	.451	0	1
ILLIQ_daily	900000	0	0	0	.026
ARCH_beta	903000	.72	.567	-3.392	5.126
Beta	1030000	.669	.736	-8.661	14.191

The summary statistics for variables used in further analysis: TIME and t are both time variables, n is stock specific variable; DCC is dynamic conditional correlation between each stock returns and market returns; EqVol is equivalent volume is relative liquidity variable; R_stock is returns for each stock; Group indicates the time period since the introduction of MiFID II; ILLIQ_daily is the Amihud's (2002) illiquidity measure, ARCH_ beta is the stock return beta estimated using the ARCH model; Beta is linearly estimated beta.

Methodology

4.1.Theoretical framework

The existing literature presents evidence that transactions related to ETF trading and arbitrage activity that exploits ETF mispricing effectively are associated with the underlying stock return co-movement (Staer & Sottile, 2017; Broman, 2016). Qin & Singal (2015), report that the growing popularity of indexing has decreased the price efficiency of the constituent stocks. Traders use ETFs as vehicles for their investment strategies due to their low-cost structure. Consequently, it produces many homogenic impulses on the prices of the underlying stock prices through the ETF creation/ redemption process and arbitrage trading. Oppositely, according to Xu & Yin (2017), increased trading activity of exchange traded funds has a positive effect on the pricing efficiency of the underlying index due to improved liquidity of company shares caused by arbitrage trading and creation/ redemption process. This contradiction is discussed in the paper by Caginalp & DeSantis (2016), where they present evidence that the relation between ETF activity and price efficiency can be modelled as a concave function. Meaning that at a certain point, additional ETF trading brings too many noise traders who in turn damage the efficient pricing of equity. De Winnie et al. (2014), examine the CAC 40 index being included in an ETF and find that it had a positive impact on the liquidity of the underlying stocks. CAC 40 is an index fund tracking French stock market, consequently, the study by De Winnie et al. (2014) show that French market is on the upwards sloping part of the previously mentioned liquidity function. I point out this study, because it presents an evidence that liquidity in European financial markets has a room for improvement. My aim is to approximate to what extent the stock co-movement is present on a broader European market level.

The launch of MiFID II had a sudden impact on the ETF activity due to overnight change in the reporting requirements. The market went through a rapid transformation and became increasingly transparent, which, according to Olly (2018), should leave a significant impact on the underlying stock market as well. Thus, the subsequent impact on the stock co-movement and the liquidity measures should be significant and give an unambiguous conclusion to whether the ETFs have an impact on the informational efficiency of European stocks. I, therefore, look empirically at the development in liquidity measures and return co-movement of stocks included in largest Europe specific indexes around the time when MiFID II was launched.

Additionally, according to Ben-David et al. (2017), ETFs are very popular with high frequency traders due to their low-cost design and because they are easy to trade. Conversely, algorithmic trading of ETFs increases the volatility of the underlying stocks, which is consistent with the research by Bertone et al. (2015). In their research, Bertone et al. (2015), discusses the liquidity mismatch between the funds and the underlying stocks, which exerts strong price pressure on the less liquid constituent stocks increasing their return variance and the co-movement with other stocks included in the fund. The increased variance of stock returns is attributable to growing systematic risk factor, which cannot be diversified away. Considering that the new reporting standards introduced by MiFID II prompted a large amount of data regarding the derivatives market to become public, European ETF market is attracting algorithmic traders (Stafford, 2019). Consequently, I observe the development of the systematic risk measures of stocks included in largest Europe specific indexes around the time when MiFID II was launched. The goal of this research is to analyze the impact of European ETF ownership induced stock co-movement and systematic risk factor development on a more comprehensive market level.

4.2. Analysis of stock co-movement

Currently the studies analyzing stock price co-movement have been looking at samples including stocks listed in US (Da & Shive, 2017; Staer & Sottile, 2017). There are various strategies for approaching the analysis of ETF induced stock co-movement. Considering the limitations of computing power and data availability I find that it would be best suited to closely follow the methodological structure of the analysis done by Staer & Sottile (2017). They employ a panel regression to explain stock co-movement, estimated as dynamic conditional correlation (time varying excess correlation) between each individual stock and the ETF tracking it. As discussed earlier, I have modified the estimation of stock co-movement as the daily dynamic conditional correlation between the individual stock returns and market returns (estimated by STOXX TMI returns). I chose to estimate correlations between the returns of individual stocks and the market returns because I am interested in looking at the market wide stock co-movement instead of looking at the co-movement within a single ETF. Therefore, I put forward the hypothesis that stocks are experiencing market wide co-movement, since I am interested if the overlap of ETF stock ownership together with the specifics of the ETF design creates broader stock co-movement in financial markets.

The analysis explains the absolute values of the dynamic conditional correlation (DCC). Contrary to the study by Staer & Sottile (2017), I am not using the natural logarithm of the DCC variable since the correlation between stocks and the market can also take negative values. Natural logarithm would exclude these observations making the sample biased. Also, the first differences of the DCC variable is not employed, since the data for co-movement is already stationary and normally distributed and using first differences would make the results more difficult to interpret. The regression is approximated in the following manner:

$$DCC_{i,t} = \alpha + \beta_1 DCC_{i,t-1} + \beta_3 ln(EqVol)_{i,t} + \beta_4 R_{i,t-1} + \beta_5 R_{i,t} + \beta_6 R_{m,t} + \beta_7 ILLIQ\_daily_{i,t} + \beta_8 Group_t + \varepsilon_{i,t}$$

$DCC_{i,t}$ measures the approximated daily dynamic conditional correlation for the individual stock returns with the stock market returns.

$DCC_{i,t-1}$ equals the one day lagged value of $DCC_{i,t}$.

$EqVol_{i,t}$ measures the relative liquidity of each constituent stock compared to the liquidity of the ETFs the stock is included in.

$R_{i,t}$ equals the daily returns of each observed stock.

$R_{m,t}$ equals the daily market returns.

$ILLIQ\_daily_{i,t}$ measures the liquidity of each stock according to the Amihud's (2002) illiquidity measure.

$Group_t$ is a dummy variable indicating the period before the introduction of MiFID II (if value equals to 0), and after MiFID II (if value equals to 1).

The model is approximated using fixed effects panel regression with within-regression estimators. Fixed effects model was chosen after running the Hausmann test, which showed that difference in coefficients between the fixed effect and random effect models is systematic. Also, the correlation between the omitted explanatory variables specific for each stock and the model residuals significantly differs from zero, therefore, the random effect model would be less efficient since it assumes zero correlation in residuals. After suspecting a within-panel serial correlation in the residual values, model is adjusted for heteroscedastic error term.

During the analysis various combinations of explanatory variables was used to explain the model and the results are discussed in the upcoming sections of this research.

4.3. Analyzing systematic risk factor

If stock prices experience an increased co-movement, the excessive correlation is damaging the price to adjust according to the fundamental value of the asset. The price path becomes co-integrated with the market and it leads to stocks being more prone to systematic risks, like market wide price corrections. The systematic risk is by definition a not diversifiable risk, which is required to be compensated for the investors. According to Olly, (2018), the increased systematic risk could potentially exacerbate stock price volatility in times of economic distress. Xu & Yin (2017), argues that ETF trading is negatively affecting the price efficiency of the underlying stocks.

Commonly the measurement for systematic risk factor is the CAPM beta. According to Da, Guo, & Jagannathan (2011), the CAPM beta is still valid for estimating the cost of capital. For the analysis, I employ two estimations for the CAPM beta: simple linear estimation and ARCH estimation. In both models I condition individual stock returns on the Europe market returns (STOXX TMI).

For the analysis, I generate a dummy variable indicating the time period after the introduction of MiFID II. A simple t test is performed to examine if the change in mean values of beta, before and after the introduction of MiFID II, is significantly different from zero. Further, if the change is proven to be significant, the same test will show also if the change has been positive or negative. The same test is performed also for the co-movement estimate and relative liquidity measure. T test is not very elegant way of looking at the systematic risk factor in European markets, however, it presents whether derivatives market could potentially be linked to development of systematic risk of the underlying stocks. I am using MiFID II as a break point for analyzing systematic risk because it brought a significant shift in the derivatives market. According to Flood (2018) MiFID II had to have an especially significant impact on the transparency and trading activity of ETFs.

Further, systematic risk factors are analyzed by conditioning them on the values of the co-movement estimates (*DCC*), relative liquidity (*EqVol*), and absolute liquidity (*ILLIQ_daily*) of the underlying stocks.

$$ARCH\_beta_{i,t} = \beta_1 DCC_{t,i} + \beta_2 \ln{(EqVol)_{t,i}} + \beta_3 \ln\left(ILLIQ_{daily}\right)_{t,i} + \varepsilon_{t,i}$$

$$Beta_{i,t} = \beta_1 DCC_{t,i} + \beta_2 \ln{(EqVol)_{t,i}} + \beta_3 \ln\left(ILLIQ_{daily}\right)_{t,i} + \varepsilon_{t,i}$$

The regressions are estimated using a fixed effect linear panel model adjusted for heteroscedastic residual terms.

Results

In this section of my research I am in turn addressing the results of the mathematical analysis in relation to all of my previously posed hypotheses. First hypothesis I investigated was - stocks included in the largest Europe specific indexes are experiencing market wide co-movement. Examining the level of stock co-movement and whether it indeed was negligible required estimating the time varying conditional correlation (DCC) between each individual stock returns and market returns. It was done using the multivariate GARCH model, more precisely, the dynamic correlation is estimated as the prediction for t=1 from the covariate matrix using the information up until t-1. Therefore, the initial values should be excluded from the analysis as they can be considered both visually and mathematically as outliers because the model lacked the necessary information to correctly predict the correlation. The volatile nature of the stock returns did not allow for all 1624 stocks to reach convergence and produce valid estimations. In total 1131 stocks reached convergence. The further analysis is based on this sample of stocks.

After sorting the data into a panel form, the variables used in the further analysis were winsorized at 10% threshold and checked for stationarity. After running Fisher-type unit root test, which is the Augmented Dickey-Fuller unit root test designed for data defined in panel format, it was decided to use DCC variable in absolute values, and the natural logarithms of relative liquidity and absolute liquidity. The null hypothesis that these variables contain a unit root was strongly rejected.

First of all, I ran a Student's t test to examine whether the co-movement is present in European stocks. The null hypothesis for this test was - the mean value of the variable DCC is equal to zero. In conclusion, the hypothesis was strongly rejected. Additionally, it showed that the mean value for co-movement approximation is significantly larger than zero, also, if the distribution is plotted as a histogram, it shows that DCC follows a left skewed distribution with majority of observations having a positive value. Therefore, I can conclude that the mean value of the stock co-movement measurement is graphically and mathematically shown to be positive, which supports my first hypothesis.

Examining the fit of the linear panel regression model using Hausman test, the results showed that random effects are not consistent for the specification of the stock co-movement model. More precisely, the conclusion was that the unobserved stock specific explanatory variables significantly differ from zero. The assumption of random effect that this correlation is zero would produce spurious results. Consequently, I employ linear panel regression with fixed effect, and the results are presented in table 1.

In the output from the regressions (Table 1), it is not possible to estimate the exact magnitude of economic impact for any of the regressors. However, it is possible to observe whether the impact of independent variables is positive or negative on the co-movement of underlying stocks and if it is significant. Regarding the second hypothesis proposed earlier in the research, the equivalent volume regressor in all modifications of the model retains a positive and exceptionally significant relation with the DCC variable. Meaning that stocks with increased relative liquidity experiences diminishing of return co-movement, which arguably means more efficient pricing. Accordingly, also the second hypothesis - decrease in relative liquidity of stocks listed in Europe (compared to the liquidity of ETFs, which are tracking them) is related to higher price co-movement; is consistent with the findings of the co-movement analysis.

Table1: Regression output

	(1) DCC_w	(2) DCC_w	(3) DCC_w	(4) DCC_w	(5) DCC_w	(6) DCC_w
L.DCC_w	0.913***	0.917***	0.870***		0.914***	0.903***
	(0.004)	(0.004)	(0.006)		(0.004)	(0.000)
l_EqVol_w	0.001***	0.001***	0.001***		0.001***	0.001***
	(0.000)	(0.000)	(0.000)		(0.000)	(0.000)
R_stock_w	0.012***	0.013***	0.010*			0.011***
	(0.003)	(0.003)	(0.005)			(0.003)
Market_R	-0.028***	-0.029***	-0.017**			-0.030***
	(0.003)	(0.004)	(0.009)			(0.003)
l_ILLIQ_daily_w	0.000***	0.001***	0.001***		0.000***	0.000**
	(0.000)	(0.000)	(0.000)		(0.000)	(0.000)
Group	0.000**			0.001	0.000	0.001***
	(0.000)			(0.002)	(0.000)	(0.000)
L.R_stock_w					-0.085***	-0.080***
					(0.004)	(0.003)
L.Market_R					-0.122***	-0.128***
					(0.005)	(0.003)
L.l_EqVol_w						0.001***
						(0.000)
_cons	0.050***	0.051***	0.072***	0.392***	0.048***	0.046***
	(0.002)	(0.003)	(0.003)	(0.000)	(0.002)	(0.001)
Obs.	871139	622766	248373	1033734	871139	844736
R-squared	0.837	0.846	0.754	0.000	0.838	0.817

Standard errors are in parenthesis
*** p<0.01, ** p<0.05, * p<0.1

The dependent variable DCC is a dynamic conditional correlation between the daily returns of stocks tracked by major European indexes and the market returns (STOXX TMI index returns). DCC is a proxy for the stock co-movement in European markets, which in this model is conditioned on: the relative liquidity between stocks and the ETFs tracking them (EqVol), the daily returns of individual stocks (R_stock) and the STOXX TMI index (Market_R); measure of daily absolute stock liquidity (ILLIQ_daily); and a dummy variable indicating the period since the introduction of the MiFID II.

As for the third hypothesis - higher price co-movement is related to lower absolute liquidity measure in the stocks listed in Europe; data is showing exceedingly significant and positive link between the Amihud's (2002) measure ILLIQ and the proxy for return co-movement, which is consistent with the notion presented by the hypothesis. The DCC variable is presented to have a negative and significant relation with absolute liquidity of the individual stocks across all variations of the regression.

In the regressions presented in table 1, I included control variables in the form of daily stock returns (*R_stock*) and daily market returns (*Market_R*), which served as control variables and were taken from the study by Staer & Sottile (2017). Additionally, I included dummy variable Group, which indicated the period after introduction of MiFID II. It produced significant results in two of the regression. On the other hand, all of the results for Group signaled a positive link between the introduction of MiFID II and the dynamic correlation of stock returns.

Further analyses evolve around the introduction of MiFID II. The investigation of relevant variables before and after the launch of MiFID II is split into two part: first, a series of Welch's t tests are performed to examine the hypothesis that the difference of the mean value for the variable in question is significantly different from zero. Welch's t test allows for the variation in the compared samples to differ. In this case, it is important because the sample period after the introduction of MiFID II is shorter in comparison (2,5 years vs 1 year), hence the variation predictably is smaller for the shorter time period (Table 2). Second, fixed effect and random effect (depending on the results of the Hausman test for each equation) linear panel regressions using the variable Group as a regressor to observe if the measurements have experienced an increase or decrease after MiFID II was introduced (Table 3). Also, daily stock returns and daily market returns are included in the regressions as control variables.

Table 2: Walch' t test

	obs1	obs2	Mean1	Mean2	dif	St_Err	t_value	p_value
l ILLIQ daily w by~1	643923	256483	-21.486	-21.59	.103	.009	12.1	0
l EqVol w by Group~1	681605	274742	-3.772	-4.205	.433	.004	121.05	0
DCC w by Group: 0 1	740805	292929	.392	.392	-.001	.001	-1.6	.112
ARCH beta w by Gro~1	649364	253696	.692	.78	-.088	.001	-73.55	0
Beta w by Group: 0 1	740805	292929	.635	.74	-.105	.002	-82.85	0

This table presents the results for multiple Walch's t tests, examining if the difference between two median values, varying depending on the time variable Group values, are equal to zero.

Earlier in the research I presented 4 hypotheses regarding the development of relevant factors measuring the liquidity, co-movement, and systematic risk of the stocks tracked by the major European indexes –

i) After the introduction of MiFID II liquidity has improved for the stocks included in the largest Europe specific index funds;
ii) The relative liquidity of stocks compared to the liquidity ETFs tracking them has decreased after the introduction of MiFID II;
iii) After the introduction of MiFID II, the systematic risk factor has increased for stocks included in the largest Europe specific index funds;
iv) After the introduction of MiFID II, the co-movement of stocks included in the largest Europe specific index funds has increased.

All results, for all variables are consistent between the Welch's t test (table 3) and the panel regressions (table 2). Regarding the liquidity measures tested for changes, both relative and absolute liquidity measures are projecting a positive trend after the introduction of MiFID II. The observed liquidity measures show positive change compared to pre-MiFID II values (both measures present the illiquidity level, therefore, negative trend means increased liquidity). In conclusion the data support the hypothesis number 4 but contradicts the hypothesis number 5.

The linear panel regression does not allow to approximate the real economic impact in absolute terms, in this case. It is possible to determine whether the link between the dependent variable and the regressor is positive or negative. For systematic risk factors (linear beta and ARCH beta) and the introduction of MiFID II it is clearly positive and very significant. However, the interesting conclusion comes from the Welch's t test, the mean values of both estimated betas have increased by 0.1, compared to the pre-MiFID II period. The evidence clearly supports the hypothesis number 6. However, I would like to dismiss this evidence as invalid, and argue that more evidence is needed to analyze this hypothesis. First of all, ARCH beta is approximated quarterly, which gives only 4 observations for each stock. Linear beta is measured monthly, which does not give much better sample of observations after the introduction of MiFID II – 12 for each stock. I consider that the regulatory changes introduced by MiFID II has conveyed significant changes for the financial system in Europe, and further research is needed to study the development of systematic risk factor in the period after MiFID II.

Table 3: Regression output

	(1)	(2)	(3)	(4)	(5)
	l_ILLIQ_daily_w	l_EqVol_w	DCC_w	ARCH_beta	Beta_w
Group	-0.041***	-0.433***	0.001	0.106***	0.105***
	(0.014)	(0.002)	(0.002)	(0.010)	(0.007)
R_stock_w	-1.675***	-1.756***	0.049***	-0.044	-0.103*
	(0.109)	(0.068)	(0.006)	(0.047)	(0.060)
Market_R	-3.071***	-1.961***	0.052***	-0.314***	-0.241***
	(0.112)	(0.084)	(0.006)	(0.033)	(0.042)
_cons	-21.504***	-3.745***	0.391***	0.690***	0.635***
	(0.004)	(0.044)	(0.000)	(0.003)	(0.002)
Obs.	900406	956347	1033734	903060	1033734
R-squared	0.002	.z	0.000	0.013	0.011

Standard errors are in parenthesis

*** p<0.01, ** p<0.05, * p<0.1

This table represents the output for linear panel regression with the variable Group as its main regressor analyzing the effect of introduction of MiFID II on the following dependent variables: ILLIQ_daily – a relative liquidity measure; EqVol – absolute liquidity measure; DCC – measurement for the stock co-movement; ARCH_beta and Beta – systematic risk measurements.

Looking at the development of dynamic correlation measurement, it seems that it had not changed at all when comparing for the period before and after the launch of the new regulatory system. Welch's t test gives evidence that the difference between the mean value of stock co-movement before and after the launch of MiFID II is not significantly different from zero. Also, in the panel regression, although the model generated a positive link between introduction of MiFID II and the DCC variable, the results are insignificant. In conclusion, the data does not support the hypothesis number 7, however it does not show the polar opposite results, as well. The stock co-movement has not experienced any significant changes during this period.

Lastly, I examine the connection between the stock co-movement and the systematic risk factor. Fixed effect linear panel regression (Table 4) shows that dynamic conditional correlation has a consistently positive and significant relation with the beta factors of the underlying stocks. Stocks with higher measurement for co-movement also has increased systematic risk factor. Data presented from these calculations are consistent with the hypothesis number 8: if stocks included in the largest Europe specific index funds have marginally higher price co-movement with the market, they also experience increased systematic risk factor.

Table 4: Regression output

	(1)	(2)	(3)	(4)
	ARCH_beta_w	Beta_w	ARCH_beta_w	Beta_w
DCC_w	1.009***	1.928***	1.138***	1.876***
	(0.044)	(0.047)	(0.038)	(0.049)
R_stock	-0.149***	-0.176***	-0.220***	-0.301***
	(0.032)	(0.058)	(0.033)	(0.043)
l_EqVol_w			-0.032***	-0.049***
			(0.003)	(0.003)
l_ILLIQ_daily_w			0.002	0.008***
			(0.002)	(0.001)
_cons	0.323***	-0.091***	0.200***	-0.092**
	(0.017)	(0.018)	(0.041)	(0.043)
Obs.	903060	1033734	762078	872100
R-squared	0.047	0.102	0.060	0.095

Standard errors are in parenthesis
*** p<0.01, ** p<0.05, * p<0.1

The table presents results for linear panel regression analyzing the systematic risk factors ARCH_beta and Beta.

5.1.Discussion of results

Mathematical analysis presented above examined connections between stock co-movement, liquidity, and systematic risk factors around the time of ESMA introducing improved regulatory system for the financial sector in Europe. The analysis proved that theory discussed in the existing researches examining the effects of excessive stock indexing are applicable also to European stock markets as well. Firstly, I present evidence that European stock market do experience stock return co-movement. It was not possible to determine empirically a clear causal link between any of the ETF ownership structure and the issues discussed in this research because the ETF market in Europe has been very opaque and lacks the necessary data.

Looking at the connection between liquidity measures and the dynamic correlation levels for the observed stocks, data from the analysis shows evidence consistent with the findings of Bertone et al. (2015) that less liquid stocks have higher return co-movement.

Following the same logic, after the introduction of MiFID II, derivatives should have become more liquid due to increased transparency and, consequently, increased the discrepancy between stock liquidity and ETF liquidity. This discrepancy theoretically should have increased the co-movement of stock returns because the data showed that stocks with lower relative liquidity measures had increased co-movement measures. Even if there is no causal relationship, the significance of the results indicate that these factors should move together. On the other hand, according to Caginalp & DeSantis (2016) the growth of the liquidity in the underlying stock signal that European markets are on the upwards sloping part of the liquidity function.

Finally, as discussed by Flood (2018), ETF market has been growing rapidly due to technological advance and, the low-cost structure, and the ease of diversification. The MiFID II regulations has improved the liquidity in the market and allows for even faster growth of these derivatives. Therefore, I suggest that it is important to consider the evidence showing that systematic risk factors are positively linked to the stock co-movement. The results of higher stock co-movement being positively related to the systematic risk factor in their pricing were derived using the stocks tracked by the largest European indexes, therefore these can be considered as the biggest and most liquid stocks in Europe. In conclusion, even the largest stocks in Europe are experiencing return co-movement and, consequently, increased systematic risk factor.

Conclusion

My aim with this research was to approximate to what extent the stock co-movement is present on a broader European market level and to analyze the impact of ETF ownership induced stock co-movement on the systematic risk factor of European stocks. Existing literature presents that there are various channels in which ETFs are affecting the pricing of the underlying stocks – creation/ redemption process, arbitrage, liquidity mismatch. Ben-David, Franzoni, and Moussawi (2018) even argue that the volatility and co-movement induced in the underlying stocks by ETF activity is compensated with higher premium covering the increased systematic risk factor. From the empirical examination of the stock co-movement I found that there is a significant level of co-movement among the European stock returns by approximating the dynamic correlation of 1131 stocks with the daily market returns.

In the beginning of 2018, a new regulatory system was launched, which introduced ETFs as an asset class in European markets and required for ETFs to adhere to same reporting standards as any other asset class. Improved reporting standards attracted more informed investors and revealed a large dark pool of ETF trading that was traded in OTC venues, which before MiFID II did not require any reporting. The improved reporting standards are attracting more informed investors (Hadfield, 2018), which will increase the activity of ETFs and potentially exacerbate the systematic risk factor in European stocks through increased stock co-movement and lower relative liquidity, since more of the daily volume traded will go through ETFs. However, the data for the first year after implementing MiFID II shows no significant increase in the co-movement of underlying stocks.

The analysis of stock return co-movement shows that it has a significantly positive relation to the relative amount of the stock volume traded through the ETF because the arbitrage trading related to mispricing of the ETFs is exhorting a continuous price pressure of the underlying stocks. The most worrying thing is that stock co-movement has a positive and significant impact on the systematic risk factor of the constituent stocks, which could potentially exacerbate the damage of economic downturn on each individual stock. To answer my research question – ETF activity has a positive connection with the systematic risk factor of underlying stocks through the exacerbated co-movement of constituent stocks, which is more prominent in less liquid stocks.

A potential area for future researches is to compare the stock co-movement between US and European markets.

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