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The returns, risk and liquidity relationship in high frequency trading: Evidence from the Oslo stock market

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ABSTRACT

The main purpose of this research is to investigate the relationship between returns, risk, and liquidity in high frequency trading. Panel analysis for single stocks is employed to investigate this relationship. The empirical results imply that in high frequency trading idiosyncratic risk plays a more pronounced role than systematic risk in asset pricing. First, idiosyncratic risk and liquidity have a highly significant impact on returns. Second, no evidence has been found for a significant relationship between systematic risk and returns. Finally, liquidity has a higher significant effect on idiosyncratic risk than systematic risk. The empirical results of the paper contribute to the previous literature in the high frequency context. Some previous literature suggests that idiosyncratic risk has a matter on low frequency trading, but has not yet investigated its effects on high frequency trading.

1. Introduction

The relationship between risk and returns is a major topic, discussed by many researchers. This relationship is recognized in the CAPM theory developed by Sharpe (1964), Lintner (1965), and Mossin (1966). An underpinning notion of this theory is that a diversified portfolio of stocks is less risky than any of its components (Mullins, 1982). Aggregate risk includes specific and systematic risk; the effects of specific risk are reduced as more securities are added to a portfolio. An investor holding a properly diversified portfolio is therefore not compensated for specific risk, but only for the systematic. However, Merton (1973) and Boehme et al. (2009) argue that investors cannot hold a properly diversified portfolio because of incomplete stock information and the existence of many different costs in the financial market. Investors are willing to invest in stocks that they are familiar with. Idiosyncratic risk should therefore be priced in predicting stock returns when investors hold a diversified portfolio, but not one which is a properly diversified, and the relationship between them could be positive. Mullins (1982) also suggests that corporate securities move together to some extent in the financial market, so the complete

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elimination of specific risk from a simple portfolio is impossible. Hence, idiosyncratic risk should be priced in cross-sectional stock returns.

The goal of this research is to provide an examination of how aggregate volatility risk is priced in the cross-section of stock returns. The differences between this research and previous work are that the past literature does not investigate idiosyncratic risk at the intraday level and does not employ the panel data of individual stocks for analysis. The highest frequency level of data used to estimate idiosyncratic risk is found at the daily level in the research of Ang et al. (2006), while idiosyncratic risk in this research is estimated by using intraday data. This research does not examine the relationship between risk and returns by sorting stocks into portfolios as the previous literature does, but explores the panel analysis of individual stocks. Although there are some differences between this study and previous ones, the results of it are consistent with previous ones. For example, finding idiosyncratic risk in a negative relation with returns is consistent with findings of the studies by Ang et al. (2006, 2009).

This research contributes to the previous literature in the following ways. It first employs variables at a higher frequency than past research does. It uses the daily variables estimated from intraday ones which are at one minute intervals. Several prior empirical studies indicate that idiosyncratic risk matters in low frequency trading, but its effect on high frequency trading has not yet to be investigated. Second, the use of panel data analysis rather than portfolio analysis is another contribution of the paper. Third, this research answers the question of the extent to which liquidity contributes to pricing expected returns, by addressing the risk and liquidity relationship. Moreover, it supports the findings of Ang et al. (2006, 2009) that idiosyncratic risk and returns are in an inverse relationship, and of other past studies which found that systematic risk does not affect returns. Finally, finding that liquidity variables affect idiosyncratic risk implies that when this risk is considered in pricing stock returns, liquidity factors should be also considered.

This research is important for two reasons. First, high frequency trading has become popular nowadays, but the existing literature on the risk and returns relationship is largely focused on low frequency trading. It could be of great value to extend the existing empirical work to high frequency trading. Finding the relationship between these factors in high frequency trading is important for all market participants as it would help them to manage their trading portfolios more efficiently. Finally, the existing empirical work uses traditional portfolio analysis. It would be useful to examine the relationship by employing the method of panel analysis for single stocks. The reason for this is that individual stocks interact together to some extent cross-sectionally and over time. Adding individual stocks to a portfolio for analysis would limit their interaction.

The results of this research indicate that idiosyncratic risk plays a more important role than beta in high frequency trading when pricing expected returns. This can be summarized as follows. First, there is a negative relation between returns and idiosyncratic risk, similar to that in some prior literature. Second, the relationship between returns and liquidity is positive. Third, a flat relation between beta and returns is suggested, which is consistent with the previous empirical studies. Finally, liquidity variables affect idiosyncratic risk more than beta. The positive or negative effects depend on how the liquidity variables are defined.

The remainder of this paper proceeds as follows: in section two, previous related empirical literature is reviewed. Section three describes the data, variables, panel analysis and panel data. In section four, two models, the empirical results are presented, and the some discussions are in the next section. The conclusions are addressed in the final section.

2. Literature review

There is a vast body of literature that has examined the relationship between risk and stock returns. Much of it, however, employs low frequency data and documents different results. Many researchers suggest that the risk-return relationship is an inverse one, while some demonstrate that these factors have a positive relationship. However, Bali and Cakici (2008), and Berggrun et al. (2016) find no significant relationship between them.

A flat relationship between returns and idiosyncratic risk is found in the research by Bali and Cakici (2008), and Berggrun et al. (2016). Generating two different monthly idiosyncratic risks, first from the daily returns of previous months and second from 25 to 60 monthly returns, Bali and Cakici (2008) model the relationship between idiosyncratic risk and cross-section returns and apply the CAPM and the three factor Fama–French models to examine the relationship. They state that there is no strongly significant relationship between idiosyncratic risk and returns for both types of idiosyncratic risk. They indicate, however, that some other factors affect returns, such as data frequency, weighting schemes for calculating portfolio returns, breakpoints for sorting stocks, and a screen for size, price and liquidity. Berggrun et al. (2016) investigate this relationship by using stocks in the MILA, but they could not find any relationship between idiosyncratic risk and returns. They suggest that idiosyncratic risk is not a price factor in this market.

Some literature demonstrates that idiosyncratic risk and returns have a positive relationship. Employing a different method to Merton (1987) and Ang et al. (2006), Fu (2009) applies the exponential GARCH model to investigate the relationship between idiosyncratic risk and expected returns. He finds a positive relation between these factors. Fu also mentions that the research by Merton (1987) and Ang et al. (2006) should not infer that there is a relationship between idiosyncratic risk and expected returns because idiosyncratic volatility is time-varying. Malkiel and Xu (2002) also address the positive relation between idiosyncratic risk and returns by applying the framework of the Fama–MacBeth, and the Fama–French models. Their empirical results conclude that idiosyncratic risk is very useful variable in explaining cross-sectional expected returns. Another result found by Malkiel and Xu (2002) is that liquidity variables and idiosyncratic risk have an insignificant relationship. Goyal and Santa-Clara (2003) found that idiosyncratic risk and market returns have a positive relationship,