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THE CONTRIBUTION OF OPTIONS ON LIQUIDITY AND MISPRICING
OF INTERNATIONAL EXCHANGE-TRADED FUNDS

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ABSTRACT

Recently international exchange-traded funds (ETFs) have become popular investment vehicles for investors because they represent diversified portfolios of securities on an international basis. The basic arbitrage mechanism, which is an essential function to eliminate mispricing, is limited for international ETFs due to time differences and regulation in the underlying asset market.

The liquidity provider has the opportunity to execute a correlated hedge like ETF options to overcome the closed underlying asset market. This thesis argues that the ETF option will therefore increase liquidity due to the hedge opportunity. Prior research finds evidence that the ETF mispricing is partly caused by illiquidity. To overcome the illiquidity issue, derivatives like options tend to contribute to a more liquid market. The thesis tests the hypotheses that liquidity is impacting ETF mispricing and that options contribute to increased liquidity and eliminate mispricing of international ETFs with the help of an ordinary least squares (OLS) multiple regression model and an event study in the form of a simple means test. The thesis finds evidence that liquidity is causing mispricing and strong evidence that liquidity is increasing and premium is decreasing after option introduction.
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This thesis examines the impact of exchange-traded funds (ETFs) index option introductions on the underlying exchange-traded fund (ETF) market liquidity and in consequence the contribution to ETF mispricing. The motivation for this thesis derives from the findings that especially internationally oriented ETFs exhibit mispricing that contradicts investment objectives. Therefore, the purpose is to provide new and comprehensive evidence on whether ETF options introductions have beneficial consequences to pricing and market quality in the form of liquidity of ETFs. A second motivation derives from the fact that the ETF industry and the ETFs as popular investment vehicles present high growth numbers and are therefore significant in today’s financial markets. Increased investor demand for ETFs appears not only because ETFs offer numerous advantages like diversification, convenience, flexibility, cost-effectiveness and tax efficiency. The U.S. registered ETFs represent the largest ETF landscape. According to the ICI, the number of index-based and actively managed ETFs increased to 1,134 with total net assets of $1,048 billion at the end of the year 2011. In comparison, 102 ETFs had total net assets of 83 trillion in the year 2001 (ICI, 2012). Globally speaking, 3,253 ETFs account for $1,498.7 billion Assets Under Management (AUM) as of June 2012. From the beginning of 2012 to June 2012 the global growth rate for AUM is 10.9 percent. Approximately 160 providers increased the number of listed ETFs by 8 percent within the same time (Black Rock, 2012).

ETFs are of interest to finance researchers due to the relatively new fund structure. The investment vehicles inherent characteristics which are new not only to regulators, market makers and institutional investors but also to private investors since it is argued that ETFs replace mutual funds in the long run.
An estimated 3.5 million U.S. households held ETFs in 2011, which is clearly, according to the Wall Street Journal, a scenario of a swing in investment strategies by financial advisers of important brokerage houses. They are seeking exposure to lower cost ETFs and clearly moving away from stocks. The bond market is also not an alternative. Evidence is the outflow of investors’ money of $200 billion from American Funds, which is a fund company that invests in the classical fixed income asset classes like stocks, bonds and mutual funds. Whereas investors pumped $452 billion into Vanguard Group, which is the largest U.S. fund company and offers over 64 ETFs (Lauricella, 2012).

According to the Investment Company Institute (ICI), an ETF is an investment company whose shares trade like publicly traded company shares on exchanges at market-determined prices. The shares are structured as open-end investment companies or unit investment trusts. The rapid industry growth and the popularity led to innovative further developments like the extension to niche or international markets, which result in different other structures.

Invented nearly 20 years ago in the year 1993, the first ETF was a broad based domestic equity fund tracking the S&P 500 Index. For example, the Standard & Poors Depository Receipts (SPDR) ETF, like all other initiated index-based ETFs since 1993, choose an index and a method for tracking its target index. The underlying index can replicate different kinds of markets or industries (real estate, automotive, energy, pharmaceutical), sizes (large cap, mid cap, small cap), countries, investments styles (inverse, leveraged) or fixed income assets (government, inflation, credit). The ETF can hold every security in a particular index (replication index-based ETF) or a representative sample of securities (sample index-based ETF). For an index with a large number of securities the method of representative sampling is a practical solution. Like many other ETFs, the Standard & Poors SPDR is passively managed. However, an increasing number of
sponsors define an investment objective and manage the ETF actively by trade weekly or monthly for a number of reasons, including risk minimizing. The portfolio holdings, namely the creation basket, have to be published, either a replicate or a sample, by the fund on a daily basis. When an authorized participant, typically an institutional investor such as a market maker or broker-dealer, deposits the daily creation basket shares with the ETF, so-called creation units are given to the authorized dealer in return. These creation units range in size of 25,000 to 200,000 shares and can be kept or sold like publicly traded company shares on stock exchanges by the market maker. If the market maker returns the ETF shares to the ETF sponsor, the creation unit is liquidated and receives in return the daily redemption basket in the form of the index shares portfolio, which typically mirrors that of the creation basket.

ETF pricing is market driven and influenced by forces of supply and demand. Imbalances can cause the ETF price to deviate from its underlying Net Asset Value (NAV). Several studies examine the ETF mispricing issue and show short-lived mispricing and more constant and greater mispricing depending on the type of ETF.

Figure 1 and Figure 2 visualize the premiums and discounts the two ETFs are trading. The iShares ETF is incorporated in the U.S. and tracks the MSCI Singapore Index. The db x-trackers ETF is incorporated in Luxembourg and tracks the MSCI World TRN Index. This study distinguishes between U.S. and European based ETFs. It is clearly visible that these ETFs show constant mispricing in a form of discount and premium to their NAV. The period between February 2008 and July 2009 in both ETFs indicate extraordinary mispricing. During this period, the financial crisis was impacting the global economies and it can be assumed that crisis factors have significant impact on this incident.
Figure 1 Trend of Premium / Discount: iShares MSCI Singapore

Figure 1 illustrates the trend of the premium and discount in percent during the period of January 2006 and July 2012 for the iShares MSCI Singapore Index Fund.

![Trend of Premium / Discount](image1)

Figure 2 Trend of Premium / Discount: db x-trackers MSCI World TRN

Figure 2 illustrates the trend of the premium and discount in percent during the period of January 2006 and July 2012 for the db x-trackers – MSCI World TRN Index Fund.

![Trend of Premium / Discount](image2)

However, arbitrage opportunities promote trading of ETF shares close to the underlying securities and their Net Asset Value (NAV) in order to reduce intraday mispricing. Day traders seek arbitrage opportunities by using the creation and redemption mechanism to make a profit. If
the value of the underlying portfolio is greater than the ETF price, the authorized participant will redeem the lower priced ETF shares by receiving the higher priced underlying securities. In contrast, the investor exchanges underlying securities against ETF shares when the ETF unit price is greater than the security share price. The so called in-kind process eliminates large and long-lasting deviations between the ETF price and its NAV.

When the arbitrage mechanism is limited for international ETFs due to legal restrictions or time issues, then the market maker or authorized participant can use a correlated hedge to overcome the exposure which occurs when the underlying assets are not accessible. The market maker can hedge his position in the ETF and reduce the potential risk. After he has the access to the underlying stocks, he can submit a creation order in the ETF. This will show up in increased assets under management and shares outstanding. The authorized participant can manage the process in several ways.
Figure 3 Methods of Hedging when Providing Liquidity

This figure illustrates the methods of hedging which can be used by the authorized participant.

According to the practical ETF handbook written by David J. Abner (2010) and illustrated in Figure 3, the customer places an order and the authorized participant can buy ETF shares on the market (A). This scenario would not increase liquidity. The second possibility is to buy the assets of the underlying basket (B). In scenario C the authorized participant will buy a correlated hedge that will track the ETF well. He will be short in ETF shares and long in the correlated hedge. Scenarios B and C will increase liquidity in the market (Abner, 2010).

This study corresponds to scenario C in Figure 3, and the ETF option will stand for a correlated hedge. Furthermore, this study explains in the following sections the limitation of the arbitrage mechanism especially for international ETFs and outlines the findings of constant mispricing and their reasons. Illiquidity is discovered as one central aspect of ETF mispricing, and if options tend to increase liquidity on the underlying asset the introduction should therefore lower mispricing and contribute to an increase of liquidity of the ETF. The central research
questions are therefore if liquidity impacts mispricing and if options therefore have an effect on ETF liquidity. It can be assumed that if liquidity causes mispricing of ETFs and options impose liquidity that the price of ETFs is closer to the NAV after the option introduction. The authorized participant can use the ETF option to process a correlated hedge to overcome a shortage of the underlying basket and sell the ETF shares to the customer. The statistical test to answer the research questions is conducted via two hypotheses and two basic models. Further explanation for the research design and methodology can be found in the following chapters.

The next section will explain the findings from the financial research literature concerning price efficiency, arbitrage, ETF pricing, liquidity and options. Following the literature review are two null hypotheses explanations, the data section with the descriptive statistics, the methodology of the research models, the data results and the conclusion.
The literature review will introduce the reader to the findings for price efficiency, followed by the arbitrage mechanism in terms of ETF pricing, the liquidity around ETFs and the connection to mispricing. In order to later measure liquidity, the common liquidity measures will be discussed. The derivatives market and in particular options tend to increase liquidity, and the findings seen in the literature will complete the literature review section.

2.1 Price Efficiency

The Efficient Market Hypothesis (EMH) claims that financial markets are efficient when all information is reflected in asset prices and that arbitrage stabilizes speculation (Friedman 1953) and contributes to efficient asset pricing. The limitations of market efficiency are discussed by several research studies to a great extent during the last decade. Multiple findings restrict the EMH theory in claiming that prices are unpredictable and follow a “random walk.” Lo and MacKinlay (1999) reject the hypothesis that stock prices follow a random walk by finding that short run correlations of stock prices are not zero. Another test of price efficiency by Shiller (2000) finds that psychological contagion was leading to irrational exuberance during the rise in the stock market of the 1990s. Therefore, it is proven that under certain market conditions asset prices can lack efficiency and show mispricing.
2.2 Arbitrage and ETF Pricing

Arbitrage is an essential mechanism for efficient ETF pricing. A long time before the invention of ETFs, arbitrage was explained as “the simultaneous purchase and sale of the same, or essentially similar, security in two different markets for advantageously different prices” (Sharpe and Alexander, 1990). The price discovery process for ETFs includes these arbitrage opportunities by giving authorized participants the possibility to create and redeem ETF shares when a deviation in prices between an ETF and the underlying portfolio is detected. This mechanism should eliminate mispricing between the ETF share price and the NAV of the underlying assets. For ETFs with international exposure, the arbitrage mechanism in the form of the creation and redemption process (in-kind process) is limited.

There are several issues with liquidity which come with the international ETFs. Local regulations and certain restrictions on timing of creations and redemptions of the underlying basket are potentially added costs for the authorized participant, which he must recoup for transacting in the local market of the underlying basket. The additional fees as broker costs will therefore increase the bid-ask spread. Since the ETF and the underlying basket are trading in different time zones and the underlying basket can be unavailable, there is no real-time arbitrage mechanism possible. Two prices (ETF price and NAV) will independently move. One will represent the most recent close price, and one will represent the expectations for the next opening day of the underlying basket market. Thus international ETFs will trade at a discount or premium to the NAV because there is no arbitrage mechanism possible and the bid-ask price will be higher (Abner, 2010).
Evidence for the failure of arbitrage mechanisms not only for ETFs is investigated by other studies. In terms of arbitrage as a mechanism to promote price efficiency, Emmons and Schmid (2002) find out that “the existence of professional arbitrageurs mitigates—but cannot eliminate—mispricing in the market relative to intrinsic values.” The failure of price efficiency is also detected for closed-end funds. Pontiff (1997) finds a higher price variance due to noise trading in closed-end fund prices than the fund’s respective NAV. Klibanoff et al (1998) test prices and net asset values of single-country closed-end funds and conclude that price returns are not efficient, since they incorporate, on average, only about 60 percent of NAV return information. The ETF research literature discusses several tests of mispricing. Tse and Martinez (2007) analyze the relationship between prices and NAVs of iShares, in the manner of Klibanoff et al (1998), and find that ETF prices reflect all NAV information. Efficiency of these assets is further supported by the fact that the iShares prices contribute significantly to the price discovery process with the NAVs. The overall results indicate that international iShares efficiently reflect fundamental information from their underlying stocks. Guo, Jiang and Lan (2010) examine the price deviation of the Chinese SSE 50 ETF and conclude that the small premium of 0.023 percent on average is not persistent over time and statistically not significant. According to Kayali (2007), the international Turkish DJIST (Dow Jones Istanbul 20) ETF tracks the Dow Jones Turkey Titans 20 Index and even though the ETF is priced at a discount, the mispricing disappears within two days. Chan, Hsu and Lin (2005) investigate the pricing efficiency of the Taiwan Top 50 Tracker Fund (TTT), which contains the largest 50 stocks in Taiwan in terms of market value. Empirical evidence suggests that the TTT tends to sell at a premium even if the premium at 0.041 percent is not significant. They conclude that the TTT is pricing efficient.
In contrast, Aber, Li and Can (2009) investigate four iShares and find premiums to their NAVs. In addition, these premiums were consistent, which challenges the arbitrage theory. Research by Rompotis (2009) supports the mispricing of iShares by discovering premiums to their NAV. Moreover, international iShares experience the higher premiums.

Ackert and Tian (2008) discover that a sample of 28 U.S. and country ETFs are priced inefficiently consistent with significant limits to arbitrage. Especially for international ETFs, the consistent premium is more than 10 basis points on average and less than 2 basis points for the U.S. funds. They report, in contrast to the efficient pricing hypothesis, that persistent mispricing is related to momentum, illiquidity and size effects. Thereafter, liquidity impacts the fund premiums. The relationship between fund premium and market liquidity is U-shaped, which suggests that only after a certain level of liquidity the more active trading leads to lower mispricing. For U.S. funds, higher liquidity results in a lower premium. In general, international emerging markets ETFs have lower liquidity than developed U.S. market ETFs. Since the liquidity is lower, the mispricing for international ETFs is higher. An explanation could be perhaps because the creation and redemption process for country funds is more complex than for U.S. funds due to taxes and impediments to trade (Engle and Sarkar 2006).

2.3 ETF Liquidity and Mispricing

Liquidity in financial terms is when an asset “can be quickly exchanged at a minimal cost” (Gabrielsen, Marzo, Zagaglia, 2011). In terms of the ETF liquidity ecosystem the practical analysis is given by David J. Abner in his ETF handbook. He clearly states that ETF liquidity is based upon its underlying basket as the most important measure. The creation of ETF shares is
unlimited and is mainly driven by ETF demand by the customers. The constraining factor is the access to the underlying assets. Especially in international ETFs, the underlying basket of assets is driving ETF liquidity and pricing. Four liquidity components are working together in the ETF market:

1. Average Daily Volume (ADV)
2. Derivatives based upon the ETF
3. Correlated trading vehicles
4. Implied Daily Tradable Shares (IDTS) or ETF implied liquidity

Average daily volume is the average number of shares the ETF is traded during a certain period. Derivatives can be options and futures—a liquid option market will therefore contribute to liquidity. The option (or future) supplements the underlying basket as a liquidity source. Especially when the underlying assets are closed during the trading day of the ETF, a correlated asset or another ETF can supplement the actual underlying basket. The ETF implied liquidity is by far the most important liquidity measure. The ETF implied liquidity measures the potential tradable shares of the underlying basket which can be traded in the market. Based upon the underlying basket, the potential IDTS can be bought and ETF shares can be created. Therefore the underlying basket limits the ETF liquidity. The creation of ETF shares itself is theoretically unlimited.
The calculation of the ETF implied liquidity is shown in the following:

\[
IDTS = \frac{(30\text{-Day ADV of Each Constituent} \times VP)}{\text{Constituent Shares per CU}} \times \text{Creation Unit Size}
\]

where IDTS is the intraday tradable shares, 30-Day ADV the average daily volume over 30 days, VP the variable percentage (defaulted to 25 percent)\(^1\), Constituent Shares per CU is the number of shares of each stock required in the basket and Creation Unit is the number of ETF shares for each basket of stocks (Abner, 2010)\(^2\). The literature is offering general explanations of liquidity which will be discussed in the following part in order to derive the measures the study uses in the models.

2.4 Measuring Liquidity

In general, the basic liquidity components are the transaction time (speed of executing transactions) and costs (exchanging assets in the market without dramatic changes in the prevailing market price). According to Baker (1996) three main properties of liquid markets are depth (orders above and below the trading price), breadth (large volume of orders) and resiliency

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\(^1\) variable percentage is defaulted to 25 percent of the average daily volume of each of the underlying components in order to adjust the ETF shares that can be traded without having an impact on the price of each underlying stock.

\(^2\) The liquidity measure of ETF implied Liquidity (implied daily tradable shares –IDTS) is presented by Bloomberg Professional Service on a daily basis. Historical data on the IDTS is to this time not available and this study is not considering the measure in the research models. Common liquidity measures used in financial research and explained in the literature review and in the data section of this thesis are applied in my research models.
(many orders in response to price changes). Market liquidity has important asset pricing implications, which are discussed by Amihud and Mandelson (1980, 1987) and Amihud and Mendelson (1991). They discover the fact that with higher transaction costs due to illiquidity, the market will experience lower asset prices and higher rates of return. Other authors like French and French, Roll (1986), Campbell, Grossman and Wang (1993), McInish and Wood (1992), and Blume, Easley and O’Hara (1994) link return, volume or trade indicators to liquidity. The “conventional liquidity ratio” provides a measure for how much traded volume is necessary to induce a price change of 1 percent (Gabrielsen, Marzo, Zagaglia, 2011). Besides volume-based measures liquidity can be explained by its price behavior expressed in price-variability indices. For example Marsh and Rock (1986) link the relation of number of transactions and asset price rather than volume to a liquidity ratio. The liquidity measure called “market efficiency coefficient” (MEC) measures the impact of execution costs on price volatility over short horizon by claiming that a more liquid market implies a smaller variance of transaction prices around the equilibrium price (Gabrielsen, Marzo, Zagaglia, 2011). Vector autoregressive (VAR) models are used to identify the effects and transmission channels of shocks on the structure of economy. Hasbrouck (2002) uses the VAR model to explain fluctuation in a market by swings in another market. The most common measure of transaction costs is the bid-ask spread, which is the difference between the best (lowest) ask price and the best (highest) bid price in dealer markets. The negative relationship between the spread and asset prices is explicitly discussed by Amihud and Mendelson (1991).

The role of asymmetric information as an influence to liquidity and market price is defined in models of Roll (1984) and Glosten (1987). Additional research suggests the consideration of inventory and information effects. Stoll (1989) combines these components in his model by
considering spread, inventory and adverse information. The model and liquidity measures which are used in this study are explained later on in the data section.

2.5 Options and Liquidity

The lack of liquidity of mispriced ETFs turns the attention to the contribution of derivatives like options to infuse liquidity, eliminate mispricing and contribute to market efficiency.

Gao and Bell (2003) study the ETF option market and give evidence that ETF options have achieved a respectable level of popularity and acceptance in the investment community as shown by their contract volumes, high liquidity and tight bid-ask spread. ETF options trade on five U.S. options exchanges—the Chicago board Options Exchange (CBOE), American Stock Exchange, International Securities Exchange (ISE), Pacific Stock Exchange (PCX) and Philadelphia Stock Exchange (PHLX). For the investors these ETF options are leveraged, low-cost and flexible tools for asset allocation, hedging, arbitrage and risk management.

The literature argues whether option introduction has a positive effect on the underlying asset in terms of increased liquidity as one measure of market quality. Kumar, Sarin and Shastri (1998) state that option listings have a beneficial impact on the quality of the market for the underlying stocks in terms of higher liquidity, lower information asymmetry and greater pricing efficiency. Particularly, a decrease in the bid–ask spread, an increases in depth, trading volume, transaction size and trading frequency. Furthermore, the spread decreases and depth increases even after controlling for the changes in variance, volume and price.
Another study by Kumar, Sarin and Shastri (1995) indicate that trading volume, volatility, and bid-ask spreads as market quality measures decline for the stocks contained in the Japanese Nikkei 225 Index after the listing of the index options. This study concentrates on index options rather than on single stock options which would also be the case for ETF option introduction because ETFs track indices or a basket of stocks. Moreover, they can exclude that index option introduction destabilizes the market by increased arbitrage related activity causing volatility. Their results support the hypothesis that the advent of trading in a derivative security is associated with a reduction in speculative trading and information-based trading in the underlying security. The main difference in the results is that in U.S. markets, trading volume increases after options introduction, while the opposite holds true in this case of the Nikkei 225 options. They present possible reasons for this new finding for index options. Firstly, the increase in liquidity trading after a decline in spreads does not offset the decrease in speculative or informed trading. Secondly, the Nikkei 225 are closely held companies and have low liquidity of the component stocks. Thus the introduction of the alternative market that makes it substantially easier, in terms of execution and cost, to mimic the Nikkei 225 Index could cause a reduction in trading activity in the cash market (Kumar, Sarin, Shastri, 1995).

Following the method of Kumar, Sarin and Shastri (1998) of examining spreads, volume and volatility as measures of market quality (Danielsen, Van Ness, Warr, 2007) can support the overall improvement on market quality after option introduction. However, they rule out that the improved market quality is a consequence of the option introduction. Rather their created model suggests that improved market quality in the form of improving liquidity is a selection criterion for the option listing decision. A decreasing bid-ask spread is the most important determinant of an option listing decision.
The literature offers multiple further studies like the one of de Jong, Koedijk, Schnitzlein (2006) and indicates improvements of market quality of the underlying assets after option introduction. The aspect of the price discovery made by the SPDRs ETF after SPDR option introduction is analyzed by Chen and Chung (2011). The findings suggest that the major benefit of improved market quality in terms of liquidity and price discovery has led to a reduction in trading costs. They support the transaction cost hypothesis by Fleming et al (1996) that lower trading costs make a higher contribution to price discovery. Further support for increased market quality in form of drops in return variance of underlying stocks after option introduction is presented by Skinner (1989), Conrad (1989), Bansal (1989) and Damadoran (1991).

In contrast, Bollen (1997) can reject the null hypothesis that two groups have equal changes in variance where one control group of stocks is not optioned. It can be concluded that option listings have no significant effect on stock return variance. Using the GARCH process of (Bollerslev, 1986), who uses a generalized autoregressive conditional heteroskedasticity model, (Mazouz, 2004) tests if option listing causes any permanent volatility change in the underlying asset. His findings are that option listings are volatility-neutral. Supportive findings that option listings are volatility-neutral are provided by the works of Edwards 1988, Baldauf and Santoni 1991, Lee and Ohk 1992 and Bollen 1998. Concerning the price mechanism, Conrad 1989 finds empirical evidence that option introduction causes a permanent price increase of individual securities during the period 1974 to 1980. This price effect also explains a decline in volatility even though the evidence is not significant.

In conclusion, evidence for positive, negative and no effect on the underlying assets after option introduction can be found. So far, the literature is not providing me with evidence for effects of ETF option introduction on ETFs. This thesis will therefore close the gap and test how
liquidity effects mispricing and what contribution ETF options have on ETF liquidity and mispricing. The more practical use of ETF options, as discussed above, is the use as correlated hedge to overcome the limitation of access to underlying assets due to international restrictions and time differences.
In the following the two null hypotheses are explained which are needed to make a conclusion and give answers to the scenarios described above. After explaining the null hypotheses the research models are introduced that address the null hypotheses are explained in detail.

First it is to test if liquidity is causing mispricing. Mispricing is indicated by the premium and negative premium. In case liquidity is not impacting the premium, then it can be assumed that illiquidity is not the main factor and reason why international ETFs have higher premiums or negative premiums.

The first hypothesis is stated as:

1. $H_0 = \text{liquidity has no impact on the premium of ETFs}$

If the first hypothesis is rejected, then it is to test if option introductions impose liquidity into the ETF market, which would lead to a more efficient price. The closer the ETF price to the NAV of the underlying assets, the more efficient is the ETF price. If the market maker uses options to overcome illiquidity in the market for the underlying assets, which might be the case for international investing ETFs, the options would contribute to a more efficient price because the market is more liquid.
The second hypothesis is stated as:

2. $H_0 = \text{ETF option introductions do not contribute to liquidity}$

It is expected that in the best case scenario the models reject both hypotheses with significance. In that case it can be drawn the conclusion that illiquidity is causing mispricing and option introduction will contribute to higher liquidity. Options can be used as a financial tool to cause a more efficient ETF price closer to the NAV of the underlying basket. In the worst case, liquidity is not a factor for the premium and no evidence can be presented that options might impose more liquidity. The literature on the positive tests concerning options and ETF price behavior are promising that it can be presented the best case scenario which would contribute to the financial industry and research environment with important findings.
The following section will explain the data sample and the liquidity measures. In order to evaluate the data in detail, the descriptive statistics are presented. Additionally, the research design will be introduced in the form of the models which test the hypotheses of the thesis.

4.1 Data

A data sample of 36 international ETFs is screened by different criteria using the Bloomberg professional service accessed by the Bloomberg Terminal. Since this thesis investigates mispricing and option effects on international ETFs, all ETFs in the sample are managed in a different country or geographic region than the ETF is investing. The screening criteria are therefore:

- Fund Type: Exchange-traded funds
- Country of Domicile: USA and Western Europe
- Geographic Focus (Holdings Based): Africa / Middle East, Asia Pacific, Central Asia, Eastern Europe, South & Central America, Western Europe (when country of domicile is USA) and North America (when country of domicile is Western Europe)
- Market Status: Active
- Options on ETF available
To test if options have an effect on the ETFs it is important to find the date for the first and only option introduction. Bloomberg is offering the option monitor to explore all available options on different exchanges. The ETF sample consists of ETFs which have options listed on one exchange either CBOE or EUREX to guarantee the listing date which cannot be falsified by existing options.

To test for liquidity on the ETFs the liquidity measures are derived from the variables extracted from the Bloomberg professional service platform and include the bid-price, ask-price, bid-ask spread, volume, current market capitalization, 90 days volatility, 30 days volatility, 10 days volatility, turnover, fund net asset value, fund total assets, shares outstanding, closing price and percentage of premium. Moreover, the Bloomberg data is used to calculate further measures as the daily return derived from the one day percent closing price change. The return is used for the Amihud illiquidity measure explained in detail below.

The bid price is the highest price a dealer is willing to pay for a security, whereas the ask-price is the lowest price a dealer will agree to sell a security. The bid-ask spread in percent is calculated using the formula \(100 \times \frac{\text{ask-price} - \text{bid-price}}{\text{ask-price}}\).

Volume represents the total number of shares traded on a security on the current day. If the security has not traded, then it is the total number of shares from the last day the security traded. If an exchange sends official closing price without a volume, the return will be 0. If no closing price data is sent by the exchange, the return will reflect the last data received from the exchange.

The current market capitalization is the total current market value of all of a company’s outstanding shares stated in the pricing currency. Volatility is the measure of the risk of price moves for an ETF calculated from the standard deviation of day to day logarithmic historical
price changes. The 90-, 30- and 10-day price volatility equals the annualized standard deviation of the relative price change for the 90, 30 and 10 most recent trading days’ closing prices, expressed as a percentage. Turnover is the total amount traded in the security’s currency. This value represents all trade prices, multiplied by the number of shares relating to each price. This value is then summed. Fund NAV is determined by subtracting the liabilities from the portfolio value of the fund’s securities, and dividing that figure by the number of outstanding shares. Total net assets of the fund equal the total amount of money invested in the fund and include cash and securities. The amount is displayed in millions.

Shares outstanding is the total current number of shares outstanding quoted in millions. Closing price is the last price the security traded at as of the previous trading day. Today is not considered the current day until after the market opens.

Percentage of premium is the difference between the fund’s closing price and that day’s NAV. The value is displayed on a percentage basis. A negative premium is commonly called a discount. The calculation is: \((\text{Closing Price} - \text{NAV})/\text{NAV} \times 100\). In order to test for option introduction for the event study explained in the following research methodology, a dummy variable for option introduction is created that is equal to 0 for those dates in the pre-listing period, and 1 thereafter.

The Amihud illiquidity measure considers the ratio of the daily absolute returns to the dollar trading volume. Resulting in the absolute percentage price change per dollar of daily trading volume, or in other words the price impact on the order flow, the ratio measures the consensus belief among investors about new information.

Therefore, this study investigates liquidity with the help of Amihud illiquidity (AMIHUD), bid-ask spread (BIDASK), 10, 30, 90 days volatility (VOLA10, VOLA20,
VOLA30), volume (VOLUME), shares outstanding (SHOUT), turnover (TURNOVER), fund total assets (ASSETS) and current market capitalization (CAP) as liquidity measures. The abbreviations for each liquidity measure used in the models are in parentheses.

Two dummy variables are created to control for geographic region and option introduction date. The dummy variable $D_{geo}$ refers to either western European ETFs (“0”) or U.S. based ETFs (“1”), which are all investing mainly in internationally undeveloped or emerging countries (Eastern Europe, Asia, Middle East etc.). Broad country funds are considered which do not invest in special sectors or securities (bonds, currencies etc.) but in equities to replicate indices. The second dummy variable is introduced to control for the pre-listing and post-listing period of the option introduction on a special date, which is different for every ETF. For the pre-listing period $D_{opt}$ is “0,” and for the post-listing period $D_{opt}$ is “1.” To find the option introduction date, the listing notifications of the CBOE and the EUREX exchanges for the ETFs options are investigated, and if there appears a second listing, just the first listing is recognized as the event date to guarantee the testing of impacts of options. With that procedure it is guaranteed that the period with no option available and the time after with options on the ETF are tested.

All variables are presented in a data set on a daily basis beginning on the first trading day of 2006, which is the 3rd of January in the year 2006. The end date of the data set is the 27th of July in the year 2012. The sample excludes all non-trading days.

Table 1 presents the summary statistics of the sample. The bid-price ranges from 4.3 to 186.04 and the ask-price respectively from 5.98 to 187.04. The bid-ask spread is thereafter ranged between 0.1 percent and 56.1 percent. The mean bid-ask spread is 3.1 percent. Volume, market capitalization total assets and shares outstanding range from a low value to a relatively high value because the value varies significantly during the days.
The mean 10-, 20- and 90-day volatility is similar with values of 27.02, 27.8 and 28.7 respectively. The Amihud illiquidity measure ranges between 0 and 1194.27 and a mean of 0.14. The ETF premium presents a mean of 0.15 percent with the highest value of 22.3 percent and the lowest value of -18.9 percent. The daily percentage return is on average 0.14 percent with a peak of 0.3 percent and a minimum of -0.2.

Table 1 Table of Descriptive Statistics

This table presents the descriptive statistics for all sample variables. The values for the number of observations, the mean, the standard deviation, the standard error, the minimum and the maximum are presented.

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>Std Dev</th>
<th>Std Error (Mean)</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>BID</td>
<td>22309</td>
<td>41.70</td>
<td>26.17</td>
<td>0.18</td>
<td>4.30</td>
<td>186.04</td>
</tr>
<tr>
<td>ASK</td>
<td>22309</td>
<td>42.90</td>
<td>26.36</td>
<td>0.03</td>
<td>5.98</td>
<td>187.04</td>
</tr>
<tr>
<td>BIDASK</td>
<td>22288</td>
<td>3.12</td>
<td>5.05</td>
<td>0.03</td>
<td>0.10</td>
<td>56.07</td>
</tr>
<tr>
<td>VOLUME</td>
<td>34901</td>
<td>544894</td>
<td>1520652</td>
<td>8140</td>
<td>1</td>
<td>49075583</td>
</tr>
<tr>
<td>CAP</td>
<td>34402</td>
<td>818.70</td>
<td>813.95</td>
<td>4.39</td>
<td>2.44</td>
<td>5250.11</td>
</tr>
<tr>
<td>VOLA90</td>
<td>33283</td>
<td>28.74</td>
<td>18.73</td>
<td>0.10</td>
<td>3.55</td>
<td>174.59</td>
</tr>
<tr>
<td>VOLA30</td>
<td>34103</td>
<td>27.78</td>
<td>20.14</td>
<td>0.11</td>
<td>2.70</td>
<td>200.06</td>
</tr>
<tr>
<td>VOLA10</td>
<td>34498</td>
<td>27.03</td>
<td>21.81</td>
<td>0.12</td>
<td>1.16</td>
<td>260.89</td>
</tr>
<tr>
<td>TURNOVER</td>
<td>34903</td>
<td>13179799</td>
<td>27221658</td>
<td>145708</td>
<td>15</td>
<td>853384800</td>
</tr>
<tr>
<td>NAV</td>
<td>35140</td>
<td>41.60</td>
<td>25.19</td>
<td>0.13</td>
<td>5.27</td>
<td>183.08</td>
</tr>
<tr>
<td>ASSETS</td>
<td>28158</td>
<td>919.16</td>
<td>987.07</td>
<td>5.88</td>
<td>2.23</td>
<td>6286.59</td>
</tr>
<tr>
<td>SHOUT</td>
<td>34389</td>
<td>26.75</td>
<td>35.05</td>
<td>0.19</td>
<td>1.00</td>
<td>161.60</td>
</tr>
<tr>
<td>PRICE</td>
<td>34927</td>
<td>41.80</td>
<td>25.35</td>
<td>0.14</td>
<td>5.26</td>
<td>186.00</td>
</tr>
<tr>
<td>PREM</td>
<td>34704</td>
<td>0.15</td>
<td>1.32</td>
<td>0.01</td>
<td>-18.90</td>
<td>22.30</td>
</tr>
<tr>
<td>RET</td>
<td>34683</td>
<td>0.00</td>
<td>0.02</td>
<td>0.00</td>
<td>-0.25</td>
<td>0.34</td>
</tr>
<tr>
<td>AMIHUD</td>
<td>34505</td>
<td>0.14</td>
<td>7.19</td>
<td>0.04</td>
<td>0.00</td>
<td>1194.27</td>
</tr>
</tbody>
</table>

Correlation of variables is expected since the sample includes several liquidity measures. An impact on liquidity should increase or decrease liquidity measures in a highly correlated manner.

In the following the study presents the person correlation coefficient that measure the strength and direction of the linear relationship between the variables. The correlation
coefficient can range from -1 to +1, with -1 indicating a perfect negative correlation, +1 indicating a perfect positive correlation, and 0 indicating no correlation at all.

Volume is highly positively correlated with turnover (0.89) and shares outstanding (0.63), market capitalization with total assets (0.97) and shares outstanding (0.70), turnover with shares outstanding (0.5) and total assets with shares outstanding (0.69). As expected the volatility measures for the 10-, 30- and 90-day average are also highly positively correlated.
Table 2 Correlation Matrix

This table presents the Pearson correlation coefficient, the test of significance indicated with the p-value and sample size for all sample variables.

<table>
<thead>
<tr>
<th>BID</th>
<th>ASK</th>
<th>BIDASK</th>
<th>VOLUME</th>
<th>CAP</th>
<th>VOLARR</th>
<th>VOLA30</th>
<th>VOLA10</th>
<th>TURNOVER</th>
<th>NAV</th>
<th>ASSETS</th>
<th>SHOUT</th>
<th>PRICE</th>
<th>PREM</th>
<th>RET</th>
<th>AMIHUD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>-0.16</td>
<td>-0.24</td>
<td>0.12</td>
<td>-0.09</td>
<td>0.08</td>
<td>-0.07</td>
<td>-0.06</td>
<td>1.00</td>
<td>0.05</td>
<td>0.04</td>
<td>-0.38</td>
<td>1.00</td>
<td>0.05</td>
<td>0.04</td>
</tr>
<tr>
<td>22309</td>
<td>22309</td>
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<td>22092</td>
<td>21172</td>
<td>21153</td>
<td>21617</td>
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<td>23931</td>
<td>21797</td>
</tr>
<tr>
<td>ASK</td>
<td>1</td>
<td>-0.10</td>
<td>-0.25</td>
<td>0.11</td>
<td>-0.08</td>
<td>-0.08</td>
<td>-0.06</td>
<td>-0.07</td>
<td>1.00</td>
<td>0.03</td>
<td>0.05</td>
<td>-0.39</td>
<td>1.00</td>
<td>0.05</td>
<td>0.04</td>
</tr>
<tr>
<td>22309</td>
<td>22288</td>
<td>22092</td>
<td>21172</td>
<td>21153</td>
<td>21617</td>
<td>21824</td>
<td>22092</td>
<td>22140</td>
<td>16489</td>
<td>21466</td>
<td>22117</td>
<td>21959</td>
<td>23931</td>
<td>21797</td>
<td></td>
</tr>
<tr>
<td>BIDASK</td>
<td>1</td>
<td>-0.04</td>
<td>-0.20</td>
<td>0.15</td>
<td>0.13</td>
<td>0.11</td>
<td>-0.07</td>
<td>-0.14</td>
<td>-0.29</td>
<td>-0.11</td>
<td>-0.14</td>
<td>-0.02</td>
<td>-0.01</td>
<td>-0.01</td>
<td>0.0164</td>
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<tr>
<td>22288</td>
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<td>34713</td>
<td>34659</td>
<td>34505</td>
<td>34505</td>
<td></td>
</tr>
<tr>
<td>VOLUME</td>
<td>1</td>
<td>0.30</td>
<td>0.02</td>
<td>0.03</td>
<td>0.04</td>
<td>0.89</td>
<td>-0.25</td>
<td>0.24</td>
<td>0.63</td>
<td>-0.25</td>
<td>-0.03</td>
<td>-0.02</td>
<td>-0.01</td>
<td>-0.01</td>
<td>0.0164</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

- The correlation coefficient is presented for each pair of variables.
- The p-value is indicated below the correlation coefficient,
- The sample size is provided for each variable.
4.2 Research Methodology

The study tests the two main hypotheses with one accepted model and one statistical approach. The following will explain the two test procedures in detail.

4.2.1 Multiple Regression Model

The first hypothesis that states that liquidity has no impact on the premium of ETFs is deducted into nine hypotheses statements each with one liquidity measure and is tested with the ordinary least squares (OLS) multiple regression model as defined in the following equation:

\[ H_0 = \text{PREM} = \beta_0 + \beta_1 \text{BIDASK} + \beta_2 \text{VOLUME} + \beta_3 \text{CAP} + \beta_4 \text{VOLA10} + \beta_5 \text{NAV} + \beta_6 \text{ASSETS} + \beta_7 \text{SHOUT} + \beta_8 \text{TURNOVER} + \beta_9 \text{AMIHUD} + \ D_{opt} + D_{reg} \epsilon_t \]

where PREM is the \((\text{Closing Price} - \text{NAV})/\text{NAV} \times 100\), BIDASK is \((\text{ask-price} - \text{bid-price}) / \text{ask-price} \times 100\), AMIHUD is the ratio of the daily absolute returns to the dollar trading volume and VOLUME, CAP, TURNOVER, VOLA10, NAV, ASSETS, SHOUT are without calculation adopted from the data set.

The dummy variables \(D_{opt}\) and \(D_{reg}\) control for the pre-listing and post-listing time of the option introduction date and if the ETFs are European or U.S. based. For volume, market capitalization, total assets and shares outstanding the values are transformed to logarithms (logarithm transformation).
4.2.2 Event Study: Simple Means Test

After testing for liquidity impact on mispricing, the second hypothesis concerning the effect of option introduction on the liquidity and therefore the contribution to mispricing is tested. The method is a simple means test in the form of an event study. A test of the changes in microstructure liquidity variables around the option listing day is conducted. Similar to the test by Kumar, Sarin and Shastri (1998), the study uses the window of 250 days around the option introduction date—125 before and 125 days after the option introduction date. The average value is measured for European, U.S. and entire sample ETF liquidity measures over the event window before and after the event date.
EMPIRICAL RESULTS

Results of the OLS multiple regression model and the event study are described below.

5.1 Multiple Regression Results

Table 3 shows the regression results for the three samples: U.S. based, European based and the combined ETF sample. Three models for each sample are presented and each model contains one liquidity measure. All the models regress the same most significant liquidity measures for all samples. The most significant liquidity measures are volume, shares outstanding and turnover. In order to avoid multicollinearity because of correlated measures the models contain only one liquidity measure. The correlation matrix gives evidence that we find correlated measures as seen in the section of the descriptive statistics. It can be assumed that when testing for one specific microstructure market condition like liquidity, measures which test the same condition will be correlated and drive in the same direction. It is therefore important not to evaluate regression models that include correlated variables.
Table 3 OLS Multiple Regression Models

Table 3 presents the following multiple regression models for the combined ETF sample, U.S. based sample and the European based ETF sample: $H_0 = \text{PREM} = \beta_0 + \beta_1 \text{BIDASK} + \beta_2 \text{VOLUME} + \beta_3 \text{CAP} + \beta_4 \text{VOLA10} + \beta_5 \text{NAV} + \beta_6 \text{ASSETS} + \beta_7 \text{SHOUT} + \beta_8 \text{TURNOVER} + \beta_9 \text{AMIHUD} + D_{opt} + D_{reg} \varepsilon_t$. For each variable the beta coefficient is presented and *, **, *** and **** indicate statistical significance at the 10%, 5%, 1% and 0.1% levels, respectively. T-statistics are presented in parentheses. For each model the R-squared and the number of observations are presented.

<table>
<thead>
<tr>
<th>Regression Results for Liquidity Measures on Premium</th>
<th>Combined Sample ETFs</th>
<th>US based ETFs</th>
<th>European based ETFs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Independent Variables</strong></td>
<td><strong>Model 1</strong></td>
<td><strong>Model 2</strong></td>
<td><strong>Model 3</strong></td>
</tr>
<tr>
<td>Intercept</td>
<td>0.37****</td>
<td>0.27****</td>
<td>0.25****</td>
</tr>
<tr>
<td></td>
<td>(-5.19)</td>
<td>(-8.85)</td>
<td>(4.51)</td>
</tr>
<tr>
<td>VOLUME</td>
<td>-0.02****</td>
<td>-0.06****</td>
<td>-0.07****</td>
</tr>
<tr>
<td></td>
<td>(-5.19)</td>
<td>(-10.89)</td>
<td>(-11.60)</td>
</tr>
<tr>
<td>SHOUT</td>
<td>-0.05****</td>
<td>-0.07****</td>
<td>-0.03***</td>
</tr>
<tr>
<td></td>
<td>(-8.85)</td>
<td>(-11.60)</td>
<td>(3.33)</td>
</tr>
<tr>
<td>TURNOVER</td>
<td>-0.01*</td>
<td>-0.04****</td>
<td>-0.03****</td>
</tr>
<tr>
<td></td>
<td>(-1.83)</td>
<td>(-7.35)</td>
<td>(-3.82)</td>
</tr>
<tr>
<td>adjusted R-squared</td>
<td>0.0008</td>
<td>0.0023</td>
<td>0.0001</td>
</tr>
<tr>
<td>Number of observations</td>
<td>34.659</td>
<td>33.994</td>
<td>34.661</td>
</tr>
<tr>
<td></td>
<td>8.382</td>
<td>7.729</td>
<td>8.384</td>
</tr>
</tbody>
</table>

****, ***, **, * indicate significance at the 0.1%, 1%, 5% and 10% levels, respectively.
The data results clearly reject the first hypothesis that liquidity measures do not have an effect on the mispricing in the form of a premium (negative premium). Several liquidity measures show significant impact on premium and therefore on mispricing. Furthermore, it can be assumed that if liquidity is increasing then the premium tends to narrow as the price approaches to NAV hence eliminate mispricing.

Except for two liquidity measures, the measures result in negative beta coefficients, which indicates inverse relationships to the premium as the dependent variable.

For the combined ETF sample (European and U.S. based ETFs), model 1 includes volume, model 2 includes shares outstanding and model 3 includes turnover. Shares outstanding provides the highest and most significant negative beta coefficient of -0.05 to the 0.1 percent level. Every one percent change in shares outstanding is accompanied with a 5 percent change in premium. The overall fit of the 33,994 observations is measured by the R² and variation in shares outstanding is explaining 0.2 percent of the premium. The less significant measure in the combined sample is turnover with a significant to the 10 percent level of the -0.01 beta coefficient. The R² for model 3 is explaining 0.01 percent of the premium. The U.S. based ETF sample is presenting similar results. All three measures hold beta coefficient values which are significant to the 0.1 percent level. Similar to the combined sample, shares outstanding in model 5 is the measure which presents the highest beta coefficient of -0.07. Variation in shares outstanding explain 0.6 percent of the variation of the independent variable premium. The European based ETF sample is presenting no contradictory values, since the most significant beta coefficient of -0.03 with significance to the 0.1 percent level is presented by volume in model 7, and also turnover in model 9 can present a beta coefficient of -0.03 with significance to the 0.1 percent level. Similar results can be presented for shares outstanding in model 8 with a
beta coefficient of -0.03 with significance to the 1 percent level. The observations are significantly lower compared to the combined and U.S. based ETF sample. The average number of observations is 8,165, whereas the observations for the U.S. sample averaged at 26,277 and 34,438 for the entire sample.

The three samples offer similar values for the liquidity measures volume, shares outstanding and turnover. The beta coefficients all indicate an inverse relationship to the premium. It is visible that the variation in the independent variables volume, shares outstanding and turnover explain a portion of the variation in premium measured by R-squared. However, the greater proportion is unexplained. That fact is not questioning that liquidity is impacting the premium, it just offers more room for further explanations and findings.

The data results clearly reject the first hypothesis that liquidity measures do not have an effect on the mispricing in the form of a premium (negative premium). Volume, shares outstanding and turnover indicate significant impact on premium and therefore on mispricing.

5.2 Simple Means Test Results

Table 4 presents the test of the null hypothesis that option introductions do not contribute to liquidity by comparing the means of the liquidity measures before and after option introduction using a simple t-test. If the liquidity measures result in significant different values in favor of more liquidity, then the hypothesis can be rejected.
Table 4 Simple Means Test

Table 4 presents the simple means test for the samples combined ETFs, U.S. based ETFs and European based ETFs. For each liquidity measure the mean values, the t-value and the significance of the t-value are presented.

<table>
<thead>
<tr>
<th></th>
<th>Combined Sample ETFs</th>
<th>US Based ETFs</th>
<th>European Based ETFs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Mean</td>
<td>Mean</td>
</tr>
<tr>
<td>ANIHID</td>
<td>0.09</td>
<td>0.02</td>
<td>2.23***</td>
</tr>
<tr>
<td>BIDASK</td>
<td>2.96</td>
<td>3.77</td>
<td>3.94****</td>
</tr>
<tr>
<td>VCLA10</td>
<td>27.33</td>
<td>23.82</td>
<td>5.79****</td>
</tr>
<tr>
<td>VOLUME</td>
<td>11.59</td>
<td>11.75</td>
<td>3.65****</td>
</tr>
<tr>
<td>SHOLIT</td>
<td>2.26</td>
<td>2.52</td>
<td>3.81****</td>
</tr>
<tr>
<td>ASSETS</td>
<td>5.04</td>
<td>6.15</td>
<td>4.49****</td>
</tr>
<tr>
<td>CAP</td>
<td>0.01</td>
<td>0.34</td>
<td>3.77****</td>
</tr>
<tr>
<td>TURNOVER</td>
<td>15.19</td>
<td>15.37</td>
<td>3.99****</td>
</tr>
<tr>
<td>PRRM</td>
<td>0.28</td>
<td>0.19</td>
<td>2.24****</td>
</tr>
</tbody>
</table>

***, ***, * indicate significance at the 0.1%, 1%, 5% and 10% levels, respectively.

The liquidity measures for the combined ETF sample present mostly highly significant t-statistics after the option introduction. The highly significant measures are bid-ask spread, volatility, volume, shares outstanding, total assets, market capitalization, turnover. In the entire sample, volatility results in the highest t-value with 5.79 and a significance to the 0.1 percent level. The premium drops from the mean percentage of 0.2045 to 0.126, which results in a t-value of 3.24 and a significance to the 1 percent level.

Similar results can be presented for the U.S. ETF sample where all liquidity measures have significant t-statistics after the event date. Total assets is higher after option introduction with significance to the 0.1 percent level in the t-value of 4.54. Mispricing measured by the premium is significantly lower with a t-value of 3.83. All other measures are highly significant to the 0.1 percent and 1 percent level.

Not all liquidity measures in the European ETF sample inherent the same significance in the t-statistics before and after the option introduction. In the sample only total assets and volatility are highly significant to the 0.1 percent level. Their t-value is indicated with 7.12 for
volatility and 10.69 for total assets. Contrary to the U.S., the bid-ask spread for the European sample is decreasing after option introduction. The difference in the mean value is decreasing from 0.3669 to 0.3199. However, the difference is insignificant to the 10 percent level.

Another remarkable result is the difference in premium for European ETF. The premium tends to be 0.0413 percent higher and a t-value of 1.33 after option introduction and is not significant at all.
CONCLUSION

This thesis examines the effect of liquidity on the premium of 36 ETFs which either are incorporated in Europe or the U.S. and investing internationally. Further research is made on the effect of ETF option introductions on the effect on liquidity and mispricing in form of the premium.

The OLS multiple regression models clearly show significance that liquidity measures like volume, shares outstanding and turnover have significant impact on the premium. The beta coefficient values indicate that if liquidity is increasing, the premium is decreasing, which can be seen by the inverse relationship. The overall fit, indicated by the R-squared values, is relatively low but indicates a significant relationship. It can be concluded that liquidity explains the premium to a certain extent, but a portion is unexplained. The findings of Ackert and Tian 2008 who suggest that more active trading leads to a lower premium can be supported. The hypothesis that liquidity is not affecting mispricing measured by the premium can be rejected.

Using an event study methodology around the date of option introduction on the Chicago Board of Options Exchange for the U.S. and the EUREX for Europe the thesis examined the contribution of option introduction on liquidity and premium elimination.

In order to overcome illiquidity and eliminate mispricing, financial tools must contribute to the limitation of arbitrage for international ETFs and impose liquidity into the market. The process of handling the order flow of clients by the liquidity provider is done by shorting ETF shares and going long in the underlying assets. International ETFs can sometimes not offer the direct exposure to the underlying assets. It is therefore essential for the liquidity provider to buy correlated assets or a correlated hedge. Traditional hedging tools in the financial industry are
options and futures. ETF options are available for many international ETFs. It is assumed that they can function as a correlated hedge the liquidity provider uses to minimizing his risk exposure while providing liquidity. Therefore he would be able to impose liquidity and offer a price closer to the NAV because his risk of price movements of the underlying assets until he can buy the assets is hedged. Conducting the simple means test in the event study of this thesis evidence is found that liquidity is increasing after option introduction. The combined sample and the U.S. sample result in a lower premium and higher liquidity measures. The European subsample indicates a not significant increased premium, which points to the assumption that increased liquidity is not contributing to a lower premium. Since the finding is not significant it can be assumed that the sample must be extended to find a more significant result in order to claim that liquidity is not eliminating mispricing. The results can assume that the U.S. results will also hold in the European sample and that liquidity eliminates mispricing.

The time horizon of this study falls in the beginning of the financial crisis. All results must be therefore put into the perspective of the crisis event. One of the crisis effects is increased price spreads due to increased risk premiums. For instance the spread for EU country government bonds and non-benchmark bonds increased due to general risk aversion (Juergen von Hagen, Ludger Schuknecht, Guido Wolswijk, 2010).

The increased bid-ask spread in the U.S. and combined sample points to the fact that the liquidity provider has increased risk and higher transaction costs due to the crisis. In contrast, the European sample is resulting in a not highly significant bid-ask spread decrease. Despite the insignificance the European market tends to have a lower post-crisis impact on transaction costs and risk.
Overall the null hypothesis that option introductions do not have an impact on liquidity and eliminating mispricing can be rejected. The study finds strong evidence that liquidity is increasing after option introduction and that the premium is decreasing. Liquidity provider tend to buy ETF options to buy a correlated hedge to expose to the underlying assets even though the access to the actual assets is limited due to time differences, regulation or illiquidity.

Further study can support the findings by investigating different time periods without the impact of a global financial crisis. Using the ETF implied liquidity as a liquidity measure would extend the research to the liquidity of the underlying assets. Since the liquidity of the underlying assets is important and constrains the ETF share creation, it would be a valuable investigation. The literature is offering even more liquidity measures and models and further research could consider them. Evidence from the literature that especially international ETFs are mispriced due to illiquidity can be found. The same fact could be investigated for domestic ETFs or other ETF classifications. It should be found more aspects of ETF mispricing to derive to a high R-squared to explain the entire scope of premiums. This thesis delivers valuable explanations and can be used as reference for further study on ETF mispricing, liquidity and option effects.
REFERENCE LIST


