Economic Modelling 51 (2015) 454–459

Contents lists available at ScienceDirect

Economic Modelling

journal homepage: www.elsevier.com/locate/ecmod

Liquidity and conditional market returns: Evidence from German exchange traded funds

Katrin Czauderna, Christoph Riedel, Niklas Wagner *

Department of Business and Economics, Passau University, 94030 Passau, Germany

A R T I C L E I N F O

Article history:
Accepted 27 August 2015
Available online xxxx

Keywords:
Market liquidity
Market illiquidity
Time-varying expected market returns
Illiquidity measures
Exchange traded funds

A B S T R A C T

In the spirit of Merton (1973), we assert that temporary aggregate market illiquidity is compensated for in the form of higher conditional market returns. In order to test this hypothesis, we use two available liquidity proxies, namely versions of the Amihud illiquidity measure and a measure based on exchange traded fund prices. Our investigation is based on vector autoregressive models for the German stock market between July 2006 and June 2010. The fund-based illiquidity proxy dominates in capturing consistent results for the determination of time-varying market returns. Temporary illiquidity is indeed compensated for by higher market returns. We confirm a bidirectional relation between illiquidity and market returns, i.e. current returns depend on lagged illiquidity and current illiquidity can be determined by a combination of past returns as well as past illiquidity. The relation shows that illiquidity is persistent and driven by market declines.

1. Introduction

In their seminal paper, Amihud and Mendelson (1986) point out that liquidity has a significant impact on asset prices. Periods of market stress repeatedly exhibit that liquidity dries up and therefore stock markets overall do no longer provide the characteristics of stable turnover, balanced spreads, and smooth adjustments of price.[1] Any form of temporary illiquidity increase in stock markets is therefore an important signal to market participants. It is of particular interest to study the characteristics and determinants of aggregate market liquidity as well as its impact on aggregate asset prices.[2]

The present paper investigates temporary aggregate stock market illiquidity premia in the form of higher conditional expected market returns. We consider how liquidity affects market returns and, in turn, whether liquidity is determined by past returns. Part of our investigation of market liquidity concerns the availability of alternative measures, which can be used as illiquidity proxies. Our paper provides a contribution in this area, since few studies deal with these aspects so far.[3] In our study, liquidity is captured by two different proxies that are applied in two versions, respectively. First is the established Amihud (2002) illiquidity proxy, ILLIQ, which measures the price-impact of a one-dollar trading volume. Our first version follows Amihud and calculates absolute returns based on closing quotes. The second version, calculates absolute returns based on opening and closing quotes. Second is an illiquidity proxy as proposed by Chacko et al. (2010). It captures illiquidity based on the price difference between an index and an exchange traded fund (ETF) that designed to replicate the index. This fund-based illiquidity measure is also applied in two versions, namely as the general version as well as a transformed measure, which is denoted as EILLIQ. The object of our investigation is the German stock market, where a set of several ETFs based on the DAX index is available.

We use vector autoregressive (VAR) models in order to investigate the multivariate relation between market returns and illiquidity. We estimate the models for the German stock market index DAX during the period from July 2006 to June 2010. Our results confirm a significant

* Corresponding author. Tel.: +49 851 509 3241; fax: +49 851 509 3242.
E-mail address: nwagner@alum.calberkeley.org (N. Wagner).

[1] Sarr and Lybek (2002) and Ourir and Snoussi (2012) consider market liquidity under stress, where liquidity proxies may tend to provide unreliable results as the normally positive relation of volumes and volatility does not hold; see e.g. Marsh and Wagner (2000). Claessens et al. (2011) argue that financial markets are cyclic and that stress periods hence evolve at regular intervals. Market liquidity appears to be related to the development of the business cycle; see e.g. Næs et al. (2011) and Apergis et al. (2015).

[2] For example, Hasbrouck and Seppi (2001) fail in detecting a significant relationship between liquidity and returns. Amihud (2002) finds a positive relationship between expected illiquidity and returns, whereas unexpected illiquidity causes prices to decline. Bekaert et al. (2007) show that the local risk of variations in liquidity has the largest positive impact on expected returns, even assuming that markets are globally integrated. Wagner (2008) shows that lagged illiquidity relates to expected stock market returns and that illiquidity shocks in the U.S. are followed by illiquidity reactions in other developed markets. Uddin (2009) examines relative market liquidity and confirms a negative relation between stock returns and liquidity. Hameed et al. (2010) find that market drops decrease stock liquidity and that, following such drops, significant returns to supplying liquidity are obtainable. Bank et al. (2010) detect a compensation for illiquidity in the form of increased individual stock returns.

[3] Chacko et al. (2010) indicate that liquidity measures applied thus far may capture risks rather than illiquidity. Goyenko et al. (2009) find evidence for different liquidity measures capturing the same fundamental liquidity aspects. Muscarella and Piwowar (2001) and Bank et al. (2010) obtain results that confirm that applied liquidity measures indeed capture liquidity.

http://dx.doi.org/10.1016/j.econmod.2015.08.028
0264-9993/

and positive compensation of illiquidity in the form of higher conditional returns. We find that the results differ for the applied illiquidity measures. The findings for the Amihud illiquidity measure ILLIQ, confirm that current market illiquidity is persistent and Granger-caused by lagged market drops. The illiquidity measure ELLIQ dominates the Amihud measure in capturing the illiquidity–return relation and thereby yields consistent and significant overall results. These underline a positive illiquidity premium as part of a bidirectional relationship between illiquidity and returns, i.e. current returns depend on lagged illiquidity and current illiquidity depends on past returns as well as illiquidity. This bidirectional relationship is not found for the model based on the ILLIQ proxy.

The remainder of this paper is organized as follows. Section 1 presents a brief theoretical view on liquidity and outlines our basic hypothesis. Section 2 contains the empirical investigation including the data, the illiquidity proxies and the model estimation results. Section 3 concludes.

1. Liquidity and returns

From a theoretical perspective, liquidity has an impact on asset pricing and variations in liquidity result in a variation of asset prices. In the cross-sectional setting, the models derive the implications of liquidity and liquidity risk in the capital asset pricing model context; see for example Pastor and Stambaugh (2003), Acharya and Pedersen (2005), and Wang and Chen (2012).

In the time-series setting, the level of liquidity varies over time, as shown by Amihud et al. (1990) and Amihud (2002). With the arguments used by Merton (1973) who derives a time-varying market risk premium, it follows that time-variation in aggregate market illiquidity should relate to a time-varying market illiquidity premium. Assume that $\sigma^2_{M,t}$ denotes the conditional variance of market returns and $ILL_{M,t}$ denotes the conditional aggregate market illiquidity. It then follows that not only one but several risk factors are priced on the market level. Investors that try to hedge against adverse changes in the investment opportunity set, will adjust their holdings in the risky asset (i.e. the market portfolio) based on their expectations of future risk as well as liquidity. The purest hypothesis we can derive is therefore that expected market returns conditional on time-t illiquidity information are given as

$$\mathbb{E}_t(R_{M,t+1}) - \mu = \lambda\, ILL_{M,t}, \quad (1)$$

where μ is a constant and we expect a positive illiquidity premium, $\lambda > 0$. As market liquidity is not directly observable it has to be captured by proxies. Obviously, there is no single measure that is able to capture all properties of liquidity. The Amihud (2002) proxy will—as all other liquidity proxies—generally suffer from drawbacks.[4] Nevertheless, ample of financial studies have found the measure to be helpful. We will use two measures as examples in order to test the hypothesis in Eq. (1): The fund-based illiquidity proxy by Chacko et al. (2010) as well as the well-established Amihud measure.

2. Empirical analysis

In this section we investigate how market returns are affected by aggregate illiquidity proxies. We take the German market as an example and use performance data for the DAX index as well as for several related DAX ETFs. The second subsection deals with the illiquidity measure proxies ILLIQ and EILLIQ. The calculation and interpretation of the illiquidity measures is presented in the third subsection. The last subsection investigates the multivariate relationship between returns and illiquidity within a VAR model setting.

2.1. Data

The empirical tests are based on daily returns of the DAX index. DAX index data including open quote, close quote and volume are collected from Thomson One Banker. The Deutsche Börse StatistiX data base provided DAX ETF information based on six ETF issues that were available, see Table 1 for details. All data is in Euro. The period of investigation includes four years with 1015 trading day observations, starting June 28, 2006 and ending on June 28, 2010. DAX index returns are continuously compounded. Market returns are not only derived by daily close prices, but also by daily open and close prices.

The DAX index reflects the performance of the German stock market. It is composed of the leading German listed companies and reinvests cash dividends as well as cash profits from subscription rights. In case main entry criteria match for several companies, inclusion in the index is solely based on the highest market capitalization of company free-float. The weight of each single stock in the index is determined by the market capitalization of free-float.

ETFs replicate stock market indices such as the DAX and promise intraday-liquidity to their holders. ETFs represent a fast-growing investment segment. Price differences between the ETF and the underlying index may arise due to transaction costs or due to differences between the index strategy and the replication strategy that is implemented by the manager. Frequently, index rebalancing due to changes in the index composition can be seen as a trigger for pricing errors. Tracking errors further arise due to differences in tax assumptions. In our study, a constant number of six different DAX ETFs as given in Table 1 is used to form a representative average daily ETF net asset value (NAV).

2.2. Illiquidity measures

2.2.1. ILLIQ and ILLIQ OC

Amihud (2002) derives the price-impact measure ILLIQ to capture the level of illiquidity and to determine the relationship between illiquidity and returns over time. ILLIQ tries to capture the percentage change in price that is impacted by a trading volume of one dollar of a particular asset on a particular day t, thus representing the level of illiquidity:

$$ILLIQ_t = \frac{\left|R_t^{CC}\right|}{VOLD_t}. \quad (2)$$

Here, R_t^{CC} represents the return on day t, calculated based on close to close prices. $VOLD_t$ stands for the respective traded dollar volume. In particular, it is derived by the number of shares multiplied by the respective day's closing price. The higher ILLIQ, the greater the measured level of illiquidity. The approach follows the idea of market depth as represented by Kyle's-λ, which defines the effect of order flow on price. It also follows the concept of thinness of a market by measuring the outstanding supply in relation to the absolute change of price. There is a relation to the so-called Amivest measure (see e.g. Khan and Baker (1993)).

We use the Amihud measure ILLIQ as well as a modified version. The standard measure is based on day t and day $t-1$ close quotes which yield close–close returns R_t^{CC} that are used in Eq. (2). Our modified proxy ILLIQ OC is based on day t open and day t close quotes, i.e. on intraday returns, R_t^{OC} in Eq. (2). ILLIQ OC is expected to provide better results as the denominator in Eq. (2), i.e. volume, solely considers trading within the intraday period, and therefore liquidity should only be affecting intraday price activity excluding overnight price changes. To our

[4] A drawback of the Amihud proxy includes the fact that the proxy measure cannot distinguish between price changes, which are due to unobservable common information events and those which are not. Information driven events increase the illiquidity measure but do not indicate illiquidity. A different issue considers market risk factors that may be associated with available illiquidity proxy measures; see e.g. Chordia et al. (2001) and Chacko et al. (2010).