How Does the Introduction of an ETF Market with Liquidity Providers Impact the Liquidity of the Underlying Stocks?[α]

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Abstract

This article examines how the inception of an ETF market where liquidity providers (LPs) act as market makers, impacts the liquidity of the ETF-underlying-index stocks. Using detailed data from Euronext Paris, we find that: (1) trading costs in the ETF market are significantly lower than those observed in the market for the underlying stocks, and show that ETF LPs are largely responsible for this cost reduction; (2) the market for the underlying stocks becomes more liquid after the ETF introduction for investors who trade at the best-limit quotes; (3) but the stock market becomes less deep for larger traders, most probably because some large liquidity traders exit the underlying stocks' market for the ETF market.

1. Introduction

Exchange-Traded Funds (ETFs) are widely acknowledged to be one of the most useful innovations of the past few decades, especially for index traders. They are essentially exchange-traded assets that represent a basket of securities comprising a particular index. ETFs allow investors to take positions in a given market without selecting individual securities, and provide them with an opportunity to easily trade indices, in small amounts, and at very low costs. They are thus generally not considered as redundant assets, but rather as new financial instruments that complete markets in an economic sense. They are particularly well suited for passive investors, and combine the advantages of closed-end and open-end mutual funds with much lower expense fees. On the one hand, as close-end funds, ETFs can be traded throughout the day in the secondary market. On the other hand, they can be considered as open-end mutual funds, as the creation and redemption of ETF shares is allowed.

As a result of these attractive features, ETFs are now very popular investment vehicles. A Morgan Stanley report found that the number of ETFs available worldwide in 2007 stood at 1,137. Assets under management in these funds totalled US$ 773.2 billion and they were listed on 42 exchanges. Understanding how and why ETFs contribute to the quality of stock markets is thus of great interest, and our research specifically investigates the impact of the first introduction of an ETF on the liquidity of the underlying stocks when the ETF market involves designated market makers. We find that not all dimensions of liquidity are influenced in the same fashion and argue that designated ETF market makers may play a role in that.

Previous literature provides diverse results on the liquidity effect of ETF inception. Hegde and McDermott (2004) investigate the liquidity effects of the introduction of ETFs for the DJIA 30 and the Nasdaq 100 stock indices, the Diamonds index, and the QQQ, respectively, and find a liquidity improvement largely related to a decline in the cost of informed trading in the underlying stocks. Richie and Madura (2007) also test the impact of the QQQ fund's creation on the liquidity of the component securities and the risk of the underlying securities. They find that the liquidity improvement following the QQQ's creation is more pronounced for less heavily weighted stocks and that the systematic risk of the underlying stocks declines relative to a control sample. However, using matched samples, Van Ness, Van Ness, and Warr (2005) do not find a similar improvement for the DJIA 30. They test the hypothesis that uninformed traders prefer to invest in the Diamond ETF rather than individual stocks constituting the index. They find that following the introduction of the Diamond ETF, the bid-ask spreads of the DJIA 30 actually increase relative to spreads of matching stocks, but they do not find a consistent change in the adverse selection components of the Dow stocks' spreads.

Our paper tests the liquidity effects of the first ETF replicating the French CAC 40 index and contributes to the extant literature in several ways. First, the introduction of ETFs on Euronext is of particular interest, because the inception of an ETF on this exchange not only creates a new means of trading the underlying index, but also changes the microstructure of the index market. On Euronext, ETFs are traded in a hybrid, continuous, order-driven market, in which designated market makers, the so-called *Liquidity Providers* (LPs), have to provide immediacy services. Using non-public complete order book data, we show that ETF LPs greatly contribute to the liquidity of the ETF market. Given the benefit of those LPs, liquidity effects may differ from those observed for ETFs listed on other exchanges. Second, we not only analyze bid-ask spreads to measure liquidity, but also examine other measures related to depth, thanks to the availability of more detailed data for the French stock market. This leads us to more specific conclusions than previous articles. Third, we investigate which theories best explain our empirical findings by analyzing the cross-section of the CAC 40 stocks and the composition of the trade flow in these securities. We find that the market for the underlying stocks becomes more liquid after the ETF introduction for investors who trade at the best-limit quotes, and cannot reject the hypothesis that arbitrage activity increases following the ETF introduction. Nevertheless, for larger traders, the stock market is less deep after the ETF introduction, probably because some large liquidity traders have left the underlying stocks' market for the ETF market, as suggested by the changes observed in the trade flow distribution. This may relate to the market making activity of LPs.

This article is organized as follows. In Section 2, we describe the Lyxor CAC 40, present its market microstructure, and assess its economic role by estimating implicit trading costs incurred by index traders. For that purpose, we use a complete database that allows measurement of the precise contribution of market makers to the reduction in trading costs. In Section 3, we review different theories on the impact of the inception of an ETF on the liquidity of the basket stocks, and derive testable hypotheses. Those hypotheses are then tested in Sections 4 and 5. Section 4 presents an empirical test of the liquidity effect of the Lyxor CAC 40 introduction, while Section 5 conducts additional tests to explain the findings of Section 4. Section 6 concludes.

2. The Lyxor CAC 40: description, trading mechanisms, and associated cost savings

Whereas ETFs were created in the 1990s in North-America,[1] they were not introduced before the early 2000s in European markets. The Lyxor CAC 40, which tracks the performance of the CAC 40 index, was the first ETF to be listed on Euronext.[2] With €2.5 billion euro under management in early March 2009, it has now become one of the most actively traded funds on NextTrack, the segment of Euronext dedicated to the listing and trading of ETFs.

2.1. The Lyxor CAC 40 fund

The CAC 40 index, which takes its name from the Paris Bourse's early electronic system "Cotation Assistée en Continu," is the flagship French stock market index and comprises forty large capitalization stocks. It is a market-value weighted index whose composition is reviewed quarterly by an independent Index Steering Committee. The main criteria for inclusion in the CAC 40 are market size and turnover.[3] Its base value

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[1] ETFs were first introduced on the Toronto Stock Exchange in March 1990 with the creation of the TIPs (Toronto Index Participation units). This initial creation was followed in 1993 by the inception of the SPY which replicates the S&P 500 on the AMEX. Currently, the three most active ETFs are the SPY, the QQQ which replicates the Nasdaq 100, and the DIA which tracks the DJIA 30.

[2] In 2001, the European exchange Euronext comprised the former exchanges of Amsterdam, Brussels, and Paris. It then took over the Portuguese exchanges of Porto and Lisbon. More recently, in 2007, it merged with the NYSE and is now a subsidiary of the transatlantic group Nyse-Euronext.

[3] At each review date, the companies listed on Euronext Paris are ranked according to free float capitalization and turnover over the twelve past months. From the top 100 companies in that ranking,

was set to 1,000 on December 31, 1987. It serves as an underlying asset for futures contracts and options traded on Euronext.Liffe.

The Lyxor CAC 40 was the first ETF created to replicate the value of the CAC 40. It is a French mutual fund that complies with the UCITS III European directive. It was issued on NextTrack, on January 22, 2001, by Lyxor, a subsidiary of Société Générale. One unit of the ETF is worth 1/100 of the index and the index return is tracked by way of synthetic replication, which guarantees a tracking error of less than 1%. Management fees equal no more than 0.25% per year and no entrance or exit fees are charged. That allows investors to buy the index with perfect replication, even for small amounts, at low fees, and without the constraints of derivative markets – such as deposits and margin calls. Share creation and redemption are always possible for a minimum amount of 50,000 units and are charged €10,000 per subscription request.

2.2. Trading mechanisms

The European stock markets of Nyse-Euronext currently rank among the most important trading venues in Europe and rely on a homogeneous order-driven structure. The CAC 40 stocks are traded continuously in the NSC[4] electronic order book. The trading day starts with a call auction at 9.00am following a pre-opening phase beginning at 7.15am. Then the market switches over to continuous trading and closes with a call auction at 5.30 pm following a 5-minute pre-closing period. Both opening and closing prices are set by matching the supply and demand curves and selecting the price that

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forty are chosen to enter the CAC 40 in order to make it "a relevant benchmark for portfolio management" and "a suitable underlying asset for derivative products."

[4] NSC stands for *Nouveau Système de Cotation* and designates the electronic order-driven system run by Euronext.

maximizes the trading volume. The continuous trading system enforces a price-time order priority rule to arrange trades.

ETFs listed on NextTrack are also continuously traded on NSC, but their trading session is delayed by five minutes compared with the cash stock market session, so that the price discovery process on underlying stocks precedes that on ETFs. In spite of that similarity with the cash market microstructure, the ETF's market is different on two aspects. First, while CAC 40 stocks are traded in a pure limit-order book market, market members may act as *Liquidity Providers* (LPs) on NextTrack. As market specialists for their stocks, LPs have a business agreement with Euronext whereby they undertake to quote two-way bid and ask prices in the limit order book, with a minimum volume and within a maximum spread. They commit to maintain a spread of firm bid and offer prices during the fifteen minutes preceding the market opening, and then throughout the trading day including the order accumulation period preceding auctions. In return for those commitments, orders placed by LPs and their resulting trades are subject to tariff benefits which are conditioned on their performance in providing liquidity without exceeding 50% of explicit trading fees. LPs benefit from the maximum fee reduction of 50%, provided that they comply with 80% of their commitments in terms of quote time, quoted spreads, and quoted quantities. Second, a large portion of the ETF order flow is executed in the OTC market by LPs. As the Markets in Financial Instruments Directive (MiFID) does not apply to ETF trading, there is no commitment of post-trade transparency for those OTC trades. As a result, a large fraction of ETF transactions with institutional investors is veiled.

2.3. Cost savings related to the ETF and LPs' contribution

We assess the economic relevance of ETFs by comparing the implicit transaction costs associated with the Lyxor CAC 40 with those associated with the CAC 40 stock basket. We then assess the extent to which ETF LPs contribute to the cost savings observed.

2.3.1. The data used to compare trading costs in the ETF and in the stock basket

We base our analysis on the database used by De Winne and D'Hondt (2007). This database contains very detailed information about every state of the limit order book during October 2002. Our sample contains the CAC 40 stocks and the Lyxor CAC 40 security. At every second, we know exactly what is registered in the limit order book for a given stock – the set of the five best bid/ask quotes (not only the best ones), both displayed and hidden quantities associated with these quotes, and the portion of these quantities stemming from client orders, principal orders, or LPs' orders. Additional information[5] about this database and about the process used to build the limit order book may be found in De Winne and D'Hondt (2007).

2.3.2. Comparing trading costs in the CAC 40 stocks and the Lyxor CAC 40 stock

We compare the cost of a round-trip trade in the CAC 40 stock basket and in the CAC 40 tracker using order book data during October 2002. Results show that trading the index in the tracker market is less costly than trading the index in the individual stock market.

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[5] A note describing the methodology applied to build the limit order book from Euronext order and trade files is available on request. The analysis performed in this section relies on the availability of such detailed data, which in turn justifies the choice of this particular period.

As mentioned by Irvine, Benston, and Kandel (2000), an ex ante liquidity measure is useful to indicate the upper bound of transaction cost at which an order can be immediately executed. Of course, we know that many traders will try to obtain a better price for the whole amount of shares by splitting their orders but the cost of a round-trip trade (CRT) gives some idea of the implicit costs that one could expect from a naive order placement strategy. At a given point in time *t*, the CRT for a trade size *T* corresponds to the difference between the cost of buying *T* shares of a stock *i* ($B_{T,i,t}$) and the amount received from selling these *T* shares ($S_{T,i,t}$). Due to the spread, this difference is always positive in continuous trading. For the purpose of comparison across stocks or trade sizes, this difference is divided by the value of these *T* shares at the mid-point. The CRT for a trade size of *T* shares of stock *i* at time *t* will be computed as follows:

$$CRT_{T,i,t} = \frac{B_{T,i,t} - S_{T,i,t}}{T \times \frac{\left(B_{1,i,t} + S_{1,i,t}\right)}{2}} \ , \tag{1}$$

where both displayed and hidden orders are accounted for.[6]

For each stock in our sample and for the tracker, we compute this measure every time a new order is placed. We measure the CRT for 5,000 and 50,000 shares of the Lyxor CAC 40. According to the weight of each stock in the CAC 40 index measured at the opening auction every day, we compute the corresponding number of shares to be traded for respectively 5,000 and 50,000 shares of the tracker. These numbers are then used to measure the CRT of individual stocks according to Equation (1). For each of the 40 individual stocks, the time-weighted average CRT is calculated. The monetary

[6] On Euronext and NextTrack, hidden orders are allowed and undisclosed depth is likely to lower this cost compared with what one could expect from depth displayed on the screens.

CRT is obtained from Equation (1) by omitting to divide by the value of the *T* shares at the mid-point. When summing up the 40 individual monetary CRTs, we obtain a cost that can be directly compared with the monetary CRT of the Lyxor CAC 40. Comparative results are reported in Table 1.

[Insert Table 1]

The costs associated with trading the basket of stocks appears to be higher than that associated with trading the ETF. Indeed, trading the underlying stocks is nearly 45% (33%) more expensive than trading 5,000 (50,000) shares of the tracker.

2.3.3. The role of LPs

As explained earlier, the organization of both the ETF and the single stock markets is very similar, the only difference being the presence of LPs in the tracker's market. We therefore test to what extent the LPs' activity explains the dramatic difference in costs between the tracker and the underlying stocks. Among the pieces of information available for each state of the order book, the status of each order allows us to distinguish depth due to, respectively, usual traders and LPs. Our results are based on 432,266 order book states. The last two lines of Table 1 allow us to conclude that LPs contribute massively to the reduction in CRT. Omitting orders placed by LPs multiplies the CRT by about four.[7]

Table 2 presents some liquidity measures for the Lyxor CAC 40. Average relative quoted spreads, as well as average depths at the first and at the five best limits are first

[7] This result is even downward biased if we consider that, for some states of the order book, CRTs were not computed because the five best limits were not sufficient to trade the amount of 5,000 or 50,000 shares.

computed using all the orders waiting in the limit order book. Then those measures are recomputed without accounting for orders submitted by LPs. Comparing the two scenarios confirms that LPs greatly contribute to the liquidity of the ETF market.

[Insert Table 2]

However, LPs seem to behave strategically in the way they provide liquidity. Table 3 shows that the contribution of the LPs is not associated with a frequent presence at the best quotes. On the contrary, no LP is found at the best bid (ask) price for 67% (70%) of the order book states, and they are totally absent from both best quotes during half of the time. Further, the proportion of order book states where LPs are alone at the best bid (ask) price does not exceed 19% (15%).

[Insert Table 3]

3. Related theories and testable hypotheses

Since the introduction of the Lyxor CAC 40 allows trading of the CAC 40 index at lower costs, as shown in Section 2, and in small denominations, it can have diverse effects such as attracting new investors to the stock market or diverting particular categories of traders from the market of the underlying stocks to the ETF market. Those effects, if they occur, are likely to impact the liquidity of the basket of underlying stocks, either positively or negatively. This section presents the different hypotheses that explain how the inception of an ETF can alter the liquidity of the index components. The theories most cited in the literature that address the impact of ETF introduction are the *adverse selection hypothesis* and the *arbitrage hypothesis*. Richie and Madura (2007) also put forward the *recognition hypothesis*. From these theories, we derive a set of hypotheses that will be tested in Sections 4 and 5.

3.1. The adverse selection hypothesis

The consequences of the introduction of a basket security for liquidity have been modeled by Subramanyam (1991) in the theoretical settings of Admati and Pfleiderer (1988). In this model, a population of informed and uninformed traders can choose to trade either in *N* individual asset markets or in the *N*-assets index stock market. Informed traders hold two types of signals: specific private information or systematic private information. At equilibrium, specific-information traders preferably trade in the underlying stock market while systematic-information traders elicit the basket market for trading, and discretionary liquidity traders go to the basket market, where their losses to informed traders are usually lower. As a result of reduced liquidity trading in the component securities, adverse selection costs and spreads may increase in the underlying security markets, and this increase is predicted to be more significant for securities with smaller weights in the basket than for heavily weighted securities.

3.2. The arbitrage hypothesis

Introducing financial instruments derived from existing securities may reduce market incompleteness and expand the investment and arbitrage opportunities facing investors (Ross, 1976; Hakansson, 1982). If these new instruments generate additional arbitrage trading, price efficiency, and liquidity in the underlying markets are consequently improved. For instance, Kumar, Sarin, and Shastri (1998) provide unambiguous evidence of improved market quality following option listings. The introduction of ETFs may create similar arbitrage benefits, for two reasons. First, assuming that markets are informationally segmented, the introduction of an index security mitigates structural problems besetting inter-market arbitrage: it lowers arbitrage costs such as tracking errors or the randomness in the intervening dividend payoffs and it therefore favors arbitrage trading (Hegde and McDermott, 2004). Second, upon introduction of the ETF, traders or ETF LPs can exploit new arbitrage opportunities via the creation and redemption mechanisms of shares in the new ETF (Richie and Madura, 2007). Increased arbitrage activity would then result in increased liquidity, lower adverse selection risk, and lower price volatility (Fremault, 1991). However, in the case of the Lyxor CAC 40, arbitrage opportunities resulting from creation and redemption of ETF shares seem difficult to exploit because of the dissuasive costs charged in the ETF primary market,[8] and new arbitrage opportunities should essentially arise from the ETF secondary market.

3.3. The recognition hypothesis

This hypothesis is based on Merton's (1987) *Investor Recognition Theory* and the assumption that the inception of the ETF raises more interest from investors in the index and the index securities. The creation of an ETF allows small investors to trade the index easily, at low cost, without the expertise required in index options and futures contract markets. It makes index investing more attractive and creates interest for all the securities related to the index, even the index components that were less traded prior to the ETF introduction – those with the lowest weight in the index. Merton's (1987) theory argues that when there is added participation of investors in the market, liquidity increases, and the dispersion of beliefs on expected future payoffs decreases, so price volatility is reduced. These effects should be greater for the smallest components of the index.

[8] A minimum amount of 50,000 units is required to create or redeem ETF shares. Each subscription request is charged €10,000.

3.4. Testable hypotheses

According to the adverse selection hypothesis, the liquidity of the basket stocks is reduced after the introduction of the ETF, because adverse selection increases in the cash stock market. Therefore, this theory can be examined by testing the following hypotheses:

Immediately after the inception of the ETF,

H1a. Index stocks' liquidity decreases while non-index stocks' liquidity does not;

H2. Index stocks' adverse selection costs increase while those of non-index stocks do not.

Alternatively, according to the arbitrage and recognition hypotheses, the underlying stocks' liquidity is improved with the ETF introduction and short-term volatility is reduced, so that these two theories may hold if we find evidence to support H1b, the alternative of H1a, and H3:

Immediately after the inception of the ETF,

H1b. Index stocks' liquidity increases while non-index stocks' liquidity does not;

H3. Index stocks' temporary volatility decreases while non-index stocks' volatility does not.

Finally, if we find support for H1b and H3, the arbitrage hypothesis can be discriminated from the recognition theory by comparing large and small components of the index. The effect of arbitrage can be expected to be equivalent for all index components while the recognition effect should mostly affect the smallest constituents. Consistently, evidence for the recognition hypothesis would come from support for H4:

H4. The increase in liquidity and the decrease in temporary volatility are greater for the smallest components of the index.

Section 4 focuses on H1a and H1b. H2, H3, and H4 are tested in Section 5.

4. The impact of the tracker inception on the liquidity of underlying stocks

In order to test H1a and H1b, we examine the variation in several measures of liquidity for CAC 40 stocks and for a control sample on two 3-month intervals surrounding the tracker-inception date of January 22, 2001. After excluding securities added to and cancelled from the index during the observation period, we obtain a sample of 38 stocks. The pre-introduction observation period is defined as the three months between October 19, 2000 and January 15, 2001, while the post-introduction period comprises the three months from February 1, 2001 to April 27, 2001. The week immediately preceding and the one immediately following the Lyxor CAC 40 inception are excluded from the sample periods so as to avoid temporary liquidity effects. We build the control sample by selecting the 40 most traded non-CAC 40 stocks.

For stocks that are eligible for block trading, Euronext defines a Normal Block Size (NBS),[9] that is the minimum share quantity for which the block trading procedure applies. Euronext continuously computes the bid-ask spread that would result from buying and selling the NBS against orders standing in the order book. This spread is obtained by weighting the different bid and ask limit prices hit to execute the NBS with associated quantities, and is designated as the *fourchette moyenne pondérée* (literally average weighted spread) by Euronext. It will be referred to as the “block spread” in the remainder of the article.

While all CAC 40 securities are eligible for block trading, not all control stocks are. The elimination of stocks for which the block spread is not computed by Euronext

[9] *Taille normale de bloc (TNB).*

leaves us with a control sample of 34 stocks. We conduct a univariate analysis and a multivariate analysis for both the CAC 40 sample and the control sample, to compare liquidity in the pre-ETF and in the post-ETF period.

4.1. Data

The high frequency trade and quote data used in Section 4 and 5 are extracted from the Euronext BDM market database. Trade files provide the date, time, price, and volume of each trade executed during the opening auction, the continuous session, or the closing auction. The quote data cover best bid and ask limit prices with associated visible quantities as posted during the trading session. Hidden quantities are not provided.

Quote and trade timestamps are based on a second-by-second frequency. In best quote files, a new record appears each time any feature of the best limits, either a price or a quantity, changes. In the trade database, if one buy (sell) marketable order executes against *n* sell (buy) orders with the same limit price, then *n* trades with the same timestamp and price will be recorded. Also, each time an order is executed against a pending limit order, it modifies the best bid and ask quotes, so that a new best quote record is automatically produced with the same timestamp as the trade from which it results. If a trade is executed against several orders, there will be several successive quotes produced by the trade and they will be recorded in chronological order in the quote file. In order to rebuild the trade and quote dynamics, and then to sign trades, we aggregate trade records with the same timestamp and price in a single trade record. When several quote records have the same timestamp, we keep the last one recorded in the best quote file. When ordering trades and best quotes, if a trade and a quote have the same timestamp, the quote is considered as consecutive to the trade. Trades are then signed according to their price relative to the prevailing mid-quote at the time of the trade. As in Lee and Ready (1991), trades whose prices are higher (lower) than the mid-quote are considered as purchases (sales). Finally, specific files report bid and ask block prices as calculated by Euronext, with the corresponding NBSs.

4.2. Univariate analysis

We consider measures related to trading volumes, trading frequency, spreads, and depth, and test the difference in their cross-sectional means between the pre-ETF and the post-ETF observation periods. Measures of volumes and trading frequency comprise the average daily trading volume in euros, the total trading volume in number of shares, the average daily number of trades, and the average trade size. We then compare cross-sectional means of bid-ask spread measures as, first, the cross-sectional mean of average duration-weighted quoted spreads,

$$DWQS = \frac{1}{M}\sum_{i=1}^{M}\left(\frac{1}{\sum_{n=1}^{N_i} d_{i,n}}\sum_{n=1}^{N_i} d_{i,n}\frac{ask_{i,n} - bid_{i,n}}{mid_{i,n}}\right), \tag{2}$$

and, second, the cross-sectional mean of average effective spreads,

$$ES = \frac{1}{M}\sum_{i=1}^{M}\left(\frac{1}{T_i}\sum_{t-1}^{T_i} 2\times\frac{P_{i,t} - mid_{i,t}}{mid_{i,t}}\right) = \frac{1}{M}\sum_{i=1}^{M} ES_i, \tag{3}$$

where:

$bid_{i,n}$, $ask_{i,n}$, and $mid_{i,n}$ are respectively the best bid, best ask, and middle prices at the time of the n^{th} spread quoted for stock *i*;

$d_{i,n}$ is the duration of the n^{th} spread quoted for stock *i*;

N_i is the number of spreads quoted for stock *i* over the considered period;

$bid_{i,t}$, $ask_{i,t}$, and $mid_{i,t}$ are respectively the best bid, best ask, and middle prices prevailing before the t^{th} transaction for stock at price $P_{i,t}$;

T_i is the number of trades for stock *i* over the considered period;

and *M* is the number of stocks in the sample (38 for the index basket and 34 for the control sample).

As all CAC 40 and control stocks are eligible for the block trading procedure, we also compute their average block spreads before and after the tracker introduction with the following cross-sectional mean:

$$BS = \frac{1}{M}\sum_{i=1}^{M}\left(\frac{1}{\sum_{m=1}^{M_i}\delta_{i,m}}\sum_{m=1}^{M_i}\delta_{i,m}BS_{i,m}\right), \tag{4}$$

where

$BS_{i,m}$ is the m^{th} block spread computed for stock *i* over the period;

$\delta_{i,m}$ is the duration of the m^{th} block spread computed for stock *i*;

and M_i is the number of block spreads computed for stock *i* over the period.

Finally, we examine depth measured by the euro volumes associated with best limits:

$$D = \frac{1}{M}\sum_{i=1}^{M}\left(\frac{1}{\sum_{n=1}^{N_i}d_{i,n}}\sum_{n=1}^{N_i}d_{i,n}\left(Qbid_{i,n}\times bid_{i,n}+Qask_{i,n}\times ask_{i,n}\right)\right) \tag{5}$$

where $Qbid_{i,n}$ is the number of shares demanded at the best bid price and $Qask_{i,n}$ is the number of shares offered at the best ask price at the time of the n^{th} spread quoted for stock *i*.

The results displayed in Table 4 indicate an improvement in liquidity at the best-limit level, with a significant reduction in duration-weighted quoted spreads and effective spreads, and no significant variation in best-limit depth for the CAC 40 stock sample. No similar improvement is observed for the control sample. Those observations partially validate H1b. Nevertheless, we observe an opposite liquidity effect at upper limits. Block spreads widen significantly for CAC 40 stocks, meaning that the immediacy costs for large quantities have risen.

[Insert Table 4]

4.3. Multivariate analysis

We complete our analyses with multiple panel regressions that control for volatility, trading volume, price level, and order imbalance. We consider four dependent variables: (1) the duration-weighted average of the relative quoted spread; (2) the average of the relative effective spread; (3) the time-weighted mean of the quantities available at the best-limit quotes, measured in euros and taken in logarithm, referred to as the best-limit depth; and (4) the average duration-weighted block spread. We compute those variables on a daily basis for the 38 CAC 40 stocks of our sample and the 34 stocks of the control sample. We thus have 72 cross-sections with 120 daily observations by cross-section.

Each panel regression is run by implementing the Parks method, which captures two-way fixed effects and includes a one-lag autocorrelation term in the residuals. For each dependent variable, denoted DV_{it} on day t for stock i, the model stands as follows:

$$DV_{it} = a + b\sigma_{it} + c\ln V_{it} + d\ln P_{it} + eI_{it} + fETF_t + gETF_t \times CAC40_i + hETF_t \times w_i + u_{it}. \quad (6)$$

In Equation (6):

σ_{it} denotes the price range calculated as the difference between the highest price and the lowest price divided by the lowest price during day t for stock i;

$\ln V_{it}$ is the logarithm of the euro volume traded on stock i at date t;

$\ln P_{it}$ is the logarithm of stock i's open price on day t;

I_{it} is the absolute value of the difference between sell trade volumes and buy trade volumes reported to the total trade volume for stock i on day t;

ETF_t is a dummy variable that equals 0 for dates preceding the ETF introduction; in the post-ETF period, it equals the number of shares outstanding for the ETF on day t divided by the number of shares issued at inception;

$CAC40_i$ is a binary variable that equals 1 if stock i belongs to the CAC 40 index, 0 otherwise;

w_i is the weight of stock i in the CAC 40 index at the ETF inception date when i is a CAC 40 stock, 0 otherwise;

and $u_{it} = \rho_i u_{it-1} + \varepsilon_{it}$ is an auto-correlated residual term in which the ρ_i coefficient is fixed per cross-section and $E(\varepsilon_{it}) = E(\varepsilon_{it}\varepsilon_{it-1}) = 0$.

According to H1a, the g coefficient should be significantly positive when DV_{it} is a spread measure and significantly negative when DV_{it} is the best-limit depth, whereas H1b predicts opposite signs for g.

The results displayed in Table 5 confirm those of the univariate tests. Quoted and effective spreads decrease with a high level of economic and statistical significance in the post-ETF period, but only for CAC 40 stocks. A g coefficient of -0.0402 (-0.0141) in the regression of quoted (effective) spreads means that these decrease, on average, by 12% (9%) in the post-ETF period for index stocks, and these coefficients are significantly negative at the 0.1% level. Depth decreases for all stocks after the ETF inception date: f is negative at the 5% threshold for best-limit depths and positive at the

0.1% level for block spreads. However, the increase in block spreads and the decrease in best-limit depth are greater for CAC 40 stocks, with a statistical significance of 0.1% and 5%, respectively. The values of the corresponding *g* coefficients indicate significant economic effects.

[Insert Table 5]

The tightening of quoted and effective spreads we observe for CAC 40 stocks in the post-ETF period is evidence supporting H1b and leads to rejection of H1a , which is consistent with the previous studies of Hegde and McDermott (2004) and Richie and Madura (2007). However, the validation of H1b is only partial as the observation of block spreads and depths leads to opposite conclusions. Therefore, in contrast with other studies, we cannot yet conclude that a general improvement in the liquidity of the underlying stocks occurs after ETF introduction. Besides, H1b is derived from the arbitrage and the recognition hypotheses, and discriminating between the two theories requires further analysis.

5. Explaining liquidity changes around the ETF's inception date

In this section, we attempt to discriminate between the two theories supporting the bid-ask spread reduction we observe for CAC 40 stocks around the Lyxor CAC 40 introduction by testing H3 and H4, and we seek to explain the opposite changes in bid-ask spreads and block spreads. In particular, we test whether:

1. The increase in block spreads observed for CAC 40 stocks could be related to an increase in adverse selection costs (H2);

2. The bid-ask spread reduction observed for CAC 40 stocks is accompanied by a decrease in temporary volatility (H3), as predicted by the arbitrage and recognition hypotheses;

3. The reduction in bid-ask spreads and volatility is greatest for the smallest components of the index (H4), consistent with the recognition hypothesis.

H2 and H3 are tested in the first sub-section, and the second sub-section addresses H4. In the last sub-section, we analyze the trade flow distribution before and after the launch of the ETF to explain the contradictive findings about best-limit bid-ask spreads and block spreads.

5.1. Temporary volatility and price impact comparisons

To test H3, we compare return variance ratios, for the CAC 40 stock sample and the control sample, in the pre-ETF period with those in the post-ETF period. We consider two variance ratios: the variance of 1-minute returns divided by that of 5-minute returns and the variance of 1-minute returns reported to that of 30-minute returns. 1-minute, 5-minute and 30-minute returns are computed from 9:15am to 5:15pm. According to the results displayed in Panel A of Table 6, the 1-minute return variance of CAC 40 stocks significantly decreases relative to the variance of their returns measured over longer intervals whereas similar variance ratios do not decrease for control stocks. Therefore, the null hypothesis of H3 is rejected.

[Insert Table 6]

We then conduct spread decompositions to test H2 and use two methods: (1) the decomposition of the effective spread in a realized spread and a price impact within a 30-minute interval in the manner of Bessembinder and Kaufman (1997), and (2) the approach of Lin, Sanger and Booth (1995).[10] Using the notations of Section 4, average price impacts at a 30-minute interval are calculated as follows:

$$PI_{30\min} = \frac{1}{M}\sum_{i=1}^{M}\left(\frac{1}{T_i}\sum_{t=1}^{T_i}\frac{mid_{i,t+30\min} - mid_{i,t}}{mid_{i,t}}\right), \tag{7}$$

The Lin, Sanger and Booth (LSB) adverse selection component is estimated as the sensitivity λ^{LSB} of mid-price revisions to trade sizes with the following regression model for each stock *i*:

$$mid_{i,t+1} - mid_{i,t} = \lambda_i^{LSB}\left(P_{i,t} - mid_{i,t}\right)Q_{i,t} + e_{i,t+1}^{LSB}, \tag{8}$$

where $Q_{i,t}$ is the sign of trade *t*. Adverse selection costs are then estimated as a percentage of the mid-quote by multiplying λ_i^{LSB} with the average effective spread of stock *i*, ES_i, defined in Equation (3). This parameter product is then averaged across the sample for each observation period:

$$AS^{LSB} = \frac{1}{M}\sum_{i=1}^{M}\lambda_i^{LSB} \times ES_i \quad . \tag{9}$$

Comparative results are reported at Panel B of Table 6. Pre/post-ETF differences in price impact measures or in the LSB adverse selection component do not significantly differ from 0 for any sample, which supports the rejection of H2.

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[10] The Huang and Stoll (1997) two- and three-factor spread decomposition models were also tested, but we experienced convergence problems for some stocks. Thus an average coefficient across stocks could not be computed.

5.2. Analysis by market size

H4 is tested in two ways. First, we have included a variable related to market size, $ETF_t \times w_i$, in the regression of Equation (6). Results in Table 5 show that the coefficient of this variable is significantly positive at the 1% level for all measures of spreads. This finding indicates that the bid-ask spread tightening is less pronounced for large capitalization stocks and that the block spread increase is greater for those components. Second, we conduct the spread, depth, and variance ratio comparisons around the Lyxor CAC 40 introduction using market size quartiles based on the market value observed at the ETF inception date of January 22, 2001. Q1 (Q4) denotes the sub-sample on the ten largest (smallest) capitalization stocks of the CAC 40 sample. The intermediary quartiles, Q2 and Q3, comprise nine securities each.

Given the small size of the quartiles, the statistical significance of value differences is established by using non parametric tests. According to the average differences by quartiles provided in Table 7, block spreads increase in the post-ETF period for all quartiles with similar levels of economic and statistical significance. Average best-limit depths expressed in euros do not change significantly.

[Insert Table 7]

Quoted and effective spreads tighten for all quartiles. Variance ratios decrease for all quartiles but Q1. However, according to the Wilcoxon tests, these spread and price quality improvements are statistically significant for Q3 only. We thus have no evidence of greater effects for Q4, and we fail to find support for the recognition hypothesis (H4) which predicts the strongest liquidity effect for the smallest capitalization stocks.

5.3. Changes in the trade flow distribution

According to the findings of Section 4, the market for the underlying stocks becomes more liquid after ETF introduction for investors who trade at the best-limit quotes, yet for larger traders the cost of immediacy increases as block spreads become larger. In other words, the market is less deep. To interpret this observation, we break down trades into two categories: trades for which the price is at or inside the best quotes and trades for which the price exceeds the best ask price or stands below the best bid price because the trade size exceeds the quantities offered at the best quote. The former will be referred to as "trades at the bid-ask-spread," and the latter will be referred to as "trades outside the bid-ask spreads." For each stock, we compute the share of each class of transactions in the total number of trades and in the total trading volume, and test the average difference in this variable before and after the ETF introduction. Panel A of Table 8 compare the results for the CAC 40 sample and for the control sample. Panel B of Table 8 lays down the results by market size quartiles.

[Insert Table 8]

Trading volumes of CAC 40 stocks, measured as number of shares traded per period, significantly increase in the post-ETF period, but this effect is significant only for quartile Q1. The distribution of trades between those executed at the bid-ask spread and those executed outside the bid-ask spread changes significantly to the benefit of the former and the expense of the latter, while changes for the control sample are not significant at the 5% level. On average, the share of trades executed at the bid-ask spread in the total number of CAC 40 stocks' trades increases by 2.53%. This relative variation is significantly positive at the 0.1% level. Simultaneously, the average share of trades executed outside the bid-ask spread decreases by 11.16%, which is also significantly different from 0 at the 0.1% level. When breaking down the CAC 40 sample by size quartiles, this phenomenon is observed for all quartiles and is statistically significant at the 10% threshold for all quartiles except Q1.

From these results we conclude that some large liquidity traders probably left the underlying stocks' market when the ETF market was created. The proportion of informed traders among those who consume liquidity beyond the best quotes has thus increased. Consequently, limit order traders who place orders behind the best limits have a lower probability of being executed, they incur higher adverse selection costs, and therefore they are prompted to quote more expensive prices than before. As a result, there is a bigger incentive for liquidity consumers remaining in the stock market to split their orders and trade at the best quote, which explains the liquidity improvement observed at the best limit level.

In conclusion, the adverse selection hypothesis – first rejected when considering the change in average spreads only – cannot be fully rejected as it seems to hold for a particular class of traders. We fail to find support for the recognition hypothesis, as the smallest components of the index are the most impacted, but we cannot rule out the arbitrage hypothesis to explain the bid-ask spread reduction in the post-ETF period. Indeed, the CAC 40 stocks for which the spread reduction is most significant are those for which variance ratios decrease most. However, enhanced trading activity does not suffice to explain all of our findings. In particular, the improvement in liquidity is concentrated at the best limit quotes, whereas block spreads have widened. In other words, the price slope in the order book has become steeper. For that reason, we conclude that an alternative explanation should be sought.

5.4. The liquidity-provision hypothesis as a potential explanation

Because ETF LPs contribute substantially to the liquidity of the ETF market, as shown in Section 2, we propose an alternative explanation which we call the *liquidity-provision hypothesis*. The introduction of ETFs on NextTrack not only creates a new means to invest in the underlying index, but also introduces market making on the index. The Lyxor CAC 40 trades in a continuous order-driven market with LPs, who are designated market makers, while the market for the underlying stocks is purely order-driven. On the one hand, the introduction of market making for the security replicating the index possibly provides the index stock market with added liquidity by offering immediacy services. Indeed, LPs have been proved to improve the liquidity of stock markets in some cases. In particular, Menkveld and Wang (2009) show that contracting with designated market makers improves the liquidity level and reduces the liquidity risk of small-cap stocks on Euronext. On the other hand, LPs likely divert passive large institutional investors from the cash stock market, which may increase block spreads. The ability of market makers to attract the least informed and thus the most profitable order flow of securities traded in hybrid markets has been acknowledged in previous research (Easley, Kiefer, and O'Hara, 1996; Gajewski and Gresse, 2007).

6. Conclusion

Using data from the French stock market, we test the impact of the introduction of the first ETF replicating the CAC 40 index on the liquidity of the underlying securities. Consistent with the findings of Hegde and McDermott (2004) and Richie and Madura (2007), and contrary to those of Van Ness et al. (2005), we show that spreads associated with the best-limit quotes tighten after the ETF inception. Yet, in contrast to the conclusion of Hegde and McDermott (2004), our measures of adverse selection do not change significantly in the post-ETF period, so the decrease in quoted and effective spreads cannot be due to a reduction in information asymmetry for constituent stocks. When analyzing mean spread differences around the ETF introduction date by quartiles of market size, the quartile of smallest index components is not the one that experiences the most significant improvements. For that reason, we cannot interpret our findings as supporting the recognition theory either. The analysis of return variance ratios observed for the whole sample and by market size quartiles suggests that bid-ask spreads measured for the ETF underlying stocks are rather associated with a reduction in temporary volatility, which supports the arbitrage hypothesis.

Our findings are somewhat mitigated by the fact that block spreads increase after the ETF launch. Through an analysis of the trade flow distribution, we argue that some large liquidity traders have left the underlying stocks' market to trade the index at lower costs in the ETF market. As a consequence, adverse selection costs incurred against large traders have probably increased, so that block spreads widen, while it has simultaneously become more profitable to split orders and trade at the best-limit prices only.

Our analysis of the ETF order book data shows that the advantage large uninformed index investors gain from trading in the ETF market is the outcome of the ETF LPs' market making activity. For that reason, we consider that our results may well stem from the impact of introducing LPs in the index trading sector, and we believe that studying the actual role and trading strategies of ETF LPs could be a promising ground for future research.

References

Admati, A. R., Pfleiderer, P., 1988. A theory of intraday patterns: volume and price variability. *Review of Financial Studies* 1, 3-40.

Bessembinder, H., Kaufman, H. M., 1997. A comparison of trade execution costs for NYSE and NASDAQ-listed stocks. *Journal of Financial and Quantitative Analysis* 32, 287-310.

De Winne, R., D'Hondt, C., 2007. Hide-and-seek in the market: Placing and detecting hidden orders. *Review of Finance* 11, 663-692.

Easley, D., Kiefer N., O'Hara, M., 1996. Cream-skimming or profit-sharing? The curious role of purchased order flow. *Journal of Finance* 51, 811-833.

Fremault, A., 1991. Stock index futures and index arbitrage in a rational expectations model. *Journal of Business* 64, 523-547.

Gajewski, J.-F. and C. Gresse, 2007. Centralised order books versus hybrid order books: A paired comparison of trading costs on NSC (Euronext Paris) and SETS (London Stock Exchange). *Journal of Banking and Finance* 31, 2906-2924.

Hakansson, N. H., 1982. Changes in the financial market: Welfare and price effects and the basic theorems of value conservation. *Journal of Finance* 37, 977-1004.

Hegde, S. P., McDermott, J. B., 2004. The market liquidity of DIAMONDS, Q's, and their underlying stocks. *Journal of Banking and Finance* 28, 1043-1067.

Huang, R., Stoll H., 1997. The components of the bid-ask spread: A general approach. *Review of Financial Studies* 10, 995-1034.

Irvine, P. J., Benston, G. J., Kandel, E., 2000. Liquidity beyond the inside spread: Measuring and using information in the limit order book. http://ssrn.com/abstract=229959.

Kumar, R., Sarin, A., Shastri, K., 1998. The impact of options trading on the market quality of the underlying security: An empirical analysis. *Journal of Finance* 53, 717-732.

Lee, C. M. C., Ready, M. J., 1991. Inferring trade direction from intraday data. *Journal of Finance* 46, 733-746.

Lin, J.-C., Sanger, G. C., Booth, G. G., 1995. Trade size and components of the bid-ask spread. *Review of Financial Studies* 8, 1153-1183.

Menkveld, A. J., Wang, T., 2009. How Do Designated Market Makers Create Value for Small-Caps?. working paper, VU Univerty Amsterdam.

Merton, R., 1987. A simple model of capital market equilibrium with incomplete information. *Journal of Finance* 42, 483-510.

Richie, N., Madura, J., 2007. Impact of the QQQ on liquidity and risk of the underlying stocks. *Quarterly Review of Economics and Finance* 47, 411-421.

Ross, S. A., 1976. Options and efficiency. *Quarterly Journal of Economics* 90, 75-89.

Subrahmanyam, A., 1991. A theory of trading in stock index futures. *Review of Financial Studies* 4, 17-51.

Van Ness, B. F., Van Ness, R. A., Warr R. S., 2005. The impact of the introduction of index securities on the underlying stocks: The Case of the Diamonds and the Dow 30. *Advances in Quantitative Analysis of Finance and Accounting* 2, 105-128.

Table 1

Comparing the cost of a round-trip trade of the CAC 40 stock basket and the Lyxor CAC 40 security

	For 5,000 ETF shares		For 50,000 ETF shares	
	CRT in %	**CRT in €**	**CRT in %**	**CRT in €**
Index stocks' basket		311.20		4,051.06
ETF (all orders included)	0.15%	214.96	0.21%	3,055.02
ETF (without LP orders)	0.56%	873.13	0.80%	12,458.25

The cost of a round-trip trade (CRT) is computed for 5,000 and 50,000 shares of the Lyxor CAC 40 and its stock component counterpart. CRTs are expressed in percentage of the mid-price and in euros. For the ETF, CRTs are computed by using all orders waiting in the limit order book on the one hand, and by omitting the orders submitted by liquidity providers on the other hand.

Table 2

Contribution of the liquidity providers (LPs) to the liquidity of the Lyxor CAC 40 market

	With LP	Without LP
Relative quoted spread	0.13%	0.62%
Depth at the best limits	45,763	9,540
Depth at the 5 best limits	225,059	23,800

This table reports the duration-weighted averages of two liquidity measures: the relative quoted spread and the quoted depth in number of shares. Depth, measured at the best limit level and at the 5 best limit level, refers to the total of displayed and hidden quantities. Those liquidity measures are computed using all the orders included in the limit order book (With LPs) and then omitting the orders submitted by LPs (Without LPs).

Table 3

Presence of the liquidity providers (LPs) at the best limits in the Lyxor CAC 40 market

	No LP	**Mixed**	**LPs only**
Best bid quote	67.00%	13.60%	19.40%
Best ask quote	70.00%	15.10%	14.90%
Best bid and ask quotes	47.40%	50.40%	2.30%

From 432,266 order book states observed for the Lyxor CAC 40 during October 2002, this table shows the percentages of order book states where no liquidity provider is present at the best quotes (No LP); where both LPs and non-LP traders participate in the best quotes (Mixed); and where only LPs are present at the best quotes (LPs only).

Table 4

Pre/post tracker-introduction comparison of liquidity measures

	CAC 40 stock sample		Control sample	
	Mean difference	***t*-statistic**	**Mean difference**	***t*-statistic**
Daily trading volume (in thousand euros)	274	0.05	178	0.24
Total trading volume (in thousands of shares)	13,639**	2.08	2,680*	1.71
Daily number of trades	4.829	0.04	-71.709	-1.40
Average trade size (in euros)	2,200**	2.04	1,853**	2.14
Duration-weighted quoted spreads (in % of mid-price)	-0.0213***	-4.67	0.005	0.47
Average effective spreads (in % of mid-price)	-0.0263***	-5.83	-0.0241	-1.08
Average depth at best limits (in euros)	4,394	1.42	4,607	1.15
Average block spreads (in % of mid-price)	1.332***	18.74	-0.9651*	-2.00

For each liquidity variable, the mean difference equals the equally-weighted cross-sectional mean in a 60-day post-ETF period minus that measured in a 60-day pre-ETF period. The sizes of the CAC 40 sample and the control sample are 38 and 34 respectively, with the exception that block spreads are available for only 37 stocks of the CAC 40 sample. *,**,*** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 5

Panel regressions of spread and depth measures

	Quoted spread	**Effective spread**	**Best-limit depth**	**Block spread**
Intercept	1.2896***	0.6109***	3.8193***	9.3985***
	(97.76)	(87.34)	(81.18)	(110.37)
σ_{it}	0.0192***	0.0163***	-0.0350***	0.0493***
	(81.89)	(91.70)	(-37.03)	(26.02)
$\ln V_{it}$	-6.3990***	-3.0489***	33.0061***	-40.6612***
	(-91.76)	(-73.75)	(132.56)	(-78.75)
$\ln P_{it}$	-0.0005	-0.0047***	0.3007***	-0.1359***
	(-0.42)	(-8.09)	(59.30)	(-24.10)
I_{it}	0.0459***	0.0291***	-0.1967***	0.5361***
	(18.64)	(15.68)	(-19.06)	(24.92)
ETF_t	0.0224***	0.0021**	-0.0188***	0.6070***
	(9.53)	(2.32)	(-3.33)	(15.47)
$ETF_t \times CAC40_i$	-0.0402***	-0.0141***	-0.0142**	0.0970***
	(-17.83)	(-15.83)	(-2.43)	(9.57)
$ETF_t \times w_{it}$	0.0022***	0.0019***	0.0421***	0.0480***
	(8.26)	(9.88)	(22.50)	(33.16)
Average auto-correlation	0.4264	0.2565	0.4910	0.1607
R-square	62.31%	65.41%	79.22%	53.10%

This table reports the estimates of panel regressions conducted on 120 daily observations for 72 stocks using the Parks method. The dependent variables are the duration-weighted average bid-ask spread, the average effective spread per trade, the duration-weighted average best-limit depth measured in euros and taken in logarithm, and the duration-weighted average block spreads. σ_{it}, $\ln V_{it}$, $\ln P_{it}$, and I_{it} are, respectively, the price range, the euro trading volume in logarithm, the close price in logarithm, and the imbalance between buy and sell traded volumes in percentage of the total traded volume, for stock i on day t. ETF_t is a binary variable set to 0 before the ETF introduction and equal to the number of outstanding ETF shares divided by the number of shares at inception, after the ETF introduction. $CAC40_i$ is equal to 1 for CAC 40 stocks, 0 otherwise. w_{it} is the weight of stock i in the CAC 40 index at the ETF inception date and is set to 0 for non-CAC 40 stocks. t-statistics are in brackets. *,**,*** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 6

Pre/post-ETF comparison of price volatility and spread adverse selection component

	CAC 40 stock sample		Control sample	
	Mean difference	***t*-statistic**	**Mean difference**	***t*-statistic**
Panel A – Variance ratio comparison				
1-minute to 5-minute variance ratios	-0.0084**	-2.60	0.0071	1.51
1-minute to 30-minute variance ratios	-0.0017*	-1.71	0.0012	0.76
Panel B – Spread component comparison				
30-mn realized spread (in % of mid-price)	-0.0277***	-6.32	-0.0154*	-1.75
30-mn price impact (in % of mid-price)	0.0010	0.35	-0.0087	-0.41
LSB adverse selection component	-0.0011	-0.93	0.0020	1.07

Panel A reports comparisons of return variance ratios before and after the Lyxor CAC 40 introduction, while Panel B compares spread components, for a sample of 38 CAC 40 stocks and a control sample of 34 non-CAC 40 stocks over observation periods of 60 days. For each variable, the mean difference equals the equally-weighted cross-sectional mean in the post-ETF period minus that in the pre-ETF period. *,**,*** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 7

Pre/post-ETF comparison of spreads, depths, and variance ratios for the CAC 40 stocks by quartiles of market capitalization

	Q1		Q2		Q3		Q4	
	Mean difference	**Wilcoxon test *p*-value**	**Mean difference**	**Wilcoxon test *p*-value**	**Mean difference**	**Wilcoxon test *p*-value**	**Mean difference**	**Wilcoxon test *p*-value**
Duration-weighted quoted spreads (in % of mid-price)	-0.0131	0.1527	-0.0174	0.2181	-0.0327**	0.0252	-0.0228	0.2179
Trade-weighted quoted spreads (in % of mid-price)	-0.0126	0.1237	-0.0174	0.1487	-0.0317**	0.0385	-0.0253*	0.0952
Effective spreads (in % of mid-price)	-0.0138	0.1763	-0.0242	0.1290	-0.0370**	0.0313	-0.0309*	0.0526
Depth at best limits (in euros)	-421	0.5147	5,134	0.2729	5,734	0.2729	7,337	0.3421
Block spreads (in % of mid-price)	1.295***	0.0019	1.338***	0.0004	1.340***	0.0014	1.358***	0.0002
1-minute to 5-minute variance ratios	0.0047	0.1575	-0.0032	0.6193	-0.0264***	0.0071	-0.0102	0.1763
1-minute to 30-minute variance ratios	0.0020	0.1575	-0.0011	0.3332	-0.0067**	0.0387	-0.0015	0.4853

This table compares measures of spreads, depth, and variance ratios for 38 CAC 40 stocks around the Lyxor CAC 40 introduction date, by size quartiles. Quartiles are defined according to market capitalisation values observed at the ETF inception date. Q1 comprises the ten largest capitalisations, while Q4 consists of the ten smallest ones. For each variable, the mean difference equals the equally-weighted cross-sectional mean in the post-ETF period minus that in the pre-ETF period. The statistical significance of the difference in level for each variable is established by using the Wilcoxon sum-rank test. One-sided *p*-values are reported. *,**,*** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 8

Pre/post-ETF comparison of the trade flow composition

			All trades		Trades executed at the bid-ask spread		Trades executed outside the bid-ask spread	
			Total trade number	**Total trading volume**	**% in number of trades**	**% in trading volumes**	**% in number of trades**	**% in trading volumes**
Panel A								
CAC 40 stock sample		**Mean variation**	+3,90%	+20,90%***	+2.53%***	+2.01%***	-11.16%***	-9.22%***
		***t*-statistic**	0.88	2.95	4.27	3.28	-4.59	-3.27
Control sample		**Mean variation**	-9.66%**	+10.25%	+0.84%**	+0.30%	-6.79%*	+2.63%
		***t*-statistic**	-2.05	1.18	2.36	1.14	-1.74	0.35
Sample difference		**Mean variation**	+13.55%**	+10.65%	+1.69%**	+1.70%**	-4.38%	-11.85%
		***t*-statistic**	2.09	0.95	2.44	2.56	0.95	1.46
Panel B								
CAC 40 stock sample by size quartile	**Q1**	**Mean variation**	+2.16%	+20.66%*	+0.94%	+0.53%	-6.86%	-5.90%
		Wilcoxon test *p*-value	0.7695	0.0645	0.3750	0.4922	0.1934	0.4922
	Q2	**Mean variation**	-2.59%	+20.06%	+4.00%**	+3.01%*	-16.14%**	-13.22%*
		Wilcoxon test *p*-value	0.9102	0.1289	0.0273	0.0547	0.0391	0.0742
	Q3	**Mean variation**	+4.07%	+10.11%	+2.45%**	+2.00%*	-11.59%**	-8.66%
		Wilcoxon test *p*-value	0.7344	0.1289	0.0195	0.0977	0.0117	0.1289
	Q4	**Mean variation**	+11.32%	+31.59%	+2.88%*	+2.58%***	-10.61%*	-9.43%***
		Wilcoxon test *p*-value	0.4316	0.1602	0.0840	0.0098	0.0645	0.0098

This table tests the changes in different characteristics of the trade flow between a 60-day pre-ETF period and a 60-day post-ETF period. Cross-sectional mean relative variations are computed for the total number of trades, the total trading volume in number of shares (after corrections for corporate actions), the percentage of trades and the percentage of trade volumes executed at the bid-ask spread, the percentage of trades and the percentage of trade volumes executed outside the bid-ask spread. We test whether these mean variations are significantly different from 0.Panel A compares the results for CAC 40 stocks (38 securities) with those obtained for the control sample (34 securities). Panel B analyzes the mean variations for CAC 40 stocks by size quartiles. Quartiles are defined according to market capitalisation values observed at the ETF inception date. Q1 comprises the ten largest capitalisations, while Q4 consists of the ten smallest ones. The statistical significance of the difference in level for each variable by size quartiles is established by using the Wilcoxon sum-rank test. Two-sided *p*-values are reported. In both panels, *,**,*** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.