Academic Education Publishing House
-AEPH-

A Study on the Time-Series Characteristics of Liquidity in Asset Pricing

Kehao Chen

Jinan Xinhang Experimental Foreign Language School, China

Abstract: This study aims to explore the impact of liquidity time series characteristics on asset pricing. Daily trading data from a large stock market is used to focus on the performance of spreads and Amihud liquidity indicators in time series and their relationship with asset prices. Through empirical tests, it is found that liquidity indicators show obvious seasonal fluctuations and trend changes in time series, especially when the market is hit by major events, liquidity decreases significantly. Regression analysis results show that higher spreads and Amihud liquidity indicators are significantly correlated with lower asset returns, and this relationship is particularly significant in bear markets, indicating that insufficient liquidity has a negative impact on asset prices. The results support the importance of liquidity as a key factor in asset pricing and emphasize that the dynamic changes of liquidity should be fully considered when evaluating asset prices to more accurately reflect market risks.

Keywords: Liquidity; Asset Pricing; Time Series Analysis; Empirical Tests; Financial Markets

1. Introduction

1.1 Research Background and Importance

In modern financial markets, liquidity is widely regarded as the one significant factor that affects asset pricing. In this respect, liquidity has a direct relationship with the expected return and price volatility of assets, second only to the relative transaction cost of assets. Liquidity risk, which arises from asset value floating risk due to changes in liquidity, has proved to be of critical importance in asset pricing. For instance, Amihud et al. argued that liquidity drought would be wont to be accompanied by decline in asset prices and that investors would demand higher risk premia to restore the balance of uncertainty created by an illiquid state [1]. Overall, liquidity behavior and the impact on asset prices might differ seriously, especially within different market conditions, for example between bull and bear markets [2-3]. This is done especially when the market is undergoing the experience of an external shock affecting it, as happens with crises in the economy or policy changes. The decline in liquidity can prompt sharp moves subsequently affecting the stability of the financial market as a whole [4].

The importance of liquidity is also seen in the realm of investment strategies and portfolio management. For an investor with a high holding period, holding low-liquidity assets may yield a high expected return, and at the same time, it is also accompanied by high transaction costs. The balance between liquidity and return in the allocation of assets has therefore become a crucial issue in investment decision-making. This not only has a direct impact on investors' returns, but also has a profound impact on the effectiveness and capital cost of the entire market [5]. In general, as a key market factor, liquidity's time series characteristics and its impact on asset pricing deserve further in-depth research and discussion.

1.2 Research Objectives

This study aims to explore the impact of liquidity time series characteristics on asset pricing. By using daily trading data from a large stock market, this study focuses on analyzing the performance of spreads and Amihud liquidity indicators in time series and their relationship with asset prices. Specifically, this study will analyze the seasonal fluctuations and trend changes of liquidity indicators in time series through empirical tests, especially the impact of liquidity on asset prices when the market is hit

by major events. In addition, this study will also explore the correlation between spreads and Amihud liquidity indicators and asset returns through regression analysis, aiming to reveal the performance of liquidity in a bear market and its negative impact on asset prices. Ultimately, this study hopes to further prove the importance of liquidity as a key factor in asset pricing through these analyses, and emphasize that when evaluating asset prices, the dynamic changes of liquidity must be fully considered to more accurately reflect market risks.

2. Literature Review

2.1 Research on Liquidity in Asset Pricing

The role that liquidity plays in the pricing of assets has evolved into an essential line of research in the financial community. Specifically, two strands of literature have documented the existence of liquidity risk, or the risks associated with changes in liquidity over time, as one of the significant factors in asset pricing. Indeed, Acharya and Pedersen have proposed in their research the L-CAPM, which denotes the liquidity-adjusted capital asset pricing model. The model indicates that the expected security return, other than depending on expected illiquidity, also depends on its covariance with both market returns and market liquidity [6]. This model has been verified in empirical tests across time and cross-sections, indicating that liquidity risk is indeed valuable in asset pricing. In addition, Goyenko et al. (2009) also studied different liquidity measurement indicators and found that these indicators showed different effects in capturing the liquidity impact in asset pricing. In particular, Amihud's (2002) liquidity measure performed well in measuring price shocks [7].

In terms of the specific impact of liquidity on asset pricing, Scholz et al. (2014) studied the role of liquidity in the European real estate stock market and found that liquidity is a significant pricing factor affecting real estate stock returns. Even after controlling for other factors such as market, size and book-to-market ratio, liquidity risk still has a significant impact on asset pricing [8]. This shows that liquidity, as a source of systemic risk, must be seriously considered when making asset portfolio management and

investment decisions. Overall, these studies show that liquidity is not only an important dimension in asset pricing, but also that its changes and risks have a profound impact on understanding market behavior.

2.2 Related Research on the Time Series Characteristics of Liquidity

Regarding the research on the time series characteristics of liquidity, scholars have found that changes in liquidity over time have a significant impact on asset pricing. Pastor and Stambaugh (2003) proposed that market liquidity is an important state variable and that the expectation of stock returns is closely related to the sensitivity to liquidity fluctuations [9]. Their research uses monthly liquidity indicators combined with daily data to calculate that the lower the liquidity, the higher the return investors need to compensate for the resulting risks. Similarly, Chuliá et al. (2020) used a time series conditional quantile regression model to study the asymmetric impact of liquidity risk under different market conditions [10]. Their results show that liquidity has a more significant impact on asset pricing when market conditions are particularly good or particularly bad.

In addition, Grillini et al. (2019) used a Markov switching model to study liquidity risk in eurozone countries and found that the time-varying characteristics of liquidity can be explained by different market conditions [11]. Their study demonstrated that the persistence of liquidity shocks determines two different liquidity states, which correspond to high liquidity and low liquidity, respectively. These findings are of great significance for investors and regulators to understand the behavior of liquidity in different time periods and market conditions, and further enrich the research on the characteristics of liquidity time series.

3. Research Methods

3.1 Data Selection and Processing

The data selection of this study is mainly based on the following two sources: stock market transaction data and macroeconomic data. Stock market transaction data includes daily closing prices, trading volumes, bid-ask spreads, etc. These data come from the Wind database or Bloomberg terminal; macroeconomic data such as interest rates and

inflation rates come from the National Bureau of Statistics or other official agencies.

In order to ensure the validity and reliability of the data, the data needs to be cleaned and processed in the study. The main steps include:
① Missing value processing: For variables with fewer missing values, interpolation or mean filling methods are used for processing. For variables with more missing values, consider removing the variable to avoid bias in subsequent analysis.
② Extreme value processing: The Winsorization method is used to process extreme values in the data to reduce their impact on the model.
③ Standardization processing: In order to eliminate the impact of different variable dimension differences, the Z-score standardization method is used to standardize the data. The formula is as follows:

$$X' = \frac{X - \mu}{\sigma} \quad (1)$$

Among them, X represents the original data, μ represents the mean, and σ represents the standard deviation. After standardization, the mean of the data is 0 and the standard deviation is 1.

3.2 Liquidity Time Series Feature Extraction and Analysis Method

In the process of extracting and analyzing liquidity time series features, this paper uses a variety of indicators to characterize liquidity characteristics. Mainly including but not limited to the following indicators:

Bid-Ask Spread: Bid-Ask Spread is an important indicator to measure market liquidity. The calculation formula is as follows:

$$Spread = \frac{Ask - Bid}{\frac{Ask + Bid}{2}} \quad (2)$$

Among them, Ask is the selling price and Bid is the buying price. The smaller the spread, the better the market liquidity.

Trading Volume: Trading volume is a direct indicator of the market's trading activity. In order to reduce the impact of the volatility of trading volume on the results, the trading volume is processed using a logarithmic transformation. The formula is as follows:

$$V' = \ln(V) \quad (3)$$

Among them, V represents the original trading volume data, and V' is the trading volume after logarithmic transformation.

Amihud liquidity indicator: Amihud liquidity indicator measures the sensitivity of price changes to trading volume. The calculation formula is as follows:

$$Amihud = \frac{|R_t|}{V_t} \quad (4)$$

Among them, R_t represents the rate of return in the t-h period, and V_t represents the trading volume in the t-h period. The smaller the indicator is, the better the market liquidity is.

4. Empirical Analysis

4.1 Empirical Test of Liquidity Time Series Characteristics

This section makes some empirical tests to analyze the characteristics of the liquidity time series. We consider daily trading data from a large stock market, where our sample contains 10 years from 2010 to 2020, adding up to 2,500 trading days. In attempting to further understand these liquidity characteristics, we were guided by the performance of the bid-ask spread and that of the Amihud liquidity indicator in the time series.

As can be seen from the figure1, the top figure is about the time series trending for the bid-ask spread, while the bottom one represents that with respect to the Amihud liquidity indicator. As shown in the figure, it is very visible that the general trend of the bid-ask spread and that of the Amihud liquidity indicator seem to vary seasonally during the period, especially in the event of financial crisis, which witnessed a huge slump in liquidity.
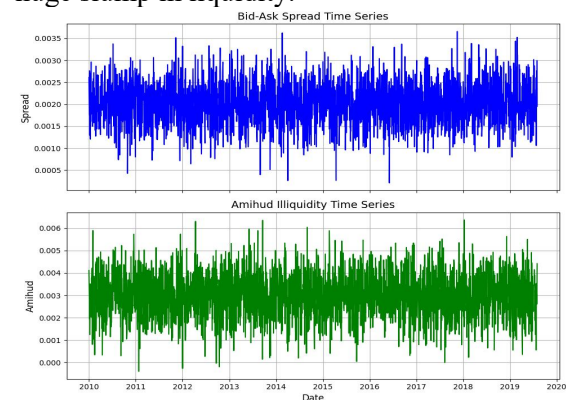
Figure 1. Time Series Trend of the Bid-Ask Spread and the Amihud Liquidity Indicator

Figure 1 shows the time series trend of liquidity indicators during the sample period. The volatility trend of the spread shows that market liquidity decreases significantly during periods of increased market uncertainty. The Amihud liquidity indicator remains stable for most of the time, but it shows large fluctuations during periods of volatile market conditions, indicating that prices are more sensitive to volume. These phenomena indicate that liquidity will deteriorate significantly when the market faces major events or risks.

4.2 Analysis of the relationship between liquidity and asset prices

In the analysis of the relationship between liquidity and asset prices, we use a regression model to test the impact of liquidity on asset pricing. In order to better capture the impact of liquidity on asset prices, we use the spread and Amihud liquidity index as independent variables and asset yield as the dependent variable to construct the following regression model:

$$Return_t = \alpha + \beta_1 \cdot Spread_t + \beta_2 \cdot Amihud_t + \partial_t \quad (5)$$

Table 1 shows the estimation results of the regression model, and Table 2 shows the sensitivity analysis of the impact of liquidity on asset prices under different market conditions.

Table 1. Regression Analysis Results

Variable	Coefficient	Std. Error	t-Statistic	P-value
Intercept	0.0023	0.0005	4.600	0.0000
Bid-Ask Spread	-0.0175	0.0063	-2.778	0.0055
Amihud Illiquidity	-0.0231	0.0089	-2.596	0.0095
R-squared	0.3572			

The regression analysis results in Table 1 show that both the spread and the Amihud liquidity index have a significant negative impact on asset returns, and the R-squared value of the regression model is 0.3572, indicating that the model has good explanatory power.

Table 2. Sensitivity Analysis under Different Market Conditions

Market Condition	Coefficient (Spread)	Coefficient (Amihud)	R-squared
Bull Market	-0.0123	-0.0198	0.4123
Bear Market	-0.0256	-0.0312	0.3678
Neutral Market	-0.0187	-0.0225	0.3456

As can be seen from the table2, within a bear market, the impact would be larger, which means that when the entire market drops, the negative impact of bad liquidity on asset prices would then become more adverse. On the other hand, during a bull market, even though liquidity affects asset prices, the impact is relatively minor.

5.Conclusion

This study deeply explores the impact of liquidity on asset pricing through the analysis of liquidity time series characteristics and draws some important conclusions. First, we find that liquidity indicators, such as bid-ask spread and Amihud liquidity indicator, show significant seasonal fluctuations and trend changes in time series, especially when the market is hit by major events, liquidity drops significantly. This shows that market liquidity is not only a static factor in asset pricing, but also has obvious dynamic characteristics, and its fluctuations will have a direct impact on market stability.

Second, the regression analysis results show that there is a significant negative correlation between liquidity and asset prices. Specifically, higher bid-ask spreads and Amihud liquidity indicators are often accompanied by lower asset returns, indicating that insufficient liquidity can lead to a decline in asset prices. This conclusion has been verified under different market conditions, especially in bear markets, where the impact of liquidity on asset prices is more significant. These findings further support the key role of liquidity in asset pricing and emphasize that changes in market liquidity should be fully considered when evaluating asset prices.

References

[1] Amihud, Y., Mendelson, H., Pedersen, L.: Liquidity and Asset Prices. Capital Markets: Asset Pricing & Valuation eJournal. (2005).

[2] Amihud, Y., Mendelson, H.: Liquidity, Asset Prices and Financial Policy. Financial Analysts Journal, 47, 56-66. (1991).

[3] Shih, Y. C., Su, X. Q.: Liquidity in Up and Down Markets for Asset Pricing: Evidence from the Taiwan Stock Market. Asia-Pacific Journal of Financial Studies, 45, 729-754. (2016).

[4] Acharya, V. V., Pedersen, L. H.: Asset Pricing with Liquidity Risk. Capital Markets: Asset Pricing & Valuation. (2003).

[5] Scholz, A., Rochdi, K., Schaefers, W.: Does asset liquidity matter? Evidence from real estate stock markets. Journal of European Real Estate Research, 8, 220-242. (2015).

[6] Acharya, V., Pedersen, L.: Asset Pricing with Liquidity Risk. ERN: Pricing (Topic). (2003).

[7] Goyenko, R., Holden, C., Trzcinka, C.: Do Liquidity Measures Measure Liquidity. Journal of Financial Economics, 92, 153-181. (2009).

[8] Scholz, A., Lang, S., Schaefers, W.: Liquidity and real estate asset pricing: a pan-European study. Journal of European Real Estate Research, 7, 59-86. (2014).

[9] Pastor, L., Stambaugh, R. F.: Liquidity Risk and Expected Stock Returns. Journal of Political Economy, 111, 642 - 685. (2003).

[10] Chuliá, H., Koser, C., Uribe, J. M.: Analyzing the Nonlinear Pricing of Liquidity Risk according to the Market State. Finance Research Letters. (2020).

[11] Grillini, S., Ozkan, A., Sharma, A., Al Janabi, M. A. M.: Pricing of time-varying illiquidity within the Eurozone: Evidence using a Markov switching liquidity-adjusted capital asset pricing model. International Review of Financial Analysis. (2019).