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ETF Ownership of Stocks and Volatility of Underlying Stocks

Name student: Orhan Hakki Tekines

Student ID number: 467662

Supervisor: Ricardo Barahona

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Abstract

An Exchange Traded Fund (ETF) is a basket of securities that tracks a specific index. According to Ben-David, Franzoni, & Moussawi (2018), ETFs (in the US market) may increase the non-fundamental volatility of the securities in their baskets because of the liquidity shocks that propagate to the underlying securities through the arbitrage channel. In other words, an increase in the ETF ownership of a stock increases the volatility of underlying stock. In this paper a similar research is conducted for European market within the time period of 2010-2019. The results of panel data regressions indicate that there is no statistically significant relationship between ETF ownership and volatility of underlying stocks.

Keywords: Exchange Traded Fund, ETF ownership, Volatility

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1. Introduction and Literature Review

What are the effects of institutional ownership of securities on these securities? Are there asset-pricing implications? According to Basak & Pavlova (2013), institutions amplify the index stock volatilities by demanding a higher fraction of risky stocks than retail investors. Gabaix, Gopikrishnan, Plerou, & Stanley (2006) also found that institutional investors increase the volatility of the underlying stocks.

An exchange-traded fund (ETF) is a basket of securities that tracks a specific index. They are very similar to mutual funds. But, unlike mutual funds, they are listed on exchanges and one can buy and sell its shares intraday. According to Vanguard (2019), ETFs attracted 516.1 billion dollars in investment globally in 2018 and 3.3 trillion dollars over the past decade.

ETFs are relatively new products. Their effect on the underlying securities they hold has just recently started to draw the attention of researchers. Therefore, the literature on this topic is relatively scarce.

Trading costs of ETFs are generally low. Therefore, ETFs attract the attention of high frequency investors. According to some researchers, this influences the underlying securities ETFs hold. Da & Shive (2018) has found that ETFs can propagate non-fundamental shocks to a broad section of stocks they hold. Similarly, Ben-David, Franzoni, & Moussawi (2018) determined that ETFs may increase the non-fundamental volatility of the securities in their baskets because of the liquidity shocks that propagate to the underlying securities through the arbitrage channel. They confirmed that stocks with higher ETF ownership display higher volatility. Krause, Ehsani, & Lien (2014) also reaches the same conclusion. This paper argues the existence of volatility spillovers from ETFs to the stocks they hold. It also claims that the effect is stronger for smaller stocks.

On the contrary, Grossman (1989) argues that introduction of futures makes way for additional market-making power to absorb the impact of liquidity shocks, which in turn reduces volatility. In other words, liquidity shocks are dampened by having more vendors for satisfying the needs of investors. In our case, this translates to the existence of ETFs causing the volatility of underlying securities to decrease. It is very possible that both of these factors have influence on the volatility of securities. The question is which of these factors is more dominant than the other.

Ben-David et al. (2018) conducted their research on US ETFs and they determined the adverse effect of ownership by US based ETFs on the volatility of underlying US securities. Would one reach the same conclusion if the research was conducted on the European ETF market? Therefore, the research question of this paper is determined as whether the same relationship Ben-David et al. (2018) found at the US market holds for European market too.

What is the state of ETFs in the European market? According to Vanguard (2019), the growth of ETFs in Europe has accelerated as part of a broader shift towards indexing. By August 2018, the market had 2,320 ETFs, with 7,845 listings from 66 providers across 27 exchanges in 21 countries.

The research question is relevant because if there is such a relationship it should be seen in other markets too. And if there is no such relationship, one can investigate the reason why not. For instance, the US ETF market and the European ETF market are structurally different.

> "European investors operate in multiple languages, markets, exchanges and regulatory regimes. In the U.S., the ETF ecosystem features one unified currency, market, tax framework and price, creating an environment that encourages growth.
>
> It [appetite for ETFs] is growing, but from two different kinds of investment types. In the U.S., it is mainly through the intermediated retail channel—be it IFAs, individual retirement account investors or retail investors.

> In Europe, it’s a completely different picture; it is intermediated wholesale and institutional investors. The clientele here buy in big chunks and use ETFs for asset allocation and for tactical calls, because they are managing professional portfolios.” (Vanguard, 2019).

Clientele effect may prevent such relationship to emerge in Europe. It is, therefore, an interesting topic to investigate whether these differences between two markets hamper such a relationship to emerge in European market too. The first hypothesis is:

There is a significant positive relationship between ETF ownership of European stocks and volatility of underlying stocks.

In general, smaller firms are more volatile as their future is more unpredictable. Growth opportunities make smaller firms be more open to substantial fluctuations in their prices. Moreover, ETFs that track indices are more likely to include larger firms than smaller firms because indices usually are composed of larger firms. Both volatility of underlying stock and the possibility of being included in an ETF differ for smaller and larger firms. Krause, Ehsani, & Lien (2014) claims that the effect is stronger for smaller firms. Indeed, there may be a significant difference in the above-mentioned relationship for smaller and larger firms. The second hypothesis is:

There is a significant difference in the relationship between ETF ownership of European stocks and volatility of underlying stocks for large and small firms.

In chapter 2 and 3 methodology and data of the paper will be discussed. In chapter 4 the results of the regressions will be reported. Chapter 5 is the robustness check. In the final chapter of this paper, the conclusion will be laid out.

2. Methodology

The methodology that will be followed in this paper is not the same as the methodology of the Ben-David et al. (2018). Due to limited time and resources, indices are used in this paper instead of individual stocks. Total AUM (assets under management) of ETFs that track a specific index divided by the market capitalization of the index will be used as a proxy for the share of ETF ownership. The variable "ETF ownership" of index i on day t is defined as the sum of the euro value of AUM of all ETFs that track the index, divided by the market capitalization of the index at the end of the day, where J is the set of ETFs that track the index I.

$$\text{ETF Ownership}_{i,t} = \left(\sum_{j=1}^{J} AUM_{j,t}\right) / \text{MktCap}_{i,t}$$

Standardized (subtracting mean and dividing by standard deviation) 10-day volatility of the index will be regressed by the standardized ETF ownership. Standardization may ease the interpretation and solve the heteroskedasticity problem. The model requires time and index fixed effects in order to prevent omitted variable bias. Lagged volatility of index and lagged market cap (in euros) of index will be control variables of the model. Other control variables include daily return of the index (in percentage points), EBITDA (in billion euros), P/E ratio of the index, P/B ratio of the index, and the volume (in billion euros) of the index. These variables may have some explanatory power over the dependent variable. Moreover, Inverse price of the index and Amihud ratio[1] (in percentage points) are added as liquidity measures.

Standardized Volatility = Standardized ETF Ownership + Lagged Volatility + Lagged Market Cap + Other Control Variables + Fixed Effects + $error_i$

For the second hypothesis, just like for the first hypothesis, indices will be used instead of individual stocks. Market cap of every index is divided by the number of stocks it contains. This gives us the variable "Average Size". A dummy variable named "big" is

[1] Amihud (2002) proposes to use absolute return divided by volume as a measure of stock's liquidity.

added to the model. 8 indices with the largest values of the variable Average Size are assigned 1 for this dummy variable. Other 8 indices are assigned 0.

3. Data

Only major European market indices are used, because small indices usually do not have any ETFs tracking them. Norwegian market index OBX was originally included in the indices. But it was removed because of the substantial amount of missing values in the data. The list of all the ETFs that track the selected indices is obtained from the Morningstar dataset. ETFs with less than 1 million euro in AUM are excluded from the data. Leveraged and inverse-leveraged ETFs are also excluded. The final sample has 16 indices and 89 ETFs (all are listed in the Appendix A).

The data on selected indices and ETFs are retrieved from Bloomberg. As the emergence of ETFs in the European market is more recent compared to the US, the length of data is shorter. Substantial number of ETFs emerged in Europe after 2009. Including years earlier than 2010 would make the dataset filled with missing values. Therefore, 2010-2019 is considered as the time period of interest. There is no requirement for an ETF to be active all along in this time period for that ETF to be selected. This is to prevent any survivorship bias that may occur.

4 observations had outliers for the ETF ownership variable that are 23 standard deviations from the mean. Moreover, 7 other observations had outliers for the P/E ratio. These outliers are all removed.

Table 1

Summary Statistics of the Variables

Variable	Observations	Mean	Standard Dev.	Min	Max
volatility	40,623	16.5425	9.2142	1.7800	96.1501
ETF ownership	38,504	0.3885	0.5030	0.0076	3.1096
log market cap	41,713	27.4146	1.3011	24.5263	30.0565
daily return	40,633	0.0383	1.1621	-12.4810	14.4349
volume	40,687	0.6028	0.9091	0.0001	11.4850
P/E	39,946	23.0731	32.9949	6.0118	817.2133
P/B	40,633	1.6367	0.4222	0.5343	2.9695
EBITDA	41,728	1.0607	1.4279	0.0133	7.4732
inverse price	40,633	0.0015	0.0027	0.0001	0.0134

4. Results

Firstly, non-stationarity of the dependent variable is checked with the Fisher-type panel unit-root test. P-value of the test is 0 (Table 5 in the Appendix B). This means that dependent variable is stationary.

The decision of choosing between fixed effects and random effects in the panel setting is done according to the Hausman test. The result of the Hausman test (Table 6 in Appendix B) indicates that coefficients of the two regressions are significantly different. Consequently, the fixed effects model is chosen because it is the consistent one. In the regressions clustered errors (clustered by indices) will be used. Errors are correlated within groups, but not across groups.

Table 2

OLS Regressions of Standardized Volatility on Standardized ETF Ownership

Dependent variable	Standardized Volatility							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
standardized ETF ownership	0.0417 (1.07)	0.0681 (1.12)	0.0472 (1.33)	0.0686 (1.15)	0.0009 (0.41)	0.0026 (0.60)	0.0011 (0.51)	0.0025 (0.57)
L1.log market cap	-1.8337 (-4.57) ***	-0.3679 (-0.91)	-1.7993 (-4.45) ***	-0.3641 (-0.90)	-0.1113 (-4.13) ***	-0.0235 (-0.86)	-0.1109 (-3.94) ***	-0.0229 (-0.85)
L1.daily return	0.0112 (2.78) **	0.0168 (4.99) ***	0.0113 (2.85) **	0.0167 (4.85) ***	-0.0171 (-20.73) ***	-0.0165 (-19.12) ***	-0.0171 (-20.76) ***	-0.0165 (-19.10) ***
L1.volume	0.5194 (4.22) ***	0.4809 (4.51) ***	0.5080 (4.10) ***	0.4870 (4.55) ***	0.0466 (4.04) ***	0.0453 (4.24) ***	0.0468 (4.12) ***	0.0465 (4.52) ***
L1.P/E		-0.0012 (-2.13) **		-0.0012 (-2.19) **		-0.0001 (-2.57) **		-0.0001 (-2.65) **
L1.P/B		-1.6739 (-5.45) ***		-1.6805 (-5.53) ***		-0.1034 (-4.89) ***		-0.1060 (-4.85) ***
L1.EBITDA		-0.0480 (-0.38)		-0.0482 (-0.38)		-0.0059 (-0.75)		-0.0061 (-0.77)
L1.amihud ratio			0.0002 (1.17)	0.0002 (1.17)			0.0001 (4.08) ***	0.0001 (3.95) ***
L1.inverse price			70.1042 (0.58)	-8.1014 (-0.08)			1.1056 (0.15)	-3.4416 (-0.51)
L1.standardized volatility					0.9973 (128.91) ***	0.9965 (127.03) ***	0.9968 (130.11) ***	0.9959 (129.50) ***
L2.standardized volatility					0.0022 (0.42)	0.0020 (0.37)	0.0026 (0.52)	0.0026 (0.48)
L3.standardized volatility					-0.0598 (-17.17) ***	-0.0621 (-17.19) ***	-0.0598 (-17.53) ***	-0.0621 (-17.38) ***
time trend (t)	0.0001 (1.66)	-0.001 (-0.02)	0.0001 (2.06) *	-0.0001 (-0.04)	0.0001 (1.71)	0.0001 (0.03)	0.0001 (1.97) *	-0.0001 (-0.10)
constant	49.7864 (4.55) ***	12.6388 (1.20)	48.7236 (4.39) ***	12.5517 (1.20)	3.0137 (4.11) ***	0.7958 (1.12)	2.9993 (3.89) ***	0.7896 (1.12)
N	37,762	37,120	37,762	37,120	36,447	35,835	36,447	35,835
R-squared	0.0428	0.1258	0.0447	0.1247	0.9114	0.9206	0.9117	0.9205

Note. T-statistics are presented in the parentheses; “L” is the lag operator; *, **, and *** refers to 10%, 5%, and 1% significance levels, respectively.

In Table 2, the first thing that catches the attention is that once lags of the volatility are included R-squared goes up to the levels of 90%. This is expected since volatility is known for its autocorrelation structure. The first and the third lags of volatility have highly significant coefficients. Coefficients of the independent variable are not statistically significant in any of the Columns. Logged market cap is only significant when P/E, P/B, and EBITDA are not included in the regression. Daily return, volume, P/E, and P/B are significant in all the Columns. 1 percentage point increase in the daily return results in 0.0165 standard deviation decrease in the volatility. 1 billion euro increase in the volume results in 0.0465 standard deviation increase in the volatility. EBITDA and inverse price are never significant. Amihud ratio is only significant when lags of volatility are included in the regression. Time trend does not have significant coefficients in any of the Columns except for the Column (3) and Column (7).

Table 3

OLS Regressions of Standardized Volatility on Standardized ETF Ownership with "big" as Interaction Variable

Dependent variable	Standardized Volatility							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
standardized ETF ownership big=0	0.0654 (0.35)	0.3198 (1.17)	0.0594 (0.33)	0.3315 (1.22)	0.0031 (0.33)	0.0194 (1.15)	0.0034 (0.38)	0.0212 (1.26)
standardized ETF ownership big =1	0.0374 (1.10)	0.0353 (0.79)	0.0449 (1.58)	0.0339 (0.81)	0.0006 (0.26)	0.0005 (0.15)	0.0007 (0.36)	0.0001 (0.02)
L1.log market cap	-1.8359 (-4.54) ***	-0.3933 (-0.98)	-1.8006 (-4.40) ***	-0.3897 (-0.98)	-0.1115 (-4.13) ***	-0.0253 (-0.95)	-0.1111 (-3.93) ***	-0.0249 (-0.93)
L1.daily return	0.0112 (2.75) **	0.0171 (4.94) ***	0.0113 (2.82) **	0.0171 (4.80) ***	-0.0171 (-20.66) ***	-0.0165 (-18.68) ***	-0.0171 (-20.69) ***	-0.0165 (-18.63) ***
L1.volume	0.5189 (4.24) ***	0.4759 (4.64) ***	0.5079 (4.12) ***	0.4836 (4.69) ***	0.0465 (4.05) ***	0.0450 (4.31) ***	0.0467 (4.14) ***	0.0463 (4.62) ***
L1.P/E		-0.0014 (-3.36) ***		-0.0014 (-3.55) ***		-0.0001 (-3.90) ***		-0.0001 (-4.19) ***
L1.P/B		-1.6826 (-5.60) ***		-1.6948 (-5.68) ***		-0.1042 (-4.99) ***		-0.1072 (-4.94) ***
L1.EBITDA		-0.0361 (-0.30)		-0.0362 (-0.30)		-0.0051 (-0.63)		-0.0052 (-0.65)
L1.amihud ratio			0.0002 (1.17)	0.0002 (1.17)			0.0001 (4.07) ***	0.0001 (3.74) ***
L1.inverse price			69.7690 (0.58)	-15.9845 (-0.16)			1.0457 (0.14)	-3.9898 (-0.58)

L1.standardized volatility					0.9973 (128.90) ***	0.9965 (126.47) ***	0.9968 (130.06) ***	0.9958 (128.94) ***
L2.standardized volatility					0.0022 (0.42)	0.0020 (0.37)	0.0026 (0.52)	0.0026 (0.48)
L3.standardized volatility					-0.0598 (-17.16) ***	-0.0622 (-17.14) ***	-0.0598 (-17.53) ***	-0.0622 (-17.32) ***
time trend (t)	0.0001 (1.68)	-0.0001 (-0.05)	0.0001 (2.09) *	-0.0001 (-0.09)	0.0001 (1.71)	0.0001 (0.01)	0.0001 (1.98) *	-0.0001 (-0.15)
constant	49.8540 (4.52) ***	13.3998 (1.29)	48.7634 (4.33) ***	13.3467 (1.28)	3.0198 (4.10) ***	0.8497 (1.22)	3.0067 (3.87) ***	0.8496 (1.22)
N	37,762	37,120	37,762	37,120	36,447	35,835	36,447	35,835
R-squared	0.0428	0.1332	0.0446	0.1315	0.9114	0.9208	0.9116	0.9207

Note. T-statistics are presented in the parentheses; "L" is the lag operator; *, **, and *** refers to 10%, 5%, and 1% significance levels, respectively.

Coefficients of the independent variable are not significant for neither of the interaction terms. In the last Column coefficients for "small" and "big" are 0.0212 and 0.0001, respectively. F-test is performed to determine whether these two coefficients are significantly different. P-value of the test is 0.2359. This means that coefficients are not statistically different than each other. Other coefficients and t-values of control variables are very similar to that of Table 2.

5. Robustness

In the regressions above, control variables are added and removed to see how they affect the regression coefficients. This is the standard way of checking for robustness. In addition to that, there will be another robustness check by running the regression on monthly data instead of daily data. Daily version of the panel data sample is unbalanced because there are missing values for some indices. This also makes it unsynchronized. Thus, there may be a significant difference between the results of daily and monthly data.

Table 4

OLS Regression of Standardized Volatility on Standardized ETF Ownership with Monthly Data

Dependent variable	Standardized Volatility			
	(1)	(2)	(3)	(4)
standardized ETF ownership	0.0875 (2.05) *	0.1086 (2.10) *	0.0365 (1.59)	0.0352 (1.34)
L1.log market cap	-0.7167 (-4.73) ***	0.4719 (0.93)	0.2682 (2.19) **	0.4964 (2.33) **
L1.daily return	-0.0741 (-27.23) ***	-0.0739 (-28.33) ***	-0.0433 (-16.22) ***	-0.0447 (-17.58) ***
L1.volume	0.0285 (4.28) ***	0.0266 (4.67) ***	0.0034 (1.79) *	0.0033 (1.88) *
L1.P/E		-0.0002 (-0.30)		0.0001 (0.38)
L1.P/B		-1.1372 (-3.42) ***		-0.1748 (-1.32)
L1.EBITDA		-0.0002 (-1.45)		-0.0001 (-1.22)
L1.amihud ratio		0.0121 (1.97) *		0.0037 (1.26)
L1.standardized volatility			0.5760 (30.27) ***	0.5670 (30.19) ***
L2.standardized volatility			-0.0347 (-1.57)	-0.0338 (-1.48)
L3.standardized volatility			0.0705 (5.10) ***	0.0703 (5.76) ***
time trend (t)	-0.0048 (-5.56) ***	-0.0075 (-4.98) ***	-0.0058 (-10.93) ***	-0.0064 (-8.93) ***
constant	19.6285 (4.74) ***	-10.7726 (-0.81)	-7.0115 (-2.10) *	-12.8868 (-2.30) **
N	1,887	1,856	1,857	1,826
R-squared	0.2065	0.0212	0.3829	0.2165

Note. T-statistics are presented in the parentheses; “L” is the lag operator; *, **, and *** refers to 10%, 5%, and 1% significance levels, respectively.

Coefficients of the independent variable are significant in the first two Columns. Coefficient is 0.1086 in the second Column. 1 standard deviation increase in the ETF ownership results in 0.1086 standard deviation increase in the volatility. When lags of the volatility are added to the regression, this coefficient decreases to 0.0352 and becomes insignificant. The first and the third lags of the volatility are significant. But their t-values are much smaller than those of the main regressions (Table 2). In this case lags are 1 month away from each other. Naturally, this makes it harder to predict the current volatility with lagged volatilities. Consequently, R-squared varies between 20-40% which is low compared to 90% at Table 2. P/E and P/B are not significant anymore. And log market cap is significant now. Time trend is also significant in all Columns and has negative values.

Regressing with monthly data instead of daily increases the t-value of the independent variable. But it is not enough to make the coefficient statistically significant. Therefore, it cannot be said that using monthly data makes a significant difference.

Additionally, the regression is run with winsorized independent variable to determine whether there are any outliers distorting the result of regression substantially. Independent variable ETF ownership is winsorized at 1%. The result of the full model regression is displayed at Table 7 in Appendix B. Coefficient and t-value of the independent variable does not change in any significant way. It can be concluded that outliers do not change the result of the regressions.

6. Discussion and Conclusion

The research question of this paper was determined as "Is there a relationship between ETF holdings of European stocks and the volatility of the underlying stocks?". In order to answer this question two hypotheses were formed. The first hypothesis was:

There is a significant positive relationship between ETF ownership of European stocks and volatility of underlying stocks.

Table 2 clearly shows that coefficients of the independent variable are not statistically significant. In the first 4 Columns, t-values are bigger than 1. But when lags of volatility are added to the regression, t-values drop to 0.5.

Monthly data were used instead of daily data in order see if there is a significant difference in the results (Table 4). Even though there appears to be significant coefficients in the first two Columns, significant coefficients disappear once lags of volatility are added to the regression. Moreover, the independent variable was winsorized in order to determine whether outliers disrupt the regressions (Table 7). Coefficient did not change in a statistically significant way. Outliers do not disrupt the results.

Considering all the above-mentioned results, the hypothesis that there is a significant positive relationship between ETF ownership of European stocks and volatility of underlying stocks is rejected. The second hypothesis was:

There is a significant difference in the relationship between ETF ownership of European stocks and volatility of underlying stocks for large and small firms.

“Big” was generated as a dummy variable in order to test the second hypothesis. Two interaction terms were generated: ETF ownership for small indices and ETF ownership for large indices. Table 3 shows the results of these regressions. Coefficients of neither of interaction terms are significant in any of the Columns. F-test was performed in order to determine whether coefficients of the interaction terms in the last Column are statistically different than each other. P-value of the test is 0.2359. Therefore, it can be concluded that there is no statistical difference between being “small” or “large”. The second hypothesis is also rejected.

This paper fails to find a significant relationship between ETF ownership and the volatility of underlying stocks. Coefficients are not even nearly significant. Moreover, robustness checks also confirm this result. Ultimately, both hypotheses are rejected.

There is no relationship between ETF ownership of European stocks and volatility of underlying stocks.

Findings of Ben-David et al. (2018) is not confirmed by this paper. There may be several reasons for this. First reason that comes to mind is “inappropriate proxy”. Ben-David et al. (2018) performed their analysis on individual stocks. In this paper, however, the analysis is performed on indices due to limited time and resources. Using total AUM of ETFs that track a specific Index divided by market capitalization of the Index may not be an accurate enough proxy for ETF ownership of stocks. A future study that will investigate this research question should conduct the analysis based on individual stocks rather than using indices as proxy.

Two other reasons that might have affected the results are missing data and an incomplete model. The final sample panel data that is used in this paper is unbalanced and unsynchronized. Moreover, the regressions might have suffered from omitted variable bias due to model being incomplete. A future study should collect a more complete data and establish a more complete model.

Finally, it needs to be expressed that the conclusion this paper reaches may be, in fact, accurate. The relationship that Ben-David et al. (2018) has found for the US market may not exist in the European market. It was already mentioned that the US ETF market and the European ETF market are structurally different. Moreover, the clientele of the US and the European markets are different too. Main buyers of ETFs in the US market are retail investors. In Europe, however, ETFs are mainly used as a tool of diversification by institutional investors. Is this the reason why this paper failed to find the same relationship in the European market? Answer of this question is left to a future study that can take the clientele effect into account in the model.

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8. Appendix

Appendix A - Indices and ETFs

Europe
Euro Stoxx 50 (SX5E):

1. Amundi Index Solutions - Amundi EURO STOXX 50 UCITS ETF-C EUR | C50
2. BNP Paribas Easy Euro Stoxx 50 UCITS ETF EUR C | ETDD
3. ComStage EURO STOXX 50® UCITS ETF | CBSX5T
4. ComStage FR EURO STOXX 50® UCITS ETF | C054
5. Deka EURO STOXX 50 (thesaurierend) UCITS ETF | ELFA
6. Deka EURO STOXX 50® UCITS ETF | EL4B
7. HSBC EURO STOXX 50 UCITS ETF | 50E
8. Invesco EURO STOXX 50 UCITS ETF | SC0D
9. iShares EURO STOXX 50 UCITS ETF (DE) | EXW1
10. iShares EURO STOXX 50 UCITS ETF EUR (Dist) | EUEA
11. iShares VII PLC - iShares Core EURO STOXX 50 ETF EUR Acc (EUR) | CSX5
12. Lyxor 1 EURO STOXX 50® UCITS ETF | E950
13. Lyxor Euro Stoxx 50 (DR) UCITS ETF Dist | MSE
14. Lyxor Index Fund - Lyxor Core Euro Stoxx 50 (DR) UCITS ETF Acc | MSED
15. UBS ETF - EURO STOXX 50 ESG UCITS ETF A EUR Dis | UET5
16. UBS ETF - EURO STOXX 50 UCITS ETF (EUR) A-dis | UIM1
17. Vanguard Euro STOXX 50 UCITS ETF - EUR | VX5E
18. Xtrackers Euro Stoxx 50 UCITS ETF 1C | DXET

MSCI Europe:

1. Amundi Index Solutions - Amundi MSCI Europe UCITS ETF C EUR | CEU
2. Amundi Index Solutions - Amundi Index MSCI Europe UCITS ETF DR | CEU2
3. ComStage MSCI Europe UCITS ETF | CBMEUR
4. Deka MSCI Europe UCITS ETF | EL42
5. HSBC MSCI Europe UCITS ETF | HEU
6. Invesco MSCI Europe UCITS ETF | SC0E
7. iShares Core MSCI Europe UCITS ETF EUR (Acc) | IMEA
8. iShares Core MSCI Europe UCITS ETF EUR (Dist) | IMEU
9. Lyxor MSCI Europe (DR) UCITS ETF Dist | MEU
10. SPDR® MSCI Europe UCITS ETF | ERO
11. UBS ETF - MSCI Europe UCITS ETF (EUR) A-dis | EUREUA
12. Xtrackers MSCI Europe UCITS ETF 1C | XMEU

Stoxx Europe 600:

1. Amundi Index Solutions - Amundi STOXX Europe 600 ETF-C EUR | C6E
2. BNP Paribas Easy Stoxx Europe 600 UCITS ETF EUR C | ETZ
3. ComStage STOXX® Europe 600 UCITS ETF | C060
4. Invesco STOXX Europe 600 UCITS ETF (EUR) | SDJ600
5. iShares STOXX Europe 600 UCITS ETF (DE) | EXSA
6. Lyxor 1 STOXX® Europe 600 UCITS ETF | E960
7. Lyxor Core STOXX Europe 600 (DR) - UCITS ETF Acc | MEUD
8. Xtrackers Stoxx Europe 600 UCITS ETF 1C (EUR) | XSX6

Germany
DAX:

1. ComStage DAX® UCITS ETF (EUR) | C001
2. Amundi ETF DAX UCITS ETF DR (GBP) | CG1
3. Deka DAX® (ausschüttend) UCITS ETF | EL4F

4. Deka DAX® UCITS ETF | EL4A
5. iShares Core DAX® UCITS ETF (DE) | EXS1
6. Lyxor 1 DAX® UCITS ETF (I) | E901
7. MULTI-UNITS LUXEMBOURG - Lyxor DAX (DR) UCITS ETF - Acc (EUR) | DAX
8. Vanguard DAX UCITS ETF Shares EUR Inc | VDXX
9. Xtrackers DAX Income UCITS ETF 1D | XDDX
10. Xtrackers DAX UCITS ETF 1C (GBP) | XDAX

MDAX:
1. ComStage MDAX® UCITS ETF | C007
2. Deka MDAX® UCITS ETF | ELF1
3. Invesco MDAX® UCITS ETF Acc | DEAM
4. iShares MDAX® UCITS ETF (DE) | EXS3
5. Lyxor 1 MDAX® UCITS ETF | E907
6. Lyxor German Mid-Cap MDAX UCITS ETF Dist | MD4X

France
CAC 40:
1. Amundi Index Solutions - Amundi CAC 40 UCITS ETF-C | C40
2. BNP Paribas Easy CAC 40® UCITS ETF | E40
3. Lyxor CAC 40 (DR) UCITS ETF Dist | CAC
4. Xtrackers CAC 40 UCITS ETF 1D | XCAC

UK
FTSE 100:
1. Amundi Index Solutions - Amundi ETF FTSE 100 UCITS ETF EUR | C1U
2. HSBC FTSE 100 UCITS ETF | HUKX
3. Invesco FTSE 100 UCITS ETF | S100
4. iShares Core FTSE 100 UCITS ETF GBP (Dist) | ISF
5. iShares VII PLC - iShares FTSE 100 ETF GBP Acc (GBP) | CUKX (iShares VII PLC - iShares FTSE 100 ETF GBP Acc | CSUKX)
6. MULTI-UNITS LUXEMBOURG - Lyxor FTSE 100 UCITS ETF - Acc | L100
7. Ossiam FTSE 100 Minimum Variance UCITS ETF 1C (GBP) | UKMV
8. UBS ETF - FTSE 100 UCITS ETF (GBP) A-dis | 100GBA (UBS ETF - FTSE 100 UCITS ETF (GBP) A-dis (GBP) | UB03)
9. Vanguard FTSE 100 UCITS ETF | VUKE
10. Xtrackers FTSE 100 Income UCITS ETF 1D | XUKX
11. Xtrackers FTSE 100 UCITS ETF 1C | XDUK

FTSE all share:
1. SPDR® FTSE UK All Share UCITS ETF Acc | FTAL
2. Xtrackers FTSE All-Share UCITS ETF 1D | XASX

Italy
FTSE MIB:
1. Amundi Index Solutions - Amundi FTSE MIB UCITS ETF-C | FMI
2. iShares FTSE MIB UCITS ETF EUR (Dist) | IMIB
3. iShares VII PLC - iShares FTSE MIB ETF EUR Acc (EUR) | CSMIB
4. Lyxor FTSE MIB UCITS ETF Dist (EUR) | ETFMIB
5. Xtrackers FTSE MIB UCITS ETF 1D (EUR) | XMIB

Spain
IBEX 35:
1. Lyxor Ibex 35 (DR) UCITS ETF Dist (EUR) | LYXIBe
2. Acción IBEX 35 ETF FI Cotizado Armonizado (EUR) | BBVAIe

Austria
ATX:
1. ComStage ATX® UCITS ETF (CHF) | CBATX
2. iShares ATX UCITS ETF (DE) | EXXX
3. Xtrackers ATX UCITS ETF 1C | XB4A

Belgium
BEL 20:
1. Lyxor BEL 20 TR (DR) UCITS ETF Dist | BEL

Finland
OMX Helsinki 25 (OMXH25) (HEX25):
1. Seligson & Co OMX Helsinki 25 -indeksiosuusrahasto ETF | SLG OMXH25

Netherlands
AEX:
1. iShares AEX UCITS ETF EUR (Dist) (EUR) | IAEX
2. VanEck Vectors™ AEX UCITS ETF | TDT

Sweden
OMX Stockholm 30 (OMXS30):
1. iShares OMX Stockholm Capped UCITS ETF (GBP) | OMXS
2. XACT OMXS30 UCITS ETF | XACTOS

Switzerland
SMI:
1. UBS ETF (CH) – SMI® (CHF) A-dis | smicha
2. iShares SMI® (CH) | CSSMI

Appendix B – Tests and Regressions

Table 5

Fisher-type Unit-root Test for the Dependent Variable Zvolatility

Ho: All panels contain unit roots		Number of panels = 16	
Ha: At least one panel is stationary		Avg. number of periods =2538.94	
AR parameter: Panel-specific		Asymptotics: T -> Infinity	
Panel means: Included			
Time trend: Not included			
Drift term: Not included		ADF regressions: 0 lags	
		Statistic	p-value
Inverse chi-squared(32)	P	735.2435	0.0000
Inverse normal	Z	-25.3903	0.0000
Inverse logit t(84)	L*	-50.9782	0.0000
Modified inv. chi-squared	Pm	87.9054	0.0000

Note. Based on augmented Dickey-Fuller tests.

Table 6

Hausman Test Between Fixed Effects Model and Random Effects Model

	Coeefficients			
	(b) fixed	(B) random	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
ETF ownership	0.0025	0.0060	-0.0035	0.0037
L.1log market cap	-0.0229	-0.0134	-0.0096	0.0180
L1.daily return	-0.0165	-0.0176	0.0011	0.0001
L1.volume	0.0465	0.0168	0.0297	0.0034
L1.P/E	-0.0001	-0.0001	-0.0001	0.0001
L1.P/B	-0.1060	-0.0261	-0.0799	0.0128
L1.EBITDA	-0.0061	0.0019	-0.0080	0.0061
L1.zvolatility	0.9959	1.0046	-0.0088	0.0007
L2.volatility	0.0026	0.0001	0.0025	0.0003
L3.volatility	-0.0621	-0.0606	-0.0016	0.0003

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(2) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 221.67
Prob>chi2 = 0.0000
(V_b-V_B is not positive definite)

Note. “L” is the lag operator.

Table 7

OLS Regression of the Full Model with Independent Variable Winsorized at 1%

standardized volatility	Coef.	Robust Std. Error	t-value	P>|t|	[95% Conf. Interval]	
standardized ETF ownership_w	0.0026	0.0045	0.59	0.566	-0.0070	0.0123
L1.log market cap	-0.0229	0.0271	-0.85	0.410	-0.0806	0.0348
L1.daily return	-0.0165	0.0009	-19.09	0.000	-0.0183	-0.0147
L1.volume	0.0465	0.0103	4.52	0.000	0.0246	0.0685
L1.P/E	-0.0001	0.0001	-2.66	0.018	-0.0002	-0.0001
L1.P/B	-0.1060	0.0219	-4.85	0.000	-0.1527	-0.0594
L1.EBITDA	-0.0060	0.0078	-0.77	0.452	-0.0227	0.0106
L1.amihud	0.0001	0.0001	3.95	0.001	0.0001	0.0001
L1.inv price	-3.4395	6.7539	-0.51	0.618	-17.8351	10.9561
L1.standardized volatility	0.9959	0.0077	129.48	0.000	0.9795	1.0123
L2.standardized volatility	0.0026	0.0053	0.48	0.636	-0.0087	0.0138
L3.standardized volatility	-0.0621	0.0036	-17.38	0.000	-0.0698	-0.0545
time trend (t)	-0.0001	0.0001	-0.10	0.920	-0.0001	0.0001
constant	0.7895	0.7078	1.12	0.282	-0.7192	2.2982

Table 8

Correlation Table

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1)	1.0000												
(2)	0.0510	1.0000											
(3)	-0.1807	0.0237	1.0000										
(4)	0.0264	0.0026	0.0004	1.0000									
(5)	-0.0006	-0.2146	0.7551	-0.0176	1.0000								
(6)	0.0316	-0.0212	-0.1062	0.0126	-0.0215	1.0000							
(7)	-0.3104	-0.0140	0.2165	0.0253	-0.0249	-0.1175	1.0000						
(8)	0.1313	0.2028	-0.2610	-0.0016	-0.1778	0.2174	-0.2943	1.0000					
(9)	0.1416	-0.0612	-0.4831	0.0130	-0.2281	0.0045	-0.2146	-0.0367	1.0000				
(10)	-0.0021	-0.2487	0.3808	-0.0042	0.5005	-0.0775	0.1859	-0.3656	-0.1314	1.0000			
(11)	0.9594	0.0514	-0.1820	0.0305	-0.0124	0.0328	-0.3088	0.1315	0.1000	-0.0029	1.0000		
(12)	0.9166	0.0516	-0.1824	0.0387	-0.0195	0.0346	-0.3068	0.1312	0.1012	-0.0030	0.9602	1.0000	
(13)	0.8706	0.0519	-0.1827	0.0248	-0.0225	0.0358	-0.3057	0.1311	0.1004	-0.0030	0.9173	0.9596	1.0000

Note. Number-variable matching: (1)-volatility, (2)-ETF ownership, (3)-log market cap, (4)-daily return, (5)-volume, (6)-P/E, (7)-P/B, (8)-EBITDA, (9)-amihud ratio, (10)-inverse price, (11)-L1.volatility, (12)-L2.volatility, (13)-L3.volatility; "L" is the lag operator.