Equivalent volume and comovement

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ABSTRACT

We introduce a new indicator of relative liquidity, equivalent volume (EV), based on the amount of a stock traded indirectly through its inclusion in ETFs. We hypothesize that the EV of an ETF component stock is related to its comovement with other component stocks through the relative liquidity channel under trading caused by arbitrage. Using daily ETF holdings and several comovement estimators, we find that a one-unit increase in daily equivalent volume is associated with increase in comovement ranging from 1.1% to 27.6%. Our findings contribute to the literature on trading volume, liquidity and comovement by relating arbitrage-induced trading pressure to the underlying stock comovement.

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1. Introduction

In this paper, we investigate the relation among arbitrage-induced correlated price impact, relative liquidity and underlying asset comovement. The exponential increase in ETF trading volume, number of funds, and their assets under management, provides a novel opportunity to study those effects. For instance, on August 6, 2012, *Bloomberg* reported that for the first time the dollar volume of S&P 500 tracking Exchange Traded Funds (ETFs) had reached a 12-month average of $28 billion a day. This average trading volume represented 98% of the trading in the underlying stocks.[1] In other words, trading in S&P 500 ETFs essentially achieved parity with the trading of the S&P 500 stocks. More generally, one third of the volume on the U.S. stock exchanges in the period from 2011[2] to 2016[3] was due to trading of ETFs, including sector and bond funds.

ETFs have a distinguishing feature that the ETF price and NAV are kept in line by the intraday arbitrage and the daily creation-redemption mechanism at the market close. Usually, NAV values are updated intraday and can be compared with an ETF's share price almost instantly through their Intraday Indicative Value (IIV), also called intraday value of the ETF assets (iNAV).[4] Sufficiently large deviations from the NAV would prompt arbitrageurs to intervene by buying (selling) the underlying asset basket and selling (buying) the ETF shares, hence reaping arbitrage profits until the spread between the NAV and the ETF price is reduced below transaction costs.[5] Furthermore, the NAV-price arbitrage is strengthened by the creation-redemption mechanism that allows Authorized Participants (APs), usually large broker-dealers and institutions, to exchange the underlying assets with the fund for the equivalent ETF shares at the market close — an operation also called an "in-

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  [1] See "ETFs Poised to Exceed Trade in S&P 500 as Spiders Beat Apple", Bloomberg, August 6, 2012.
  [2] See "ETF trading volumes surge in market turmoil", FT.com, April 10, 2011.
  [3] See "NYSE ARCA ETF Report Q4 2017 ", NYSE.com, 2017.

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  [4] Intraday Indicative Value (IIV) or intraday value of the ETF assets (iNAV) is published every 15 s by the exchange and is an indicator of approximate value of the ETF assets using most recent market prices. IIV is similar in nature to the net asset value, however the former is calculated every 15 s by the exchange and is a non-binding indicator, while the latter is calculated around 4:00PM by the ETF and is binding in the fund's creation-redemption activity with APs.
  [5] Petajisto (2013) studies ETF premiums and finds that the magnitude of the spread between ETF price and NAV is relatively small especially for the broad-sector ETFs, but the volatility of that spread entails significant arbitrage opportunities most likely exploited by arbitrageurs on the intraday basis.

kind" transaction. Hence, APs need not to wait until prices converge but can transact the second leg of the arbitrage trade directly with the ETF, thus reducing potential inventory holding risks.

These small and frequent waves of arbitrage-caused *en masse* buying and selling of the ETF and the underlying stocks occur during the day, exerting price pressure on the underlying prices — not unlike rocking a boat — and making them covary. This covariation is unrelated to the commonalities of stock fundamentals, and thus represents excess comovement. This excess comovement is temporary given the nature of the originating shock and quickly decays if there are no subsequent arbitrager-induced shocks. However, evidence suggests (Petajisto, 2013) that arbitrage opportunities are very frequent and are exploited on a continuous basis and, hence, the excess comovement generated by these trades represents a non-trivial amount. One of the corollaries of this excess comovement is the reduction of the diversification benefits for investors and market participants.

Furthermore, the basic intuition behind the ETF arbitrage implies that the ETF price will converge with the NAV and the effect on the NAV will be minimal. However, this is not always the case — in the situations when the liquidity of the underlying assets is lower relative to the liquidity of the ETF, the arbitrage-related trading will exert more price pressure on the less liquid instrument (Kyle, 1985; Amihud & Mendelson, 1986), in this case the underlying stocks. For large ETFs, the turnover and the trading volume, which is often associated with liquidity proxies (Amihud, 2002; Holden, Jacobsen, & Subrahmanyam, 2014), are generally much higher than those of the underlying stocks, suggesting that the ETF liquidity is usually higher than that of the underlying stocks. Hence, a measure of relative liquidity of the ETF and the underlying should be associated with the differential price impact of the arbitrage trade and, consequently, the comovement of the underlying stocks.

In order to study the effects of liquidity and arbitrage-related trading on excess comovement, we develop a stock-level indicator called "equivalent volume" (EV) that attempts to capture the relative liquidity of the individual stock vs. the liquidity of the (same) stock as part of the ETF in the arbitrage framework. This indicator is a normalized ratio of weighted trading volumes of the ETF and the underlying stock.

This indicator of relative liquidity, equivalent trading volume, is economically significant, ranging from 5% to 70% of the daily volume of an average stock in our sample. Put another way, the average stock's weight in the trading volume of the ETF that it belongs to, comprises up to 70% of the stock's own trading volume. Although already large, we underestimate equivalent volume because a majority of stocks on U.S. exchanges belong to several ETFs. For instance, Google is a component in two ETFs in our sample and also in other smaller 109 domestic equity ETFs[6] not included in the sample. Hence, the aggregated equivalent volume for the stocks in our sample is most likely larger than the 5% to 75% range mentioned earlier.

We hypothesize that an increase in the weighted liquidity of the ETF relative to the liquidity of the underlying stock, represented by the equivalent trading volume, is related to the increase in the comovement of the underlying stock with the rest of the stocks in the ETF. We do not model arbitrage trading directly, but rather measure the impact of the arbitrage on the comovement of the underlying conditional on the relative liquidity.[7] We conjecture

that the more frequently the stock is traded through the ETF, which is reflected as an increase in its equivalent volume, the more frequently its return, on average, comoves with the other component returns in the ETF basket.

This study contributes to the literature in several ways. Although there are concurrently initiated studies investigating the ETF-related activity and comovement (Da & Shive, 2013), to our knowledge, this is a first look at the ETF arbitrage-induced trading and daily comovement of the underlying assets linked via a new differential liquidity measure based on trading volumes and daily ETF holdings. Furthermore, the empirical findings in this paper provide a new understanding of price shocks contagion (Antón & Polk, 2014) during daily ETF arbitrage-driven trading. We also contribute to the burgeoning ETF literature (Da & Shive, 2012; Ben-David, Franzoni, & Moussawi, 2014) by exploring unexpected consequences of ETF related daily trading activities on the pricing of the underlying assets. Interestingly, industry experts also suspect that ETF activity may pose unexplored risks (Johnson & Newlands, 2016; McNulty, 2017). Moreover, our findings extend the arbitrage literature by documenting a channel through which arbitrage, a presumably benign activity, can produce unexpected consequences via shock propagation to the underlying assets in the vein of Greenwood and Thesmar (2009) and Hong, Kubik, and Fishman (2012). Finally, we furnish the liquidity literature with a new measure of relative liquidity based on a ratio of trading volumes similar to O/S Roll, Schwartz, and Subrahmanyam (2010).

To address our research objectives, we use two approaches to estimate daily co-movement. The first approach employs dynamic conditional correlations (DCC) from the multivariate volatility model family (Engle 2002). Conditional correlations, and in particular DCC, offer sufficient flexibility to parameterize a change in the correlation as a function of the weighted average of the past and most recent return shocks. Dynamic conditional correlations also allow for the ability to specify additional independent variables in the GARCH mean equation such as market return, providing a natural way to control for fundamentals. Although comovement can be estimated more parsimoniously using intraday data, DCC has the advantage in markets where high-quality intraday data is hard to obtain or simply not available as is the case for many markets outside of the U.S.[8]

The second approach uses a shorter intraday sample to estimate short-horizon co-movement based on the Pearson correlation of intraday returns calculated using 5-min prices. Tests using intraday data should have more power in testing the comovement hypothesis given that the arbitrage-induced trading and, hence, the comovement shocks occur during the day.

To preview our results, we find that there is a strong, positive association between the liquidity of the ETF relative to the underlying stocks, proxied by equivalent volume and comovement of a stock's returns with those of the other ETF components using dynamic conditional correlations and intraday Pearson correlation estimators. In economic terms, using daily data from January 2002 to September 2011 for 12 ETFs and over 800 stocks, a daily change in the equivalent volume from 10% to 20% is associated with an increase in the dynamic conditional correlation of 0.01 or 1%. Using log transformed equivalent volume and dynamic conditional correlations, a 1% increase in equivalent volume is associated with a

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