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Exchange-traded funds' expansion and their unintended effects over underlying stocks

Volatility, liquidity and efficiency

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Abstract

Over the first two decades of this century, exchange-traded funds have become a new standard both for institutional investors seeking intraday liquidity, low tracking error, and for individuals in search of a diversified, systematic and extremely unexpensive fund. Their design enables them to track benchmarks, e.g. equity indices, through arbitrage and the creation/removal of units depending on demand. The effects of this activity on underlying stocks are not well-known yet and ETFs have been accused to exacerbate volatility and make security prices less reflective of fundamental factors. The empirical analysis is run similarly over two subsamples as a replication and expansion of existing findings : U.S. stocks, which account for the location of most ETF investments, and a set of 24 developped and emerging national stock markets. The estimation is run at a monthly frequency except for variance ratios, measured quarterly and robust controls are included in line with the asset pricing literature, institutional ownership through other instruments, and time-invariant characteristics of companies. Results depend on the subsample but are less clear than suggested in the literature: in the United States, stocks' volatility tends to rise during the month following an increase in the share of ETF ownership relative to the market value, although to a very limited extent. The price impact of trades rises on average in the month following this investment but mean reversion does not become stronger at the weekly scale. In the international sample, no statistically significant evidence of a positive link between ETF ownership and volatility can be found, but efficiency over five days decreases and the bid-ask spread also becomes wider in conjunction with ETF interest. Overall, some bold statements share in the public regarding ETFs and passive investment making markets inefficient do not tend to have realized yet but the arbitrage channel underpinning ETFs pricing may have introduced a new layer of liquidity risk into underlying stocks.

Contents

List of Tables

List of Figures

Foreword

It is a moving event that the actual beginning of the research regarding this paper nearly coincides with the death of one of the fathers, if not the demiurge of that same research topic : Mr. John C.,“Jack”, Bogle, who was born in 1929 and passed out on January 17th, 2019, best known as the founder of *The Vanguard Group* in 1975. He was already considered a legend in the investment world decades before his death and was duly praised by finance leaders and scholars, even by those who were far from sharing his views. It is interesting to notice that he was almost as famous as one of his contemporaries, namely Warren Buffett (born in 1930), chairman of conglomerate and investment company *Berkshire Hathaway*, for achieving success on a fundamentally opposite view of his role as an investor. Mr. Buffett has consolidated an empire with active bets on companies that he considered, at the time he purchased them, to be undervalued and with a high book value relative to the market price, hence showing his unique ability to exploit what can be modelled as a small set of alternative risk premia, in activities which he has a deep understanding of. Recent research about his multi-decade long winning streak has shown his success is more systematic than genius stock-picking and relies on drivers that the academic literature considers systematic with low correlation to the market premium. Still, the conclusion is often that he is an overwhelmingly successful disciple of strict principles written in the 1930s by Graham and Dodd at the Columbia Business School (Graham and Dodd 1934). Since then, the research has caught up and shed light on the value risk factor for instance, which can explain a significant share (while not all) of Buffett’s financial performance over the last 50 years[1]. Mr. Buffett is the living proof that the investor can generate long term risk-adjusted performance above the market return thanks to a mix of information available to investors and a selection based on fundamental valuation, quality criteria and low exposure to systematic risk.

On the other side, British weekly newspaper *The Economist*, has deemed Jack Bogle’s curriculum as the founder of a business that

> has radically changed money management by being boring and cheap.

The worry that Bogle’s ultimate success with widespread adoption of index funds leads to less liquidity and less research, has been expressed by Sam Zell, the billionaire chairman and founder of *Equity Group Investments*, a private investment firm. In an interview on *Bloomberg Television* in which, among various topics he was asked to react, was remembering Jack Bogle. He says that

[1] Frazzini, Kabiller, and Pedersen 2018.

> Bogle's concept and what he advocated was terrific as long as it did not get to be too big a percentage, and I think we are at that point now where there is significant risk.

Obviously, as any market participant and company representative or owner that will answer *Bloomberg* journalists' question, Sam Zell may have interests that do not match those of *Vanguard*, not necessarily as a direct competitor. That issue is also raised by the hosts and Sam Zell answers that his group of firms' business is not "yet" strongly impacted by the rise of passive investing, but that

> everybody is pretty concerned about the percentage of ownership of New York Stock Exchange companies, particularly the REITs[2] owned by passive players. [. . .] If your percentage [in index funds] gets too high, then you institutionalize mediocrity.

Later he admits the long-run rise of passive investing may even cause a positive effect on capital flows to private equity, at the expense of active managers in public companies (concern with regard to hedge funds), so the overall effect on Zell's businesses is probably only clear to himself, as a manager of a private company.

Despite having developped the first index fund at time the idea was only nascent[3], Jack Bogle expressed harsh criticism of index-tracking ETFs, altough they present some tax advantages over open-end index funds. The so-called issues raised by these widespead and quick growth of their volume related to the use made by some investors rather than the very nature of ETF. Opposite to the idealized buy-and-hold (and most importantly but less often stated, "rebalance") passive

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[2] Real estate investment trusts own, manage and even in some cases finance real estate assets, for example commercial surfaces (offices), residential buildings as well as malls and hotels. Sam Zell's companies are especially active in real estate and another part of the interview to *Bloomberg* was about comments (strong words as he seems to be famous for that form of communication) regarding the trends in commercial real estate.

[3] As Jack Bogle himself wrote in a 2012 piece of the *Journal of Indexes* about his impact in the industry, the idea was probably not only his, but he was the first to achieve such a development, although as it was commonly viewed as a mere failure at that time. To quote his introduction, "ideas are a dime; implementation is everything" Among earlier attempts starting in the late 1960s, not always based on the S&P 500 Index, he recalls about modelling by *Wells Fargo Bank* for the pension fund of *Samsonite*, then by a mutual fund firm from. . . Boston (of course, as his own Master's thesis from 1951 was inspired by a *Fortune* magazine piece titled "Big Money in Boston"), the *American National Bank* in Chicago (later absorbed by *J.P. Morgan Chase*), *American Express* before its management stopped the project and finally an insurance and pension company for teachers advised by Milton Friedman. Mr. Bogle concludes : "In all of these forays of indexing: ideas A+; implementation F."

portfolio, ETFs exhibit turnover rates in line with intraday trading. They are rather traded as short term instruments than lifetime investments. With the individual investor in mind during his whole career, which he served by cutting management fees and the fund *load* of his products, Jack Bogle noticed that they were tools enabling speculation. An abundant literature he authored condemned speculation as a net financial loss for fund investors and ultimately a serious lack of stewardship by the very industry he had been part of for more than six decades. While it is possible to track similar indices with traditional index funds and ETFs, the actual use of those securities differ to a great extent : while the former, in line with Bogle's, are generally long-term buy-and-hold investments, the latter, continuously tradeable, may and do serve for hedging, short-selling and thus for arbitrage purpose.

In this paper, we are especially curious to find, if not why, at least how this improved trading characteristic of ETFs may have changed the underlying securities' markets. Admittedly, studying an issue discussed by few people outside Jack Bogle himself means standing on the shoulder of a giant.

This short recount of ongoing debates that flourish in the financial press only serves as an element of context. Additionally, it would have been a historical faux-pas not to mention Jack Bogle's impact in the passive investing world. Yet the fact that the relative size of index funds holdings in general and ETF holdings of stocks in particular is discussed outside scientific publications tends to show that the question deserves to be asked and is the rationale for further enquiry. This paper humbly seeks to contribute to this major debate.

1. Motivation

1.1. Context

Few investment vehicles have reached both a significant role in financial markets and a great variety of investors in such a short period, as exchange-traded funds have during the last three decades. Their staggering growth has been fueled by various factors that we will try to describe before suggesting aspects of the underlying securities that may be influenced by the growth of asset under management within ETFs. Index investing already existed before ETFs made their debut but the use of tracking instruments has drastically changed as shows the fact that ETFs are on average held for a much shorter time than stocks. However, there could be so far hidden disadvantages with the new place of ETFs, hidden because they do not affect on ETF investors but the market as a whole.

1.2. Research questions

By studying several *unintended effects*, the aim is to show that the problems may exist on several aspects. It is of scientific but also regulatory interest to determine whether and to what extent index-tracking products cause the securities they own to become more volatile. Some authors have even designated those effects as the "dark side of exchange-traded funds". There three simple questions giving its structure to this pied of research are:

- Do ETFs make the securities they hold more volatile in the short run ?
- Is there a change in the liquidity of underlying securities synthetic baskets are available for uninformed investors ?
- Is it possible, according to some claims expressed in the public, that the prices react to ETF trading in addition of fundamental news and therefore are less efficient ?

The following sections design an empirical panel estimation in order to answer the questions, with a significant support of the existing literature which provides methodological guidance and reality checks regarding the results.

1.3. Structure of the paper

The research questions imply a tranmission mechanism between two layers of trading, thus an overview of both the structure and the context is needed. First, focusing on the specific nature of ETFs and on distinctive characteristics of the ETF markets, Section 2 provides a brief institutional summary. Section 3 navigates along the time dimension in order to put the recent expansion in context. The review of literature in Section 4 has a narrow scope since the focus of this part is exclusively on recent published research about the impact of ETFs on stocks. Next, the data used are described in Section 5, before Section 6 explicits the methodology : how the key variables are computed, what the best-known theoretical explanations for various controls are and which model specifications are estimated. This part draws heavily on multiple strands of the asset pricing literature. Logically, the outcome is disclosed and discussed in Section 7. Finally, Section 8 summarizes the main findings, draws conclusions regarding the research question, attempts at showing how the current methodology could be extended.

Three parts in the appendix provide additional information and systematic results that would not match the goal of concision in the main body: section A is an extension of the characteristics and history of ETFs; regarding econometrics, section B clarifies two aspects mentioned in estimation results summaries; section C contains the exhaustive estimation results summarized in the main body.

2. Characteristics of Exchange-Traded Funds

The creation and more recently the significant ownership share of Exchange-Traded Funds in major stock markets (among other asset classes) yields several empirical statements. For about a decade, further investigation has started measuring the impact of ETFs and confronting hypotheses while theory has been following with models that embed the mechanisms observed in practice :

- how ETFs and mutual funds, as investment vehicles, can coexist in equilibrium, due to a trade-off between cost efficiency and exposure to liquidity shocks; more generally, the rise of ETFs coincides with debates about the effects of indexing (the rise of passive investment) and about the increasing concentration of institutional investors causing larger and more correlatied fund flows and subsequent comovements among securities.

- how participants cause both the dry-up and increased price movements of multiple securities held through ETFs during high volatility times, a behavior that propagates turmoil in an unpredictable way;

- how ETFs may also increase pricing efficiency by providing arbitrageurs a proxy in order to sell short some securities that are precisely subject to short-sale limitations.

These topics will be discussed in greater depth in the next section. First, in order to understand why ETFs have experienced such an outstanding growth[4] and raised such concerns, it is necessary to describe how this structure appeals to investors and why they were a timely innovation that matched deep trends in financial markets' research and practice from the late 20th century until now.

2.1. Goal

As it has been briefly exposed in the Foreword, ETF are the most successful implementation of an objective initially aimed at and reached by institutional investors. This objective was, then, to design a contiuously, publicly tradable vehicle tracking a diversified value-weighted equity index. The first ETF issued on a U.S. exchange (back in 1993) was indeed the SPDR S&P 500 ETF, the archetype of the first products ever designed. Its net assets as of September 30, 2018, according to the trust prospectus, amount to nearly USD 280 billion, only USD 1.3 billion being held in cash. Several thousand products have appeared in the ETF category[5] as well as in the broader Exchange-Traded Products family. The assets under management amounted to more than USD 4.5 trillion. Although there is wide range investment objectives and sophisticated strategies, the fund with the highest absolute net inflows over the year (USD 30.2 billion) was the iShares Core S&P 500 ETF.

ETFs differ from open-end index funds, sometimes called *traditional index funds*, in that they offer permanent liquidity throughout trading hours, they publish the fund's Net Asset Value at regular intervals and the creation/redemption of shares is the task of institutions entitled to exchange a certain in kind securities for a newly created batch of ETF shares or to do the opposite trade with the fund sponsor to redeem ETF shares. The close tracking of the index is made possible by the privilege that authorized participants, a designation essentially applied to market makers, have to perform an arbitrage between the NAV and the actual value of underlying securities on the exchange. (Ben-David, F. Franzoni, and Moussawi 2017)

Standardized blocks of shares created and redeemed by ETF sponsors are called creation units. In exchange for a basket of securities matching the current index composition and an amount

4 . . . whether measured in the number of products issued, the value of assets under management, the share in exchanged volume or the variety of asset classes, sectors and invesment styles covered. . .

5 At least 5400 ETFs were trading globally as of late 2017, according to research firm ETFGI. Source : https://www.marketwatch.com/story/efts-shattered-their-growth-records-in-2017-2017-12-11

in cash amounting to the value of dividends granted on stocks, the counterparty will receive a multiple of fixed number of shares, e.g. 50000 shares. The same process exist for in-kind redemption : in this case, the ETF hands back the basket of securities and erases a multiple of a creation unit. Actual delivery delays of assets vary according to regulation, allowing settlment within two trading days after the transaction date. In some situations, when participants can prove their failure to deliver is involuntary[6], trades may even be settled within three additional days. In the U.S.-incorporated ETFs, there is a clearinghouse processing transactions between authorized participants on one side and ETF issuers or their distributors on the other side; its name is the National Securities Clearing Corporation and it already was the major post-trade actor before ETFs existed. Once creations and redemptions are processed after the market close, the NSCC shares a portfolio composition file with all active corporations, based on information provided by the issuer. This file then serves as the list of every security and its relevant quantity to provide in order to receive a creation unit.

The primary market for creation units is an essential feature and it is considered by research as the channel allowing for shock transmission between ETFs and securities as well as between stocks that are commonly held. Commonality in liquidity is seriously supposed to araise because of the creation/redemption mechanism as will be discussed later in this paper.

2.2. Market participants

So far, two essential actors of the primary market have been mentioned :

the ETF sponsor, or issuer is the firm managing the fund, which name is attached to the product because it decides which benchmark the ETF tracks and how the replication strategy is implemented. If the index is computed by a third party, the sponsor will benefit from tracking a well-known index since the demand exhibits a preference for widely used broad-based or sector-based indices. Replicating an index provided through another specialized company (for instance S&P, MSCI) comes at a cost, the license fee, which typically amounts for several basis points per year. The issuer is in charge of the SEC filing in the United States, before compliant documentation is published.They also appoint the otherparticipants presented in this subsection.

authorized participants (APs) are essential because they initiate share creations and redemp-

[6] The exact wording is :“their failure to deliver is the result of bona fide market making”. (Ben-David, F. Franzoni, and Moussawi 2017)

tions with the fund, based on a formal agreement with the fund. One has to recall that the price of an ETF is not automatically and instantly determined through the name of the index it tracks; nor is it derived from the last known value of its assets, the NAV. Rather, ETFs are securities traded on an exchange as their name says, which mean their price stems from supply and demand. Therefore the market price of ETF shares may deviate from the underlying index; unlike closed-end funds, ETFs are known for the scheme allowing to correct this deviation. Precisely, APs' non-mandatory role is to adjust the supply of ETF shares by providing either securities portfolios corresponding to the track index in order to create new blocks of ETF shares (excess demand of ETF shares) or handing back blocks, the creation units, to the issuer in order to get in-kind reimbursement in the form of underlying securities (excess supply of ETF shares). They are not paid by ETF sponsors, not constrained to be constantly monitoring the net asset value (NAV) either: actually, authorized participants have to pay the sponsor a creation fee (which may be fixed, independent from traded value). Their incentive is the same as market makers, and some institutions may play several roles on an ETF market : they will engage in a creation process if demand for is in excess. In other terms, they will execute a profitable trade by being able to sell the created units above the NAV, regularly disseminated by the sponsor. Of course, such an arbitrage only takes place if the trade's costs, including transaction fees on individual stocks and ETF creation fees, do not offset the profit earned on the difference between the ETF price and its intraday NAV. Thus, authorized participants generally are large banks, broker-dealers and market makers.

Beside the two main actors and the clearing corporation, the proper daily trading and liquidity is made possible through :

custodians do not only hold the assets of the ETF on behalf of the fund issuer : they reconcile positions with the index rules, in case the product replicates an index from a third party (e.g. the S&P 500 index computed by *Standard & Poor's Dow Jones Indices LLC*), and more generally with ETF rules, which are made publicly available in the prospectus. Custodians, often banks, execute periodic rebalancings and adjust the portfolio when a corporate action (e.g. stock split, delisting, merger or acquisition) so demands.

market makers create liquidity in the secondary market by steadily providing quotes based on their calculation of the ETF's fair value. It is reported that a limited number of market markers trade each ETF, unlike (liquid) stocks for which a best bid and offer is computed out of various quotes. Nevertheless, there are exists a correlation between the volume traded, the spread on the ETF market and the number of market makers.

3. Chronological background

If one wants to understand how fundamental the shift to passive investment and ETFs is, it seems necessary to step back at least to the 1970s. Masses of workers in Western countries have accessed the financial markets during the strong post-war economic boom. Mutual funds were not invented in the second half of 20$^{\text{th}}$ century, rather were they formally regulated as collective investment schemes in the 1930s and more generally as investment companies with the 1940 Act in the U.S. Traces of the earliest closed-end funds are said to have been found in the Netherlands, first in 1774 in the form of a merchant's investment trust and then after the Congress of Vienna at the king's initiative. The scheme has then spread in Europe including Switzerland among early financial places with a 1849-established company called *Société civile genevoise d'emploi de fonds*. Modern open-end funds though more relevantly have a famous and long-lived ancestor with the *Wellington Fund*, established 1928. This company from Pennsylvania was famously led by the late Jack Bogle, before he founded *The Vanguard Group* which nowadays manages the Wellington fund.

The trend of institutionalization of investment really took on during after World War II and mutual funds gained a significant attraction power in the 1980s. Mutual funds have claimed to provide a performance relative to benchmarks that are reference indices, for example the market-capitalization-weighted stock index. On the other hand, as a consequence, passive investing has become more easily available for small, individual investors thanks to a new type open-end mutual fund : the index fund, first (successfully) implemented by Jack Bogle. ETFs appeared more than a decade later[7] and remained confidential as long as the trust into mutual funds was untouched. The narrative according to which fund managers only work with their shareholder's sole interest in mind suffered increasing doubt due to public scandals : in 2003, several dozen companies were found by regulators to have violated multiple customer diligence rules, being accused of late trading and market timing. Mutual fund prices, unlike ETFs, are computed once a day at close; late trading by informed traders allowed them to trade at the set price during

[7] Charupat and Miu (2013) reports as common knowledge that the first ETF listed was the Toronto Stock Exchange Index Participation Units, a product that tracked the market-capitalization-weighted TSE 35 stock index. The ETF was launched in March 1990 and was replaced in 2000 with the iShares S&P/TSX 60 Index Fund as the benchmark on the Canadian stock market was changed.

the stock market "after-hours", instead of having to wait for the next session's fund price. Such certain profit opportunity is considered an unfair advantage granted by the fund to some traders, as is the market timing charge. Mutual funds investors, again unlike ETF investors, are generally prevented to trade back and forth beyond a certain frequence for cost reasons, since the processing of orders induces costs borne by all fund investors, and for cash management reasons too, since the cash balance needed to face frequent and potentially massive selling orders is larger. Violating their own rules, some funds arbitrarily allowed some privileged investors engage in market timing. The aim of such fund managers was reportedly to boast larger assets, which in turn positively influence their own fees. Scandals and the increased focus on managers' actual value added in exchange for their advisory fees following the 2008 financial crisis did not abruptly stop mutual funds' growth but slowed it at the benefit of Exchange-Traded Funds, considered by many as the most liquid and transparent vehicles for passive and alternative investment.

The advent of Exchange-Traded Funds takes place in an ongoing debate that have led modern financial economics at least since Fama's paper about the Efficient Market Hypothesis (hereafter EMH) around 1965. The 2013 Nobel Prize granted to Eugene Fama *and* Robert Shiller, EMH's main critic[8] has obviously acknowledged the secular importance of the debate but the discussion has certainly not been closed since then.

In a recent working paper called *The Active World of Passive Investing*, Easley et al. (2018) claim that the shift from mutual funds and individual securities to ETFs is not simply a shift from active to passive investing, that distinction being "antiquated". Popular statistical metrics such as the active share – which measures the absolute deviations of a portfolio holdings compared with a value-weighted benchmark – and the tracking error – i.e. the annualized standard deviation of the daily difference between the portfolio and market returns – show that the decennial increase in ETFs share is actually fueled by active investing, including smart beta products whose "activeness" could be debated, because they essentially try to systematically capture risk premia justified by factors studied in the academic literature (most importantly, value and momentum factors). Nevertheless, a worldwide phenomenon has been at work leading to the mutual fund industry specializing towards passive investment and the ETF products, first designed to provide an efficient tracking of value-weighted stock indices, mutating to virtually any flavour of index,

[8] As a matter of completeness, let us not forget the third recipient, Lars Peter Hansen, who developped econometric methods used to test the EMH, namely the General Method of Moments (GMM) estimators. A summary of their literature and the fields they contributed most to is Economic Sciences Prize Committee of the Royal Swedish Academy of Sciences (2012)

whether focusing on specific sizes, sectors, regions or factors.

In this paper, the focus is less on the mildly active aspect of ETF investing than on those products' impact on underlying assets. When agents shift from discretionary investing to index-tracking, the measure of success shifts from outperforming a benchmark to minimizing the difference between one's portfolio and a benchmark, and ETFs have shown that they are a convenient instruments for this latter goal. It has been said that, with the variety of products available, the actual decision is not to pick the right security but the right index. Such change is suspected to induce some correlation among securities, a claim that this paper will address after a summary of related research.

4. Review of literature

Different segments of research are relevant to this paper's questions, most of them, perhaps surprisingly, not considering ETFs specifically but studying the effects of indexing, derivatives, and institutional ownership.

Regarding the covariance of individual stock returns, a significant and positive impact of the contemporaneous share held by ETFs has been documented in several studies. An extensive *Journal of Finance* article that inspires this paper, Ben-David, F. A. Franzoni, and Moussawi (2018), brings consistent evidence of this impact by analyzing the shock propagation through arbitrage between underlying securities and funds, using a sample of U.S. stocks and ETFs. First of all, they show that ETF on average exhibit higher liquidity (measured in the form of a lower Amihud (2002) *illiquidity* ratio), a lower bid-ask spread and a higher turnover than the value-weighted baskets of securities they hold. This comparison method prevents an adverse selection bias due to ETF supposedly investing in the most liquid stock and being otherwise similar to their portfolio. This comparison is valid under the hypothesis that ETFs together hold a value-weighted basket of stocks, according to the traditional (and significant) use of ETFs.

Higher liquidity and turnover at the same time support the assumption of a clientele effect : as Amihud and Mendelson (1986) predicted in general and tested for NYSE stocks, investors with a shorter expected holding horizon have a preference for liquid securities and the relative bid-ask spread is a measure correlated with illiquidity. The focus on short term drives the investor's choice towards the most liquid stocks while buy-and-hold investors accept keeping less liquid assets since they do not expect and/or need to sell them immediately.

Ben-David, F. A. Franzoni, and Moussawi (2018) call their main hypothesis regarding a positive impact of ETF ownership over underlying stocks the *liquidity trading hypothesis*: volatility reflects the fact that the shocks occurring on asset prices are non-fundamental, i.e. not related with cash flows nor with any news about the company. Therefore, the price is expected to revert to its initial value, ceteris paribus, because the shock is purely driven by liquidity. This sort of shock propagation differs from a two alternative hypotheses:

the price-discovery hypothesis : permanent, i.e. fundamental, price adjustment related to some news spreading among investors. More precisely, this alternative hypothesis predicts that fundamental changes happen in the ETFs *before* they hit the concerned stocks themselves. Having shown that ETF trading have an impact on the prices of underlying assets, the tests try to assess whether the shocks due to ETF trading have a permanent (fundamentally driven) or temporary (liquidity-driven) impact. The acceleration in stock prices' response to fundamental news has been documented in theory and empirical results in Andrei and Hasler (2015) : in their model, there is a positive quadratic relationship between the time-varying degree of attention of investors and the stock's return variance, as well as a similar relation between learning uncertainty and variance, though weakly significant. This may come from the model, which specifies uncertainty as depending negatively from attention : participants will learn more information by being more attentive and therefore reduce their uncertainty. In other terms, stable prices require the market to take news into account (attention) as well as converging to similar conclusions based on news (the opposite of uncertainty, i.e. trust in your forecasts). It is perhaps more intuitive to think of attention and uncertainty in terms of the proxy used empirically than based on the stochastic processes defined in the model : time-varying attention to news is proxied using statistics of Google searches on a financial and economic set of words, whereas uncertainty is derivded from the dispersion in analyst forecasts.

the liquidity buffer hypothesis : instead of acting as a propagation channel for demannde shocks, ETF are supposed to act as substitutes for the underlying, less liquid securities since investors find the properties of stocks replicated in another liquid product. Thus, the introduction of an ETF captures part of the stocks's volatility non-fundamental volatility, which in turn decreases. This hypothesis was not developped in an ETF setting as it was first appeared in a commodity production model (Danthine (1978)) relating the introduction of futures with stabilized spot prices thanks to the information futures convey about rational expectations and therefore on supply – although it is recognized that futures attracts speculators too. In short, this theory is used as if ETFs were the new futures and as if they could reflect expectations on the underlying assets. Empirical evidence with futures and stocks is not unanimous and results are mixed : the introduction of futures has been linked with an increase in the volatility of Nikkei index stocks. What is more, if one assumes that the futures market's importance is proxied through traded volume and open interest, Bessembinder and Seguin (1992) find that indeed the introduction of futures decreased volumes exchanged on spot equity markets, that futures expected volume, resp. open interest, and spot volatility are negatively correlated together thanks to the increased market depth brought by futures. On the other side, the unexpected component of futures trading volume correlates positively with spot volatility. In general, their results are consistent with the hypothesis of the index arbitrage activity improving market depth highlighted in Grossman (1988) and they show no sign of support for increased instability due to liquid and relatively cheap correlated assets – at that time, futures, and nowadays ETFs ?

5. Data

Most of the available literature regarding the impact of ETF ownership on stock's volatility and liquidity uses a specialized dataset that was unfortunately not available for this paper, namely the Thomson Reuters Mutual Fund Ownership Database also known as S12. Completeness is theoretically guaranteed in this dataset since its direct source is the filings that all investment companies[9] have to report quarterly to the U.S. Securities and Exchange Commission (SEC). Whereas access to the Institutional Holdings (aggregated at the management companies' level), also known as S34, were available through WRDS at the University of Pennsyvania, they lacked granularity since most of if not all the major ETFs (according to the amount of funds held) are issued by a limited number of investment management companies. Nevertheless, Thomson Reuters data regarding the fund ownership of stocks can be found alternatively on their *Eikon* platform and the systematic lookup is implemented through an open application programmation interface (API) for which libraries have been written in common programming languages. Nevertheless, the origin of fund holdings data is less clear as I cannot ascertain that they come from

[9] A note by Wharton Research Data Services at the University of Pennsylvania lists the various types of investment companies reporting their holdings : "banks, insurance companies, parents of mutual funds, pension funds, university endomwents [as well as][...] professional investment advisors". Together, because of the form they report current assets held, they are called *13f institutions* and file with the regulator at least quarterly.

S12 nor that they have not been modified before integration in *Eikon*[10].

The availability of ETF ownership is the critical variables when it comes to put time boundaries to the analysis : there are ETF holdings before 1999, whereas the Thomson Reuters Mutual Fund Ownership database starts around 1980 and would therefore theoretically allow to track the first ETFs active in the US ever, back in the early 1990s. Nevertheless, the aggregate value invested in those funds was almost insignificant during most of the decade and therefore I choose to collect month-end observations from January 1999 to December 2018, that is, over 240 months. Further restrictions due to lags will limit the effective length of the panel.

5.1. Exchange-Traded Funds characteristics

One of the most extensive sources of basic ETF data may be the items under share code `73` in the dataset maintained by the Center for Research in Security Prices (CRSP) at the University of Chicago, with access again granted through WRDS. Since the first Exchange-Traded Fund's inception in 1990 in Canada, they refer 2893 funds in this category, with the important restriction that CRSP only tracks securities in the United States. Without any restriction on the country of incorporation, Thomson Reuters exhibits 4085 active ETFs and it is not possible to get the sample of discontinued ETFs; on the other hand, the active sample seems to be a substantial share of all ETFs currently live worldwide.

In general, index-tracking ETFs[11] may engage in three different implementations of index-tracking:

Full (or *physical*) replication The securities in the index portfolio are all held by the ETF in the actual proportions used to compute the index. We could say that this product is fully collateralized.

[10] As of the date of redaction of this section, transition is ongoing towards a rebranding of the mentioned products, after the sale of the data unit of Thomson Reuters to Refinitiv.

[11] The context of this analysis still can be summarized as a gross distinction between mutual funds (actively managed, open-end funds without intraday liquidity and priced at their Net Asset Value at market close), index funds which are their passive counterpart (e.g. the iconic Vanguard 500 Index Fund with its beta of 1.00 to the S&P 500 equity index) and the ETFs that are open-end, index-tracking funds with a continuous arbitrage mechanism enabled by issuing their indicative intraday NAV every 15 seconds throughout the day. This polarized landscape has been changing during the last decade though : preliminary results (Easley et al. (2018)) show that the share of ETFs explicitly labelled as active portfolios has been increasing (1.8% of assets under management in US equity ETF as of 2017, Ben-David, F. Franzoni, and Moussawi (2017)) while somewhat mixed performance relative to their benchmarks have made mutual funds less reliant on their managers' skills

Optimized replication The ETF generally uses a proprietary algorithm to tilt its holdings towards the securities with the most contribution to the index volatility. Thus smaller securities encompassed by the index are neglected, in whole or in part.

Swap-based replication The ETF does not hold the "physical" securities but enters into derivatives such as a total return swap agreements which replicate the index performance including cash flows such as dividends. ETF shares creations and redemptions are therefore made in cash. Swap-based ETFs indirectly allow investors to access swaps while they - especially individuals - would not be able to enter such contracts with a bank on their own, but those products also expose them to the counterparty risk in exchage for tax advantages (i.e. income treated as capital gain).

While swap-based replication for instance allows leveraged and inverse ETFs, thefact those products do not actually trade the underlying securities prevents a demand shock happening on themselves from subsequently influencing the volatilityand liquidity of stocks. Since they constitute a minority of the broad ETF market in terms of value, especially in the United States, they are not kept in the sample of interest. Hence, there are 1798 full-replication, 1497 (explicitly) optimized-replication ETFs and 29 more exhibiting *Other*. Their documentation shows it means either an optimization regarding a specific sector or a mix between a majority of physical shares and derivatives in addition. It is relatively more worrying to acknowledge the 277 funds for which the value of the `Index replication method` variable is missing. At least a part among them may be actually swap- or option-based and therefore hold no physical asset – in which case, they could have been excluded from the sample of 3324 remaining ETFs.

5.2. Common stocks' fund ownership

The sample of live U.S.-traded stocks provided through the Screener function in Eikon is the basis for this analysis; it does not only include companies that are headquartered in the United States but also foreign (from the U.S. point of view) ones with a listing on a U.S. stock exchange. Overall, the sample contains 4978 active companies (as of March 4, 2019) with no conditioning on size, lifetime nor stock price; out of them, 4426 are U.S. companies and the remainder is split across 48 other countries, with almost 30% of them being located in China.

Fund ownership is available through the variable `TR.FundAdjShrsHeld`, meaning *the number of shares of a given stock held by a given fund, adjusted for corporate actions (e.g. stock splits)*. For a stock at a given date, a query through the Thomson Reuters Eikon API allows to retrieve

Table 1: Summary of the variables' coverage in the ETF Characteristics table

Data columns	(total 20 columns)
Lipper_RIC	3601 non-null object
CUSIP	1814 non-null object
ISIN_Code	3577 non-null object
Asset_Name	3601 non-null object
Asset_Full_Name	1990 non-null object
SEC_Inception_Date	1378 non-null datetime64[ns]
Fund_Management_Company_Long_Name	3601 non-null object
Closed_Date	0 non-null float64
Exchange_Traded_Fund(ETF)	3601 non-null int64
ETF_Ticker	2509 non-null object
Asset_Status	3601 non-null object
UCITS	736 non-null float64
Legal_Structure	2221 non-null object
Index_Tracking	3333 non-null float64
Index_Replication_Method	3324 non-null object
Investment_Objective	3600 non-null object
Style_Matrix	1223 non-null object
Broad-Based_Index	1376 non-null object
Peer_Index	1369 non-null object
Type:	*<class 'pandas.core.frame.DataFrame'>*
RangeIndex:	*3601 entries, 0 to 3600*
dtypes:	*datetime64[ns](1), float64(3), int64(2), object(14)*
Memory usage:	*562.7+ KB*

the whole fund ownership at once (ignoring the reporting issues. . .), with the fund ID, category and an essential information : the date of holdings reporting, which is a metadata of the shares held value. Enquiries in the database have shown that ETF holdings are generally up to date, whereas a larger share of other funds exhibit a reporting delay, i.e. a reporting date earlier than the query date. Indeed, in order not to introduce erroneous data, no spurious extrapolation (from the latest reported date to the query date) is decided, except if both dates lie in the same momth of the same year. Once they are grouped by month of report, only holdings of ETFs are kept, they are summed at the stock level and finally divided by the number of shares outstanding at month end (adjusted for corporate actions) to obtain the relative ETF ownership. Some outliers above or close to 100% ownership have been identified when specific companies went under the Chapter 11 protection of the US Bankruptcy Code and the fund amounts of shares held were not immediately updated for the equity being destroyed. Whenever this case occurred, the *de facto* invalid observations have been dropped. The final sample for U.S. stocks includes 712445 non-null observations.

5.3. Common stocks' market and accounting data

The Eikon API also provides an extensive access to time series of market data, of which daily close price, traded volume in terms of shares and – in order to compute the Amihud (2002) illiquidity ratio, a control variable – the volume-weighted average price (VWAP). Cross-sectional queries, similar to those regarding fund ownership, allowed to retrieve the remaining control variables, respectively the input necessary to compute them. Availability differs for every variable in the panel, which limits the number of observations actually used; by its very nature of gathering stocks that have entered the sample at different times over twenty years, the panel is heavily unbalanced, which does not prevent the statistical analysis to hold as long as the availability of data is not correlated with variables of interest.

As it is obvious from Table 2 which sorts the frequencies of entities across subsamples and overall, the vast majority of securities identified through a unique Reuters Identifier Code (RIC) are ordinary shares, i.e. common equity stock. The first two rows gather more than 97.5% of the sample and the remainder is scattered across multiple categories. The three next most frequent categories are close to stock (preference share is a synonym for preferred stock and American depository receipt, the latter being a proxy for a foreign (non-U.S.) stock issued by a U.S.-based bank) or to trusts (the "Unit" category). The numerous marginal types are either country-specific investment vehicles or clearly outliers for which one can suspect a classification

Table 2: U.S. and International broad samples of underlying securities: categories of instruments

Asset Category Description	International	US	All
Ordinary Share	15225	4634	19859
Fully Paid Ordinary Share	1030	5	1035
Unit	57	114	171
American Depository Receipt	0	127	127
Preference Share	105	0	105
Global Depository Receipt	13	0	13
Participation Share	13	0	13
Depository Receipt	7	4	11
Closed-End Fund	6	3	9
Dutch Certificate	7	0	7
Brazilian Unit	5	0	5
Preferred Share	2	2	4
Stapled Security	3	1	4
Bond	2	1	3
Swedish Depository Receipt	3	0	3
Brazilian Depository Receipt	2	0	2
Genussschein	2	0	2
Savings Share	2	0	2
Convertible Preference Share	0	1	1
Exchange-Traded Commodity	1	0	1
Exchange-Traded Note	1	0	1
Non-Cumulative Preference Share	1	0	1
No available information	9	20	29
All	16496	4912	21408

error (bonds, exchange-trade products. The general statement taught through this category breakdown is that the securities from this global sample do not exclusively belong to common stock, although an overwhelming majority does. Still, the total value of those alternative vehicles held through ETFs is likely not a significant share since they focus their equity investments on large-cap and liquid equity. A possible robustness check would be to further restrict the following analysis to actual ordinary equity shares.

6. Methodology

6.1. Independent variables

6.1.1. Volatility

In order to keep the amount of data treated at a tractable level[12] and due to data availability limits, stock volatility is measured over a calendar month (end-to-end, adjusted for the number of trading days) as the standard deviation of simple returns using daily close series.

$$\text{Volatility}_{i,t} = \sqrt{\frac{1}{N\_d_{i,t} - 1} \sum_{d=1}^{N\_d_{i,t}} (r_{i,d} - \bar{r}_{i,t})^2} \tag{1}$$

Computing and analyzing intraday volatility is a different avenue for research, shown in Ben-David, F. A. Franzoni, and Moussawi (2018) : they use the US Trade and Quote (TAQ) database and compute intraday volatility over second-by-second returns, which which is used in a panel OLS regression with the following regressors : the absolute mispricing as a proxy for arbitrage activity, ETF ownership and the same controls included in their monthly database and in this paper (cf. subsubsection 6.4.1, p.37).

6.1.2. Liquidity : Amihud (2002) ratio

Liquidity has to be implied from various proxy variables. The illiquidity ratio introduced in Amihud (ibid.) is one of them and it has been used in literature both as a variable of interest in itself (e.g. Israeli, Lee, and Sridharan (2017)) and as a control for the volatility impact of ETF ownership (Ben-David, F. A. Franzoni, and Moussawi 2018). An assessment of liquidity measures, Goyenko, Holden, and Trzcinka (2009), more precisely the relevance of several low frequency metrics includes the Amihud (2002) ratio to predict high frequency spread and price impact benchmarks using randomly selected U.S. stocks. Although its performance in order to predict the spread is not considered convincing (which does not come in this metric's design or goals), the Amihud (ibid.) illiquidity ratio is the most correlated with price-impact benchmarks

[12] A quick enquiry returns that the datasets overall more than 20 Gigabytes large, with monthly fund ownership files, segregated into US and international subsamples, being the largest arrays.

among tested metrics.

$$\begin{aligned}\mathsf{Illiq}_{i,t} &= \frac{1}{N\_d_{i,t}} \sum_{d=1}^{N\_d_{i,t}} \frac{\mid r_{i,d} \mid}{\mathsf{Volume\_D}_{i,d}} \\ &= \frac{1}{N\_d_{i,t}} \sum_{d=1}^{N\_d_{i,t}} \frac{\mid r_{i,d} \mid}{\mathsf{Volume}_{i,d} \cdot \mathsf{VWAP}_{i,d}}\end{aligned} \tag{2}$$

The first line is Amihud (ibid.)'s original definition, whereas the second shows that the daily dollar volume, $Volume\_D$, is computed as the product between the volume expressed in terms of stock shares traded, $Volume$, and the volume-weighted adjusted price, or $VWAP$, since it is not an available data in the source database.

The method followed in liquidity regressions comes from Israeli, Lee, and Sridharan (2017), which document both liquidity and information-related effects due to ETF ownership : correlation between, on one side, higher ETF ownership and, on the other side :

lower liquidity : higher bid-ask spread and higher price impact of trades

lower price efficiency : higher stock returns synchronicity, lower future earnings response and, in the long run, lower analyst coverage.

The liquidity regressions will be explained in greater detail in the appropriate subsection (subsubsection 6.4.2, p.38).

6.1.3. Price efficiency

The notions of pricing and informational efficiency, sometimes used as synonyms (ibid.), do not match precisely a unique statistic but several empirical strategies have been designed, some being more parsimonious in terms of data. Variance ratios have for instance been used in O'Hara and Ye (2011) at high frequency in order to test whether the fragmentation of the U.S. stock market into off-exchange trading venues harm or improve market efficiency – the reseachers in this case correlate fragmentation with swifter and cheaper execution as well as higher efficiency measured in terms of a price movements closer to a random walk.

Pricing efficiency in Ben-David, F. A. Franzoni, and Moussawi (2018) is tested as follows : they test whether the increased ETF ownership yield a higher degree of mean-reversion in pprices. In other terms, a stronger negative auto-correlation in prices (over 5 days) is the sign that they become noisier due an increased non-fundamental volatility. Such evidence is considered a empirical confirmation of the liquidity-trading hypothesis.

The variance ratio is defined as :

$$VR_{i,t} = \frac{Var(r_{5,i,t})}{5 \cdot Var(r_{1,i,t})} \tag{3}$$

with $r_{5,i,t}$, the return on security i over the previous 5 (trading) days, i.e. the (trading) week, and $r_{1,i,t}$ the daily return; therefore, index t stands for a period longer than a week. The sampling period to the quarterly frequency in order to generate a meaning variance of non-overlapping weekly returns.

Under the assumption that daily prices follow a random walk, with independent and identically distributed values, the variance ratio should equal 1, whereas mean-reversion causes the ratio to shrink. A less restrictive test rely on the assumption of any auto-correlation, whether a trend component or mean reversion and thus the literature suggests to study the absolute deviation of the ratio from one, which represents the null hypothesis of a random walk:

$$absVR_{i,t} = |VR_{i,t} - 1| \tag{4}$$

6.2. Regressor of interest : ETF ownership

The purpose of this paper is to identify and quantify the effect of the share of exchange-traded companies' equity being held through ETFs over several characteristics, namely the stocks' volatility, liquidity and price efficiency, all of three will be the dependent variables in dynamic panel regressions. Based on raw monthly fund-stocks number of shares held, the set of funds belonging to the ETF category and the overall number of shares outstanding of the given stock, the percentage of shares outstanding held is determined :

$$\mathsf{ETF\_Ownership}_{i,t} = \frac{\sum_{f=1}^{N_f} \#\_\mathsf{AdjShares\_Held}_{f,i,t} \cdot B_f}{\#\_\mathsf{Shares\_Out}_{i,t}} \tag{5}$$

$\forall i = 1 : N_i$ (stocks), $t = 1 : T$ (periods) with $B_f = 1$ if fund f is an ETF, 0 else.

The reporting frequency plays an important role as far as the accuracy of this variable is concerned: a substantial part of the reporting of their holdings to ETF, which is a regulatory task, is delayed each month : for example, the query for the number of shares owned by an ETF on February 28, 2018 yields a data pointas of the January 31, 2018; the delay can be more than one month. Two competing choices have been tried before it was decided to apply the same rule to the whole sample, out of a need of internal consistency. Even if both branches of this alternative contain disadvantages, a unique choice has to be made regarding the whole sample so that no spurious relationship appears later between one group of stocks and the other. Either unavailable monthly values are considered a marginal share of the aggregate, stock-level ownership ratios, and they are simply ignored, or the latest reported fund-level values are considered the "best guess" one can make regarding how many shares of this stock are currently owned through this fund, and they are included in our global, stock-level ratio; this guess will be referred to as *extrapolation*. In other terms, is the bias more severe by including slightly delayed, and therefore possibly outdated portfolios, or by only selecting the information that one has at hand with certainty, though incomplete ? The challenge is to understand, even *a priori*, whether the statistical and even economic interpretation of results will be less hamperedby a main regressor, total ETF ownership, computed precisely wrong (no extrapolation) or approximately correct (short term stale holdings). Without further intuition on the massive data collection and its coverage, one possible way of figuring how serious this issue actually is, is to compare several estimation results obtained with both methodologies. Even if the issue is known, its effects on a large panel are not guaranteed to be sizeable.

The granular data availability question is also relevant for other institutional ownership controls that will be used to capture a possible influence of other fund types over variables of interest. The fund categories distinguished in the database are, exhaustively, mutual funds, pension funds and hedge funds, all subject to an at least quarterly disclosure of their holdings. Due to the lower update frequency observed with those controls, it has been decided to assume the fund-stock holdings constant between the last available date and the current one, which reduces the volatility of aggregate ownership shares. Another strategy would be to reduce the frequency of observations from monthly to quarterly (at each calendar quarter end) over the whole sample. This estimation strategy remains to investigate in order to state whether such three-month periods are granular enough to perform relevant analyses.

6.3. Control variables

In this subsection, besides a precise definition of every control's construction, the aim is to increase the depth of the analysis. The first impression that may come from this type of empirical analysis[13] is a form of agnosticism. In other terms, the controls are various and numerous, but little comment is spent in empirical contributions about the theoretical foundations. This subsection, though very concise, shall provide more insight from the literature about the reasons behind a factor's presence in regressions.

[13] The bibliography, which is even unable to account for the whole corpus of relevant articles in this field, testifies that dynamic panels in empirical pricing are a broad family.

6.3.1. Bid-ask spread

The most straightforward way to compute the difference between the bid price – the highest price at which buyers on the market are agreeing to pay for the security on the spot market – and the ask price – the lowest price sellers agree to receive for their shares – is to compute the difference between the variables `TR.AskPrice` and `TR.BidPrice` at day close . Whenever both values returned by the data provider are not null, the absolute (difference) measure can be computed and in cross-sectional regressions, the relative measure is used as a liquidity control :

$$\mathsf{Pct\_BidAskSpread}_{i,t} = \frac{\mathsf{Ask}_{i,t} - \mathsf{Bid}_{i,t}}{\frac{\mathsf{Ask}_{i,t} + \mathsf{Bid}_{i,t}}{2}} \tag{6}$$

The denominator in the relative bid-ask spread is the mid-price approximated as the arithmetic average between both quoted prices, without considering the rounding that can occur due to the tick size.

The relative bid-ask spread accounts for the cost of trading, which is itself assumed to correlate positively with the illiquidity, i.e. the weak number of agents willing to trade on a market. The market makers require a higher price, the bid-ask spread, in order to compensate for the risk of note being able to net out their position in an asset rapidly. Thus, a higher bid-ask spread constitutes a limit to arbitrage across markets or assets.

Another explanation has been studied : according to the Glosten and Milgrom (1985) market-microstructure model, the bid-ask spread reveals the presence of informed traders and it can even exist in a competitive market without trading costs. If there are both informed and uninformed (so-called *noise*) traders and and market makers (such as the operators acting as middlemen on the NYSE) cannot tell whether a submitted order in which they are the counterparty comes from either group of traders, they (market makers) will infer determine their bid and ask prices based on the conditional expectation about the asset value based on the direction (buy or sell) of the order they are facing. In this model, the bid-ask spread accounts for the adverse selection, because transactions convey information, and creates a divergence between observed returns on securities and the returns that could be made by an uninformed trader – a difference that becomes relatively smaller, the longer the investor holds its asset, the authors show. The bid-ask spread can therefore be included in cross-sectional regressions in order to account for the unequal liquidity provision as well as the unequal availability of information regarding firms.

As a matter of comparison with the existing literature, the use of the closing bid and ask closing prices is justified by a concern for tractability, based on the large population of stocks over a long time horizon. The implicit assumption that the closing spread generally represents the spread throughout the trading hours (not to even mention the after hours). Higher frequency, intraday data are not commonly available, although some access is allowed over limited periods for U.S. stocks through the Trade and Quote (TAQ) database. Some authors estimate the bid-ask spread through a model making use of the highest and lowest daily price series (Corwin and Schultz (2012), Abdi and Ranaldo (2017)) and prove their efficiency, in the absence of end-of-day quote data, with the available TAQ effective spread, a benchmark.

6.3.2. Fama-French factors

In the original paper about the cross-section of stock returns (Fama and French 1992) as well as in their generalization to bond returns using a new methodology (Fama and French 1993), Eugene Fama and Kenneth French introduce an empirically-founded, five-factor (counting the market return) extension to the Capital Asset Pricing Model. Three factors come from the equity universe : market return, size and value, while two factors are specific to bonds : a term (i.e. maturity) premium and a default risk premium. The methodology in the later paper provides a common framework for stocks and bonds and conclude that the explanatory power of the CAPM beta nearly disappears when the size and value factors are taken into account. They change the common, "CAPM-based" view by showing that, across sorted all portfolios, the residual sensitivity to the market return is the same and reflects a risk premium attached to any stock, compensating the investor for not investing in a bond instead. Here we will retain the three-factor model that is already powerful for explaining the differences of returns across stocks.

Size Small-capitalization firms have been shown to yield a higher return adjusted by their market exposure and this phenomenon justifies the existence of a risk premium according to Fama and French (1992). More fundamentally, the fact that the market β of small capitalizations is not able to fully account for their higher returns can already be found a decade earlier in Banz (1981), which reports its existence over more than forty years among NYSE common stocks.

Since the simple designation as an *anomaly* is not a viable reason for this persisting phenomenon, several explanations for the existence of a small-minus-big risk premium have been proposed.

Risk-based explanations Earlier theories (Berk 1995) claim that the size factor, since it is measured through market value, only reflects the fact that riskier firms have to pay higher expected returns, or conversely have a lower market value. If this hypothesis is true, the market value captures an individual risk premium but no other non-price-based measure of firms' size, whether the book value of equity, of total assets, the sales revenue or even the number of employees, will have any explanatory power regarding expected returns. Another theory yields the same relationship through growth options : they are assumed to be a risky component that is concentrated in small firms and, therefore, smaller companies have to pay their investors higher returns in order to compensate for the included growth options. Gârleanu, Panageas, and Yu (2012) support their model with consistent simulation results and empirical evidence of the size effect but fail to exhibit simulateneously a size and a value factor: both effects drive each other out.

Behavioral explanations In this strand of literature, the focus on size is relatively minor compared to value and momentum (over/underreaction, see subsubsection 6.3.3, although K. D. Daniel, Hirshleifer, and Subrahmanyam (2001) develop a model that jointly allows for the book-to-market ratio and the market value (our size effect) to predict returns. Their model incorporates overly confident insiders that cause mispricing and other risk-averse traders that do not completely eliminate mispricing.

Liquidity-based explanations The third branch of competing hypotheses regarding the size effect is based on liquidity, whether its level or its risk – and it is shown that both seem negatively correlated. Small firms are both less liquid on average and more risky, which explains a positive risk premium relative the rest of the market. Acharya and Pedersen (2005) propose a model with four betas, i.e. three additional covariances between the respective market and security returns and liquidity risks, those being proxied through a normalized version of the Amihud (2002) ratio.

After it had been considered less important in magnitude over history, yielding weaker returns than other risk premia (e.g. value, momentum) when targetted specifically, possibly arbitraged away after the 1980s or at least hard to find outside the U.S.[14] Cliff Asness, a principal at AQR Capital Management who wrote his PhD thesis under Eugene Fama's supervision, has tried to ressurrect size in a *Journal of Financial Economics* paper, C. Asness et al. (2018), with an eloquent title : *Size matters, if you control for your junk.* The authors show that the significance of the factor greatly increases once another, so far ignored, factor is taken into account : it is called quality and this factor can only be a composite statistic built over several more explicit measures: profitability, which is used as a control and developed later (subsubsection 6.3.4,

[14]This is not a comprehensive inventory of somewhat mixed evidence regarding the size risk premium.

p.36), earnings and cash flows growth, safety (low beta, leverage, bankruptcy risk and earnings volatility), payout: characteristics of a stock assumed to be sought for by investors. C. S. Asness, Frazzini, and Pedersen (2019) present empirical tests for 25 countries using a normalized metric that combines the aforementioned aspects and show that high-quality firms, which on average have a low beta and low exposures to alternative factors (size, value, momentum), perform better than so-called junk companies during market downturns.

As mentioned earlier, in this paper it would be too intensive in data for the expected benefit of such a metric, and size along with its best counterpart are only controls that should account for possible, yet extremely speculative influence over volatility, not expected returns. Thus I consider sufficient to proxy the quality composite metric of C. Asness et al. (2018) using one of its component only, i.e. gross profitability.[15]

Book-to-Market ratio Similar to the size effect, the inability of the CAPM to account for positive excess returns in high versus low book-to-market value firms, also called respectively value and growth companies, appears at least as early as in Rosenberg, Reid, and Lanstein (1985).[16]

It may further be noted, as an application for a long-short equity portfolio, that C. S. Asness, Frazzini, and Pedersen (2019) demonstrate improved risk-adjusted returns (measured through the Sharpe ratio) for a strategy they call *Quality at a reasonable price.* The baseline case is a portfolio based on sorting a portfolio on the HML (value) factor and adding a quality sort is a possible way to implement this improvement. The authors explain that quality (meant as desirable characteristics) actually complements value (the expensiveness of a company relative

[15]Typically, precision is traded for tractability in the estimation methods and data availability issues would only make the sample even smaller, less representative – and so the conclusions drawn from results, because, precisely, small firms often lack data points. I am nevertheless conscious that such a shortcut may not account for the perceived quality-versus-junk judgement : a profitable company may exhibit earnings forecasts that are unstable, even around positive trend. It may profit from a market with entry barriers or a even a protected monopoly and commit little investment. These are examples of situations where the quality rating is impaired and a good profitability ratio is the only good component – intellectual honesty commands to raise this flag.

[16]Even if both additional factors in this section nowadays bear his name, Eugene Fama writes in his academic biography, *My Life in Finance*, that his Fama and French (1992) "contains nothing new", precisely because the main results were already published individually in papers dating back to the early 1980s. Fama thinks that the collection of evidence into one paper (actually, the first of a series) spread the message, before Fama and French (1993) passed the test for replacing a model, the CAPM : introducing a new model with more explanatory power, at least in statistical terms (R^2). Indeed, the economic or behavioral justification attempts, though summarized by Fama in its address, are "unconvincing" in his opinion.

to its balance sheet) because this double sort excludes shares with high book-to-market ratio that score low on quality – in other terms, stocks that only look undervalued but are not.

6.3.3. Momentum

Momentum is, chronologically, the fourth factor that has been found to explain the cross-section of expected returns, identified in Carhart (1997), a paper about persistence in mutual funds' risk-adjusted returns; this paper shows that the one-year momentum effect from Jegadeesh and Titman (1993) makes the manager's skill or superior information irrelevant to explain the fund's performance, except for the worst-performing funds.

A portfolio based on buying the (relative, say top quintile) winners and selling the losers based on their return over the previous month only (Novy-Marx 2012), is a definitely losing strategy. The negative coefficients are significant with very little doubt (t-statistics between -10 and -20. If momentum has been found in the equity world, essentially the same in equal-weighted as well as value-weighted portfolios, this positive correlation is strictly bound between the past twelve to two months before the start of the securities holding period.

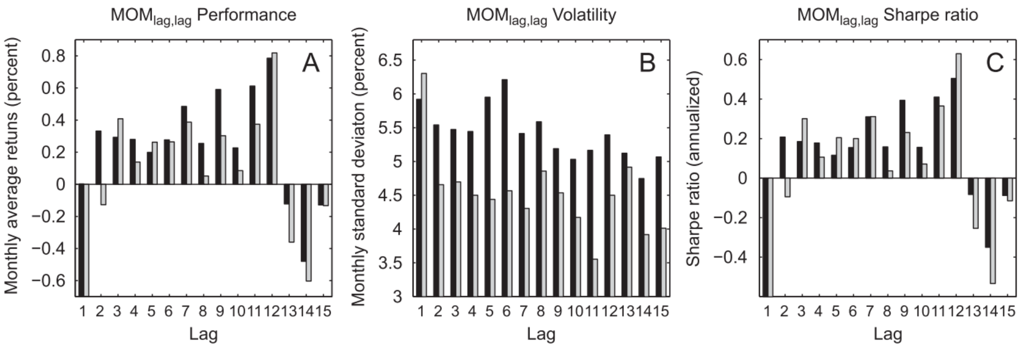
This concept of cross-sectional momentum corresponds to the traditional idea of momentum whereas Novy-Marx (ibid.) finds that positive correlation is essentially coming from the first five months of the previous year, i.e. the return between $t-12$ and $t-7$ (included). The expected return and Sharpe ratio of several trading strategies tested exhibit figures twice larger for 12-to-7 winners-minus-losers (WML) portfolios compared with 6-to-2 WML portfolios. Describing a term structure of momentum put in evidence thanks to CRSP data spanning from 1926 to 2010 Novy-Marx (ibid.) claims that

> Theoretically, the return predictability implied by the data, which looks *more like an echo than momentum*[17], poses a significant difficulty for stories that purport to explain momentum.

Results in Novy-Marx (ibid.) indeed defeat possible and competing explanations of momentum cited in his review of literature. Nevertheless, Goyal and Wahal (2015) have extensively tested and extended this surprising result: no evidence of this echo pattern has been brought outside the U.S. stock market and even in the U.S., the superior returns of 12-to-7-month sorted portfolios over their 6-to-2-month counterparts may be due to the fact that short-term reversal, usually considered over the previous month, sometimes extends further in the past over month $t-2$. I

[17] Emphasis added in the quote.

Figure 1: From Novy-Marx (2012), "Marginal strategy performance". Comparison of returns, standard deviation and Sharpe ratio of long top-decile/short bottom-decile of lagged performance strategies, varying the lag



Description from original paper:

> *Fig. 1. Marginal strategy performance. This figures shows the average monthly returns (Panel A), monthly standard deviations (Panel B) and annual Sharpe ratio (Panel C) to winners-minus-losers strategies. Winners and losers are defined as the top and bottom deciles of performance in a single month, respectively, starting lag months prior to portfolio formation. Dark bars show value-weighted results and light bars show equal-weighted results. Average monthly returns for the one month reversals are −1.04% (value-weighted) and −2.82% (equal-weighted). The sample covers April 1927 to December 2010.*

do not take any side without having tested the data from my own paper and therefore consider both alternatively in tests. The aim in this section is to explain why the momentum effect has to be included as a control in regressions involving returns or the volatility of returns, rather than provide a theoretical rationale for doing so. In general, let us summarize as follows : models "predicting short-term predictability" (i.e., attempting to explain momentum, as the author nuances) are in either of two categories:

Behavioral Momentum arises from the delayed and progressive incorporation of news into prices, meaning that the market underreacts to a news spreading out and catches up during the following months. Thanks to a model of investor sentiment based on the famous representativeness heuristics introducted by Tversky and Kahneman (1974),Barberis, Shleifer, and Vishny (1998) model simultaneously underreaction in the short term (up to 12 months after news) and overreaction in the longer term, between 3 and 5 years if the stream of news is consistently good or bad, highlighting conservatism among agents. K. Daniel, Hirshleifer, and Subrahmanyam (1998) attribute momentum to what they call *biased self-attribution*, which is a form of overconfidence in one's piece of privileged information and a common trait in behavioral finance (De Bondt and Thaler 1994). Themselves citing another article, K. Daniel, Hirshleifer, and Subrahmanyam (1998) summarize the self-attribution bias as follows: "Heads I win, tails it's chance." Confidence gets stronger, the more information confirms their private signal whereas so-called *disconfirming*, i.e. contrary, evidence only reduces confidence to a little extent. Continued confirmation therefore amplifies (in intensity) and extends (over time) the agents' initial overreaction, yielding positive price auto-correlation in the short run, i.e. momentum. Both of these behavioral models assume a single representative trader whose bias causes short-lag autocorrelation in returns; Hong and Stein (1999) choose a fundamentally different approach as they segregate investors into two categories, each being "boundedly rational": *newswatchers* are gathered into subgroups and gradually have access to private information and trade according to this piece of information but they do not condition their decision on past and current prices, only the information[18]. *Momentum traders* are the opposite category, i.e. they trade according to

[18]The authors seem conscious of the debatable realism of their modelling regarding newswatchers, which act without observing past and present prices and thus their own previous trades. It is suggested that they act like frontrunners, taking advantage of information eearly available and conscious that their trades will start a reaction (future asset price increases in case of good news). This attitude has a limited effect in the model, which means that short term underreaction still prevails.

the price trend over a finite horizon but do not have access to any private information; in other terms, they observe, follow and extend an existing trend. Overall, in this model, the momentum effect therefore does not arise from either of the two groups of traders, rather does it appear from their interaction. While K. Daniel, Hirshleifer, and Subrahmanyam (1998) build their behavior model on psychological research results, Barberis, Shleifer, and Vishny (1998) and Hong and Stein (1999) support their models with testable hypotheses and empirical evidence.

Rational Predictions of the momentum that do not rely on investors' behavior are less frequent in literature but two contributions can be shortly summarized. First, the concern of Johnson (2002) is less about providing an equilibrium model with robust empirical evidence than show that momentum can arise even in a rational setting, along with mean-reversion approximately one-year after measurement. The fact growth rate risk rises with growth rate is at the core of the momentum effect and infrequent, persistent, e.g. technological shocks would cause most of this effect. Stocks prices depend on growth rates, because the former are modelled as a claim on a stochastic stream of dividends which grow at a random stationary rate. The growth rate risk is priced in the stock and, to quote this rather quantitative paper :

> [M]omentum effects then follow because positive (negative) cumulative returns typically imply ex post that recent growth rate shocks have been positive (negative).

Another empirical paper with a real options model, Sagi and Seasholes (2007), aims specifically at identiying firm-specific variables that drive momentum and thus allow to build more profitable trading strategies conditioning on those drivers, thus outperforming the baseline Jegadeesh and Titman (1993) winners-minus-losers, 6-month holding portfolio. Positive return autocorrelation due to the company value being convex in an underlying risk factor is specified in this paper, borrowing to Johnson (2002) : the underlying risk factor was the growth rate risk. Empirical findings are the following : momentum varies positively with the volatility of revenue (sales) growth, negatively with costs of goods sold and negatively with the book-to-market ratio. For the latter, it means that a more profitable momentum strategy can be implemented on firms sorted according to their book-to-market ratio; this result does not invalidate the predictive power of the book-to-market ratio over expected returns, i.e. the HML factor from Fama and French (1992).

6.3.4. Gross profitability

According to Novy-Marx (2013), gross profitability, i.e.

$$\mathsf{Gross\_Profitability}_{i,t} = \frac{\mathsf{Revenues}_{i,t} - \mathsf{COGS}_{i,t}{}^{19}}{\mathsf{Total\_Assets}_{i,t}} \tag{7}$$

has a prediction power equal in magnitude and complementary to the book-to-market ratio over the cross-section of expected returns. Novy-Marx (ibid.) has deemed this factor the *other side of value* because it does not subsume it while it is linked to it. Both factors can be exploited together and improve each other's risk-adjusted performance in a portfolio. The value factor measures the market price of a company's assets and finances the purchase of inexpensive assets through the sale of expensive ones while the profitability ratio measures how productive assets within the firm are and finances the purchase of productive ones through the sale of unproductive (or at least, less productive) ones.

The influence of profitability had already been studied before Novy-Marx (ibid.) showed the existence of a predictive power over the cross-section of expected returns and thus the opportunity of a trading strategy : indeed Fama and French (2006) treat the book-to-market, profitability and investment effects combined, although the authors remain agnostic on the mechanism, either rational or behavioral, underpinning their threefold statement. The statement originates from the dividend discount model, which states that the market value of the company is equal to the sum of discounted divided expected to be paid to shareholders in the future:

$$M_t = \sum_{\tau=0}^{\infty} \frac{\mathbb{E}_t(Y_{t+\tau} - dB_{t+\tau})}{(1+r)^{\tau}} \tag{8}$$

where M_t is the market value cum-dividend at time t; Y_t are the earnings; $dB_t = B_t - B_{t-1}$ is the increase of the book value of equity between $t-1$ and t, and r used in the discount factor is the required rate of return. Under the so-called clean surplus accounting, earnings are either retained within the company, thus increasing the book equity, or it is distributed to shareholders; subsequently, the difference within the expected value brackets is equal to dividends. Through this identity, Fama and French (ibid.) imply and later show that, *ceteris paribus*, firms with higher earnings must yield higher expected returns (the r variable) as long as their market valuations are the same, allowing the profitability premium to exist. Regarding the value premium, for fixed earnings and book value series over the whole (here, assumed infinite) time horizon, the lower the market value, the higher the expected return must be, which is gives birth to the value premium.

[19] Cost of goods sold

Overall, two measures of profitability seem to correlate with expected returns : earnings from the income statement were tested and Fama and French (ibid.) did not find an incremental predictive power beyond the size and book-to-market factors. Novy-Marx (2013) rationale for gross profitability can be summarized as follows : some expenses are treated as costs, such as R&D, human capital development, but in fact, they will likely yield the company higher profits in the future. Therefore, one has to look at a figure higher in the income statement in order to approach the pure operating performance of the company and filter out some irrelevant costs. The same happens for the computation of free cash flows : for example, capital expenditures are not the sign that the company is less profitable, rather the opposite can be expected in the future. The author's tests putting various profitability ratios lead to conclude that gross profit over assets (and not the book equity, thus the measure is independent from the debt level) is a less-biased proxy with the most predictive power.

6.4. Dynamic panel specifications

6.4.1. Impact of ETF ownership on stocks' volatility

The theoretical basis of all main and control variables included in the models have been discussed and the inclusion of controls is justified through a summary of the abundant literature of empirical asset pricing in the previous subsection. In this subsection, the first identification strategy attempts to answer the question : does the share of a stock owned by exchange-traded funds altogether has a contemporaneous impact over the stocks' volatility, all other characteristics being equal ? The null hypothesis being conservative ("no effect"), its potential rejection would mean that the liquidity trading hypothesis is actually reflected in the panel data with a controlled error risk level, disclosed as a t-statistic in parentheses in the results exhibits (Section 7).

Due to the structure of dataset, which is an unbalanced panel of U.S., respectively international stocks, some unique characteristics inherent to each stock will be controlled through entity fixed effects. Since the trend over the measurement period has been an exponential increase in the weight of ETFs, both in terms of stock ownership and volume traded, some fixed effects over the time axis seem legitimate. Otherwise, one could imagine that, provided that the average volatility of each stock does not significantly varies, the higher ETF ownership would results in a spuriously negative coefficient (!). Another reason for month fixed effects deals with short term market events, such as several market crashes that occurred during the two decades of the sample.

$$\textsf{Volatility}_{i,t} = \beta_0 + \beta_1 \textsf{ETF\_ownership}_{i,t} + B_C^{\intercal} \textsf{Controls}_{i,t} + \alpha_i + \gamma_t + \epsilon_{i,t} \tag{9}$$

Rather than a panel analysis, it would be more accurate to call this regression a dynamic panel analysis : several lags of volatility will be included among controls in some estimations in order to account for a potential case of autocorrelation in volatility. Further investigation will also control for a potential bias in the effect of the ETF ownership share over stock volatility : what if ETFs were only a symptom of the institutional ownership, which would in that case exhibit comovement with the ETF ownership ? The collection of data allows us to account for certain other broad categories of institutional investors, legally forced to report their holdings: mutual funds, pension funds and hedge funds. Controlling for the aggregate ownership share of each category may help to distinguish between several channels between institutional trading and volatility.

In this model as in every one of the following, the ETF ownership share statistic used is lagged by one period, which means for example that its effect is measured upon the upcoming month volatility. The same is applied for controls in order to avoid any endogeneity.

6.4.2. Impact of ETF ownership on market and stock liquidity

This segment of the analysis focuses on consequence of ETF ownership on proxies for liquidity: Israeli, Lee, and Sridharan (2017) have shown that an increase in ETF ownership is correlated with higher trading costs, measured using the bid-ask spread, and lower liquidity, measured through a price-impact variable is equal to the numerator of Amihud (2002) ratio. If one assumes that securities held by ETFs are not systematically lent[20], it means that uninformed traders do not trade shares individually but only baskets of various companies at a time. Informed traders have less opportunities to trade based on company-specific information if noise traders leave the firm-level market, and the market as a whole becomes less liquid and less efficient.

The following regression is run regarding the effect of ETF ownership on the bid-ask spread:

$$\textsf{PctBidAskSpread}_{i,t} = \beta_0 + \beta_1 \textsf{ETF\_ownership}_{i,t-1} + B_C^{\intercal} \textsf{Controls}_{i,t-1} + \alpha_i + \gamma_t + \epsilon_{i,t} \tag{10}$$

Israeli, Lee, and Sridharan (2017) measure this relationship in first differences using an annual panel. The stationarity concern will be investigated further and inspiration is evidently drawn from their research scheme. They add several controls and industry-level fixed effects.

[20] Security lending is forbidden for certain structures such as unit investment trusts.

The second proxy for liquidity is Amihud (2002) illiquidity ratio, which numerator and denominator may be correlated with ETF ownership : the numerator is the absolute daily return and the denominator, feared to be especially sensitive to ETF ownership's influence, is the daily dollar volume traded. A spurious improvement (lower illiquidity) could be linked with ETF ownership if the latter increases the denominator, possibly offsetting the simultaneous increase in absolute return. The proposed way to mitigate this inherent issue is to split the ratio and consider the denominator as a regressor.

$$\mathsf{Illiq^{Num}}_{i,t} = \beta_0 + \beta_1 \mathsf{ETF\_ownership}_{i,t-1} + \beta_2 \mathsf{Illiq^{Denom}_{i,t}} + B_C^{\mathsf{T}} \mathsf{Controls}_{i,t-1} + \alpha_i + \gamma_t + \epsilon_{i,t} \tag{11}$$

Without this point being mentioned in the paper, one can notice that the illiquidity ratio is departs from the original definition : in Amihud (ibid.), quoted above in subsubsection 6.1.2, the ratio is the daily average (for example over all 252 days of the trading year) of a ratio, the absolute price return divided by daily volume expressed in monetary terms. On the other side, Israeli, Lee, and Sridharan (2017) consider the numerator (the dependent variable) to the average daily price return and the denominator (a control variable) the average daily dollar volume. Both statistics are not identical although they make use of the same set of information. As a detail, the denominator is not lagged, unlike other controls, because we precisely want it to be contemporaneous of the numerator, since they are part of the Amihud ratio.

6.4.3. Concerns about efficiency

If the volatility impounded through increased ETF ownership has no fundamental origin but is liquidity-driven, the price movements should be compensated over a few days. The security prices affected through higher ETF trading volume are noisier in the short term. One of the alternative hypotheses posits that ETF-driven movements are fundamentally driven, as the inclusion in a basket would supposedly help new information materialize in prices, which become less noisy thanks to through the "discovery channel".

As detailed in the dependent variables subsection, both the variance ratio and absolute variance ratio deviation are estimated at the quarterly frequency for each stock and one looks for an influence of ETF ownership. If variables ETF ownership and controls are available at a higher frequency, the latest one available in the quarter is preferred.

$$VR_{iq} = \beta_0 + \beta_1 \mathsf{ETF\_ownership}_{i,q-1} + B_C^{\mathsf{T}} \mathsf{Controls}_{i,q-1} + \alpha_i + \gamma_q + \epsilon_{i,q} \tag{12}$$

$$absVR_{iq} = \beta_0 + \beta_1 \mathsf{ETF\_ownership}_{i,q-1} + B_C^{\intercal} \mathsf{Controls}_{i,q-1} + \alpha_i + \gamma_q + \epsilon_{i,q} \tag{13}$$

7. Panel regression results and discussion

[21] In this whole section, descriptive statistics and results will always be given in the same order : first the U.S. stocks' sample, which is a tentative replication of Ben-David, F. A. Franzoni, and Moussawi (2018) and then the international (non-U.S.) stocks' sample, which is one of the newer contribution of this paper. The model specifications tested are the same across both samples, which makes qualitative comparisons between both distinct populations more intuitive. All regressions are performed using a heteroskedasticity and auto-correlation robust (HAC) covariance estimator following the methodology introduced in Driscoll and Kraay (1998) for panel and spatial regressions based on the widely-used HAC covariance estimator from Newey and West (1987). The mathematical detail of this covariance matrix can be found in B, p.71.

Through comparisons that are not displayed here, it has been steadily noticed that the Newey and West (ibid.) tends to yield more conservative estimates (thus lower t-stats in absolute value) than the heteroskedasticity-robust estimator with clustering both on entities (stocks) and time. Nevertheless, and that is why such comparisons are not disclosed, the degree of significance of coefficient estimates does not change the conclusions drawn from the three models tested. The estimation methodology, whose implementation is automated through a statistical package, is explained in B as well as several statistics displayed in the exhibits.

7.1. Summary statistics

This section aims first at providing an overview about the distribution of all variables in the upcoming regressions. In addition, although a thorough comparison with the emerging literature about ETF ownership effects on securities is beyond the scope of this paper, summary statistics help ensuring that the sample bears some resemblance with those used in other studies. Resemblance is obviously weaker, less precise and rigorous than similarity and one should for instance perform statistical tests such as the F-test or Bartlett's test for equal variances across

[21]The source code of all data queries, treatments and analysis output can be found online at `https://github.com/GregPichard/MasterThesis.git`. The repository is private, at the time of the writing of this thesis, and access can granted for clone or download upon request. Nonetheless, the necessary data cannot be stored there due to the important disk space required.

populations, under normality assumptions, if two samples are available.

Last, summary statistics are also useful in order to filter outliers at both ends of distributions. The general policy for this matter is first to exclude data points that are obviously wrong because they are impossible : a typical situation of a ratio $\frac{\#\text{ETF}-\text{owned\_shares}}{\#\text{Shares\_outstanding}}$ above 100% is excluded but some cases are critical because doubt is allowed : a delay in the reporting of fund holdings can yield ETF ownership ratios close to, and yet below 1. Such case, however unlikely, may as well happen and no assumption has been made regarding a maximum tolerated ETF ownership share because of a lack of relevant information. Then, for the sake of simplicity, variables are truncated rather than winsorised at the 99.99% quantile; the choice of such a high threshold has been guided by the fact that, in some variables including the essential ETF ownership share, variance concentrates in the upper percentiles of the distribution. In other terms, this variable empirical distribution is right-skewed and the intuition is that higher percentiles are not necessarily irrelevant outliers, they may even constitute an important part of our sample. For instance, the international sample exhibits very low share of (U.S.-listed) ETF ownership: the median and the 75th percentiles are 0, the 90th is equal to 0.7%, the 95th to 1.6% and the 99th to 4.3%. The value exceeded by only 0.01% of the sample, and therefore considered the threshold for truncation, is 22.5%. Although not disclosed in summary tables, ownership of other institutional investors are especially has an especially outside the U.S., which in turn raises two issues in regressions : first the usable panel is a small fraction of the overall collected sample and even for the usable intersection, the rank condition on the regressors matrix is sometimes violated unless two of those controls, the pension and hedge funds share of ownership, are excluded from the regression.

The summary statistics in Table 3 and Table 4, for the U.S. and abroad respectively, are computed entire samples, hence before truncation; only unvalaible values, encoded as `NaN` ("not a number") or as infinite, are excluded. The maxima are therefore absent from data used in following regressions, which seems a healthy precaution for ETF ownership as explained above, but also for several controls including notably the book-to-market ratio, the percent bid-ask spread and the previous 12-month return.

Table 3b and Table 4b are essentially used to control for low absolute linear correlation between regressors in order to avoid any risk of collinearity among them; such risk seems absent and no coefficient is above 0.5 in absolute value. Perhaps anecdotally, the "naïve" univariate correlation between ETF ownership and the volatility of daily stock returns is negative (approx. -0.23) in the U.S. and very close to zero outside the U.S. Similarly, the bid-ask spread, a measure of liquidity which is assumed inversely linked with liquidity, exhibits a negative ρ with ETF ownership while we may expect, in our multivariate tests, a positive correlation.

Table 3: U.S. Sample (monthly) : Summary Statistics

(a) Summary statistics

	N (obs.)	Mean	St. dev.	Min.	25%	Median	75%	Max.
Volatility	300181	0.027	0.026	0.000	0.015	0.021	0.032	1.618
ETF Ownership	300181	0.028	0.035	0.000	0.001	0.015	0.042	0.990
Book-to-market	300181	1.001	156.778	-196.776	0.243	0.439	0.740	79321.012
Market cap. ($ Mln.)	300181	716.934	2846.498	0.013	30.072	107.263	374.055	109943.606
1/Price	300181	0.089	0.120	0.000	0.026	0.048	0.098	1.000
Rel. Bid-Ask spread	300181	0.005	0.014	-0.015	0.000	0.001	0.004	1.765
Amihud ratio	300181	0.000	0.000	0.000	0.000	0.000	0.000	0.101
Past 12-to-1-month return	300181	0.154	0.652	-1.000	-0.143	0.075	0.319	43.375
Past 12-to-7-month return	300181	-0.049	3.609	-1868.259	-0.119	0.037	0.161	0.965
Gross profitability	300181	0.332	0.349	-0.850	0.150	0.272	0.438	36.028

(b) Pearson correlation coefficients

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Volatility	(1)	1.000									
ETF Ownership	(2)	-0.229	1.000								
Book-to-market	(3)	-0.000	-0.003	1.000							
Market cap. ($ Mln.)	(4)	-0.001	0.028	-0.001	1.000						
1/Price	(5)	0.010	-0.217	0.004	-0.126	1.000					
Rel. Bid-Ask spread	(6)	0.437	-0.186	0.000	-0.072	0.312	1.000				
Amihud ratio	(7)	0.016	-0.001	-0.000	-0.001	0.005	0.032	1.000			
Past 12-to-1-month return	(8)	-0.044	-0.001	-0.005	0.002	-0.089	-0.065	-0.002	1.000		
Past 12-to-7-month return	(9)	-0.006	0.003	-0.005	0.005	-0.026	-0.013	-0.000	0.010	1.000	
Gross profitability	(10)	0.019	-0.008	0.000	0.001	0.003	0.002	-0.001	0.052	0.002	1.000

Table 4: International Sample : Summary Statistics

(a) Summary statistics

	N (obs.)	Mean	St. dev.	Min.	25%	Median	75%	Max.
Volatility	1324955	0.025	0.017	0.000	0.014	0.021	0.030	1.325
ETF Ownership	1324955	0.004	0.012	0.000	0.000	0.000	0.003	0.977
Book-to-market	1324955	1.004	3.714	0.000	0.364	0.693	1.233	863.531
Market cap. ($ Mln.)	1324955	14499.864	215830.998	0.010	122.319	632.750	3457.647	39864005.168
1/Price	1324955	0.057	0.124	0.000	0.001	0.004	0.056	1.000
Rel. Bid-Ask spread	1324955	0.013	0.036	-2.000	0.002	0.005	0.013	2.000
Amihud ratio	1324955	0.000	0.004	-0.000	0.000	0.000	0.000	2.977
Past 12-to-1-month return	1324955	0.164	1.380	-1.000	-0.156	0.050	0.317	1249.000
Past 12-to-7-month return	1324955	-0.033	6.563	-5282.798	-0.126	0.019	0.152	0.997
Gross profitability	1324955	0.282	0.312	-2.636	0.122	0.215	0.366	76.409

(b) Pearson correlation coefficients

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Volatility	(1)	1.000									
ETF Ownership	(2)	-0.083	1.000								
Book-to-market	(3)	0.020	-0.003	1.000							
Market cap. ($ Mln.)	(4)	-0.013	0.085	-0.000	1.000						
1/Price	(5)	0.093	-0.071	-0.004	-0.032	1.000					
Rel. Bid-Ask spread	(6)	0.256	-0.081	-0.002	-0.018	0.077	1.000				
Amihud ratio	(7)	0.058	-0.001	0.009	-0.000	0.013	0.052	1.000			
Past 12-to-1-month return	(8)	0.008	-0.003	-0.007	0.001	-0.008	0.003	-0.000	1.000		
Past 12-to-7-month return	(9)	-0.001	0.000	-0.002	0.000	0.000	-0.011	-0.000	0.001	1.000	
Gross profitability	(10)	-0.007	-0.013	0.026	-0.004	-0.019	0.012	-0.000	0.003	-0.040	1.000

7.2. ETF ownership and underlying stocks' volatility

7.2.1. U.S. sample

Table 5 contains four different model specifications for which the coefficient on ETF ownership is always significant at a 1% error level. From the first model (column *Baseline*), one can interpret it as follows, on average, a 10 percentage point increase in the ETF interest in a stock is correlated with a 2.6 percentage point increase in this stock's daily returns over the same month. This baseline specification only uses controls relative to size, value and momentum. The column titled *Controls + Volatility lags* tests the robustness using additional liquidity (Amihud (2002) ratio and bid-ask spread) and profitability, as in Ben-David, F. A. Franzoni, and Moussawi (2018) and addresses the issue of serial correlation in the monthly volatility of returns using four lags of the dependent, all of them being positive and strongly significant. Subsequently, the magnitude of ETF ownership effect drops, from about 0.30 to 0.04. The third specification goes further in addressing the possible omitted variable bias due to institutional ownership : in order to distinguish the suspected correlation between ETF and other institutional flows into securities, three different categories of fund ownership are found to have an impact on volatility. Nevertheless, the signs are hard to justify at this stage : mutual funds' impact seems very close to zero, while an obvious contradiction[22] exists between seemingly stabilizing hedge funds andvolatility-impounding pension funds (!) Perhaps reassuringly, the effect of ETFs alone does not change substantially as a consequence, showing that the omitted variable bias did not matter; in other words, the relationship between ETFs' weight in the capital of company and its volatility is independent from other collective investment schemes. The standardization in the fourth and last column to the right means that the dependent and the main regressor of interest are centered, i.e. the sample mean is subtracted from the original variable, and divided by the sample standard deviation. The interpretation follows : a one standard deviation change in ETF ownership is related with a 0.58% to 1.05% (average : 0.81%) of a standard deviation increase in the stock's volatility. In general, clear support can be found in favor of the liquidity trading hypothesis in the sample of stocks traded in the United States.

Regarding controls in the most complete and standardized model, we notice that size surprisingly appears as a negative factor, although economically very small; volatility loads positively on the book-to-market as well as liquidity-related factors (bid-ask spread and Amihud (2002)

[22]...despite checks performed on how the variables have been computed. We have to keep in mind the level of reporting for those categories may be far less precise than for mutual funds in the Thomson Reuters database, both in terms of representativeness and reporting frequency.

ratio). Profitability is negative at 1% level but economically near zero and momentum is negative at 5% and again causes little moves. At 10 percentage point increase in the recent return would apparently reduce volatility by 2 basis points. As for all models in this paper, the coefficient of determination of all estimated models ("standard"R^2) is far lower than values displayed in analogous published studies that have served as guidance. Without any access to their sample and estimation methods further than minimal disclosures, it is not possible to come up with any rationale.

Table 5: U.S. Sample : Exchange-Traded Fund aggregate ownership share and the volatility of underlying securities' daily returns

	Baseline	**Controls + Vol. lags**	**Inst. o'ship controls**	**Standardized**
Dep. Variable	Volatility	Volatility	Volatility	Volatility
Estimator	PanelOLS	PanelOLS	PanelOLS	PanelOLS
No. Observations	413304	297405	297399	297247
Cov. Est.	Driscoll-Kraay	Driscoll-Kraay	Driscoll-Kraay	Driscoll-Kraay
R-squared	0.0545	0.1592	0.1593	0.1594
R-Squared (Within)	0.0565	0.1353	0.1351	0.1348
R-Squared (Between)	0.2009	0.7626	0.7625	0.7616
R-Squared (Overall)	0.1515	0.2716	0.2715	0.2710
F-statistic	4717.9	4643.9	3718.4	3718.6
P-value (F-stat)	0.0000	0.0000	0.0000	0.0000
Intercept	0.2964	0.0488	0.0494	-0.0154
	(22.268)	(7.1942)	(7.2977)	(-0.4273)
PctSharesHeldETF_1lag	0.2470	0.0385	0.0395	0.0081
	(8.2542)	(5.9800)	(6.2940)	(6.8269)
np.log(CompanyMarketCap_1lag)	-0.0127	-0.0018	-0.0018	-0.0102
	(-20.751)	(-5.8479)	(-5.9701)	(-6.1991)
InvClose_1lag	0.0988	0.0251	0.0251	0.1452
	(10.972)	(7.7261)	(7.7792)	(7.9151)
BookToMarketRatio_1lag	5.552e-07	7.393e-07	1.038e-06	5.019e-06
	(2.3023)	(4.1534)	(8.5166)	(5.3019)
RetPast12to1M_1lag	-0.0003	-0.0004	-0.0004	-0.0024
	(-0.6844)	(-1.8758)	(-1.8564)	(-1.8927)
AmihudRatio_1lag		3.4590	3.4611	19.952
		(2.7034)	(2.7029)	(2.7038)
PctBidAskSpread_1lag		0.1750	0.1748	1.0060
		(4.5505)	(4.5446)	(4.5471)
GrossProfitability_1lag		-0.0005	-0.0005	-0.0028
		(-2.6218)	(-2.6334)	(-2.6197)
Volatility_1lag		0.1377	0.1378	0.1376
		(6.7584)	(6.7701)	(6.7630)

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	Baseline	**Controls + Vol. lags**	**Inst. o'ship controls**	**Standardized**
Volatility__2lag		0.1605	0.1604	0.1603
		(16.002)	(15.972)	(15.949)
Volatility__3lag		0.1230	0.1229	0.1229
		(13.390)	(13.402)	(13.403)
Volatility__4lag		0.0819	0.0818	0.0817
		(9.8851)	(9.8688)	(9.8756)
PctSharesHeldOtherMutual__1lag			-0.0003	-0.0016
			(-2.5676)	(-1.1497)
PctSharesHeldPension__1lag			1.0330	0.0015
			(3.4034)	(3.6451)
PctSharesHeldHedge__1lag			-0.0284	9.023e-05
			(-3.2527)	(0.4613)
Effects	Entity	Entity	Entity	Entity
	Time	Time	Time	Time

T-stats reported in parentheses.

7.2.2. International sample

In the non-U.S. sample (Table 6), coefficients generally bear less statistical significance than in a their American counterpart. ETF ownership is only 10%-significant (positive impact) until liquidity controls and volatility lags are introduced, hence one cannot conclude, based on this evidence, that the share of a stock's capital held through ETFs plays any role on this stock's next-month volatility. It is also worth noting that almost all the variance of observed volatility explained in thos models, nearly 16% in the U.S. and 17% outside, is due to four volatility lags, whose coefficients exhibit a strong positive autocorrelation. Significant ($\alpha = 1\%$) controls are the market capitalization (with a negative sign), the book-to-market ratio (value stocks are more volatile) and the relative bid-ask spread, acting as an illiquidity proxy.

For the sake of completeness, more detail is reported in the appendix, subsection C.1, p.75, about the panel estimation results testing the relationship between the share of ETF ownership in securities and the held securities' daily returns volatility.

Table 6: International Sample : Exchange-Traded Fund aggregate ownership share and the volatility of underlying securities' daily returns

	Baseline	**Controls + Vol. lags**	**Inst. o'ship control**	**Standardized**
Dep. Variable	Volatility	Volatility	Volatility	Volatility
Estimator	PanelOLS	PanelOLS	PanelOLS	PanelOLS
No. Observations	1516791	1319966	1319966	1319966
Cov. Est.	Driscoll-Kraay	Driscoll-Kraay	Driscoll-Kraay	Driscoll-Kraay
R-squared	0.0070	0.1729	0.1729	0.1729
R-Squared (Within)	0.0148	0.2100	0.2100	0.2100
R-Squared (Between)	-0.0101	0.7081	0.7079	0.7079
R-Squared (Overall)	-0.0208	0.3261	0.3260	0.3260
F-statistic	2118.7	2.274e+04	2.099e+04	2.099e+04
P-value (F-stat)	0.0000	0.0000	0.0000	0.0000
Intercept	0.0582	0.0283	0.0283	0.6235
	(10.611)	(7.7563)	(7.7708)	(4.4628)
PctSharesHeldETF__1lag	0.0169	0.0072	0.0070	0.0028
	(1.8226)	(1.0225)	(0.9781)	(0.9781)
np.log(CompanyMarketCap__1lag)	-0.0015	-0.0008	-0.0008	-0.0310
	(-6.1428)	(-4.9380)	(-4.9511)	(-4.9511)
InvClose__1lag	0.0045	0.0015	0.0015	0.0585
	(2.5792)	(1.1485)	(1.1484)	(1.1484)
BookToMarketRatio__1lag	3.446e-05	2.54e-05	2.538e-05	0.0010
	(3.6160)	(3.3179)	(3.3206)	(3.3206)
RetPast12to1M__1lag	0.0005	0.0001	0.0001	0.0052
	(1.8965)	(1.5202)	(1.5203)	(1.5203)
AmihudRatio__1lag		0.0250	0.0250	0.9984
		(0.8272)	(0.8272)	(0.8272)
PctBidAskSpread__1lag		0.0262	0.0262	1.0496
		(6.9533)	(6.9532)	(6.9532)
GrossProfitability__1lag		-0.0001	-0.0001	-0.0056
		(-0.6729)	(-0.6731)	(-0.6731)
Volatility__1lag		0.2541	0.2541	0.2541
		(21.616)	(21.615)	(21.615)

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	Baseline	**Controls + Vol. lags**	**Inst. o'ship control**	**Standardized**
Volatility__2lag		0.1226	0.1226	0.1226
		(18.960)	(18.960)	(18.960)
Volatility__3lag		0.0968	0.0968	0.0968
		(11.790)	(11.790)	(11.790)
Volatility__4lag		0.0607	0.0607	0.0607
		(13.274)	(13.271)	(13.271)
PctSharesHeldOtherMutual__1lag			9.061e-05	0.0008
			(0.6096)	(0.6096)
Effects	Entity	Entity	Entity	Entity
	Time	Time	Time	Time

T-stats reported in parentheses.

7.3. ETF ownership and underlying stocks' liquidity

7.3.1. U.S. sample

In Table 7, the analysis of ETF ownership on two liquidity proxies, the relative bid-ask spread and the Amihud (2002) ratio is displayed. For each dependent variable, two variants, respectively with and without institutional ownership controls, yield very mixed results regarding the negative influence of ETF ownership on liquidity : indeed, both the illiquidity ratio equations exhibit positive coefficients with very high t-statistics, and those effects do not originate from a possible correlation between various categories of funds (ETF, other mutual, hedge funds). These results lead us to think that the increased degree of ETF involvement in a company's equity on average causes transactions to become more costly and, importantly for other institutional investors, to impound larger absolute moves on prices. In the Amihud ratio numerator model (first and second columns), the coefficient on ETF ownership means that a one percentage point increase in this variable is associated with a 0.19 percentage point (or 19 basis points) increase in the daily average absolute return, its dollar volume of transactions and other specified controls being kept constant. Contrary to what Israeli, Lee, and Sridharan (2017) exhibits regarding their bid-ask spread proxy, the coefficients on ETF ownership (as well as pension and hedge funds ownership) are not statistically significant from zero, and the negative one on other open-end mutual funds ownership (also noticed in the Amihud ratio model) implies a very weak sensitivity. In those models, including entity and fixed effects strongly impair the R^2: a factor of 3 to 4 lies between the actual model R^2 and the *overall* version (without fixed effects). The pooled OLS model was not considered because it is not clear whether common (global market conditions) or time-invariant (individual/industry-specific) characteristics, do not actually play a role in the spread and the price impact of trades.

Table 7: U.S. Sample : Exchange-Traded Funds' aggregate ownership share and underlying securities' liquidity

	Amihud	**Amihud w/inst. o'ship**	**Bid-Ask**	**Bid-Ask w/inst. o'ship**
Dep. Variable	AmihudNumerator	AmihudNumerator	PctBidAskSpread	PctBidAskSpread
Estimator	PanelOLS	PanelOLS	PanelOLS	PanelOLS
No. Observations	436359	436352	335170	335164
Cov. Est.	Driscoll-Kraay	Driscoll-Kraay	Driscoll-Kraay	Driscoll-Kraay
R-squared	0.0326	0.0326	0.0510	0.0510
R-Squared (Within)	0.0448	0.0448	0.0659	0.0660
R-Squared (Between)	0.1897	0.1898	0.5568	0.5572
R-Squared (Overall)	0.1291	0.1291	0.1879	0.1881
F-statistic	3643.1	2914.2	4445.9	2543.2
P-value (F-stat)	0.0000	0.0000	0.0000	0.0000
Intercept	0.3424	0.3425	0.1055	0.1057
	(30.114)	(30.084)	(15.863)	(15.819)
PctSharesHeldETF__1lag	0.1809	0.1810	0.0074	0.0073
	(7.5170)	(7.5198)	(0.8731)	(0.8642)
np.log(CompanyMarketCap__1lag)	-0.0153	-0.0153	-0.0049	-0.0049
	(-26.856)	(-26.830)	(-14.666)	(-14.622)
BookToMarketRatio__1lag	2.812e-07	2.925e-07	-4.261e-08	-4.149e-08
	(1.1005)	(1.1141)	(-0.9060)	(-0.8901)
AmihudDenominator	1.335e-11	1.335e-11		
	(4.3898)	(4.3890)		
PctSharesHeldOtherMutual__1lag		-1.157e-05		-2.123e-06
		(-5.2639)		(-6.0853)
Volatility__1lag			0.0498	0.0498
			(10.156)	(10.161)
PctSharesHeldPension__1lag				0.2846
				(1.1997)
PctSharesHeldHedge__1lag				0.0053
				(1.1511)
Effects	Entity	Entity	Entity	Entity
	Time	Time	Time	Time

T-stats reported in parentheses.

7.3.2. International sample

From results summarized in Table 8, it is difficult to draw general conclusions regarding the impact of ETF interest in liquidity: here, and it is contrary to U.S. evidence above, no price impact, controlled with traded volume, can be found but a trading cost impact is reported with a high degree of likelihood ($t - stat = 4.95$). The Amihud (2002) denominator, to be found in the first two columns, had to be transformed into its logarithm in order to perform the regression, for a yet unknown reason. No role seems to be played by other available forms of fund investments, which have been reported in the literature to trade less frequently on average. Only the size factor (market capitalization) is always negative, reducing the price impact of trades (Amihud) and also convincing more dealers to compete for orders, thus lowering their margins (bid-ask spread).

Even though no universally significant effect has been found so far in this subsection, more detail is reported in the appendix, subsection C.2, p.85, about the panel estimation results testing the relationship between the share of ETF ownership in securities and the statistics linked with stock-level liquidity (bid-ask spread, Amihud (ibid.) ratio decomposition).

Table 8: International Sample : Exchange-Traded Funds' aggregate ownership share and underlying securities' liquidity

	Amihud	**Amihud w/inst. o'ship**	**Bid-Ask**	**Bid-Ask w/inst. o'ship**
Dep. Variable	AmihudNumerator	AmihudNumerator	PctBidAskSpread	PctBidAskSpread
Estimator	PanelOLS	PanelOLS	PanelOLS	PanelOLS
No. Observations	1465561	1465555	1124265	1124260
Cov. Est.	Driscoll-Kraay	Driscoll-Kraay	Driscoll-Kraay	Driscoll-Kraay
R-squared	0.0285	0.0285	0.0227	0.0227
R-Squared (Within)	0.0287	0.0287	0.0375	0.0375
R-Squared (Between)	-0.3627	-0.3626	0.1785	0.1785
R-Squared (Overall)	-0.0089	-0.0089	0.0956	0.0956
F-statistic	1.064e+04	8514.8	6433.1	4289.0
P-value (F-stat)	0.0000	0.0000	0.0000	0.0000
Intercept	0.0776	0.0776	0.1446	0.1446
	(12.831)	(12.829)	(25.012)	(25.021)
PctSharesHeldETF__1lag	0.0038	0.0038	0.0613	0.0610
	(0.5715)	(0.5817)	(4.9367)	(4.9518)
np.log(CompanyMarketCap__1lag)	-0.0058	-0.0058	-0.0061	-0.0061
	(-21.501)	(-21.502)	(-23.176)	(-23.183)
BookToMarketRatio__1lag	0.0012	0.0012	1.107e-05	1.108e-05
	(1.0328)	(1.0328)	(0.6876)	(0.6887)
np.log(AmihudDenominator)	0.0042	0.0042		
	(16.998)	(16.998)		
PctSharesHeldOtherMutual__1lag		-1.341e-05		-1.92e-06
		(-0.9416)		(-0.2806)
Volatility__1lag			0.1772	0.1772
			(13.426)	(13.426)
PctSharesHeldPension__1lag				0.0314
				(1.1500)
Effects	Entity	Entity	Entity	Entity
	Time	Time	Time	Time

T-stats reported in parentheses.

7.4. ETF ownership and concerns about pricing efficiency

7.4.1. U.S. sample

Table 9 gathers panel OLS regressions at quarterly frequency for the U.S. stocks sample. The row of ETF ownership's coefficients (and associated t-stats below) attempting to explain either the variance ratio or the absolute deviation to 1 of the variance ratio is not statistically significant, although the displayed signs (mean reversion and thus deviation from random walk) seem to go in the expected direction. This comes generally in contradiction with Ben-David, F. A. Franzoni, and Moussawi (2018)'s findings and running the same (untabulated) analysis on subsamples sorted on market capitalization quartiles does not yield a different result. As for the estimation of ETF ownership and volatility, the estimation strategy in the original paper relies on an instrumental variable, a binary depending on the switch of the security from an index to another (the Russell 1000 and 2000 indices) in order to avoid endogeneity between volatility and ETF ownership. Unlike the aforementioned analysis, we cannot say in the light of results for the U.S. stocks sample that ownership through exchange-traded funds yields more mean reversion over non-overlapping 5-day windows. The share of the variance ratios' heterogeneity explained within entities is extremely low.

Table 9: U.S. Sample : Exchange-Traded Funds' aggregate ownership share and weekly mean reversion of underlying securities

	Abs. VR	**Abs. VR w/inst. o'ship**	**VR**	**VR w/inst. o'ship**
Dep. Variable	absVR	absVR	VR	VR
Estimator	PanelOLS	PanelOLS	PanelOLS	PanelOLS
No. Observations	126851	126847	126851	126847
Cov. Est.	Driscoll-Kraay	Driscoll-Kraay	Driscoll-Kraay	Driscoll-Kraay
R-squared	0.0079	0.0081	0.0040	0.0041
R-Squared (Within)	0.0106	0.0106	0.0040	0.0042
R-Squared (Between)	0.2814	0.2820	0.1376	0.1385
R-Squared (Overall)	0.0318	0.0320	0.0163	0.0165
F-statistic	123.79	91.734	61.843	46.323
P-value (F-stat)	0.0000	0.0000	0.0000	0.0000
Intercept	0.8523	0.8532	0.8735	0.8579
	(12.280)	(12.208)	(7.6512)	(7.4328)
PctSharesHeldETF__1lag	0.0096	0.0218	-0.1205	-0.1005
	(0.1484)	(0.3373)	(-1.4081)	(-1.1660)
np.log(CompanyMarketCap__1lag)	-0.0248	-0.0248	0.0044	0.0052
	(-7.5202)	(-7.4640)	(0.8038)	(0.9458)
InvClose__1lag	0.1276	0.1277	-0.2002	-0.1986
	(5.5223)	(5.5778)	(-6.0619)	(-5.9225)
AmihudRatio__1lag	9.9267	9.9488	-15.135	-15.117
	(3.1431)	(3.1455)	(-3.0288)	(-3.0279)
PctBidAskSpread__1lag	0.9314	0.9286	-1.2190	-1.2179
	(5.5878)	(5.6027)	(-3.5732)	(-3.5633)
BookToMarketRatio__1lag	-3.498e-06	4.433e-05	-1.257e-05	6.777e-05
	(-0.5195)	(3.9695)	(-1.4303)	(3.2826)
RetPast12to7M__1lag	0.0003	-9.153e-05	-0.0006	-0.0013
	(0.5981)	(-0.2511)	(-0.9013)	(-2.2311)
GrossProfitability__1lag	0.0011	0.0012	0.0064	0.0062
	(0.2252)	(0.2454)	(1.2767)	(1.2635)
PctSharesHeldOtherMutual__1lag		-0.0053		-0.0086
		(-3.9260)		(-3.6908)
PctSharesHeldPension__1lag		11.292		-3.7029
		(4.1468)		(-0.5362)
PctSharesHeldHedge__1lag		-0.1294		-0.1145
		(-0.8927)		(-0.6268)
Effects	Entity Time	Entity Time	Entity Time	Entity Time

T-stats reported in parentheses.

7.4.2. International sample

If no evidence of an effect of ETF ownership over the monthly volatility of daily could be shown, Table 10 brings solid arguments (at $\alpha = 1\%$) for ETFs still playing a role in the short run, more precisely increasing weekly mean reversion. Again, similar to the U.S. results summary, the coefficient of determination is nearly 0 according to the within specification and relatively higher across entities: up to 10% for absolute variance ratio deviation. The closest analysis found, Ben-David, F. A. Franzoni, and Moussawi (2018), is an instrumental-variable two-stage estimation for U.S. stocks and no information is available regarding the coefficient of determination.

Despite the, at best fragile and heterogenuous, evidence exhibited in this subsection, more detail is reported in the appendix, subsection C.3, p.95, about the panel estimation results testing the relationship between the share of ETF ownership in securities and the statistics of mean reversion.

Table 10: International Sample : Exchange-Traded Funds' aggregate ownership share and weekly mean reversion of underlying securities

	Abs. VR	**Abs. VR w/inst. o'ship**	**VR**	**VR w/inst. o'ship**
Dep. Variable	absVR	absVR	VR	VR
Estimator	PanelOLS	PanelOLS	PanelOLS	PanelOLS
No. Observations	592054	592054	591848	591848
Cov. Est.	Driscoll-Kraay	Driscoll-Kraay	Driscoll-Kraay	Driscoll-Kraay
R-squared	0.0049	0.0049	0.0014	0.0014
R-Squared (Within)	0.0055	0.0055	0.0017	0.0017
R-Squared (Between)	0.0991	0.0992	0.0757	0.0758
R-Squared (Overall)	0.0099	0.0099	0.0104	0.0104
F-statistic	354.08	314.75	98.569	87.752
P-value (F-stat)	0.0000	0.0000	0.0000	0.0000
Intercept	0.9251	0.9250	0.5297	0.5304
	(22.527)	(22.576)	(6.1864)	(6.1821)
PctSharesHeldETF__1lag	0.2529	0.2539	-0.6122	-0.6199
	(2.7216)	(2.6854)	(-3.6541)	(-3.6808)
np.log(CompanyMarketCap__1lag)	-0.0248	-0.0248	0.0106	0.0106
	(-13.525)	(-13.558)	(2.7762)	(2.7598)
InvClose__1lag	0.0015	0.0015	-0.0146	-0.0146
	(0.1169)	(0.1168)	(-0.6261)	(-0.6257)
AmihudRatio__1lag	0.2138	0.2138	-0.2476	-0.2475
	(3.3927)	(3.3923)	(-4.5128)	(-4.5122)
PctBidAskSpread__1lag	0.2117	0.2117	-0.2938	-0.2937
	(5.8326)	(5.8319)	(-5.4872)	(-5.4834)
BookToMarketRatio__1lag	0.0001	0.0001	-0.0001	-0.0001
	(1.6458)	(1.6464)	(-0.5935)	(-0.5995)
RetPast12to7M__1lag	-6.928e-05	-6.928e-05	-7.459e-05	-7.461e-05
	(-2.6264)	(-2.6265)	(-1.7080)	(-1.7081)
GrossProfitability__1lag	-0.0041	-0.0041	0.0036	0.0036
	(-3.2319)	(-3.2325)	(1.5214)	(1.5183)
PctSharesHeldOtherMutual__1lag		-0.0004		0.0026
		(-0.2369)		(0.7347)
Effects	Entity Time	Entity Time	Entity Time	Entity Time

T-stats reported in parentheses.

8. Conclusion and further research questions

8.1. Summary of objectives and results

The goal of this paper was to exhibit and explain the unintended effects of exchange-traded funds investing in stocks worldwide. Amounting to more close to 15% of the U.S. overall market capitalization and one third of the volume exchanged, these structures are suspected to make the markets more volatile due to the arbitrage mechanism allowing them to be continuously priced close to their NAV. Especially, the volatility exhibited concerns temporary shocks driven by non-fundamental demand, before prices revert towards their initial value. Effects on liquidity have also been studied and opposite conclusions drawn regarding the actual effect.

The reconstitution of ETF holdings is the key component in this study since data are available at the granular fund-stock-month level over the period 1999-2018. Based on the extensive dataset of mutual fund holdings, which include ETFs as well as other distinct types of collective investment schemes, the aggregate evolution of ETF holdings for each referred company has been structured as a panel in which the *individuals* populating the panel are the listed companies, in the U.S. and outside. The same procedure has been applied, as far as the category of fund was available, for the aforementioned funds. The quality of data is severely impaired by infrequent reporting of various categories of funds and whenever no update from the previous month is found, the fund holdings are assumed to be stale.

The replication part consists in dynamic panel OLS regressions of the volatility, liquidity and efficiency variables over the ETF aggregate holdings, relevant controls that are academically founded and whose construction is possible given the database. Those controls are, non exhaustively, related with the Fama-French-Carhart model, gross profitability and liquidity/cost of trading indicators that bear a relevance as volatility and liquidity determinants. The novel part, with regard to the known bibliography and besides treating several close research questions with the same dataset, is the expansion to the largest possible representative set of stocks and other approaching entities (e.g. American Depository Receipts) globally, over nearly two decades.

Despite a thorough concern in applying similar methodologies, the recent statements from the literature do not find a full confirmation throughout this paper. The volatility effect of (higher) ETF ownership in the U.S. is a statistically significant higher standard deviation of daily returns in the following month, *ceteris paribus* but the extent of this difference is questionable : 0.8% of a standard deviation (st. dev. over the sample : 2.6%) for a standard deviation of ETF ownership (3.5%). In comparison and using their best fits, Ben-David, F. A. Franzoni, and Moussawi (2018) find coefficients of 7.7% for S&P 500 stocks and 5.3% for Russell 3000 stocks between 2000 and 2015. The order of magnitude of this effect is between 5 and 10 lower in our analysis, based on the actual (and different) values of standard deviations employed. The standard deviation of ETF ownership is on average around 2% in their sample whereas ours is closer to 3.5%. In the international stocks' sample, the same effect is statistically equal to 0 ($t - stat = 0.98$).

Estimations of the liquidity effects of ETF ownership again are not uniform in terms of significance : only the average absolute return, i.e. the numerator in the Amihud (2002) ratio, increases when ETFs increase their share into U.S. stocks, whereas the bid-ask spread is statistically unchanged. The opposite stands for the foreign sample : only the bid-ask spread is affected to an economically narrow extent : for a 1 percentage point increase in ETF ownership, the spread is expected to rise by 6 basis points. As a comparison, Israeli, Lee, and Sridharan (2017) link a similar increase by 1.7 bp in the next year's average bid-ask spread, using an alternative proxy for the trading cost.

Finally, the concern that ETF reduce the efficiency of their underlying stocks' prices has been studied and has been confirmed only outside the U.S.: indeed, the 5-day-to-1-day variance ratio is negatively correlated with ETF ownership. In other words, provided that the weekly volatility (from Monday to Monday) remains constant, on average the volatility of daily prices increases.

8.2. Limitations and perspectives

Several methodological aspects need to be mentioned since, only addressed as much as possible over the course of this thesis, they may limit the validity or the generality of results. More robustness checks would in all cases be necessary, in order to assess whether the significant results with regard to volatility do not concentrate in either subperiod and/or subgroup of stocks (whether grouped by country/region or industry). Some doubt is casted with regard to the availability of individual fund-stock-month holdings which serve as the basis to construct aggregate ETF holdings, as well as other aggregate fund categories' holdings. Accessing another source of data specialized into mutual fund (in the broad sense) common stock holdings, namely the S12 database maintained by Thomson Reuters and a subscription service on WRDS, would perhaps have yielded more accurate results, although it is unlikely that such a service is able to warrant any reporting delay.

Additionally, the causal relationship of ETF ownership on volatility through essentially passive investments tracking famous market-capitalization indices is not proven through the specifications tested. The direct estimation of the effect of ETF ownership on volatility may bear a subtle and essential caveat: there may exist an unknown cause, an omitted factor that would be correlated both with ETF ownership and volatility. A robust identification would alleviate this possible endogeneity bias by using an instrumental variable based on a restriction. For the instrument to be valid, it has to affect the volatility only through its correlation with ETF ownership. Since a significant share of ETFs track well-known indices, the literature (e.g. Ben-David, F. A. Franzoni, and Moussawi (2018)) uses the inclusion/exclusion event of a given stock into the index to explain the variation of ETF ownership. The second step consists in an panel regression similar to the previous ones in which the observed ETF ownership is replaced with the fitted value from the first stage regression.

Reassuringly, a significant contribution studying the same question (ibid.) has demonstrated the similar conclusions of instrumental variable and OLS models up to their magnitude, for more than 3500 U.S. stocks. Such a correction, already implemented in the literature, is a privileged avenue for further research especially in the international sample, provided that a source of those index holdings (e.g. MSCI World Index, Russell 3000 for the U.S.) is openly available, which was not the case at the time of this study.

Overall, despite its mentioned limitations, the intent of this paper was to bring a novel contribution on the increasingly studied and debated subjects of Exchange-Traded Fund's global influence over major equity markets. The novel aspects are especially, first, the construction of panel of more than four thousand U.S. stocks and more than sixteen thousand stocks on twenty-four other national stock markets over twenty years, and second the analysis of several important dimensions of risk – volatility, liquidity and pricing efficiency – upon which alarming claims have been made in the media and for which investors should be eager to find solid empirical evidence.

References

Abdi, Farshid and Angelo Ranaldo (2017). "A Simple Estimation of Bid-Ask Spreads from Daily Close, High, and Low Prices". In: *The Review of Financial Studies* 30.12, pp. 4437–4480. ISSN: 0893-9454. DOI: 10.1093/rfs/hhx084. URL: https://academic.oup.com/rfs/article/30/12/4437/4047344.

Acharya, Viral V. and Lasse Heje Pedersen (2005). "Asset pricing with liquidity risk". In: *Journal of Financial Economics* 77.2, pp. 375–410. ISSN: 0304405X. DOI: 10.1016/j.jfineco.2004.06.007. URL: https://www.sciencedirect.com/science/article/pii/S0304405X05000334%20https://linkinghub.elsevier.com/retrieve/pii/S0304405X05000334.

Agarwal, Vikas et al. (2018). "Do ETFs Increase the Commonality in Liquidity of Underlying Stocks?" In: *SSRN Electronic Journal*. ISSN: 1556-5068. DOI: 10.2139/ssrn.3070550. URL: https://www.ssrn.com/abstract=3070550.

Amihud, Yakov (2002). "Illiquidity and stock returns: Cross-section and time-series effects". In: *Journal of Financial Markets* 5.1, pp. 31–56. ISSN: 13864181. DOI: 10.1016/S1386-4181(01)00024-6. URL: http://linkinghub.elsevier.com/retrieve/pii/S1386418101000246.

Amihud, Yakov and Haim Mendelson (1986). "Asset pricing and the bid-ask spread". In: *Journal of Financial Economics* 17.2, pp. 223–249. ISSN: 0304405X. DOI: 10.1016/0304-405X(86)90065-6. URL: https://doi.org/10.1016/0304-405X(86)90065-6%20https://linkinghub.elsevier.com/retrieve/pii/0304405X86900656.

Andrei, Daniel and Michael Hasler (2015). "Investor attention and stock market volatility". In: *Review of Financial Studies* 28.1, pp. 33–72. ISSN: 14657368. DOI: 10.1093/rfs/hhu059. URL: https://academic.oup.com/rfs/article-lookup/doi/10.1093/rfs/hhu059.

Asness, Clifford S., Andrea Frazzini, and Lasse Heje Pedersen (2019). "Quality minus junk". In: *Review of Accounting Studies* 24.1, pp. 34–112. ISSN: 1380-6653. DOI: 10.1007/s11142-018-9470-2. URL: http://link.springer.com/10.1007/s11142-018-9470-2.

Asness, Clifford et al. (2018). "Size matters, if you control your junk". In: *Journal of Financial Economics* 129.3, pp. 479–509. ISSN: 0304405X. DOI: 10.1016/j.jfineco.2018.05.006. URL: https://linkinghub.elsevier.com/retrieve/pii/S0304405X18301326.

Banz, Rolf W. (1981). "The relationship between return and market value of common stocks". In: *Journal of Financial Economics* 9.1, pp. 3–18. ISSN: 0304405X. DOI: 10.1016/0304-405X(81)90018-0. URL: https://www.sciencedirect.com/science/article/pii/0304405X81900180%20https://linkinghub.elsevier.com/retrieve/pii/0304405X81900180.

Barberis, Nicholas, Andrei Shleifer, and Robert Vishny (1998). “A model of investor sentiment”. In: *Journal of Financial Economics* 49.3, pp. 307–343. ISSN: 0304-405X. DOI: 10.1016/S0304-405X(98)00027-0. URL: https://www.sciencedirect.com/science/article/pii/S0304405X98000270.

Ben-David, Itzhak, Francesco A. Franzoni, and Rabih Moussawi (2018). “Do ETFs Increase Volatility?” In: *The Journal of Finance* 73.6, pp. 2471–2535. ISSN: 00221082. DOI: r. URL: http://doi.wiley.com/10.1111/jofi.12727.

Ben-David, Itzhak, Francesco Franzoni, and Rabih Moussawi (2017). “Exchange-Traded Funds”. In: *Annual Review of Financial Economics* 9.1, pp. 169–189. ISSN: 1941-1367. DOI: 10.1146/annurev-financial-110716-032538. URL: https://doi.org/10.1146/annurev-financial-%20http://www.annualreviews.org/doi/10.1146/annurev-financial-110716-032538.

Berk, Jonathan B. (1995). “A Critique of Size-Related Anomalies”. In: *Review of Financial Studies* 8.2, pp. 275–286. ISSN: 0893-9454. DOI: 10.1093/rfs/8.2.275. URL: https://academic.oup.com/rfs/article-lookup/doi/10.1093/rfs/8.2.275.

Bessembinder, Hendrik and Paul J. Seguin (1992). “Futures-Trading Activity and Stock Price Volatility”. In: *The Journal of Finance* 47.5, p. 2015. ISSN: 00221082. DOI: 10.2307/2329008. URL: https://www.jstor.org/stable/2329008?origin=crossref.

Bhattacharya, Ayan and Maureen O’Hara (2017). “Can ETFs Increase Market Fragility? Effect of Information Linkages in ETF Markets”. In: *SSRN Electronic Journal* April, pp. 1–55. ISSN: 1556-5068. DOI: 10.2139/ssrn.2740699. URL: https://www.ssrn.com/abstract=2740699.

Bogle, John (2012). “The Economic Role Of The Investment Company. Excerpts from the author’s 1951 college thesis”. In: *Journal of Indexes* April, pp. 10–19.

Browne, Reginald M. (2017). “ Exchange-Traded Funds (ETFs) ”. In: *The Capital Markets*. DOI: 10.1002/9781119220589.ch27.

Carhart, Mark M. (1997). “On Persistence in Mutual Fund Performance”. In: *The Journal of Finance* 52.1, p. 57. ISSN: 00221082. DOI: 10.2307/2329556. URL: http://www.jstor.org/stable/2329556?origin=crossref.

Charupat, Narat and Peter Miu (2013). “Recent developments in exchange-traded fund literature”. In: *Managerial Finance* 39.5. Ed. by Peter Miu, pp. 427–443. ISSN: 0307-4358. DOI: 10.1108/03074351311313816. URL: https://www.emeraldinsight.com/doi/10.1108/03074351311313816.

Chinco, Alexander and Vyacheslav Fos (2016). “The Sound of Many Funds Rebalancing”. In: *SSRN Electronic Journal*, pp. 1–56. ISSN: 1556-5068. DOI: 10.2139/ssrn.2764941. URL: https://www.ssrn.com/abstract=2764941.

Corwin, Shane A. and Paul Schultz (2012). “A Simple Way to Estimate Bid-Ask Spreads from Daily High and Low Prices”. In: *The Journal of Finance* 67.2, pp. 719–760. ISSN: 00221082. DOI: 10.1111/j.1540-6261.2012.01729.x. URL: https://www.jstor.org/stable/41419709%20https://doi.org/10.1111/j.1540-6261.2012.01729.x%20http://doi.wiley.com/10.1111/j.1540-6261.2012.01729.x.

Da, Zhi and Sophie Shive (2018). “Exchange traded funds and asset return correlations”. In: *European Financial Management* 24.1, pp. 136–168. ISSN: 1468036X. DOI: 10.1111/eufm.12137.

Daniel, Kent D., David Hirshleifer, and Avanidhar Subrahmanyam (2001). “Overconfidence, arbitrage, and equilibrium asset pricing”. In: *Journal of Finance* 56.3, pp. 921–965. ISSN: 00221082. DOI: 10.1111/0022-1082.00350. URL: http://doi.wiley.com/10.1111/0022-1082.00350.

Daniel, Kent, David Hirshleifer, and Avanidhar Subrahmanyam (1998). “Investor Psychology and Security Market Under- and Overreactions”. In: *The Journal of Finance* 53.6, pp. 1839–1885. ISSN: 00221082. DOI: 10.1111/0022-1082.00077. URL: http://doi.wiley.com/10.1111/0022-1082.00077.

Danthine, Jean-Pierre (1978). “Information, futures prices, and stabilizing speculation”. In: *Journal of Economic Theory* 17.1, pp. 79–98. ISSN: 00220531. DOI: 10.1016/0022-0531(78)90124-2. URL: https://linkinghub.elsevier.com/retrieve/pii/0022053178901242.

De Bondt, Werner F. and Richard Thaler (1994). “Financial Decision-Making in Markets and Firms: A Behavioral Perspective”. Cambridge, MA. URL: http://www.nber.org/papers/w4777.pdf.

Driscoll, John C. and Aart C. Kraay (1998). “Consistent Covariance Matrix Estimation with Spatially Dependent Panel Data”. In: *Review of Economics and Statistics* 80.4, pp. 549–560. ISSN: 0034-6535. DOI: 10.1162/003465398557825. URL: http://www.mitpressjournals.org/doi/10.1162/003465398557825.

Easley, David et al. (2018). “The Active World of Passive Investing”. In: *SSRN Electronic Journal*, p. 35. ISSN: 1556-5068. DOI: 10.2139/ssrn.3220842. URL: https://ssrn.com/abstract=3220842%20https://www.ssrn.com/abstract=3220842.

Economic Sciences Prize Committee of the Royal Swedish Academy of Sciences (2012). *Scientific Background on the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel*

2013. Understanding Asset Prices. Tech. rep. Stockholm: The Royal Swedish Academy of Sciences. URL: https://www.nobelprize.org/prizes/economic-sciences/2013/advanced-information/.

Evans, Richard B. et al. (2017). "ETF Short Interest and Failures-to-Deliver: Naked Short-Selling or Operational Shorting?" In: *SSRN Electronic Journal.* ISSN: 1556-5068. DOI: 10.2139/ssrn.2961954. URL: https://www.ssrn.com/abstract=2961954.

Fama, Eugene F. and Kenneth R. French (1992). "The Cross-Section of Expected Stock Returns". In: *The Journal of Finance* 47.2, pp. 427–465. ISSN: 00221082. DOI: 10.1111/j.1540-6261.1992.tb04398.x. URL: http://doi.wiley.com/10.1111/j.1540-6261.1992.tb04398.x.

– (1993). "Common risk factors in the returns on stocks and bonds". In: *Journal of Financial Economics* 33.1, pp. 3–56. ISSN: 0304405X. DOI: 10.1016/0304-405X(93)90023-5.

– (2006). "Profitability, investment and average returns". In: *Journal of Financial Economics* 82.3, pp. 491–518. ISSN: 0304405X. DOI: 10.1016/j.jfineco.2005.09.009. URL: https://linkinghub.elsevier.com/retrieve/pii/S0304405X06001164.

Frazzini, Andrea, David Kabiller, and Lasse Heje Pedersen (2018). "Buffett's Alpha". In: *Financial Analysts Journal* 74.4, pp. 35–55. ISSN: 0015-198X. DOI: 10.2469/faj.v74.n4.3. URL: https://www.tandfonline.com/doi/full/10.2469/faj.v74.n4.3.

Galloway, Tina M. and James M. Miller (1997). "Index Futures Trading and Stock Return Volatility: Evidence from the Introduction of Mid Cap 400 Index Futures". In: *The Financial Review* 32.4, pp. 845–866. ISSN: 0732-8516. DOI: 10.1111/j.1540-6288.1997.tb00913.x. URL: http://doi.wiley.com/10.1111/j.1540-6288.1997.tb00913.x.

Gârleanu, Nicolae, Stavros Panageas, and Jianfeng Yu (2012). "Technological Growth and Asset Pricing". In: *Journal of Finance* 67.4, pp. 1265–1292. ISSN: 00221082. DOI: 10.1111/j.1540-6261.2012.01747.x. URL: http://doi.wiley.com/10.1111/j.1540-6261.2012.01747.x.

Glosten, Lawrence R. and Paul R. Milgrom (1985). "Bid, ask and transaction prices in a specialist market with heterogeneously informed traders". In: *Journal of Financial Economics* 14.1, pp. 71–100. ISSN: 0304405X. DOI: 10.1016/0304-405X(85)90044-3. URL: https://linkinghub.elsevier.com/retrieve/pii/0304405X85900443.

Goyal, Amit and Sunil Wahal (2015). "Is Momentum an Echo?" In: *Journal of Financial and Quantitative Analysis* 50.6, pp. 1237–1267. ISSN: 0022-1090. DOI: 10.1017/S0022109015000575. URL: http://www.journals.cambridge.org/abstract%7B%5C_%7DS0022109015000575%20https://www.cambridge.org/core/product/identifier/S0022109015000575/type/journal%7B%5C_%7Darticle.

Goyenko, Ruslan Y., Craig W. Holden, and Charles A. Trzcinka (2009). “Do liquidity measures measure liquidity?” In: *Journal of Financial Economics* 92.2, pp. 153–181. ISSN: 0304405X. DOI: 10.1016/j.jfineco.2008.06.002. URL: https://linkinghub.elsevier.com/retrieve/pii/S0304405X09000099.

Graham, Benjamin and David Dodd (1934). *Security analysis*. 1st ed. New York: McGraw-Hill. ISBN: 0070244960. DOI: 10.1036/0071592539. URL: http://cds.cern.ch/record/105688.

Grossman, Sanford J. (1988). “An Analysis of the Implications for Stock and Futures Price Volatility of Program Trading and Dynamic Hedging Strategies”. In: *The Journal of Business* 61.3, pp. 275–298. URL: http://www.jstor.org/stable/2353040.

Grossman, Sanford J. and Joseph E. Stiglitz (1980). “On the Impossibility of Informationally Efficient Markets”. In: *American Economic Review* 70.3, pp. 393–408. URL: http://www.jstor.org/stable/1805228.

Hong, Harrison and Jeremy C. Stein (1999). “A Unified Theory of Underreaction, Momentum Trading, and Overreaction in Asset Markets”. In: *The Journal of Finance* 54.6, pp. 2143–2184. ISSN: 00221082. DOI: 10.1111/0022-1082.00184. URL: http://doi.wiley.com/10.1111/0022-1082.00184.

Israeli, Doron, Charles M.C. Lee, and Suhas A. Sridharan (2017). “Is there a dark side to exchange traded funds? An information perspective”. In: *Review of Accounting Studies* 22.3, pp. 1048–1083. ISSN: 13806653. DOI: 10.1007/s11142-017-9400-8.

Jegadeesh, Narasimhan and Sheridan Titman (1993). “Returns to buying winners and selling losers:implications for stock market efficiency”. In: *The Journal of finance* 48.1, pp. 65–91.

Johnson, Timothy C. (2002). “Rational Momentum Effects”. In: *The Journal of Finance* 57.2, pp. 585–608. ISSN: 00221082. DOI: 10.1111/1540-6261.00435. URL: http://doi.wiley.com/10.1111/1540-6261.00435.

Jordan, J.S (1982). “A dynamic model of expectations equilibrium”. In: *Journal of Economic Theory* 28.2, pp. 235–254. ISSN: 00220531. DOI: 10.1016/0022-0531(82)90060-6. URL: https://linkinghub.elsevier.com/retrieve/pii/0022053182900606.

Koch, Andrew, Stefan Ruenzi, and Laura Starks (2016). “Commonality in liquidity: A demand-side explanation”. In: *Review of Financial Studies* 29.8, pp. 1943–1974. ISSN: 14657368. DOI: 10.1093/rfs/hhw026.

Koehler, Derek J. and Nigel Harvey (2004). *Blackwell Handbook of Judgment and Decision Making*. Ed. by Derek J. Koehler and Nigel Harvey. Malden, MA, USA: Blackwell Publishing

Ltd. Chap. 26, pp. 1–664. ISBN: 9780470752937. DOI: 10.1002/9780470752937. URL: http://www.blackwellpublishing.com%20http://doi.wiley.com/10.1002/9780470752937.

Krause, Timothy, Sina Ehsani, and Donald Lien (2014). “Exchange-traded funds, liquidity and volatility”. In: *Applied Financial Economics* 24.24, pp. 1617–1630. ISSN: 0960-3107. DOI: 10.1080/09603107.2014.941530. URL: http://www.tandfonline.com/doi/abs/10.1080/09603107.2014.941530.

Kyle, Albert S. (1985). “Continuous Auctions and Insider Trading”. In: *Econometrica* 53.6, p. 1315. ISSN: 00129682. DOI: 10.2307/1913210. URL: https://www.jstor.org/stable/1913210%20https://www.jstor.org/stable/1913210?origin=crossref.

Leippold, Markus, Lujing Su, and Alexandre Ziegler (2015). “Do Index Futures and ETFs Affect Stock Return Correlations?” In: *SSRN Electronic Journal* 41.44. ISSN: 1556-5068. DOI: 10.2139/ssrn.2620955. URL: http://www.ssrn.com/abstract=2620955.

Newey, Whitney K and Kenneth D West (1987). “A Simple, Positive Semi-Definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix”. In: *Econometrica* 55.3, p. 703. ISSN: 00129682. DOI: 10.2307/1913610. URL: http://www.jstor.org/stable/1913610%20https://www.jstor.org/stable/1913610?origin=crossref.

Novy-Marx, Robert (2012). “Is momentum really momentum?” In: *Journal of Financial Economics* 103.3, pp. 429–453. ISSN: 0304405X. DOI: 10.1016/j.jfineco.2011.05.003. URL: http://dx.doi.org/10.1016/j.jfineco.2011.05.003.

– (2013). “The other side of value: The gross profitability premium”. In: *Journal of Financial Economics* 108.1, pp. 1–28. ISSN: 0304405X. DOI: 10.1016/j.jfineco.2013.01.003. URL: https://www.sciencedirect.com/science/article/pii/S0304405X13000044%20https://linkinghub.elsevier.com/retrieve/pii/S0304405X13000044.

O’Hara, Maureen and Mao Ye (2011). “Is market fragmentation harming market quality?” In: *Journal of Financial Economics* 100.3, pp. 459–474. ISSN: 0304405X. DOI: 10.1016/j.jfineco.2011.02.006. URL: https://linkinghub.elsevier.com/retrieve/pii/S0304405X11000390.

Petajisto, Antti (2017). “Inefficiencies in the pricing of exchange-traded funds”. In: *Financial Analysts Journal* 73.1, pp. 24–54. ISSN: 0015198X. DOI: 10.2469/faj.v73.n1.7.

Rosenberg, Barr, Kenneth Reid, and Ronald Lanstein (1985). “Persuasive evidence of market inefficiency”. In: *The Journal of Portfolio Management* 11.3, pp. 9–16. ISSN: 0095-4918. DOI: 10.3905/jpm.1985.409007. URL: http://jpm.iijournals.com/lookup/doi/10.3905/jpm.1985.409007.

Rubinstein, Mark (1989). “Market Basket Alternatives”. In: *Research Program in Finance Working Papers* 45.5, pp. 20–29. URL: https://www.jstor.org/stable/4479255%20http://ideas.repec.org/p/ucb/calbrf/rpf-187.html.

Sagi, Jacob S. and Mark S. Seasholes (2007). “Firm-specific attributes and the cross-section of momentum”. In: *Journal of Financial Economics* 84.2, pp. 389–434. ISSN: 0304405X. DOI: 10.1016/j.jfineco.2006.02.002. URL: https://linkinghub.elsevier.com/retrieve/pii/S0304405X06002066.

Subrahmanyam, Avanidhar, Tarun Chordia, and Richard Roll (2000). “Commonality in liquidity”. In: *Journal of Financial Economics* 56, pp. 3–28. ISSN: 0304405X. DOI: 10.1016/S0304-405X(99)00057-4.

Tversky, A and D Kahneman (1974). “Judgment under Uncertainty: Heuristics and Biases”. In: *Science* 185.4157, pp. 1124–1131. ISSN: 0036-8075. DOI: 10.1126/science.185.4157.1124. URL: http://www.ncbi.nlm.nih.gov/pubmed/17835457%20http://www.sciencemag.org/cgi/doi/10.1126/science.185.4157.1124.

Appendix A Institutional background

As a matter of conciseness, the description of the legal framework in which ETFs operate and the institutional design (market participants) in Section 2 (p.10) has been kept at its shortest in the main body of this paper. This appendix aims at providing a more exhaustive overview of these topics.

A.1 Legal and regulatory framework

ETFs may have at least two legal forms, based on information relevant in the United States : they may be registered as regulated open-end investment companies – exactly the same as mutual funds, intuitively – or as unit investment trusts; for instance, the much-traded SPDR S&P 500 ETF (mnemonic code SPY), nowadays sponsored and administered through State Street Global Advisors, is a unit investment trust. This legal structure prevents the funds adopting it from engaging in securities lending, which is one of the main sources of revenues of ETF sponsors. The latter legal form, which does not, in principle, exclude active investment objectives, offers the redemption of shares at Net Asset Value to the owner, which will sometimes be called the primary market as opposed to the secondary market which enables buyers and sellers to trade shares independent from the trust advisor. Open-end funds and unit investment trusts are the two main legal structures used by ETFs focusing on stocks, which is a subset of the whole (expanding) ETF universe.

In terms of management, unit investment trusts differ from open-end investment companies since they do not have a board of directors; since the portfolio is assumed fixed and is especially straightforward if such an ETF engages in systematic physical replication, a board of directors would in essence seem superfluous. Even more anecdotally, unit investment trusts are required by law to have a fixed end date, however far away it is: for instance, the ultimate termination date of the SPY ETF is scheduled 125 years after its initial deposit, i.e. on January 22, 2118.

Since the majority of ETF, both in entities and in value terms, is registered and managed in the United States of America, more emphasis has been put on the structures allowed and regulated under the Investment Company Act of 1940. More generally, the legal form chosen by ETFs differs in every regulatory system[23], which unfortunately makes an exhaustive comparison

[23] European countries even seem to have at least kept their national regulatory frame, at least according to the names advertised by those structures. Harmonization nevertheless has already started through the so-called *Undertakings for the Collective Investment of Transferable Securities*, better known as the UCITS acronym which only labels compliant funds and not debt products such as notes, certificates, etc. Reportedly, as of

of all eligible legal structures untractable for this study.

Appendix B Econometric definitions

Due to the use of a (dynamic) panel regression method throughout the empirical analysis, it is useful to discuss specifically certain statistics given in summary outputs, to be found in Section 7 (p.40), as well as in the extended outputs gathered (as a matter of brevity) in an appendix section (C, p.74.).

B.1 Covariance matrix estimator

Driscoll and Kraay (1998) has provided a contribution for panel models that is nowadays widely followed in this field. Their covariance matrix estimation is robust to heteroskedasticity, entity-specific serial correlation but also cross-sectional dependence. The method is the label for a category estimators in some statistical packages, including the one used here. As explained in the package documentation, the Driscoll-Kraay method applies when the number of periods is large. Newey and West (1987) provide an estimator for a covariance matrix robust to heteroskedasticity, and, very importantly in volatility regressions here, serial entity-specific correlation.

As a matter of convenience, we define the covariance of regressors (there are k of them):

$$\Sigma_{XX}^{-1} = \sum_{i=1}^{N} \sum_{t=1}^{T_i} x_{it}^{\intercal} x_{it} \tag{14}$$

We can notice that T_i accounts e.g. for an unbalanced panel, with varying number of observations per entity. The total number of observations is therefore: $n_{obs} = \sum_{i=1}^{N} T_i$ The bandwidth parameter is from Newey and West (ibid.):

$$bw = \lfloor 4 \cdot \left(\frac{n_{obs}}{100}\right)^{\frac{2}{9}} \rfloor \tag{15}$$

The so-called Bartlett kernel ensuring we are using the Newey and West (ibid.) estimator is:

$$K(i, bw) = 1 - \frac{i}{bw + 1} \tag{16}$$

The central factor is the actual specificity of the Newey and West (ibid.) estimator and accounts for auto-covariance across time:

$$\hat{S_{HAC}} = \hat{\Gamma_0} + \sum_{i=1}^{bw} (K(i, bw)(\hat{\Gamma_1} + \hat{\Gamma_1}^{\intercal})) \tag{17}$$

2017, three quarters of EU ordinary ETF investorshold UCITS funds. (Source : https://www.justeft.com/uk/news/etf/legal-structure-of-etfs-ucits.html [Consulted April 24, 2019])

The first term is measured over the entire time horizon, i.e. $i = 0$:

$$\hat{\Gamma_0} = \sum_{t=1}^{T} \xi_t^\intercal \xi_t \tag{18}$$

with

$$\xi_t = \sum_{i=1}^{n_t} \hat{\epsilon_{it}} x_{it} \tag{19}$$

n_t stands for the number of individual observations at time t, ϵ_{it} is the sample residual of entity i at time t. The Newey and West (1987) estimator with small sample correction is :

$$V\hat{ar}_{HAC} = \frac{n_{obs}}{n_{obs} - k} \sum_{XX}^{-1} S\hat{_{HAC}} \sum_{XX}^{-1} \tag{20}$$

B.2 Various goodness of fit indicators

Since regressions are applied on panel models with fixed effects, it is possible to compute goodness of fit statistics either within or across clusters. The displayed R^2 is always, by design, the determination coefficient of the actual model, while alternative statistics allow to gain more insight about the model's explanatory power.

In what follows, the notation conventions match those in the source code of the `linearmodels` module used for estimations. The panels with time and entitity fixed effects are in general of the form :

$$y_{it} = \alpha + x_{it}\beta + \nu_i + \gamma_t + \epsilon_{it} \tag{21}$$

The fitted values follow :

$$\hat{y}_{it} = \hat{\alpha} + x_{it}\hat{\beta} + \hat{\nu}_i + \hat{\gamma}_t \tag{22}$$

B.2.1 R^2

This corresponds to the pooled OLS model with time and entity dummies. The sum of squared residuals is computed over fitted values that include fixed effects as in (22) :

$$SSR = \sum_{i=1}^{N} \sum_{t=1}^{T_i} (y_{it} - \hat{y}_{it})^2 \tag{23}$$

And the total sum of squared dependent variables:

$$TSS = \sum_{i=1}^{N} \sum_{t=1}^{T_i} (y_{it} - \bar{y})^2 \tag{24}$$

(Here, $\bar{y}$ is the grand average of y_{it} over time and entities.)

By definition, the R-squared is the share of the dependent's variance explained by the regression:

$$R^2 = 1 - \frac{SSR}{TSS} \tag{25}$$

B.2.2 R^2 between

The *between* model is based on entity averages:

$$\bar{y}_i = \alpha + \bar{x}_i\beta + \nu i + \bar{\gamma} + \bar{\epsilon}_i \tag{26}$$

with entity-specific averages over time : $\bar{y}_i = \frac{\sum_{t=1}^{T_i} y_{it}}{T_i}$, $\bar{x}_i = \frac{\sum_{t=1}^{T_i} x_{it}}{T_i}$ and $\bar{\epsilon}_i = \frac{\sum_{t=1}^{T_i} \epsilon_{it}}{T_i}$.

The fitted values follow :

$$\hat{\bar{y}}_i = \hat{\alpha} + \bar{x}_i\hat{\beta} \tag{27}$$

The estimation thus cannot differentiate the time fixed-effects from the constant and the individual fixed effects is absobed in the error term.

The sum of squared residuals:

$$SSR_{between} = \sum_{i=1}^{N} (\bar{y}_i - \hat{\bar{y}}_i)^2 \tag{28}$$

And the total sum of squares is :

$$TSS_{between} = \sum_{i=1}^{N} (\bar{y}_i - \bar{\bar{y}})^2 \tag{29}$$

(Here, $\bar{\bar{y}}$ is the average of entity-specific average dependents, which themselves are averages over time.)

The statistic is therefore:

$$R^2_{between} = 1 - \frac{SSR_{between}}{TSS_{between}} \tag{30}$$

The *between* estimator reduces individuals to their sample means, which inherently is a loss of information but also is a way to give more weight on cross-sectional variations; hence the coefficient of determination shows how much of the variance across entities the model on average over the time of measurements.

B.2.3 R^2 within

The *within*

$$\tilde{y}_{it} = y_{it} - \bar{y}_i = (x_{it} - \bar{x}_i)\beta + (\gamma_t - \bar{\gamma}) + (\epsilon_{it} - \bar{\epsilon}_i) \tag{31}$$

The individual fixed effect disappears in the *within* transformation. FiFitted values are as follows:

$$\hat{\tilde{y}}_{it} = (x_{it} - \bar{x}_i)\hat{\beta} + (\gamma_t - \bar{\gamma}) \tag{32}$$

Depending on the implementation, the time effects may not be included in the *within* transformation.

The sum of squared residuals:

$$SSR_{within} = \sum_{i=1}^{N}\sum_{t=1}^{T_i}(\tilde{y}_{it} - \hat{\tilde{y}}_{it})^2 \tag{33}$$

And the total sum of squares is :

$$TSS_{within} = \sum_{i=1}^{N}\sum_{t=1}^{T_i}\tilde{y}_{it}^2 \tag{34}$$

The statistic is therefore:

$$R^2_{within} = 1 - \frac{SSR_{within}}{TSS_{within}} \tag{35}$$

The *within* transformation is used to measure how well regressors can explain the dependent's variance after individual specifities have been taken into account through fixed effects.

B.2.4 R^2 overall

The *overall* R^2 is estimated over a model without fixed effects, whether entity- or time-specific. Therefore, it is equivalent to the usual, unadjusted coefficient of a pooled OLS estimation.

Appendix C Detailed estimation results

One of the many advantages provided through the statistical functions library, called `linearmodels`[24], accessed through the Python 3.7.3 programming language is the ability to extract summarized as well as extended regression estimates and related statistics. Since it would have been untractable to provide extended sample descriptions (the upper panel in following tables) and more insight into regression coefficients estimates (the lower panels), those extended results have been gathered in the current supporting section.

[24] The `linearmodels`, whose current stable version at the time of writing is v.4.5, is developped and maintained by Prof. Kevin Sheppard, who provides the source code free for use at https://github.com/bashtage/linearmodels. I rely on the documentation included in the docstring as well as on https://bashtage.github.io/linearmodels/doc/

C.1 ETF ownership and underlying stocks' volatility

This subsection constitutes additional material about variants of the model attempting to explain stocks volatility, summarized and discussed in subsection 7.2 (p.45).

C.1.1 U.S. stocks sample

Dep. Variable:	Volatility	**R-squared:**	0.1582
Estimator:	PanelOLS	**R-squared (Between):**	0.7685
No. Observations:	302238	**R-squared (Within):**	0.1350
Date:	Wed, Jun 12 2019	**R-squared (Overall):**	0.2710
Time:	16:08:02	**Log-likelihood**	6.586e+05
Cov. Estimator:	Driscoll-Kraay		
		F-statistic:	4685.2
Entities:	2987	**P-value**	0.0000
Avg Obs:	101.18	**Distribution:**	F(12,299066)
Min Obs:	1.0000		
Max Obs:	174.00	**F-statistic (robust):**	196.78
		P-value	0.0000
Time periods:	174	**Distribution:**	F(12,299066)
Avg Obs:	1737.0		
Min Obs:	984.00		
Max Obs:	2794.0		

	Parameter	**Std. Err.**	**T-stat**	**P-value**	**Lower CI**	**Upper CI**
Intercept	0.0507	0.0066	7.7298	0.0000	0.0378	0.0635
PctSharesHeldETF	0.0398	0.0065	6.1376	0.0000	0.0271	0.0525
np.log(CompanyMarketCap__1lag)	-0.0019	0.0003	-6.3341	0.0000	-0.0024	-0.0013
InvClose__1lag	0.0247	0.0033	7.6046	0.0000	0.0184	0.0311
AmihudRatio__1lag	3.4497	1.2936	2.6667	0.0077	0.9143	5.9851
PctBidAskSpread__1lag	0.1795	0.0372	4.8311	0.0000	0.1067	0.2523
BookToMarketRatio__1lag	7.42e-07	1.781e-07	4.1651	0.0000	3.928e-07	1.091e-06
RetPast12to7M__1lag	6.481e-06	6.382e-06	1.0155	0.3099	-6.028e-06	1.899e-05
GrossProfitability__1lag	-0.0006	0.0002	-2.7450	0.0061	-0.0010	-0.0002
Volatility__1lag	0.1399	0.0204	6.8513	0.0000	0.0999	0.1800
Volatility__2lag	0.1613	0.0097	16.642	0.0000	0.1423	0.1803
Volatility__3lag	0.1210	0.0090	13.424	0.0000	0.1034	0.1387
Volatility__4lag	0.0796	0.0079	10.014	0.0000	0.0640	0.0952

F-test for Poolability: 49.051
P-value: 0.0000
Distribution: F(3159,299066)

Included effects: Entity, Time

Dep. Variable:	Volatility	**R-squared:**	0.1592
Estimator:	PanelOLS	**R-squared (Between):**	0.7626
No. Observations:	297405	**R-squared (Within):**	0.1353
Date:	Fri, Jun 14 2019	**R-squared (Overall):**	0.2716
Time:	10:35:11	**Log-likelihood**	6.492e+05
Cov. Estimator:	Driscoll-Kraay		
		F-statistic:	4643.9
Entities:	2932	**P-value**	0.0000
Avg Obs:	101.43	**Distribution:**	F(12,294288)
Min Obs:	1.0000		
Max Obs:	174.00	**F-statistic (robust):**	226.33
		P-value	0.0000
Time periods:	174	**Distribution:**	F(12,294288)
Avg Obs:	1709.2		
Min Obs:	966.00		
Max Obs:	2745.0		

	Parameter	**Std. Err.**	**T-stat**	**P-value**	**Lower CI**	**Upper CI**
Intercept	0.0488	0.0068	7.1942	0.0000	0.0355	0.0621
PctSharesHeldETF__1lag	0.0385	0.0064	5.9800	0.0000	0.0259	0.0511
np.log(CompanyMarketCap__1lag)	-0.0018	0.0003	-5.8479	0.0000	-0.0024	-0.0012
InvClose__1lag	0.0251	0.0032	7.7261	0.0000	0.0187	0.0314
AmihudRatio__1lag	3.4590	1.2795	2.7034	0.0069	0.9512	5.9668
PctBidAskSpread__1lag	0.1750	0.0385	4.5505	0.0000	0.0996	0.2504
BookToMarketRatio__1lag	7.393e-07	1.78e-07	4.1534	0.0000	3.904e-07	1.088e-06
RetPast12to1M__1lag	-0.0004	0.0002	-1.8758	0.0607	-0.0008	1.848e-05
GrossProfitability__1lag	-0.0005	0.0002	-2.6218	0.0087	-0.0008	-0.0001
Volatility__1lag	0.1377	0.0204	6.7584	0.0000	0.0978	0.1776
Volatility__2lag	0.1605	0.0100	16.002	0.0000	0.1409	0.1802
Volatility__3lag	0.1230	0.0092	13.390	0.0000	0.1050	0.1410
Volatility__4lag	0.0819	0.0083	9.8851	0.0000	0.0657	0.0981

F-test for Poolability: 49.697
P-value: 0.0000
Distribution: F(3104,294288)

Included effects: Entity, Time

Dep. Variable:	Volatility	**R-squared:**	0.1593
Estimator:	PanelOLS	**R-squared (Between):**	0.7625
No. Observations:	297399	**R-squared (Within):**	0.1351
Date:	Fri, Jun 14 2019	**R-squared (Overall):**	0.2715
Time:	10:35:22	**Log-likelihood**	6.492e+05
Cov. Estimator:	Driscoll-Kraay		
		F-statistic:	3718.4
Entities:	2932	**P-value**	0.0000
Avg Obs:	101.43	**Distribution:**	F(15,294279)
Min Obs:	1.0000		
Max Obs:	174.00	**F-statistic (robust):**	230.41
		P-value	0.0000
Time periods:	174	**Distribution:**	F(15,294279)
Avg Obs:	1709.2		
Min Obs:	966.00		
Max Obs:	2745.0		

	Parameter	**Std. Err.**	**T-stat**	**P-value**	**Lower CI**	**Upper CI**
Intercept	0.0494	0.0068	7.2977	0.0000	0.0361	0.0626
PctSharesHeldETF__1lag	0.0395	0.0063	6.2940	0.0000	0.0272	0.0518
np.log(CompanyMarketCap__1lag)	-0.0018	0.0003	-5.9701	0.0000	-0.0024	-0.0012
InvClose__1lag	0.0251	0.0032	7.7792	0.0000	0.0187	0.0314
AmihudRatio__1lag	3.4611	1.2805	2.7029	0.0069	0.9514	5.9709
PctBidAskSpread__1lag	0.1748	0.0385	4.5446	0.0000	0.0994	0.2502
BookToMarketRatio__1lag	1.038e-06	1.219e-07	8.5166	0.0000	7.992e-07	1.277e-06
RetPast12to1M__1lag	-0.0004	0.0002	-1.8564	0.0634	-0.0008	2.254e-05
GrossProfitability__1lag	-0.0005	0.0002	-2.6334	0.0085	-0.0008	-0.0001
PctSharesHeldOtherMutual__1lag	-0.0003	0.0001	-2.5676	0.0102	-0.0005	-6.801e-05
PctSharesHeldPension__1lag	1.0330	0.3035	3.4034	0.0007	0.4381	1.6279
PctSharesHeldHedge__1lag	-0.0284	0.0087	-3.2527	0.0011	-0.0455	-0.0113
Volatility__1lag	0.1378	0.0203	6.7701	0.0000	0.0979	0.1776
Volatility__2lag	0.1604	0.0100	15.972	0.0000	0.1407	0.1801
Volatility__3lag	0.1229	0.0092	13.402	0.0000	0.1050	0.1409
Volatility__4lag	0.0818	0.0083	9.8688	0.0000	0.0655	0.0980

F-test for Poolability: 49.713
P-value: 0.0000
Distribution: F(3104,294279)

Included effects: Entity, Time

Dep. Variable:	Volatility	**R-squared:**	0.1594
Estimator:	PanelOLS	**R-squared (Between):**	0.7616
No. Observations:	297247	**R-squared (Within):**	0.1348
Date:	Fri, Jun 14 2019	**R-squared (Overall):**	0.2710
Time:	10:35:33	**Log-likelihood**	1.287e+05
Cov. Estimator:	Driscoll-Kraay		
		F-statistic:	3718.6
Entities:	2932	**P-value**	0.0000
Avg Obs:	101.38	**Distribution:**	F(15,294127)
Min Obs:	1.0000		
Max Obs:	174.00	**F-statistic (robust):**	278.01
		P-value	0.0000
Time periods:	174	**Distribution:**	F(15,294127)
Avg Obs:	1708.3		
Min Obs:	966.00		
Max Obs:	2744.0		

	Parameter	**Std. Err.**	**T-stat**	**P-value**	**Lower CI**	**Upper CI**
Intercept	-0.0154	0.0360	-0.4273	0.6691	-0.0860	0.0552
PctSharesHeldETF__1lag	0.0081	0.0012	6.8269	0.0000	0.0058	0.0105
np.log(CompanyMarketCap__1lag)	-0.0102	0.0016	-6.1991	0.0000	-0.0134	-0.0070
InvClose__1lag	0.1452	0.0183	7.9151	0.0000	0.1092	0.1812
AmihudRatio__1lag	19.952	7.3791	2.7038	0.0069	5.4889	34.415
PctBidAskSpread__1lag	1.0060	0.2212	4.5471	0.0000	0.5723	1.4396
BookToMarketRatio__1lag	5.019e-06	9.466e-07	5.3019	0.0000	3.163e-06	6.874e-06
RetPast12to1M__1lag	-0.0024	0.0012	-1.8927	0.0584	-0.0048	8.364e-05
GrossProfitability__1lag	-0.0028	0.0011	-2.6197	0.0088	-0.0048	-0.0007
PctSharesHeldOtherMutual__1lag	-0.0016	0.0014	-1.1497	0.2502	-0.0043	0.0011
PctSharesHeldPension__1lag	0.0015	0.0004	3.6451	0.0003	0.0007	0.0024
PctSharesHeldHedge__1lag	9.023e-05	0.0002	0.4613	0.6446	-0.0003	0.0005
Volatility__1lag	0.1376	0.0204	6.7630	0.0000	0.0977	0.1775
Volatility__2lag	0.1603	0.0101	15.949	0.0000	0.1406	0.1800
Volatility__3lag	0.1229	0.0092	13.403	0.0000	0.1049	0.1409
Volatility__4lag	0.0817	0.0083	9.8756	0.0000	0.0655	0.0979

F-test for Poolability: 49.704
P-value: 0.0000
Distribution: F(3104,294127)

Included effects: Entity, Time

C.1.2 International sample

Dep. Variable:	Volatility	**R-squared:**	0.0070
Estimator:	PanelOLS	**R-squared (Between):**	-0.0101
No. Observations:	1516791	**R-squared (Within):**	0.0148
Date:	Tue, Jun 18 2019	**R-squared (Overall):**	-0.0208
Time:	00:39:07	**Log-likelihood**	4.306e+06
Cov. Estimator:	Driscoll-Kraay		
		F-statistic:	2118.7
Entities:	15431	**P-value**	0.0000
Avg Obs:	98.295	**Distribution:**	F(5,1501142)
Min Obs:	1.0000		
Max Obs:	176.00	**F-statistic (robust):**	10.285
		P-value	0.0000
Time periods:	214	**Distribution:**	F(5,1501142)
Avg Obs:	7087.8		
Min Obs:	4.0000		
Max Obs:	1.442e+04		

	Parameter	**Std. Err.**	**T-stat**	**P-value**	**Lower CI**	**Upper CI**
Intercept	0.0582	0.0055	10.611	0.0000	0.0474	0.0689
PctSharesHeldETF__1lag	0.0169	0.0093	1.8226	0.0684	-0.0013	0.0351
np.log(CompanyMarketCap__1lag)	-0.0015	0.0002	-6.1428	0.0000	-0.0020	-0.0010
InvClose__1lag	0.0045	0.0018	2.5792	0.0099	0.0011	0.0080
BookToMarketRatio__1lag	3.446e-05	9.53e-06	3.6160	0.0003	1.578e-05	5.314e-05
RetPast12to1M__1lag	0.0005	0.0003	1.8965	0.0579	-1.676e-05	0.0010

F-test for Poolability: 45.988
P-value: 0.0000
Distribution: F(15643,1501142)

Included effects: Entity, Time

Dep. Variable:	Volatility	**R-squared:**	0.1729
Estimator:	PanelOLS	**R-squared (Between):**	0.7081
No. Observations:	1319966	**R-squared (Within):**	0.2100
Date:	Tue, Jun 18 2019	**R-squared (Overall):**	0.3261
Time:	00:40:15	**Log-likelihood**	3.944e+06
Cov. Estimator:	Driscoll-Kraay		
		F-statistic:	2.274e+04
Entities:	14383	**P-value**	0.0000
Avg Obs:	91.773	**Distribution:**	F(12,1305368)
Min Obs:	1.0000		
Max Obs:	176.00	**F-statistic (robust):**	367.96
		P-value	0.0000
Time periods:	204	**Distribution:**	F(12,1305368)
Avg Obs:	6470.4		
Min Obs:	149.00		
Max Obs:	1.311e+04		

	Parameter	**Std. Err.**	**T-stat**	**P-value**	**Lower CI**	**Upper CI**
Intercept	0.0283	0.0036	7.7563	0.0000	0.0211	0.0354
PctSharesHeldETF__1lag	0.0072	0.0070	1.0225	0.3065	-0.0066	0.0210
np.log(CompanyMarketCap__1lag)	-0.0008	0.0002	-4.9380	0.0000	-0.0011	-0.0005
InvClose__1lag	0.0015	0.0013	1.1485	0.2507	-0.0010	0.0040
AmihudRatio__1lag	0.0250	0.0302	0.8272	0.4081	-0.0342	0.0841
PctBidAskSpread__1lag	0.0262	0.0038	6.9533	0.0000	0.0188	0.0336
BookToMarketRatio__1lag	2.54e-05	7.656e-06	3.3179	0.0009	1.04e-05	4.041e-05
RetPast12to1M__1lag	0.0001	8.547e-05	1.5202	0.1285	-3.759e-05	0.0003
GrossProfitability__1lag	-0.0001	0.0002	-0.6729	0.5010	-0.0005	0.0003
Volatility__1lag	0.2541	0.0118	21.616	0.0000	0.2310	0.2771
Volatility__2lag	0.1226	0.0065	18.960	0.0000	0.1099	0.1353
Volatility__3lag	0.0968	0.0082	11.790	0.0000	0.0807	0.1128
Volatility__4lag	0.0607	0.0046	13.274	0.0000	0.0517	0.0697

F-test for Poolability: 13.772
P-value: 0.0000
Distribution: F(14585,1305368)

Included effects: Entity, Time

Dep. Variable:	Volatility	**R-squared:**	0.1729
Estimator:	PanelOLS	**R-squared (Between):**	0.7079
No. Observations:	1319966	**R-squared (Within):**	0.2100
Date:	Tue, Jun 18 2019	**R-squared (Overall):**	0.3260
Time:	00:41:41	**Log-likelihood**	3.944e+06
Cov. Estimator:	Driscoll-Kraay		
		F-statistic:	2.099e+04
Entities:	14383	**P-value**	0.0000
Avg Obs:	91.773	**Distribution:**	F(13,1305367)
Min Obs:	1.0000		
Max Obs:	176.00	**F-statistic (robust):**	354.85
		P-value	0.0000
Time periods:	204	**Distribution:**	F(13,1305367)
Avg Obs:	6470.4		
Min Obs:	149.00		
Max Obs:	1.311e+04		

	Parameter	**Std. Err.**	**T-stat**	**P-value**	**Lower CI**	**Upper CI**
Intercept	0.0283	0.0036	7.7708	0.0000	0.0212	0.0355
PctSharesHeldETF__1lag	0.0070	0.0071	0.9781	0.3280	-0.0070	0.0210
np.log(CompanyMarketCap__1lag)	-0.0008	0.0002	-4.9511	0.0000	-0.0011	-0.0005
InvClose__1lag	0.0015	0.0013	1.1484	0.2508	-0.0010	0.0040
AmihudRatio__1lag	0.0250	0.0302	0.8272	0.4081	-0.0342	0.0841
PctBidAskSpread__1lag	0.0262	0.0038	6.9532	0.0000	0.0188	0.0336
BookToMarketRatio__1lag	2.538e-05	7.642e-06	3.3206	0.0009	1.04e-05	4.035e-05
RetPast12to1M__1lag	0.0001	8.547e-05	1.5203	0.1284	-3.758e-05	0.0003
GrossProfitability__1lag	-0.0001	0.0002	-0.6731	0.5009	-0.0005	0.0003
PctSharesHeldOtherMutual__1lag	9.061e-05	0.0001	0.6096	0.5421	-0.0002	0.0004
Volatility__1lag	0.2541	0.0118	21.615	0.0000	0.2310	0.2771
Volatility__2lag	0.1226	0.0065	18.960	0.0000	0.1099	0.1353
Volatility__3lag	0.0968	0.0082	11.790	0.0000	0.0807	0.1129
Volatility__4lag	0.0607	0.0046	13.271	0.0000	0.0517	0.0697

F-test for Poolability: 13.766
P-value: 0.0000
Distribution: F(14585,1305367)

Included effects: Entity, Time

Dep. Variable:	Volatility	**R-squared:**	0.1729
Estimator:	PanelOLS	**R-squared (Between):**	0.7079
No. Observations:	1319966	**R-squared (Within):**	0.2100
Date:	Tue, Jun 18 2019	**R-squared (Overall):**	0.3260
Time:	02:17:45	**Log-likelihood**	-9.246e+05
Cov. Estimator:	Driscoll-Kraay		
		F-statistic:	2.099e+04
Entities:	14383	**P-value**	0.0000
Avg Obs:	91.773	**Distribution:**	F(13,1305367)
Min Obs:	1.0000		
Max Obs:	176.00	**F-statistic (robust):**	354.85
		P-value	0.0000
Time periods:	204	**Distribution:**	F(13,1305367)
Avg Obs:	6470.4		
Min Obs:	149.00		
Max Obs:	1.311e+04		

	Parameter	**Std. Err.**	**T-stat**	**P-value**	**Lower CI**	**Upper CI**
Intercept	0.6235	0.1397	4.4628	0.0000	0.3497	0.8973
PctSharesHeldETF__1lag	0.0028	0.0029	0.9781	0.3280	-0.0029	0.0086
np.log(CompanyMarketCap__1lag)	-0.0310	0.0063	-4.9511	0.0000	-0.0432	-0.0187
InvClose__1lag	0.0585	0.0510	1.1484	0.2508	-0.0414	0.1584
AmihudRatio__1lag	0.9984	1.2070	0.8272	0.4081	-1.3672	3.3640
PctBidAskSpread__1lag	1.0496	0.1510	6.9532	0.0000	0.7538	1.3455
BookToMarketRatio__1lag	0.0010	0.0003	3.3206	0.0009	0.0004	0.0016
RetPast12to1M__1lag	0.0052	0.0034	1.5203	0.1284	-0.0015	0.0119
GrossProfitability__1lag	-0.0056	0.0083	-0.6731	0.5009	-0.0217	0.0106
PctSharesHeldOtherMutual__1lag	0.0008	0.0013	0.6096	0.5421	-0.0018	0.0035
Volatility__1lag	0.2541	0.0118	21.615	0.0000	0.2310	0.2771
Volatility__2lag	0.1226	0.0065	18.960	0.0000	0.1099	0.1353
Volatility__3lag	0.0968	0.0082	11.790	0.0000	0.0807	0.1129
Volatility__4lag	0.0607	0.0046	13.271	0.0000	0.0517	0.0697

F-test for Poolability: 13.766
P-value: 0.0000
Distribution: F(14585,1305367)

Included effects: Entity, Time

C.2 ETF ownership and underlying stocks' liquidity

This subsection constitutes additional material about variants of the models using several liquidity proxies as dependent variables, summarized and discussed in subsection 7.3 (p.52).

C.2.1 U.S. stocks sample

Dep. Variable:	PctBidAskSpread	**R-squared:**	0.0510
Estimator:	PanelOLS	**R-squared (Between):**	0.5568
No. Observations:	335170	**R-squared (Within):**	0.0659
Date:	Fri, Jun 14 2019	**R-squared (Overall):**	0.1879
Time:	12:35:13	**Log-likelihood**	8.49e+05
Cov. Estimator:	Driscoll-Kraay		
		F-statistic:	4445.9
Entities:	3995	**P-value**	0.0000
Avg Obs:	83.897	**Distribution:**	F(4,331034)
Min Obs:	1.0000		
Max Obs:	138.00	**F-statistic (robust):**	105.77
		P-value	0.0000
Time periods:	138	**Distribution:**	F(4,331034)
Avg Obs:	2428.8		
Min Obs:	1448.0		
Max Obs:	3939.0		

	Parameter	**Std. Err.**	**T-stat**	**P-value**	**Lower CI**	**Upper CI**
Intercept	0.1055	0.0067	15.863	0.0000	0.0925	0.1186
PctSharesHeldETF__1lag	0.0074	0.0084	0.8731	0.3826	-0.0092	0.0239
np.log(CompanyMarketCap__1lag)	-0.0049	0.0003	-14.666	0.0000	-0.0056	-0.0042
BookToMarketRatio__1lag	-4.261e-08	4.703e-08	-0.9060	0.3649	-1.348e-07	4.956e-08
Volatility__1lag	0.0498	0.0049	10.156	0.0000	0.0402	0.0594

F-test for Poolability: 9.5533
P-value: 0.0000
Distribution: F(4131,331034)

Included effects: Entity, Time

Dep. Variable:	PctBidAskSpread	**R-squared:**	0.0510
Estimator:	PanelOLS	**R-squared (Between):**	0.5572
No. Observations:	335164	**R-squared (Within):**	0.0660
Date:	Fri, Jun 14 2019	**R-squared (Overall):**	0.1881
Time:	12:35:22	**Log-likelihood**	8.49e+05
Cov. Estimator:	Driscoll-Kraay		
		F-statistic:	2543.2
Entities:	3995	**P-value**	0.0000
Avg Obs:	83.896	**Distribution:**	F(7,331025)
Min Obs:	1.0000		
Max Obs:	138.00	**F-statistic (robust):**	68.466
		P-value	0.0000
Time periods:	138	**Distribution:**	F(7,331025)
Avg Obs:	2428.7		
Min Obs:	1448.0		
Max Obs:	3939.0		

	Parameter	**Std. Err.**	**T-stat**	**P-value**	**Lower CI**	**Upper CI**
Intercept	0.1057	0.0067	15.819	0.0000	0.0926	0.1188
PctSharesHeldETF__1lag	0.0073	0.0085	0.8642	0.3875	-0.0093	0.0239
np.log(CompanyMarketCap__1lag)	-0.0049	0.0003	-14.622	0.0000	-0.0056	-0.0043
BookToMarketRatio__1lag	-4.149e-08	4.662e-08	-0.8901	0.3734	-1.329e-07	4.987e-08
Volatility__1lag	0.0498	0.0049	10.161	0.0000	0.0402	0.0594
PctSharesHeldOtherMutual__1lag	-2.123e-06	3.488e-07	-6.0853	0.0000	-2.806e-06	-1.439e-06
PctSharesHeldPension__1lag	0.2846	0.2373	1.1997	0.2302	-0.1804	0.7497
PctSharesHeldHedge__1lag	0.0053	0.0046	1.1511	0.2497	-0.0037	0.0143

F-test for Poolability: 9.5287
P-value: 0.0000
Distribution: F(4131,331025)

Included effects: Entity, Time

Dep. Variable:	AmihudNumerator	**R-squared:**	0.0326
Estimator:	PanelOLS	**R-squared (Between):**	0.1897
No. Observations:	436359	**R-squared (Within):**	0.0448
Date:	Fri, Jun 14 2019	**R-squared (Overall):**	0.1291
Time:	12:35:36	**Log-likelihood**	6.724e+05
Cov. Estimator:	Driscoll-Kraay		
		F-statistic:	3643.1
Entities:	4079	**P-value**	0.0000
Avg Obs:	106.98	**Distribution:**	F(4,432102)
Min Obs:	1.0000		
Max Obs:	175.00	**F-statistic (robust):**	210.33
		P-value	0.0000
Time periods:	175	**Distribution:**	F(4,432102)
Avg Obs:	2493.5		
Min Obs:	1501.0		
Max Obs:	3986.0		

	Parameter	**Std. Err.**	**T-stat**	**P-value**	**Lower CI**	**Upper CI**
Intercept	0.3424	0.0114	30.114	0.0000	0.3202	0.3647
PctSharesHeldETF__1lag	0.1809	0.0241	7.5170	0.0000	0.1338	0.2281
np.log(CompanyMarketCap__1lag)	-0.0153	0.0006	-26.856	0.0000	-0.0164	-0.0142
BookToMarketRatio__1lag	2.812e-07	2.556e-07	1.1005	0.2711	-2.197e-07	7.821e-07
AmihudDenominator	1.335e-11	3.042e-12	4.3898	0.0000	7.392e-12	1.932e-11

F-test for Poolability: 67.422
P-value: 0.0000
Distribution: F(4252,432102)

Included effects: Entity, Time

Dep. Variable:	AmihudNumerator	**R-squared:**	0.0326
Estimator:	PanelOLS	**R-squared (Between):**	0.1898
No. Observations:	436352	**R-squared (Within):**	0.0448
Date:	Fri, Jun 14 2019	**R-squared (Overall):**	0.1291
Time:	12:35:49	**Log-likelihood**	6.724e+05
Cov. Estimator:	Driscoll-Kraay		
		F-statistic:	2914.2
Entities:	4079	**P-value**	0.0000
Avg Obs:	106.98	**Distribution:**	F(5,432094)
Min Obs:	1.0000		
Max Obs:	175.00	**F-statistic (robust):**	187.56
		P-value	0.0000
Time periods:	175	**Distribution:**	F(5,432094)
Avg Obs:	2493.4		
Min Obs:	1501.0		
Max Obs:	3986.0		

	Parameter	**Std. Err.**	**T-stat**	**P-value**	**Lower CI**	**Upper CI**
Intercept	0.3425	0.0114	30.084	0.0000	0.3201	0.3648
PctSharesHeldETF__1lag	0.1810	0.0241	7.5198	0.0000	0.1338	0.2282
np.log(CompanyMarketCap__1lag)	-0.0153	0.0006	-26.830	0.0000	-0.0164	-0.0142
BookToMarketRatio__1lag	2.925e-07	2.625e-07	1.1141	0.2652	-2.221e-07	8.07e-07
AmihudDenominator	1.335e-11	3.042e-12	4.3890	0.0000	7.389e-12	1.931e-11
PctSharesHeldOtherMutual__1lag	-1.157e-05	2.197e-06	-5.2639	0.0000	-1.587e-05	-7.259e-06

F-test for Poolability: 67.421
P-value: 0.0000
Distribution: F(4252,432094)

Included effects: Entity, Time

C.2.2 International sample

Dep. Variable:	PctBidAskSpread	**R-squared:**	0.0227
Estimator:	PanelOLS	**R-squared (Between):**	0.1785
No. Observations:	1124265	**R-squared (Within):**	0.0375
Date:	Tue, Jun 18 2019	**R-squared (Overall):**	0.0956
Time:	01:38:54	**Log-likelihood**	2.381e+06
Cov. Estimator:	Driscoll-Kraay		
		F-statistic:	6433.1
Entities:	15940	**P-value**	0.0000
Avg Obs:	70.531	**Distribution:**	F(4,1108128)
Min Obs:	1.0000		
Max Obs:	140.00	**F-statistic (robust):**	175.81
		P-value	0.0000
Time periods:	194	**Distribution:**	F(4,1108128)
Avg Obs:	5795.2		
Min Obs:	177.00		
Max Obs:	1.466e+04		

	Parameter	**Std. Err.**	**T-stat**	**P-value**	**Lower CI**	**Upper CI**
Intercept	0.1446	0.0058	25.012	0.0000	0.1332	0.1559
PctSharesHeldETF__1lag	0.0613	0.0124	4.9367	0.0000	0.0370	0.0857
np.log(CompanyMarketCap__1lag)	-0.0061	0.0003	-23.176	0.0000	-0.0066	-0.0056
BookToMarketRatio__1lag	1.107e-05	1.609e-05	0.6876	0.4917	-2.048e-05	4.261e-05
Volatility__1lag	0.1772	0.0132	13.426	0.0000	0.1513	0.2030

F-test for Poolability: 31.560
P-value: 0.0000
Distribution: F(16132,1108128)

Included effects: Entity, Time

Dep. Variable:	PctBidAskSpread	**R-squared:**	0.0227
Estimator:	PanelOLS	**R-squared (Between):**	0.1785
No. Observations:	1124260	**R-squared (Within):**	0.0375
Date:	Tue, Jun 18 2019	**R-squared (Overall):**	0.0956
Time:	01:39:28	**Log-likelihood**	2.381e+06
Cov. Estimator:	Driscoll-Kraay		
		F-statistic:	4289.0
Entities:	15940	**P-value**	0.0000
Avg Obs:	70.531	**Distribution:**	F(6,1108121)
Min Obs:	1.0000		
Max Obs:	140.00	**F-statistic (robust):**	123.33
		P-value	0.0000
Time periods:	194	**Distribution:**	F(6,1108121)
Avg Obs:	5795.2		
Min Obs:	177.00		
Max Obs:	1.466e+04		

	Parameter	**Std. Err.**	**T-stat**	**P-value**	**Lower CI**	**Upper CI**
Intercept	0.1446	0.0058	25.021	0.0000	0.1332	0.1559
PctSharesHeldETF__1lag	0.0610	0.0123	4.9518	0.0000	0.0368	0.0851
np.log(CompanyMarketCap__1lag)	-0.0061	0.0003	-23.183	0.0000	-0.0066	-0.0056
BookToMarketRatio__1lag	1.108e-05	1.609e-05	0.6887	0.4910	-2.045e-05	4.261e-05
Volatility__1lag	0.1772	0.0132	13.426	0.0000	0.1513	0.2030
PctSharesHeldOtherMutual__1lag	-1.92e-06	6.845e-06	-0.2806	0.7790	-1.534e-05	1.15e-05
PctSharesHeldPension__1lag	0.0314	0.0273	1.1500	0.2501	-0.0221	0.0848

F-test for Poolability: 31.560
P-value: 0.0000
Distribution: F(16132,1108121)

Included effects: Entity, Time

Dep. Variable:	AmihudNumerator	**R-squared:**	0.0285
Estimator:	PanelOLS	**R-squared (Between):**	-0.3627
No. Observations:	1465561	**R-squared (Within):**	0.0287
Date:	Tue, Jun 18 2019	**R-squared (Overall):**	-0.0089
Time:	01:36:03	**Log-likelihood**	2.721e+06
Cov. Estimator:	Driscoll-Kraay		
		F-statistic:	1.064e+04
Entities:	15905	**P-value**	0.0000
Avg Obs:	92.145	**Distribution:**	F(4,1449462)
Min Obs:	1.0000		
Max Obs:	174.00	**F-statistic (robust):**	157.52
		P-value	0.0000
Time periods:	191	**Distribution:**	F(4,1449462)
Avg Obs:	7673.1		
Min Obs:	1.0000		
Max Obs:	1.501e+04		

	Parameter	**Std. Err.**	**T-stat**	**P-value**	**Lower CI**	**Upper CI**
Intercept	0.0776	0.0061	12.831	0.0000	0.0658	0.0895
PctSharesHeldETF__1lag	0.0038	0.0066	0.5715	0.5677	-0.0091	0.0166
np.log(CompanyMarketCap__1lag)	-0.0058	0.0003	-21.501	0.0000	-0.0063	-0.0053
BookToMarketRatio__1lag	0.0012	0.0011	1.0328	0.3017	-0.0010	0.0033
np.log(AmihudDenominator)	0.0042	0.0002	16.998	0.0000	0.0037	0.0047

F-test for Poolability: 7.0240
P-value: 0.0000
Distribution: F(16094,1449462)

Included effects: Entity, Time

Dep. Variable:	AmihudNumerator	**R-squared:**	0.0285
Estimator:	PanelOLS	**R-squared (Between):**	-0.3626
No. Observations:	1465555	**R-squared (Within):**	0.0287
Date:	Tue, Jun 18 2019	**R-squared (Overall):**	-0.0089
Time:	01:37:26	**Log-likelihood**	2.721e+06
Cov. Estimator:	Driscoll-Kraay		
		F-statistic:	8514.8
Entities:	15905	**P-value**	0.0000
Avg Obs:	92.144	**Distribution:**	F(5,1449455)
Min Obs:	1.0000		
Max Obs:	174.00	**F-statistic (robust):**	128.11
		P-value	0.0000
Time periods:	191	**Distribution:**	F(5,1449455)
Avg Obs:	7673.1		
Min Obs:	1.0000		
Max Obs:	1.501e+04		

	Parameter	Std. Err.	T-stat	P-value	Lower CI	Upper CI
Intercept	0.0776	0.0061	12.829	0.0000	0.0658	0.0895
PctSharesHeldETF__1lag	0.0038	0.0066	0.5817	0.5608	-0.0090	0.0167
np.log(CompanyMarketCap__1lag)	-0.0058	0.0003	-21.502	0.0000	-0.0063	-0.0053
BookToMarketRatio__1lag	0.0012	0.0011	1.0328	0.3017	-0.0010	0.0033
np.log(AmihudDenominator)	0.0042	0.0002	16.998	0.0000	0.0037	0.0047
PctSharesHeldOtherMutual__1lag	-1.341e-05	1.424e-05	-0.9416	0.3464	-4.131e-05	1.45e-05

F-test for Poolability: 7.0237
P-value: 0.0000
Distribution: F(16094,1449455)

Included effects: Entity, Time

C.3 ETF ownership and concerns about pricing efficiency

This subsection constitutes additional material about variants of the model studying two forms of variance ratios, summarized and discussed in subsection 7.4 (p.56).

C.3.1 U.S. stocks sample

Dep. Variable:	VR	**R-squared:**	0.0040
Estimator:	PanelOLS	**R-squared (Between):**	0.1376
No. Observations:	126851	**R-squared (Within):**	0.0040
Date:	Wed, Jun 12 2019	**R-squared (Overall):**	0.0163
Time:	16:09:53	**Log-likelihood**	-7.813e+04
Cov. Estimator:	Driscoll-Kraay		
		F-statistic:	61.843
Entities:	2966	**P-value**	0.0000
Avg Obs:	42.768	**Distribution:**	F(8,123807)
Min Obs:	1.0000		
Max Obs:	71.000	**F-statistic (robust):**	12.114
		P-value	0.0000
Time periods:	71	**Distribution:**	F(8,123807)
Avg Obs:	1786.6		
Min Obs:	1087.0		
Max Obs:	2836.0		

	Parameter	**Std. Err.**	**T-stat**	**P-value**	**Lower CI**	**Upper CI**
Intercept	0.8735	0.1142	7.6512	0.0000	0.6498	1.0973
PctSharesHeldETF__1lag	-0.1205	0.0856	-1.4081	0.1591	-0.2882	0.0472
np.log(CompanyMarketCap__1lag)	0.0044	0.0054	0.8038	0.4215	-0.0063	0.0150
InvClose__1lag	-0.2002	0.0330	-6.0619	0.0000	-0.2650	-0.1355
AmihudRatio__1lag	-15.135	4.9970	-3.0288	0.0025	-24.929	-5.3407
PctBidAskSpread__1lag	-1.2190	0.3412	-3.5732	0.0004	-1.8877	-0.5503
BookToMarketRatio__1lag	-1.257e-05	8.787e-06	-1.4303	0.1526	-2.979e-05	4.655e-06
RetPast12to7M__1lag	-0.0006	0.0006	-0.9013	0.3675	-0.0018	0.0007
GrossProfitability__1lag	0.0064	0.0050	1.2767	0.2017	-0.0034	0.0162

F-test for Poolability: 7.6661
P-value: 0.0000
Distribution: F(3035,123807)

Included effects: Entity, Time

Dep. Variable:	VR	**R-squared:**	0.0041
Estimator:	PanelOLS	**R-squared (Between):**	0.1385
No. Observations:	126847	**R-squared (Within):**	0.0042
Date:	Wed, Jun 12 2019	**R-squared (Overall):**	0.0165
Time:	16:09:55	**Log-likelihood**	-7.812e+04
Cov. Estimator:	Driscoll-Kraay		
		F-statistic:	46.323
Entities:	2966	**P-value**	0.0000
Avg Obs:	42.767	**Distribution:**	F(11,123800)
Min Obs:	1.0000		
Max Obs:	71.000	**F-statistic (robust):**	13.710
		P-value	0.0000
Time periods:	71	**Distribution:**	F(11,123800)
Avg Obs:	1786.6		
Min Obs:	1087.0		
Max Obs:	2836.0		

	Parameter	**Std. Err.**	**T-stat**	**P-value**	**Lower CI**	**Upper CI**
Intercept	0.8579	0.1154	7.4328	0.0000	0.6317	1.0841
PctSharesHeldETF__1lag	-0.1005	0.0862	-1.1660	0.2436	-0.2694	0.0684
np.log(CompanyMarketCap__1lag)	0.0052	0.0055	0.9458	0.3443	-0.0056	0.0160
InvClose__1lag	-0.1986	0.0335	-5.9225	0.0000	-0.2643	-0.1328
AmihudRatio__1lag	-15.117	4.9926	-3.0279	0.0025	-24.903	-5.3317
PctBidAskSpread__1lag	-1.2179	0.3418	-3.5633	0.0004	-1.8878	-0.5480
BookToMarketRatio__1lag	6.777e-05	2.065e-05	3.2826	0.0010	2.731e-05	0.0001
RetPast12to7M__1lag	-0.0013	0.0006	-2.2311	0.0257	-0.0024	-0.0002
GrossProfitability__1lag	0.0062	0.0049	1.2635	0.2064	-0.0034	0.0159
PctSharesHeldOtherMutual__1lag	-0.0086	0.0023	-3.6908	0.0002	-0.0132	-0.0041
PctSharesHeldPension__1lag	-3.7029	6.9063	-0.5362	0.5918	-17.239	9.8333
PctSharesHeldHedge__1lag	-0.1145	0.1826	-0.6268	0.5308	-0.4724	0.2435

F-test for Poolability: 7.6650
P-value: 0.0000
Distribution: F(3035,123800)

Included effects: Entity, Time

Dep. Variable:	absVR	**R-squared:**	0.0079
Estimator:	PanelOLS	**R-squared (Between):**	0.2814
No. Observations:	126851	**R-squared (Within):**	0.0106
Date:	Wed, Jun 12 2019	**R-squared (Overall):**	0.0318
Time:	16:09:57	**Log-likelihood**	-3.697e+04
Cov. Estimator:	Driscoll-Kraay		
		F-statistic:	123.79
Entities:	2966	**P-value**	0.0000
Avg Obs:	42.768	**Distribution:**	F(8,123807)
Min Obs:	1.0000		
Max Obs:	71.000	**F-statistic (robust):**	37.102
		P-value	0.0000
Time periods:	71	**Distribution:**	F(8,123807)
Avg Obs:	1786.6		
Min Obs:	1087.0		
Max Obs:	2836.0		

	Parameter	**Std. Err.**	**T-stat**	**P-value**	**Lower CI**	**Upper CI**
Intercept	0.8523	0.0694	12.280	0.0000	0.7163	0.9884
PctSharesHeldETF_1lag	0.0096	0.0646	0.1484	0.8820	-0.1170	0.1362
np.log(CompanyMarketCap_1lag)	-0.0248	0.0033	-7.5202	0.0000	-0.0312	-0.0183
InvClose_1lag	0.1276	0.0231	5.5223	0.0000	0.0823	0.1729
AmihudRatio_1lag	9.9267	3.1583	3.1431	0.0017	3.7365	16.117
PctBidAskSpread_1lag	0.9314	0.1667	5.5878	0.0000	0.6047	1.2580
BookToMarketRatio_1lag	-3.498e-06	6.733e-06	-0.5195	0.6034	-1.669e-05	9.699e-06
RetPast12to7M_1lag	0.0003	0.0005	0.5981	0.5497	-0.0006	0.0012
GrossProfitability_1lag	0.0011	0.0047	0.2252	0.8218	-0.0082	0.0104

F-test for Poolability: 4.7953
P-value: 0.0000
Distribution: F(3035,123807)

Included effects: Entity, Time

Dep. Variable:	absVR	**R-squared:**	0.0081
Estimator:	PanelOLS	**R-squared (Between):**	0.2820
No. Observations:	126847	**R-squared (Within):**	0.0106
Date:	Wed, Jun 12 2019	**R-squared (Overall):**	0.0320
Time:	16:09:59	**Log-likelihood**	-3.696e+04
Cov. Estimator:	Driscoll-Kraay		
		F-statistic:	91.734
Entities:	2966	**P-value**	0.0000
Avg Obs:	42.767	**Distribution:**	F(11,123800)
Min Obs:	1.0000		
Max Obs:	71.000	**F-statistic (robust):**	41.510
		P-value	0.0000
Time periods:	71	**Distribution:**	F(11,123800)
Avg Obs:	1786.6		
Min Obs:	1087.0		
Max Obs:	2836.0		

	Parameter	**Std. Err.**	**T-stat**	**P-value**	**Lower CI**	**Upper CI**
Intercept	0.8532	0.0699	12.208	0.0000	0.7162	0.9902
PctSharesHeldETF__1lag	0.0218	0.0647	0.3373	0.7359	-0.1050	0.1487
np.log(CompanyMarketCap__1lag)	-0.0248	0.0033	-7.4640	0.0000	-0.0313	-0.0183
InvClose__1lag	0.1277	0.0229	5.5778	0.0000	0.0829	0.1726
AmihudRatio__1lag	9.9488	3.1629	3.1455	0.0017	3.7496	16.148
PctBidAskSpread__1lag	0.9286	0.1657	5.6027	0.0000	0.6037	1.2534
BookToMarketRatio__1lag	4.433e-05	1.117e-05	3.9695	0.0001	2.244e-05	6.622e-05
RetPast12to7M__1lag	-9.153e-05	0.0004	-0.2511	0.8017	-0.0008	0.0006
GrossProfitability__1lag	0.0012	0.0047	0.2454	0.8062	-0.0081	0.0104
PctSharesHeldOtherMutual__1lag	-0.0053	0.0013	-3.9260	0.0001	-0.0079	-0.0026
PctSharesHeldPension__1lag	11.292	2.7230	4.1468	0.0000	5.9547	16.629
PctSharesHeldHedge__1lag	-0.1294	0.1450	-0.8927	0.3720	-0.4136	0.1548

F-test for Poolability: 4.7965
P-value: 0.0000
Distribution: F(3035,123800)

Included effects: Entity, Time

C.3.2 International sample

Dep. Variable:	VR	**R-squared:**	0.0014
Estimator:	PanelOLS	**R-squared (Between):**	0.0757
No. Observations:	591848	**R-squared (Within):**	0.0017
Date:	Tue, Jun 18 2019	**R-squared (Overall):**	0.0104
Time:	02:02:54	**Log-likelihood**	-2.192e+05
Cov. Estimator:	Driscoll-Kraay		
		F-statistic:	98.569
Entities:	14237	**P-value**	0.0000
Avg Obs:	41.571	**Distribution:**	F(8,577533)
Min Obs:	1.0000		
Max Obs:	71.000	**F-statistic (robust):**	17.954
		P-value	0.0000
Time periods:	71	**Distribution:**	F(8,577533)
Avg Obs:	8335.9		
Min Obs:	3231.0		
Max Obs:	1.343e+04		

	Parameter	**Std. Err.**	**T-stat**	**P-value**	**Lower CI**	**Upper CI**
Intercept	0.5297	0.0856	6.1864	0.0000	0.3619	0.6975
PctSharesHeldETF_1lag	-0.6122	0.1676	-3.6541	0.0003	-0.9406	-0.2838
np.log(CompanyMarketCap_1lag)	0.0106	0.0038	2.7762	0.0055	0.0031	0.0181
InvClose_1lag	-0.0146	0.0233	-0.6261	0.5313	-0.0602	0.0311
AmihudRatio_1lag	-0.2476	0.0549	-4.5128	0.0000	-0.3551	-0.1401
PctBidAskSpread_1lag	-0.2938	0.0535	-5.4872	0.0000	-0.3987	-0.1889
BookToMarketRatio_1lag	-0.0001	0.0002	-0.5935	0.5529	-0.0004	0.0002
RetPast12to7M_1lag	-7.459e-05	4.367e-05	-1.7080	0.0876	-0.0002	1.1e-05
GrossProfitability_1lag	0.0036	0.0024	1.5214	0.1282	-0.0010	0.0082

F-test for Poolability: 5.4789
P-value: 0.0000
Distribution: F(14306,577533)

Included effects: Entity, Time

Dep. Variable:	VR	**R-squared:**	0.0014
Estimator:	PanelOLS	**R-squared (Between):**	0.0758
No. Observations:	591848	**R-squared (Within):**	0.0017
Date:	Tue, Jun 18 2019	**R-squared (Overall):**	0.0104
Time:	02:03:43	**Log-likelihood**	-2.192e+05
Cov. Estimator:	Driscoll-Kraay		
		F-statistic:	87.752
Entities:	14237	**P-value**	0.0000
Avg Obs:	41.571	**Distribution:**	F(9,577532)
Min Obs:	1.0000		
Max Obs:	71.000	**F-statistic (robust):**	16.725
		P-value	0.0000
Time periods:	71	**Distribution:**	F(9,577532)
Avg Obs:	8335.9		
Min Obs:	3231.0		
Max Obs:	1.343e+04		

	Parameter	**Std. Err.**	**T-stat**	**P-value**	**Lower CI**	**Upper CI**
Intercept	0.5304	0.0858	6.1821	0.0000	0.3623	0.6986
PctSharesHeldETF_1lag	-0.6199	0.1684	-3.6808	0.0002	-0.9499	-0.2898
np.log(CompanyMarketCap_1lag)	0.0106	0.0038	2.7598	0.0058	0.0031	0.0180
InvClose_1lag	-0.0146	0.0233	-0.6257	0.5315	-0.0602	0.0311
AmihudRatio_1lag	-0.2475	0.0549	-4.5122	0.0000	-0.3551	-0.1400
PctBidAskSpread_1lag	-0.2937	0.0536	-5.4834	0.0000	-0.3987	-0.1887
BookToMarketRatio_1lag	-0.0001	0.0002	-0.5995	0.5489	-0.0004	0.0002
RetPast12to7M_1lag	-7.461e-05	4.368e-05	-1.7081	0.0876	-0.0002	1.1e-05
GrossProfitability_1lag	0.0036	0.0024	1.5183	0.1289	-0.0010	0.0082
PctSharesHeldOtherMutual_1lag	0.0026	0.0036	0.7347	0.4625	-0.0044	0.0096

F-test for Poolability: 5.4745
P-value: 0.0000
Distribution: F(14306,577532)

Included effects: Entity, Time

Dep. Variable:	absVR	**R-squared:**	0.0049
Estimator:	PanelOLS	**R-squared (Between):**	0.0991
No. Observations:	592054	**R-squared (Within):**	0.0055
Date:	Tue, Jun 18 2019	**R-squared (Overall):**	0.0099
Time:	02:06:49	**Log-likelihood**	2.883e+04
Cov. Estimator:	Driscoll-Kraay		
		F-statistic:	354.08
Entities:	14238	**P-value**	0.0000
Avg Obs:	41.583	**Distribution:**	F(8,577738)
Min Obs:	1.0000		
Max Obs:	71.000	**F-statistic (robust):**	41.568
		P-value	0.0000
Time periods:	71	**Distribution:**	F(8,577738)
Avg Obs:	8338.8		
Min Obs:	3232.0		
Max Obs:	1.344e+04		

	Parameter	**Std. Err.**	**T-stat**	**P-value**	**Lower CI**	**Upper CI**
Intercept	0.9251	0.0411	22.527	0.0000	0.8447	1.0056
PctSharesHeldETF_1lag	0.2529	0.0929	2.7216	0.0065	0.0708	0.4349
np.log(CompanyMarketCap_1lag)	-0.0248	0.0018	-13.525	0.0000	-0.0284	-0.0212
InvClose_1lag	0.0015	0.0125	0.1169	0.9070	-0.0231	0.0260
AmihudRatio_1lag	0.2138	0.0630	3.3927	0.0007	0.0903	0.3373
PctBidAskSpread_1lag	0.2117	0.0363	5.8326	0.0000	0.1405	0.2828
BookToMarketRatio_1lag	0.0001	8.185e-05	1.6458	0.0998	-2.571e-05	0.0003
RetPast12to7M_1lag	-6.928e-05	2.638e-05	-2.6264	0.0086	-0.0001	-1.758e-05
GrossProfitability_1lag	-0.0041	0.0013	-3.2319	0.0012	-0.0065	-0.0016

F-test for Poolability: 4.4707
P-value: 0.0000
Distribution: F(14307,577738)

Included effects: Entity, Time

Dep. Variable:	absVR	**R-squared:**	0.0049
Estimator:	PanelOLS	**R-squared (Between):**	0.0992
No. Observations:	592054	**R-squared (Within):**	0.0055
Date:	Tue, Jun 18 2019	**R-squared (Overall):**	0.0099
Time:	02:05:19	**Log-likelihood**	2.883e+04
Cov. Estimator:	Driscoll-Kraay		
		F-statistic:	314.75
Entities:	14238	**P-value**	0.0000
Avg Obs:	41.583	**Distribution:**	F(9,577737)
Min Obs:	1.0000		
Max Obs:	71.000	**F-statistic (robust):**	37.209
		P-value	0.0000
Time periods:	71	**Distribution:**	F(9,577737)
Avg Obs:	8338.8		
Min Obs:	3232.0		
Max Obs:	1.344e+04		

	Parameter	**Std. Err.**	**T-stat**	**P-value**	**Lower CI**	**Upper CI**
Intercept	0.9250	0.0410	22.576	0.0000	0.8447	1.0053
PctSharesHeldETF_1lag	0.2539	0.0946	2.6854	0.0072	0.0686	0.4393
np.log(CompanyMarketCap_1lag)	-0.0248	0.0018	-13.558	0.0000	-0.0284	-0.0212
InvClose_1lag	0.0015	0.0125	0.1168	0.9070	-0.0231	0.0260
AmihudRatio_1lag	0.2138	0.0630	3.3923	0.0007	0.0903	0.3373
PctBidAskSpread_1lag	0.2117	0.0363	5.8319	0.0000	0.1405	0.2828
BookToMarketRatio_1lag	0.0001	8.189e-05	1.6464	0.0997	-2.568e-05	0.0003
RetPast12to7M_1lag	-6.928e-05	2.638e-05	-2.6265	0.0086	-0.0001	-1.758e-05
GrossProfitability_1lag	-0.0041	0.0013	-3.2325	0.0012	-0.0065	-0.0016
PctSharesHeldOtherMutual_1lag	-0.0004	0.0016	-0.2369	0.8127	-0.0035	0.0027

F-test for Poolability: 4.4561
P-value: 0.0000
Distribution: F(14307,577737)

Included effects: Entity, Time