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# Liquidity and return in the Swedish stock market

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## Summary

**Title**:

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**Purpose:**

This paper investigates if liquidity (or illiquidity) is a factor influencing returns on the Swedish stock market during the period of January 2001 to December of 2010. The time-series effects of illiquidity as well as differences in the effects of illiquidity across stocks with different characteristics are investigated. In addition, the paper addresses the question of whether sensitivity of stock

returns to illiquidity, as well as to other explanatory factors, is persistent over time.

**Methodology:**

The Sharpe-Lintner CAPM augmented with an illiquidity factor is fitted to time series monthly excess returns of stocks listed on the Swedish stock market during the period of January 2001 to December of 2010. In order to test the robustness of the coefficient of illiquidity, factors controlling for size (measured by market capitalization) and price-to-book value are step by step added as explanatory variables in the asset pricing regressions. In addition, the standard Sharp-Lintner CAPM and the Fama-French three-factor model are estimated for comparison.

In addition to the market portfolio of the CAPM, three zero-investment portfolios (factors) are created controlling for illiquidity, size and price-to-book value. These factors are used as explanatory variables for excess returns of 27 portfolios sorted by illiquidity, size and price-to-book value.

Monthly excess returns of the 27 portfolios are created as the intersection of monthly returns from three illiquidity sorted portfolios (illiquid/moderately liquid/very liquid), three size sorted portfolios (small/medium/big) and three price-to-book value sorted portfolios (low/medium/high) minus the 1 month SSVX. The purpose of sorting the data in this way is to neutralize the effects of size and price-to-book value and to thereby tease out the effects of illiquidity.

The sample is split into three separate time periods and the Fama-French three-factor model augmented with the illiquidity factor is estimated for each subsample, in order to investigate the stability of the coefficients over time.

**Results:**

The results presented below indicate that illiquidity affects returns in the Swedish stock market during the sample period. The Fama-French three-factor model augmented with an illiquidity factor produces the best fit (measured by $R^2$) among the models considered in this paper.

However, alphas are generally large and significant across all models, which indicate that the models lack in capacity to explain returns. Furthermore, illiquidity is found to have a negative effect on returns of stocks sorted as very liquid. This is a surprising result and is not in line with what was expected beforehand. For illiquid stocks, the effect is found to be positive but also frequently insignificant. The sensitivity of returns to illiquidity thus seems to be decreasing with illiquidity.

# 1 Theoretical framework

In this section a theoretical framework is presented. A short description of the concept of liquidity is followed by a discussion regarding why liquidity is important in relation to asset prices. Thereafter, the causes of illiquidity are identified together with the channels through which it affects asset prices.

## 1.1 What is liquidity?

The concept of liquidity is quite difficult to define but the characteristics of a liquid asset can more or less be identified. An asset is for example characterized as liquid if it has a low cost of immediate execution (Amihud and Mendelson 1986:224) or if the asset can be traded in large amounts without affecting its price (Sarr and Lybek 2002:4). The liquidity of an asset seems to be closely related to the direct costs associated with performing a transaction involving the asset. Yakov Amihud and Haim Mendelson point out that there are other ways of thinking about liquidity. For example, the liquidity of an asset could theoretically be measured as the difference between the price of the asset when it is traded, as opposed to the price of the same asset in the absence of a trade. (Amihud and Mendelson 1991:56). Amihud and Mendelson also show that the even thought the direct transaction cost associated with a trade can be quite small, its indirect effect on the asset price can be much larger.

A general description of a liquid market for an asset includes characteristics such as tightness, immediacy, depth, breadth and resiliency[1]. These characteristics can exist in various degrees and are not always mutually exclusive. Together they describe a market where transaction costs are low, where it is possible to trade an asset immediately, where (both buy and sell) orders are abundant and where it is possible to execute large trades without significantly affecting the market price. Also, in a liquid market, there are no long-term deviations from the price warranted by fundamentals due to order imbalances (Sarr and Lybek, 2002:5).

[1] **Tightness**: Low transaction costs (tight bid-ask spreads), **Immediacy**: The speed with which an order can be executed, **Depth**: Existence of abundant orders at and around the current price, **Breadth**: Numerous and large orders with minimal impact on prices. **Resiliency**: Orders flow quickly in order to correct order imbalances that move prices away from what is warranted by fundamentals.

## 1.2 Why does liquidity matter?

The importance of liquidity, at least for this paper, comes from its effect on asset prices. Arguably one of the most famous models for pricing assets is the Capital Asset Pricing Model (CAPM) introduced by William Sharpe (1964), John Lintner (1965) and Fischer Black (1972). The CAPM is an equilibrium model that builds on the work of Harry M. Markowitz (1959) and explains the expected return of an asset in equilibrium as a function of its systematic risk. One of the key contributions of Harry M. Markowitz was the realization that it was possible to reduce the risk of a portfolio of assets without sacrificing expected return. This was done through the "magic" of diversification.

The CAPM builds on the results of Markowitz and states that, in equilibrium, the rate of return of any risky asset is a function of its covariance with the market; its market risk. The market risk is the risk that an asset has in common with the market and is referred to as its beta-risk. This risk is common to all assets although it may vary in degree. Central to the CAPM is the result that the market will only compensate an investor (through higher expected return) for taking on market risk. Since risk that is specific to any given asset can be eliminated using diversification without sacrificing expected return, the market will not pay a premium for this risk (Copeland Weston Shastri 2005:147).

Under the CAPM it is assumed that markets are frictionless, that information is costless and simultaneously available to all investors, that investors are price takers and have identical holding periods (Copeland Weston Shastri 2005:147-148). The CAPM implies that assets with the same exact cash flows need to trade at the same exact price. If not, an investor could make a riskless (arbitrage) profit. (Almihud, Mendelson and Pedersen 2005:276).

The CAPM is often criticized for resting on implausible assumptions. For example, there are clear empirical suggestions as to the existence of withstanding price differences between assets with the same cash flows. It has for example been shown that the most actively traded U.S. Treasury bonds (on-the-run issues) trade at yields of 5 to 10 basis points below of-the-run bonds (Swansen, David 2009:83). There are a growing number of studies that point to variations in liquidity as one of the major causes of these price differences. One example is the LCAPM derived by Viral V. Acharya and Lasse Heje Pedersen in their paper *"Asset pricing with liquidity risk"* (2005). Here they derive a liquidity-adjusted capital asset pricing model (LCAPM) in which the expected return of an asset is increasing in its expected illiquidity but also in the covariance of its return (net of its illiquidity costs) and the return of the market portfolio (net of its illiquidity costs) (Acharya and Pedersen 2005:376). These studies are doing their part in formalizing the relationship between liquidity and expected return.

## 1.3 The causes of illiquidity

The literature concerned with the causes and effects of illiquidity relaxes some of the assumptions of the CAPM. The assumption of frictionless markets is relaxed and information is no longer assumed to be perfect. Holding periods are no longer identical and agents are no longer assumed to be price takers. The existence of high exogenous trading costs such as fees and taxes are among the more apparent market frictions. These costs can be assumed to reduce an agents' demand for trades.

### Information asymmetries

There are other, perhaps not as clear, causes of illiquidity, for example the existence of information asymmetries. Amihud, Mendelson and Pedersen put forward the work of Sandford Grossman and Josef Stigliz when discussing the effects of information asymmetries on transaction costs in the book Foundations and trends in finance (2005). While under the assumptions of the CAPM, all information is costless and simultaneously available to investors, Grossman and Stiglitz show how investors who seek out information are rewarded with higher expected returns on their investments. They even go as far as to argue that the very existence of informationally efficient markets is impossible since it would destroy all incentives to find new information and hence the market would collapse (Grossman and Stiglitz, 1980:404).

The existence of market makers is often used proof of price-affecting frictions in the market. The argument is that since market makers are compensated for alleviating frictions, if there were no frictions, there would be nothing to warrant the existence of market makers (Amhud, Mendelson, Pedersen 2005:275). Lawrence Glosten and Paul Milgrom (1985) show that market makers take information asymmetries into consideration when quoting prices. This result in a bid-ask spread. They show that, under certain assumptions, the bid-ask spread can result purely from information asymmetries. A sellers concession is included in the bid price in order to compensate the market maker for the risk that the seller might have private (negative) information on the asset, and a premium is included in the ask price in order to compensate the market maker for the risk of a buyer having private (positive) information on the asset (Glosten and Millgrom 1985:72). If there are many agents willing to trade with the market makers, the costs associated with private information are lower since the information asymmetries are reviled to a larger extent (Lybeck and Saff 2002:9).

### Inventory risk

Market makers also carry the inventory risk of large price movements when buyers and sellers are not simultaneously present in the market (so called inventory-carrying cost). From the time of purchase to the time of sale, price may change. If this time is short, i.e. if the market for an asset is liquid, then the risk is low and the compensation required by market makers is small. If this time is lengthy, however, the risk can be substantial and so can the compensation required by the market maker. (Lybeck and Saff 2002:9)

### Market-impact costs

Large trades move prices of illiquid assets, while liquid assets can be traded in large volumes without a significant price impact. This is often referred to as the "market-impact costs" of an asset. If an investor wants to buy/sell a large quantity of an illiquid asset, then the investor is forced to pay a larger premium/accept a larger concession than were the investor to buy/sell a large quantity of a liquid asset, the larger the quantity bought/sold, the larger the forced premium/concession (Amihud and Mendelson, 1991:57). The existence of market-impact costs would for example refute the assumption of the CAPM that all investors are price takers.

### Delay and search costs

These costs occur when a trade is delayed by the buyer/seller as he/she searches for a better price than the one currently quoted by a market maker. It can also be the case that the buyer/seller is looking for a way to reduce the price-impact of a trade. It is also a matter of the risk of unfavourable price changes borne by the buyer/seller while looking for a more favourable price. (Amihud and Mendelson 1991:57)

## 1.4 Liquidity and expected return

The existence of an illiquidity premium is quite intuitive. Assets that are difficult to sell are in less demand by investors who are risk averse and thereby take into account the risk of a forced sale. Hence prices of illiquid assets can be expected to be lower (all else equal) than those of liquid assets.

Among the first to formalize the relationship between expected return and liquidity were Yakov Amihud and Haim Mendelson. In their paper "Asset pricing and the bid-ask spread" from 1986, they proposed two things: 1) The observed market return is an increasing and concave function of the illiquidity of an asset and 2) In equilibrium, less liquid assets are allocated to portfolios with longer expected holding periods (Amihud and Mendelson 1986:278).

The positive relationship between illiquidity and asset return comes about through the significant effect on the price of an asset that even small transaction costs incur. Since illiquidity costs are incurred each time an asset is traded, a buyer is aware, that upon selling an asset back to the market, the new buyer will take into account the illiquidity cost that will arise at the time of its sale, the same will then be done by the next buyer buyer and the next and so on. This means that the buyer of an asset will discount, not only the expected illiquidity cost incurred when selling the asset, but also all of the future illiquidity costs incurred each time the asset is traded (Amihud et al. 2005:279). Amihud and Mendelson exemplify the effect price effect of small transaction costs using a simple example. They assume a perpetuity bond traded once a year to a cost of $1 and a real rate of return of 4 percent. They then discount all the future transaction costs to present value.

$$\sum_{t=0}^{\infty} \frac{1}{1{,}04^{t}} = \$26 \tag{1}$$

As can be seen from this example, a transaction cost of $1 under these circumstances, amount to a present value of $26. An asset that is traded less frequently will also incur transaction costs less frequently and will thereby have a higher expected return net the present value of transaction costs (all else equal). (Amihud and Mendelson 1991:58)

Amihud and Mendelson argue that the concavity of the relationship between the expected return and illiquidity is related to the differences in expected holding periods of investors. The longer the expected holding period of an investor, the less is the compensation required for any given increase in illiquidity. This since investors with longer expected holding periods could discount the illiquidity cost of an asset over a longer period of time. Viewing the illiquidity cost of an asset induced at the time of purchase/sale in proportion to the yearly expected return of the asset, it can be seen that increasing the holding period will reduce the illiquidity cost in proportion to the expected return. Hence the longer the holding period, the less important are the illiquidity costs (Amihud and Mendelson 1986:228-229).

# 2 Empirical issues

In this section the question of how to measure liquidity is discussed. A number of different measures are presented and described. The ILLQ-measure of liquidity used in this paper is described in some detail at the end of the section.

## 2.1 How to measure liquidity?

Liquidity has been measured in many ways and using many different methods and proxies. Even though no single measure is thought to able to capture all the different dimensions of liquidity, taken together these measures are assumed to be able to do an adequate job.

### Transaction cost measures

Perhaps the most frequently used measure of liquidity is the bid-ask spread. For an asset that is traded on an exchange, the bid-ask spread is a good measure of direct transaction costs since it is, in fact, the cost of immediate sale and repurchase of an asset. Amihud and Mendelson construct a model of a return-spread relationship where the hypothesis is that of an increasing and concave relationship between expected return and the bid-ask spread.

Even thought the bid-ask spread is generally considered a good proxy for illiquidity, there are a few issues related to it. For example, the bid-ask spread is a measure of fixed transaction costs, this in the sense that it does not depend on the size of the trade. It does not capture the impact that a transaction may have on the price of an asset. Hence it is a sensible measure of illiquidity as long as volumes traded are not out of the ordinary. Many trades take place outside of the bid-ask spread, reducing its function as a measure of liquidity (Brennan and Subrahmanyam 1996:442).

### Price impact measures

In their paper *"Market microstructure and asset pricing: On the compensation for illiquidity in stock returns"* Michael Brennan and Avanidhar Subrahmanyam uses two different models of price formation in order to estimate the components of both the fixed and the variable cost of a transaction. They act on the findings of Glosten and Harris (1988) who found that the liquidity effect of a trade is best captured by the variable component of trading costs (Brennan and Subrahmanyam 1996:442). The variable component of the trading cost, i.e. the cost that depends on the size of the trade, is that which is referred to as the price impact.

### Volume-based measures

Trade volume is perhaps the most obvious example of a volume-based measure of liquidity. High volumes traded could, during normal market conditions, indicate that an asset is liquid. By relating the volume traded in a stock to the volume of outstanding stocks, the turnover rate is derived. The turnover rate can be considered a measure of the time an asset is held by an investor. Since liquid assets are often assumed to trade with a higher frequency than illiquid assets, the turnover rate could be an indication of the liquidity of assets (Sarr and Lybek 2002:12). Datar, Naik and Radcliffe(1998) use the turnover rate as a measure of liquidity. They define the turnover rate as the number of shares traded over the total number of outstanding shares and examine if there exists a negative relationship between liquidity and stock returns. They argue that the turnover rate is a good proxy of liquidity since it has been proven that liquidity is highly correlated with trading frequency.

However, there are problems associated with using the turnover ratio as a proxy for illiquidity as it has been shown rather to reflect firm related uncertainty than liquidity and liquidity risk (Barinov 2012:30).

Another example of a volume-based liquidity measure is the ILLIQ-measure. It was derived by Yakov Amihud in the paper "*Illiquidity and stock returns: cross section and time series effects*" (2002). This measure relates the volume traded to its impact on price. Amihud uses the daily absolute return per dollar of trading volume as a proxy for illiquidity.

## 3.2 The ILLIQ-measure of illiquidity

This thesis uses the ILLQ-measure of Yakov Amihud as a proxy for illiquidity. The ILLIQ-measure holds the advantage of being a relatively intuitive and uncomplicated measure of illiquidity but above all, it is accessible. Many liquidity measures have been created as extensions of Amiuhds' ILLIQ-measure, but it has been shown that the original is still one of the more reliable measures. In their paper "Do liquidity measures measure illiquidity" Goyenko, Holden and Trzcinka show that the ILLIQ-measure of Amihud is correlated to more accurate high frequency measures of liquidity (Goyenko, Holden and Trzcinka 2009:169). Also Amihud show that the ILLIQ-measure of illiquidity is positively related to measures of price impact and the bid-ask spread (Amihud 2002:35). This indicates that even though the ILLIQ-measure might not be the best or most accurate measure, it is still useful. The ILLIQ-measure is defined as follows:

$$ILLIQ_t^i = \frac{1}{Days_t^i} \sum_{d=1}^{Days_t^i} \frac{|R_{td}^i|}{V_{td}^i} \tag{2}$$

Here $R_{td}^i$ is the return of stock *i* in day d in month *t*. $V_{td}^i$ is the SEK volume traded of stock *i* in day *d* of month *t* and $Days_t^i$ are the number of trading days for stock *i* in month *t*. The ILLIQ measure gives the price change of a given SEK-volume traded. Large price movements in relation to small volumes traded (a large value for ILLIQ) indicates that the market for the asset is thin and/or shallow as opposed to broad and deep. This in turn indicates that the asset is illiquid. Hence, just as a high bid-ask spread reflects an illiquid asset, so does a high value for the ILLIQ-measure.

## 3 Purpose and questions to be explored

In this section the purpose of the thesis is presented and the two main hypothesis of the paper are formulated.

The purpose of the thesis is to find out if liquidity had an effect on returns in the Swedish stock market during the period of January 2001 to December 2010. In accordance with the theoretical framework presented above, two main hypotheses are formed and investigated in this paper:

**Hypothesis 1:** *There exists a positive relationship between the illiquidity of a stock and its expected return*.

This hypothesis would be supported if the coefficient of illiquidity as estimated in this paper were positive and significant.

**Hypothesis 2:** *Increases in liquidity have a larger positive effect on the returns of liquid stocks than for the returns of illiquid stocks.*

This hypothesis would be supported if the coefficient of illiquidity were larger and more positive for liquid stocks than for illiquid stocks.

In the analysis part of this paper, the explanatory power of the models will be discussed in terms of their $R^2$ and the size of their alphas, evidence for and against the two hypotheses presented above will be commented upon and it will be discussed if and how the IMV-coefficient is affected by the inclusion of portfolios controlling for size and price-to-book value. It will be investigated how the explanatory power of the different models compare to that of the models that do not include a liquidity factor and it will also be explored how the market beta, SMB- and LMH-coefficients react to the inclusion of the IMV-portfolio.

# 4 Data and portfolio formation

In this section the sample is described in detail. Also the creation of the dependent variables in the form of 27 portfolios and the independent variables in the form of the market portfolio and the three "zero investment" portfolios is described and explained.

## 4.1 Describing the data

In addition to liquidity, there are many factors that have been shown to have an impact on asset prices. Among the most commonly used in the literature are market covariation (beta), size, book-to-market value, momentum, earnings-to-price, leverage and volatility. In their paper "The cross-section of expected stock returns" (1992), Eugene Fama and Kenneth French show that the size and book-to-market capture close to all of the variation of returns on the US stock market.

The three-factor model of Fama and French is an accepted and widely used framework for pricing assets and in this paper the size and book-to-market factors, together with a market portfolio, are used in order to check the robustness of the potential illiquidity effect on returns in the Swedish stock market. The construction of dependent and independent variables follows that of Howard W. Chan and Robert Faff presented in their paper "Asset pricing and the illiquidity premium" from 2005.

Monthly data on market value and price-to-book value on 613 firms listed on the Swedish stock market some time during the period of December 2000 to December 2010 is collected using Thomson Reuters DataStream. In addition, daily data on price and trading volume is collected for the same stocks and for the same period of time. Firms from the three different categories; size, price-to-book value and illiquidity (measured using the ILLQ-measure described above) are matched and only firms for which monthly data covering each of these three factors are available at the reference month (t-1) are included in the final sample. An effect of this is that the same firms are included in the size-portfolio, the price-to-book value-portfolio and the illiquidity-portfolio. It is common to reduce the sample by removing the stocks with the highest and lowest market value. This is generally done in order to reduce the noise of, for example low valued and often highly volatile stocks. Also, it is not uncommon to restrict the stocks included by some sort of "lifetime" measure. For example Acharya and Pedersen only include stocks that have at least 15 days of return and volume data each month (Acharya and Pedersen 2005:387). In this paper however, the focus is on having as large a sample as possible and therefore no stocks are excluded on the basis of market value or lifetime.

As can be seen from Table 8, 245 stocks are included in the sample in 2001 and 369 stocks are included in 2010. Hence the sample size increases over time. At the same time, the average market value is decreasing over the sample period. The highest average market value can be found in 2001 and the lowest in 2009. The average price-to-book value is fairly stable across time and the illiquidity measure is highest in the beginning and the end of the sample period with a dip in the years prior to and including 2007.

In order to get rid of any delisting bias a negative return of 20 percent is given to the stock in the same month that the firm is delisted. This is to some extent an arbitrary action since there are no actual studies (known to the author) of the recovery rate of delisted stocks in the Swedish stock market. Since information regarding the reasons for delisting is lacking, the assumption is made that all stocks are delisted due to difficulties such as financial distress. This is a convenient but unlikely assumption that may lead to that sample returns are underestimated.

## 4.2 Sorting the data and creating the portfolios representing the dependent variables

The sample of firms is independently sorted on size, price-to-book value and illiquidity. Each category is then divided into three groups. All groups are created based on a 30:40:30 split, where 30 percent of the firms are in the three categories big size/high price-to-book value/very liquid and 30 percent of the stocks are in the categories small size/low price-to book-value/illiquid. The rest of the firms are sorted into three medium categories. In order to assure a fair amount of stocks in each portfolio, the stocks are sorted on their mean values. The size and illiquidity portfolio are sorted each year by the size/liquidity of the stocks in December of year t-1. That is, for 2001 the stocks are sorted by their respective size-/liquidity-value in December of 2000. In order to make sure that accounting data is known to the investors at the time of their assumed investment decision and to thereby avoid a look-ahead bias in the data, stocks are sorted on their price-to-book value six months prior to year-end; that is in June of year t-1. If stocks are sorted on their price-to-book value of December year t-1, then they may be sorted on data that is not actually known to the investors at the time of portfolio formation. This would create what is called a look-ahead bias. From this sort, the value-weighted monthly returns of the nine portfolios sorted on size, price-to-book value and liquidity are calculated for a period of ten years. Once this is done, dependent variables are created as the simple average return of components from the three portfolios sorted on size, the three portfolios sorted on price-to-book value and the three portfolios sorted on illiquidity. Excess returns are produced using the one-month risk free rate (represented by the 1m SSVX). The 27 portfolios range from Small/High/Illiquid to Big/Low/Very Liquid.

### 4.3 Constructing the zero investment portfolios

The explanatory factors used in this paper are created in line with Chan and Faff (2005) and Fama and French (1993).

#### Illiquidity and the Illiquid minus Very liquid (IMV) - portfolio

As described above, it has been suggested that illiquid stocks are associated with a higher on average return than are very liquid stocks. It has also been shown that the ILLIQ-measure captures illiquidity in a reliable fashion. In light of the evidence, a portfolio intended to capture the effect of illiquidity is created following Chan and Faff (2005).  The return of the portfolio is the excess return of illiquid stocks over that of very liquid stocks. The average return of the nine portfolios containing very liquid stocks is subtracted from the average return of the nine portfolios containing illiquid stocks. The IMV-portfolio is then used in order to investigate the sensitivity to liquidity of the 27 portfolios containing stocks sorted on size, price-to-book value and liquidity.

### Size and the Small minus Big (SML)-Portfolio

Rolf Banz documented the “size-effect” in 1981 for NYSE firms. He found that firms with small market capitalization had higher beta-adjusted return than firms with large market capitalization (Novak and Petr 2010). Fama and French confirmed this evidence in 1992 when they investigated the effect of size and book-to-market value on the returns of stocks on the NYSE (Fama and French 1992). In line with Fama and French (1993) the SMB-portfolio used in this paper gives the monthly excess returns of small firms over those of big firms. Hence in each month, the average returns of the nine portfolios containing firms sorted as “big” are subtracted from the average returns of the nine portfolios containing stocks sorted as “small” thus creating monthly returns of a Small Minus Big (SMB) – portfolio.

### Price-to-book value and the Low minus High (LMH)-portfolio

The importance of book-to-market value in explaining returns has been documented by, among others, Dennis Stattman in his paper Book values and stock returns (1980). Fama and French find that firms with high book to market value, that is stocks with low price in relation to their book-value, tend to be associated with higher expected returns (higher costs of capital) than firms with low book-to-market value (Fama and French 1992;428). They conclude that Book-to-Market is one of the most prominent factors when explaining returns. Since Price-to-Book value is used in this paper instead of Book-to-Market value the factor is constructed as an LMH-portfolio (Low minus High) in order for the effect to be analogous to the HML-portfolio of Fama and French (1993). It gives the excess return of “value firms” over of “growth firms”.

### The market portfolio

The market portfolio is constructed as an equally weighted market index consisting of all stocks included in the original sample. This means that the only restriction put on the stocks included in the market portfolio is that return data is available in the specific month where it is to be used. The reason for using an equally weighted index is that the value-weighted index tends to underestimate the illiquidity of the market portfolio (Acharya and Pedersen 2005:388).

# 5 Estimation and results

In this section the results from the various models estimated are presented and gone through one model at a time. At the end, a short description of the results of the estimations of the three time related sub samples 2001-2003, 2004-2006 and 2007-2010 are presented.

## 5.1 Estimation

The Sharp/Lintner CAPM augmented with an illiquidity factor is estimated for the period of January 2001 to December 2010. In order to check the robustness of the effect of illiquidity, two factors controlling for size and price-to-book value are successively added. This is done using ordinary least squares (OLS) in a time series framework. In addition to the three models using the liquidity factor, both the classical Sharpe/Lintner CAPM and the Fama and French "three-factor model" are estimated in order to have comparison and robustness check. In addition to these estimations the F&F-model augmented with the IMV-factor is estimated for three different sub periods, of the original sample period 2001-2003, 2004-2006 and 2007-2010. This is done in order to get a see if the coefficient of liquidity can be considered to be stable over time.

Various tests are performed such as the augmented Dickey-Fuller test of stationarity, the Jarqe-Bera test of normality, the Ramsey Reset-test of misspecification, and the Breusch-Pagan LM test of serial correlation. Where autocorrelation is found, Newey-West standard errors are used for inference.

Presented below are the results of the five estimated models. $IMV_t$, $SMB_t$ and $LMH_t$ are the returns at time "t" of the mimicking portfolios of illiquidity, size and price-to-book value described above. $\beta_m$, $\gamma_{IMV,}$,$\gamma_{SMB}$ and $\gamma_{LMH}$ are the coefficients related to the market portfolio, IMV-portfolio, SMB-portfolio and LMH-portfolio respectively. $Z_{it}$ is the return in excess of the 1m SSVX of dependent portfolio *i* at time *t*, $Z_{mt}$ is the excess return of the market portfolio at time *t* and $\varepsilon_{it}$ is an error term which is assumed to be independent and identically distributed.

## 5.2 Models and results

### 5.2.1 The CAPM

$$Z_{it} = \alpha_0 + \beta_m Z_{mt} + \varepsilon_{it} \qquad (3)$$

#### *Explanatory power*

The explanatory power of the capital asset pricing model (CAPM), ranges from 0,90 for the MMI-portfolio to 0,69 for the BHV-portfolio. The intercepts (or alphas) are quite large and significant for all portfolios. Alphas are generally lower for portfolios containing small stocks than big, stocks. The model suffers from issues related to model misspecification.

#### *The market beta*

The market beta is larger than one and highly significant across portfolios. It is generally decreasing in price-to-book value and market betas are smaller for illiquid stocks compared to very liquid stocks. The lowest values for market betas are found for portfolios containing small, illiquid stocks with low price-to-book value. The largest market betas are found for portfolios containing medium sized, moderately liquid stocks with high price-to-book value.

### 5.2.2 Model number one

$$Z_{it} = \alpha_0 + \beta_m Z_{mt} + \gamma_{IMV} IMV_t + \varepsilon_{it} \qquad (4)$$

#### *Explanatory power*

The fit of the model, measured by $R^2$, increases with the inclusion of the IMV-portfolio and the $R^2$ now ranges from 0,79 to 0,93. The $R^2$ values are on average lowest for portfolios containing big stocks, which is a noteworthy result. On average the $R^2$ values are 85 percent for portfolios containing big stocks and on average 89 percent for portfolios containing small stocks. $R^2$ is also slightly higher for portfolios containing stocks with high price-to-book value than for portfolios containing stocks with low price-to-book value. The improvement in explanatory power from the inclusion of the IMV-portfolio can also be seen in the adjusted $R^2$. Introducing the IMV-portfolio also has the effect of, on average, reducing the alphas. Overall the alphas are still highly significant and considerable in size. They range from 0,90 percent per month for the SMV portfolio and 2,3 percent per month for the SMI portfolio. Alphas are generally larger for portfolios containing illiquid stocks.

#### *The market beta*

As can be seen in table 4, including the IMV-portfolio in the regression reduces the magnitude of the market beta for all but five portfolios. For portfolios containing small firms with low price-to-book value, the market beta increases. The market beta is still positive and highly significant across portfolios. It ranges from 1,71 for the SMI portfolio to 1,14 for the BMV portfolio. After including the IMV-portfolio, the market betas are on average smaller for portfolios containing big firms compared portfolios containing small firms.

#### *The IMV*

The IMV-coefficient is negative for all but two portfolios and significant for all but 4 portfolios. The coefficient is less negative and even positive for portfolios containing illiquid firms. The slope of the IMV-coefficient also appears to be related to size and price-to-book value. As size and price-to-book value increases, the coefficient of illiquidity turns more and more negative. Hence the IMV-coefficient is most negative for portfolios containing big stocks with high price-to-book value that are very liquid (-0,71) and most positive for portfolios containing small, illiquid stocks with low price-to-book value (0,04).

### 5.2.3 Model number two

$$Z_{it} = \alpha_0 + \beta_m Z_{mt} + \gamma_{SMB} SMB_t + \gamma_{IMV} IMV_t + \varepsilon_{it} \tag{5}$$

#### *Explanatory power*

SMB-portfolio has a small negative (on average) effect on the explanatory power of the model for small stocks. The on average $R^2$ decreases from 90 percent to 89 percent for portfolios containing small stocks, while its on average value increases for all other portfolios. The biggest increase in explanatory power can be found for portfolios containing big stocks where the on average $R^2$ increases from 85 percent to 91 percent. The $R^2$ is slightly higher for portfolios containing very liquid stocks compared to portfolios containing illiquid stocks. The inclusion of the SMB-portfolio reduces the alphas a bit compared to model 1, suggesting a slightly better fit. The alphas are, however, still large and significant. The value of the alpha is now between 0,8 percent and 1,5 percent.

#### *The market beta*

Market beta is lager than one and significant throughout. When introducing the SMB portfolio, the (on average) market beta increases in magnitude for portfolios containing big and medium-sized stocks but decreases for small stocks. Market beta is generally slightly higher for portfolios containing big stocks than for portfolios containing small stocks.

#### *The SMB*

The SMB-coefficient is insignificant for 6 out of 9 portfolios containing small firms but highly significant for portfolios containing firms of medium and big size. The coefficient is negative throughout, which contradicts previous findings of small firms being associated with a higher expected return.

#### *The IMV*

The inclusion of the SMB-portfolio into the regression reduces the negative magnitude of the IMV-coefficient. The largest change can be found in portfolios containing big firms where the (on average) magnitude of the coefficient of illiquidity changes from -0,43 to -0,16. With the inclusion of the SMB-portfolio, the slope of the IMV is no longer related to size. The slope of the IMV is, however still related to illiquidity and price-to-book value. The IMV-coefficient is still most negative for portfolios including big, liquid firms with high price-to-book value. With the inclusion of the SMB-portfolio, the IMV-coefficient turns positive for portfolios containing illiquid stocks with low price to book value. Some of the variation in the data earlier attributed to illiquidity may in fact be common to that of size. The coefficient of illiquidity is significant for 21 out of 27 portfolios compared to 23 out of 27 for the previous model.

### 5.2.4 Model number three

$$Z_{it} = \alpha_0 + \beta_m Z_{mt} + \gamma_{SMB} SMB_t + \gamma_{LMH} LMH_t + \gamma_{IMV} IMV_t + \varepsilon_{it} \qquad (6)$$

### *Explanatory power*

Adding the LMH-portfolio reduces the alpha a bit for medium and big size stocks. For small stocks however, the effect is the opposite. The effect on alphas is small and alphas stay significant across portfolios. Alphas are still large (in the range of 2,3 percent per month for the SMI portfolio to 0,8 percent per month for the BMV portfolio). The explanatory power of model 3 (measured both by $R^2$ and adjusted $R^2$) is improved or unchanged for all portfolios compared to model 2. Also the problems of misspecification are a lot less prominent

### *The market beta*

Including the LMH-portfolio into the regression has no apparent effect on market beta. It is still larger than one and highly significant across portfolios.

### *The IMV*

Including the LHM-portfolio into the regression, the pattern of the IMV-coefficient found in model 2 disappears. However, the IMV-coefficient is still negative for very liquid stocks and positive (but largely insignificant) for illiquid stocks. It is clear that big, very liquid firms are the ones that are most sensitive to changes in liquidity and the effect is negative. Also the IMV-coefficient is insignificant for 5 out of 9 portfolios containing illiquid stocks. Introducing the LMH-portfolio into the regression decreases the number of significant IMV-coefficients from 22 to 21. The IMV-coefficient turns less negative as stocks with high price-to-book value increase in size. For stocks with low price-to-book value, the IMV-coefficient turns more negative as size increases.

### *The SMB*

Introducing the LHM-portfolio into the regression, the SMB-coefficient no longer decreases with price-to-book value. However, the SMB-coefficient is still negative across portfolios and it still declines as the size of the stocks included in the portfolios increase.

### *The LMH*

The LMH coefficient is generally negative and significant for firms with high price-to-book value and positive and significant for firms with low price-to-book value. This is basically the same result that is found by Fama and French for American stocks (Fama and French1993:24).

### 5.2.5 The Fama & French three-factor model

$$Z_{it} = \alpha_0 + \beta_m Z_{mt} + \gamma_{SMB} SMB_t + \gamma_{LMH} LMH_t + \varepsilon_{it} \qquad (7)$$

The models containing the liquidity variable are here compared to the Fama and French three-factor model, this in order to investigate if liquidity provides additional explanatory power. Compared to the F&F-model, adding the IMV-portfolio means a small increase in the explanatory power of the model (measured by $R^2$ and adjusted $R^2$). There is, however, no obvious change in the size and significance of alpha between the two models. If anything, the F&F-model is slightly superior. Adding the IMV-portfolio reduces the size of the market beta on average and it has a positive effect on the SMB-coefficient, which is now less negative. The number of significant SMB-coefficients is reduced when including the IMV-portfolio. For small firms, the number of insignificant SMB-coefficients goes from 1 to 8 when introducing the IMV-portfolio into the equation.

## 5.3 Stability over time

Looking at table's 7a through 7c, alphas are generally positive, large and significant across the three sub samples. However they seem to become both smaller and less significant in the last period (2007-2010). For illiquid stocks, the IMV-coefficients turn more positive/less negative over time. They also seem to increase in explanatory power over time and are generally positive and quite significant in the second and third period. For very liquid stocks, the IMV-coefficient generally turns less negative as time passes, but the coefficient also seems to lose significance over time.

Looking at the 18 coefficients of the second and third periods, the IMV-coefficient is significant (at a five percent level) only in 3 occasions for very liquid stocks, all of which are for stocks while it is significant in 13 out of 18 cases for illiquid stocks. The market betas are decreasing over time and approaches 1 at the end of the sample period 2007-2010. It stays highly significant over time. Independent of size, price-to-book value or illiquidity, the coefficient of size is decreasing over time. It is generally negative but for the period of 2001-2003 it is positive across all portfolios containing small stocks. The LMH-coefficients are negative across all periods for portfolios containing high price-to-book values except for small ad very liquid stocks.

# 6 Analysis

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In this section, the results described above in section 6 are analyzed in a more detailed fashion. First the explanatory power of the models are compared, then the sign and magnitude of the Illiquidity (IMV)-coefficient is discussed in relation to the two hypotheses put forward above. The sign and magnitude of the additional explanatory factors are briefly discussed and the section finishes with a discussion regarding the stability of coefficients over time.

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All estimated models show decent explanatory power as measured by $R^2$. The Sharp and Linter CAPM is the worst model in the sense that it is associated with the lowest values of $R^2$ and adjusted $R^2$ as well as the highest alphas.

Model nr. 3 (the F&F model augmented with the Illiquidity factor) is the model that produces the best fit to the data of all the models estimated in this paper. This is true both when using $R^2$ and adjusted $R^2$ as measures of fit. The Fama and French "three-factor"-model is the second best with $R^2$ – values close to those of model nr. 3. However, introducing the illiquidity factor seems to improve the explanatory power of the Fama and French model.

A somewhat surprising finding is that the alphas are large and very significant across models as well as portfolios. The F&F model displays marginally smaller alphas compared to model nr. 3 but it is clear that there are problems with all of the models estimated in this paper. The alphas are very large (in the region of 1 percent a month) which of course is an indication that all models estimated in this paper are lacking in capacity to explain sample returns.

For model number 1 (the CAPM augmented with the illiquidity factor), the IMV coefficient is generally negative across portfolios, however less so for portfolios containing illiquid stocks. The IMV-coefficients are affected by adding the SMB- and LMH-factors to the regression and they are generally reduced in magnitude and turn less negative/more positive. The effect of illiquidity seem to be robust to the inclusion of other variables as the number of significant IMV-coefficient is only reduced from 25 to 21 after controlling for size and price-to-book value. The reduction in magnitude of the IMV-coefficients indicates that some of the variation attributed to illiquidity in model number 1 could actually be attributed to size or price-to-book value. Before the inclusion of the SMB-and LMH-factors, the size of the IMV-coefficient was decreasing as size and price-to-book value increased. This pattern is less clear after the inclusion of the additional explanatory factors and in most cases it has disappeared.

For model number 3, the stocks of big and liquid firms seem to be those that are most sensitive to changes in liquidity. Coefficients are generally large, negative and significant across portfolios containing very liquid stocks. For illiquid stocks the results are pretty much the opposite. The IMV-coefficient is generally positive across portfolios containing illiquid stocks. The significance of the coefficients are reduced when introducing the factors controlling for size and price-to-book value but positive and significant coefficients are found in four out of nine portfolios containing illiquid stocks even after including the factors of size and price-to-book value. The negative sign of the IMV-coefficients for stocks sorted as very liquid is clearly not in line with hypothesis nr.1 presented above. According to Amihud and Mendelson (1986) one would expect positive coefficients across portfolios.

Sensitivity to illiquidity is expected to grow larger and more positive as liquidity increases according to hypothesis nr.2 presented above. The findings in this paper suggest that the sensitivity increases, but that the coefficients grow ever more negative. Hence the second hypothesis is not supported by the findings in this paper. The findings presented here are in line with those of Chan and Faff (2005) who also note that the coefficients are decreasing as stocks grow more liquid. Chan and Faff, who use the same measure of illiquidity as is done in this paper, find that for portfolios containing very liquid stocks, the coefficient of illiquidity is generally negative while it is positive for portfolios containing illiquid stocks (Chan and Faff 2005:444). One could suggest that sensitivity to changes in liquidity does seem to diminish as stocks grow less liquid which is in line with theory even though the results in this paper indicate that the IMV-coefficients move in the “wrong” direction as liquidity increases.

Across models and portfolios, all but one SMB-coefficient are found to be negative. These results are not in line with the findings of Fama and French (1993), who conclude that the SMB-coefficient is positive and significant across portfolios. In addition, for portfolios containing small stocks, all but one of the SMB-coefficients turn insignificant when the IMV-portfolio is introduced into the regression.

The LMH-coefficient is generally negative for portfolios containing stocks with high price-to-book value and positive for portfolios containing stocks with low price-to-book value. This pattern is in line with the results of Fama and French (1993) who also find that HML-coefficients are negative for portfolios containing stocks with low book-to-market value/high price-to-book value.

The magnitude of the market betas is reduced when including the IMV-portfolio in the regression. This indicates that part of the effect on returns that in the CAPM is attributed to market beta may in fact be related to liquidity.

The coefficients are clearly not stable over time. The IMV-coefficient generally tends to get more and more positive form one sub period to the next. As mentioned above, the IMV-coefficient seems to increase in importance over time for illiquid stocks as most of the significant IMV-coefficients are found in the last two sub-periods (2001-2003 and 2004-2006). The opposite is true for very liquid stocks, for which the IMV-coefficient seems to loose significance as time passes. The SMB-coefficient seem to turn more negative over time but at the same time increase in importance, as more of the SMB-coefficients are significant in the later sub periods. The size and significance of the alphas decrease as time passes and the fit of the model thereby seem to improve slightly. The market beta collapses towards one over time but remains highly significant. The pattern for the LMH-coefficient is somewhat unclear.

## 7 Conclusions and suggestions for further research

In this section the findings are summarized and a few problems and suggestions for further research are discussed.

The findings presented above does indicate that illiquidity has an impact on returns in the Swedish stock market, be it not exactly in the way that was expected beforehand. The negative IMV-coefficients are not in line with the predicted findings presented in hypothesis but the IMV-coefficients are generally significant and positive for illiquid stocks. The fact that IMV-coefficients turn more and more negative as liquidity increases is also a surprise and does not support the second hypothesis. However it does seem as if the sensitivity to changes in liquidity is larger for liquid stocks than for illiquid.

The model referred to as model nr.3 including mimicking portfolios controlling for size, price-to-book value and illiquidity is the model that that has the "tightest" fit among the models estimated here. However the Fama and French "three-factor" model is slightly superior when comparing the magnitude of the alphas.

It is clear that all the models estimated in this paper leave much room for improvement. With alphas in the range of 1% a month, clearly something is missing. For the future, it could perhaps be of interest to include one or more of the variables thought to affect asset prices that were excluded in this paper. For example, price-to-earnings ratio, leverage and momentum are all factors that have been shown to impact asset prices. It is possible that one (or more) of these variables could help improve the results of the models estimated in this paper. It has also been argued that liquidity is correlated with volatility. The intuition is that if volatility increases more trades are executed and illiquid stocks are priced even lower because of higher trading costs. Volatility is hence another possible factor to take into account.

Also, this paper doesn't take into account changes in market liquidity and the relationship between the liquidity of a single asset and that of the entire market. It is possible that the illiquidity of a particular stock is priced differently depending on how its own liquidity relates to the general liquidity of the market.

Both Acharya/Pedersen (2005) and Amihud (2002) investigate this relationship and it might be of interest to do so in the Swedish stock market as well.

# 8 Tables - Estimation results

## Table 1

### The CAPM

$$Z_{it} = \alpha_0 + \beta_m Z_{mt} + \varepsilon_{it}$$

| Coefficient | | HI | HM | HV | MI | MM | MV | LI | LM | LV |
|---|---|---|---|---|---|---|---|---|---|---|
| $\alpha*10^2$ | **S** | **1,10** | **1,30** | **1,00** | **2,30** | **1,10** | **0,90** | **1,04** | **1,30** | **1,10** |
| P-value | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| | **M** | **1,50** | **1,70** | **1,60** | **1,20** | **1,50** | **1,30** | **1,40** | **1,70** | **1,50** |
| | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| | **B** | **1,40** | **1,70** | **1,50** | **1,20** | **1,40** | **1,30** | **1,30** | **1,60** | **1,40** |
| | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| $\beta_m$ | **S** | **1,30** | **1,38** | **1,23** | **1,69** | **1,25** | **1,25** | **1,16** | **1,24** | **1,23** |
| P-value | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| | **M** | **1,34** | **1,40** | **1,40** | **1,21** | **1,28** | **1,27** | **1,19** | **1,26** | **1,26** |
| | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| | **B** | **1,31** | **1,39** | **1,38** | **1,19** | **1,26** | **1,25** | **1,17** | **1,24** | **1,24** |
| | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| **R2** | **S** | **0,87** | **0,86** | **0,83** | **0,88** | **0,91** | **0,85** | **0,86** | **0,89** | **0,83** |
| Adj. R2 | | *0,87* | *0,86* | *0,83* | *0,88* | *0,91* | *0,85* | *0,86* | *0,89* | *0,83* |
| | **M** | **0,87** | **0,85** | **0,79** | **0,90** | **0,89** | **0,84** | **0,87** | **0,87** | **0,82** |
| | | *0,87* | *0,85* | *0,79* | *0,90* | *0,89* | *0,84* | *0,86* | *0,87* | *0,82* |
| | **B** | **0,78** | **0,77** | **0,69** | **0,81** | **0,81** | **0,72** | **0,77** | **0,78** | **0,70** |
| | | *0,78* | *0,77* | *0,69* | *0,81* | *0,80* | *0,72* | *0,77* | *0,78* | *0,70* |
| **P-values** | | | | | | | | | | |
| Autocorr | **S** | 0,21 | 0,19 | 0,38 | 0,28 | 0,62 | 0,84 | 0,35 | 0,82 | 0,44 |
| Reset | | 0,02 | 0,01 | 0,15 | 0,03 | 0,10 | 0,30 | 0,00 | 0,03 | 0,03 |
| Normality | | No | No | Yes | No | Yes | Yes | No | No | No |
| Autocorr | **M** | 0,75 | 0,94 | 0,73 | 0,11 | 0,22 | 0,09 | 0,09 | 0,25 | 0,05 |
| Reset | | 0,03 | 0,02 | 0,09 | 0,03 | 0,21 | 0,21 | 0,00 | 0,02 | 0,01 |
| Normality | | No | No | No | No | Yes | Yes | No | No | No |
| Autocorr | **B** | 0,76 | 0,98 | 0,41 | 0,13 | 0,21 | 0,02 | 0,09 | 0,13 | 0,01 |
| Reset | | 0,01 | 0,02 | 0,03 | 0,09 | 0,04 | 0,03 | 0,00 | 0,00 | 0,00 |
| Normality | | No | No | No | No | No | No | No | No | No |
| ADF-test | **S** | 0,01 | 0,00 | 0,00 | 0,00 | 0,01 | 0,00 | 0,01 | 0,01 | 0,00 |
| | **M** | 0,00 | 0,00 | 0,00 | 0,00 | 0,01 | 0,01 | 0,00 | 0,01 | 0,01 |
| | **B** | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,01 | 0,00 | 0,01 | 0,01 |

## Table 2

## Model number 1

$$Z_{it} = \alpha_0 + \beta_m Z_{mt} + \gamma_{IMV} IMV_t + \varepsilon_{it}$$

| Coefficient | | HI | HM | HV | MI | MM | MV | LI | LM | LV |
|---|---|---|---|---|---|---|---|---|---|---|
| $\alpha*10^2$ | S | 1,10 | 1,30 | 1,01 | 2,30 | 1,07 | 0,90 | 1,10 | 1,30 | 1,10 |
| P-value | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| | M | 1,40 | 1,60 | 1,40 | 1,20 | 1,40 | 1,20 | 1,40 | 1,60 | 1,40 |
| | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| | B | 1,30 | 1,50 | 1,30 | 1,10 | 1,30 | 1,10 | 1,30 | 1,15 | 1,30 |
| | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| $\beta_m$ | S | 1,23 | 1,28 | 1,26 | 1,71 | 1,24 | 1,22 | 1,23 | 1,28 | 1,26 |
| P-value | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| | M | 1,30 | 1,33 | 1,30 | 1,20 | 1,24 | 1,20 | 1,19 | 1,23 | 1,19 |
| | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| | B | 1,24 | 1,28 | 1,24 | 1,14 | 1,18 | 1,14 | 1,13 | 1,17 | 1,13 |
| | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| IMV | S | -0,15 | -0,31 | -0,29 | 0,02 | -0,15 | -0,32 | 0,04 | -0,12 | -0,29 |
| | | 0,00 | 0,00 | 0,00 | 0,68 | 0,00 | 0,00 | 0,32 | 0,00 | 0,00 |
| | M | -0,20 | -0,36 | -0,53 | -0,04 | -0,20 | -0,37 | -0,01 | -0,18 | -0,35 |
| | | 0,00 | 0,00 | 0,00 | 0,26 | 0,00 | 0,00 | 0,76 | 0,00 | 0,00 |
| | B | -0,37 | -0,54 | -0,71 | -0,22 | -0,38 | -0,55 | -0,19 | -0,35 | -0,52 |
| | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| R2 | S | 0,92 | 0,93 | 0,88 | 0,88 | 0,91 | 0,89 | 0,89 | 0,91 | 0,88 |
| Adj.R2 | | *0,91* | *0,93* | *0,87* | *0,88* | *0,91* | *0,88* | *0,89* | *0,91* | *0,87* |
| | M | 0,89 | 0,91 | 0,91 | 0,90 | 0,92 | 0,92 | 0,87 | 0,89 | 0,89 |
| | | *0,89* | *0,91* | *0,91* | *0,90* | *0,92* | *0,92* | *0,86* | *0,89* | *0,88* |
| | B | 0,85 | 0,89 | 0,88 | 0,83 | 0,88 | 0,87 | 0,79 | 0,84 | 0,83 |
| | | *0,85* | *0,89* | *0,88* | *0,83* | *0,88* | *0,86* | *0,79* | *0,84* | *0,83* |
| Autocorr. | S | 0,43 | 0,38 | 0,74 | 0,88 | 0,18 | 0,87 | 0,60 | 0,41 | 0,59 |
| Reset | | 0,02 | 0,01 | 0,20 | 0,11 | 0,19 | 0,28 | 0,09 | 0,12 | 0,02 |
| Normality. | | No | No | Yes | Yes | Yes | Yes | No | No | No |
| Autocorr | M | 0,70 | 0,78 | 0,70 | 0,09 | 0,13 | 0,09 | 0,05 | 0,17 | 0,05 |
| Reset | | 0,04 | 0,03 | 0,17 | 0,20 | 0,61 | 0,26 | 0,08 | 0,23 | 0,01 |
| Normality | | Yes | Yes | Yes | Yes | Yes | No | No | No | No |
| Autocorr | B | 0,25 | 0,40 | 0,25 | 0,05 | 0,18 | 0,05 | 0,02 | 0,07 | 0,02 |
| Reset | | 0,07 | 0,07 | 0,11 | 0,19 | 0,53 | 0,12 | 0,13 | 0,17 | 0,01 |
| Normality | | Yes | Yes | Yes | Yes | Yes | Yes | No | No | No |

## Table 3

## Model number 2

$$Z_{it} = \alpha_0 + \beta_m Z_{mt} + \gamma_{IMV} IMV_t + \gamma_{SMB} SMB_t + \varepsilon_{it}$$

| Coefficient | | HI | HM | HV | MI | MM | MV | LI | LM | LV |
|---|---|---|---|---|---|---|---|---|---|---|
| **$\alpha*10^2$** | **S** | **1,00** | **0,04** | **1,00** | **2,30** | **1,10** | **0,80** | **0,97** | **1,20** | **0,90** |
| P-value | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| | **M** | **1,20** | **1,50** | **1,20** | **1,00** | **1,30** | **1,00** | **1,18** | **1,40** | **1,20** |
| | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| | **B** | **1,04** | **1,30** | **1,04** | **0,80** | **1,10** | **0,80** | **1,00** | **1,22** | **1,00** |
| | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| **$\beta_m$** | **S** | **1,28** | **1,32** | **1,17** | **1,69** | **1,22** | **1,18** | **1,17** | **1,21** | **1,17** |
| P-value | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| | **M** | **1,32** | **1,35** | **1,32** | **1,23** | **1,26** | **1,23** | **1,22** | **1,26** | **1,22** |
| | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| | **B** | **1,28** | **1,31** | **1,28** | **1,19** | **1,22** | **1,19** | **1,18** | **1,22** | **1,18** |
| | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| **IMV** | **S** | **-0,13** | **-0,33** | **-0,22** | **0,06** | **-0,14** | **-0,28** | **0,12** | **-0,08** | **-0,22** |
| | | 0,00 | 0,00 | 0,00 | 0,41 | 0,00 | 0,00 | 0,03 | 0,10 | 0,00 |
| | **M** | **-0,05** | **-0,24** | **-0,38** | **0,14** | **-0,06** | **-0,20** | **0,20** | **0,00** | **-0,13** |
| | | 0,33 | 0,00 | 0,00 | 0,00 | 0,19 | 0,00 | 0,00 | 0,93 | 0,00 |
| | **B** | **-0,13** | **-0,33** | **-0,46** | **0,05** | **-0,14** | **-0,28** | **0,12** | **-0,08** | **-0,21** |
| | | 0,00 | 0,00 | 0,00 | 0,24 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| **SMB** | | | | | | | | | | |
| | **S** | **-0,02** | **0,03** | **-0,11** | **-0,05** | **-0,01** | **-0,06** | **-0,11** | **-0,06** | **-0,11** |
| | | 0,64 | 0,56 | 0,02 | 0,42 | 0,82 | 0,15 | 0,02 | 0,15 | 0,02 |
| | **M** | **-0,22** | **-0,17** | **-0,22** | **-0,26** | **-0,21** | **-0,26** | **-0,31** | **-0,26** | **-0,31** |
| | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| | **B** | **-0,36** | **-0,31** | **-0,36** | **-0,39** | **-0,34** | **-0,39** | **-0,44** | **-0,39** | **-0,44** |
| | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| **R2** | **S** | **0,88** | **0,91** | **0,88** | **0,88** | **0,92** | **0,91** | **0,86** | **0,90** | **0,88** |
| | | *0,88* | *0,91* | *0,88* | *0,88* | *0,92* | *0,91* | *0,86* | *0,90* | *0,88* |
| | **M** | **0,91** | **0,92** | **0,93** | **0,94** | **0,94** | **0,95** | **0,92** | **0,92** | **0,93** |
| | | *0,91* | *0,92* | *0,93* | *0,93* | *0,94* | *0,95* | *0,91* | *0,92* | *0,93* |
| | **B** | **0,90** | **0,92** | **0,92** | **0,91** | **0,93** | **0,93** | **0,88** | **0,91** | **0,91** |
| | | *0,89* | *0,92* | *0,92* | *0,91* | *0,93* | *0,93* | *0,88* | *0,91* | *0,90* |
| Autocorr | **S** | 0,57 | 0,45 | 0,62 | 0,92 | 0,17 | 0,82 | 0,88 | 0,42 | 0,88 |
| Reset | | 0,11 | 0,01 | 0,17 | 0,07 | 0,16 | 0,27 | 0,14 | 0,15 | 0,05 |
| Normality | | No | Yes | Yes | No | Yes | No | No | No | No |
| Autocorr. | **M** | 0,35 | 0,52 | 0,35 | 0,53 | 0,03 | 0,53 | 0,63 | 0,21 | 0,63 |
| Reset | | 0,02 | 0,004 | 0,03 | 0,02 | 0,05 | 0,08 | 0,22 | 0,42 | 0,32 |
| Normality | | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Autocorr. | **B** | 0,63 | 0,45 | 0,63 | 0,92 | 0,17 | 0,92 | 0,88 | 0,42 | 0,88 |
| Reset | | 0,03 | 0,01 | 0,02 | 0,02 | 0,04 | 0,06 | 0,16 | 0,24 | 0,20 |
| Normality | | Yes | Yes | Yes | No | Yes | No | No | No | No |

## Table 4

### Model number 3

$$Z_{it} = \alpha_0 + \beta_m Z_{mt} + \gamma_{SMB} SMB_t + \gamma_{LMH} LMH_t + \gamma_{IMV} IMV_t + \varepsilon_{it}$$

| Coefficient | | HI | HM | HV | MI | MM | MV | LI | LM | LV |
|---|---|---|---|---|---|---|---|---|---|---|
| **$\alpha$*$10^2$** | **S** | **1,00** | **1,20** | **1,00** | **2,30** | **1,10** | **0,80** | **1,00** | **1,20** | **1,00** |
| P-value | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| | **M** | **1,20** | **1,40** | **1,20** | **1,00** | **1,30** | **1,00** | **1,20** | **1,40** | **1,20** |
| | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| | **B** | **1,00** | **1,20** | **1,00** | **0,80** | **1,10** | **0,80** | **1,00** | **1,20** | **1,00** |
| | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| **$\beta_m$** | **S** | **1,28** | **1,31** | **1,18** | **1,70** | **1,22** | **1,19** | **1,18** | **1,22** | **1,18** |
| P-value | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| | **M** | **1,26** | **1,29** | **1,26** | **1,23** | **1,27** | **1,23** | **1,26** | **1,30** | **1,26** |
| | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| | **B** | **1,23** | **1,26** | **1,23** | **1,20** | **1,23** | **1,20** | **1,23** | **1,26** | **1,23** |
| | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | **0,00** | 0,00 | 0,00 | 0,00 |
| **IMV** | **S** | **-0,13** | **-0,33** | **-0,22** | **0,06** | **-0,14** | **-0,28** | **0,12** | **-0,08** | **-0,22** |
| | | 0,91 | 0,00 | 0,00 | 0,76 | 0,00 | 0,00 | 0,91 | 0,00 | 0,00 |
| | **M** | **0,10** | **-0,09** | **-0,23** | **0,12** | **-0,07** | **-0,21** | **0,10** | **-0,09** | **-0,23** |
| | | 0,02 | 0,00 | 0,00 | 0,00 | 0,16 | 0,00 | 0,02 | 0,03 | 0,00 |
| | **B** | **0,01** | **-0,19** | **-0,33** | **0,03** | **-0,16** | **-0,30** | **0,01** | **-0,19** | **-0,33** |
| | | 0,00 | 0,00 | 0,00 | 0,55 | 0,00 | 0,00 | 0,91 | 0,00 | 0,00 |
| **SMB** | | | | | | | | | | |
| | **S** | **-0,07** | **-0,02** | **-0,07** | **-0,04** | **0,00** | **-0,05** | **-0,07** | **-0,02** | **-0,07** |
| | | 0,09 | 0,55 | 0,09 | 0,54 | 0,97 | 0,02 | 0,09 | 0,55 | 0,90 |
| | **M** | **-0,27** | **-0,23** | **-0,27** | **-0,25** | **-0,21** | **-0,25** | **-0,27** | **-0,23** | **-0,27** |
| | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| | **B** | **-0,40** | **-0,36** | **-0,40** | **-0,38** | **-0,33** | **-0,38** | **-0,40** | **-0,36** | **-0,40** |
| | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| **LMH** | **S** | **-0,18** | **-0,19** | **0,15** | **0,05** | **0,03** | **0,03** | **0,15** | **0,15** | **0,15** |
| | | 0,00 | 0,00 | 0,00 | 0,27 | 0,27 | 0,24 | 0,00 | 0,00 | 0,00 |
| | **M** | **-0,18** | **-0,22** | **-0,25** | **0,05** | **0,00** | **-0,30** | **0,16** | **0,11** | **0,08** |
| | | 0,00 | 0,00 | 0,00 | 0,03 | 0,93 | 0,00 | 0,00 | 0,00 | 0,00 |
| | **B** | **-0,18** | **-0,23** | **-0,26** | **0,04** | **-0,01** | **-0,04** | **0,15** | **0,10** | **0,08** |
| | | 0,00 | 0,00 | 0,00 | 0,12 | 0,71 | 0,21 | 0,00 | 0,00 | 0,01 |
| **R2** | **S** | **0,92** | **0,94** | **0,91** | **0,88** | **0,92** | **0,91** | **0,89** | **0,92** | **0,91** |
| | | *0,88* | *0,91* | *0,88* | *0,88* | *0,92* | *0,91* | *0,87* | *0,90* | *0,88* |
| | **M** | **0,95** | **0,95** | **0,96** | **0,94** | **0,94** | **0,95** | **0,94** | **0,94** | **0,95** |
| | | *0,95* | *0,95* | *0,96* | *0,93* | *0,94* | *0,94* | *0,93* | *0,94* | *0,94* |
| | **B** | **0,92** | **0,95** | **0,94** | **0,91** | **0,93** | **0,93** | **0,91** | **0,93** | **0,92** |
| | | *0,92* | *0,94* | *0,94* | *0,91* | *0,93* | *0,93* | *0,90* | *0,92* | *0,92* |
| Autocorr | **S** | 0,33 | 0,27 | 0,92 | 0,91 | 0,18 | 0,65 | 0,92 | 0,27 | 0,92 |
| Reset | | 0,41 | 0,24 | 0,22 | 0,05 | 0,08 | 0,29 | 0,49 | 0,22 | 0,85 |
| Normality | | Yes | Yes | Yes | Yes | Yes | No | Yes | Yes | Yes |
| Autocorr | **M** | 0,59 | 0,12 | 0,59 | 0,52 | 0,03 | 0,52 | 0,59 | 0,12 | 0,59 |
| Reset | | 0,21 | 0,16 | 0,11 | 0,01 | 0,02 | 0,06 | 0,46 | 0,13 | 0,81 |
| Normality | | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Autocorr | **B** | 0,92 | 0,27 | 0,92 | 0,91 | 0,18 | 0,91 | 0,92 | 0,27 | 0,92 |
| Reset | | 0,14 | 0,18 | 0,10 | 0,01 | 0,02 | 0,03 | 0,21 | 0,14 | 0,36 |
| Normality | | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

## Table 5

### The Three-Factor Model of Fama and French

$$Z_{it} = \alpha_0 + \beta_m Z_{mt} + \gamma_{SMB} SMB_t + \gamma_{LMH} LMH_t + \varepsilon_{it}$$

| Coefficient | | HI | HM | HV | MI | MM | MV | LI | LM | LV |
|---|---|---|---|---|---|---|---|---|---|---|
| $\alpha*10^2$ | S | 1,00 | 1,20 | 0,90 | 2,30 | 1,04 | 0,80 | 1,00 | 1,20 | 0,90 |
| P-value | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| | M | 1,20 | 1,40 | 1,20 | 1,00 | 1,30 | 1,00 | 1,20 | 1,40 | 1,20 |
| | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| | B | 1,00 | 1,30 | 0,95 | 0,80 | 1,04 | 0,80 | 1,00 | 1,20 | 0,90 |
| | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| $\beta_m$ | S | 1,23 | 1,26 | 1,23 | 1,71 | 1,23 | 1,20 | 1,23 | 1,26 | 1,23 |
| P-value | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| | M | 1,25 | 1,31 | 1,29 | 1,22 | 1,27 | 1,25 | 1,25 | 1,31 | 1,29 |
| | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| | B | 1,23 | 1,31 | 1,26 | 1,20 | 1,24 | 1,22 | 1,23 | 1,28 | 1,26 |
| | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| SMB | | | | | | | | | | |
| | S | -0,07 | -0,12 | -0,23 | -0,03 | -0,08 | -0,20 | -0,07 | -0,12 | -0,23 |
| | | 0,04 | 0,00 | 0,00 | 0,59 | 0,01 | 0,00 | 0,04 | 0,00 | 0,00 |
| | M | -0,23 | -0,27 | -0,39 | -0,19 | -0,24 | -0,36 | -0,23 | -0,27 | -0,39 |
| | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| | B | -0,40 | -0,45 | -0,57 | -0,37 | -0,41 | -0,53 | -0,40 | -0,45 | -0,57 |
| | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| LMH | S | -0,18 | -0,19 | 0,15 | 0,05 | 0,03 | 0,03 | 0,15 | 0,15 | 0,15 |
| | | 0,00 | 0,00 | 0,00 | 0,27 | 0,27 | 0,24 | 0,00 | 0,00 | 0,00 |
| | M | -0,18 | -0,22 | -0,25 | 0,05 | 0,00 | -0,30 | 0,16 | 0,11 | 0,08 |
| | | 0,00 | 0,00 | 0,00 | 0,03 | 0,93 | 0,00 | 0,00 | 0,00 | 0,00 |
| | B | -0,18 | -0,23 | -0,26 | 0,04 | -0,01 | -0,04 | 0,15 | 0,10 | 0,08 |
| | | 0,00 | 0,00 | 0,00 | 0,12 | 0,71 | 0,21 | 0,00 | 0,00 | 0,01 |
| R2 | S | 0,92 | 0,93 | 0,88 | 0,88 | 0,91 | 0,89 | 0,89 | 0,91 | 0,88 |
| Adj.R2 | | *0,91* | *0,94* | *0,91* | *0,88* | *0,92* | *0,91* | *0,89* | *0,92* | *0,91* |
| | M | 0,95 | 0,95 | 0,95 | 0,93 | 0,94 | 0,93 | 0,93 | 0,94 | 0,93 |
| | | *0,94* | *0,95* | *0,94* | *0,93* | *0,94* | *0,93* | *0,93* | *0,94* | *0,93* |
| | B | 0,92 | 0,94 | 0,92 | 0,91 | 0,92 | 0,90 | 0,91 | 0,92 | 0,90 |
| | | *0,92* | *0,94* | *0,92* | *0,91* | *0,92* | *0,90* | *0,90* | *0,92* | *0,89* |
| Autocorr. | S | 0,34 | 0,58 | 0,92 | 0,78 | 0,48 | 0,76 | 0,50 | 0,58 | 0,92 |
| Reset | | 0,08 | 0,06 | 0,24 | 0,02 | 0,05 | 0,30 | 0,15 | 0,12 | 0,86 |
| Normality | | No | No | Yes | No | No | Yes | No | No | 0,63 |
| Autocorr. | M | 0,44 | 0,42 | 0,41 | 0,92 | 0,09 | 0,20 | 0,44 | 0,42 | 0,41 |
| Reset | | 0,15 | 0,12 | 0,26 | 0,01 | 0,02 | 0,11 | 0,24 | 0,09 | 0,87 |
| Normality | | No | Yes | Yes | No | Yes | Yes | No | Yes | Yes |
| Autocorr. | B | 0,50 | 0,58 | 0,86 | 0,46 | 0,48 | 0,86 | 0,50 | 0,58 | 0,92 |
| Reset | | 0,11 | 0,13 | 0,10 | 0,01 | 0,01 | 0,04 | 0,14 | 0,07 | 0,37 |
| Normality | | No | No | Yes | No | No | Yes | Yes | No | Yes |

***The autocorrelation test** performed is the Breusch Pagan LM test of serial correlation including five lags. The null hypothesis is "No autocorrelation". A p-value of less than 5 percent means that the null is rejected using a 95 percent confidence interval.*

***The Ramsey reset test** is used to test for misspecification. 4 fitted terms are included and the null hypothesis is that they are jointly equal to zero. A p-value of less than 5 percent means that the null is rejected using a 95 percent confidence interval and hence the model is misspecified.*

***The normality test** is that of Jarque-Bera. The null hypothesis is that the distribution is normal. "Yes" means that the p-value is higher than 5 percent and that the errors are normally distributed.*

*The Agumented Dickey-Fuller test is used as a **test of stationarity**. The null hypothesis is that there is a unit root. This is the same as saying that the series is non-stationary. A p-value of less than 5 percent means that the null is rejected.*

$$Z_{it} = \alpha_0 + \beta_m Z_{mt} + \gamma_{SMB} SMB_t + \gamma_{LMH} LMH_t + \gamma_{IMV} IMV_t + \varepsilon_{it}$$

## Table 6a

| SHV | 2001-2003 | 2004-2007 | 2008-2010 |
|---|---|---|---|
| Variable | Coefficient | Coefficient | Coefficient |
| **C** | **0,02** | **0,01** | **0,00** |
| Prob. | 0,01 | 0,00 | 0,22 |
| **RM** | **1,30** | **1,18** | **1,11** |
| Prob. | 0,00 | 0,00 | 0,00 |
| **SMB** | **0,12** | **0,02** | **-0,22** |
| Prob. | 0,20 | 0,74 | 0,00 |
| **LMH** | **0,17** | **0,08** | **0,26** |
| Prob. | 0,06 | 0,12 | 0,00 |
| **IMV** | **-0,52** | **-0,11** | **-0,13** |
| Prob. | 0,00 | 0,13 | 0,06 |

| MHV | 2001-2003 | 2004-2007 | 2008-2010 |
|---|---|---|---|
| Variable | Coefficient | Coefficient | Coefficient |
| **C** | **0,02** | **0,01** | **0,01** |
| Prob. | 0,00 | 0,00 | 0,00 |
| **RM** | **1,36** | **1,29** | **1,16** |
| Prob. | 0,00 | 0,00 | 0,03 |
| **SMB** | **-0,17** | **-0,25** | **-0,36** |
| Prob. | 0,02 | 0,00 | 0,04 |
| **LMH** | **-0,17** | **-0,22** | **-0,12** |
| Prob. | 0,02 | 0,00 | 0,03 |
| **IMV** | **-0,37** | **-0,09** | **-0,09** |
| Prob. | 0,00 | 0,17 | 0,06 |

| BHV | 2001-2003 | 2004-2007 | 2008-2010 |
|---|---|---|---|
| Variable | Coefficient | Coefficient | Coefficient |
| **C** | **0,02** | **0,01** | **0,00** |
| Prob. | 0,01 | 0,00 | 0,22 |
| **RM** | **1,30** | **1,18** | **1,11** |
| Prob. | 0,00 | 0,00 | 0,00 |
| **SMB** | **-0,22** | **-0,31** | **-0,55** |
| Prob. | 0,02 | 0,00 | 0,00 |
| **LMH** | **-0,17** | **-0,25** | **-0,07** |
| Prob. | 0,06 | 0,00 | 0,10 |
| **IMV** | **-0,52** | **-0,11** | **-0,13** |
| Prob. | 0,00 | 0,13 | 0,06 |

| SHM | 2001-2003 | 2004-2007 | 2008-2010 |
|---|---|---|---|
| Variable | Coefficient | Coefficient | Coefficient |
| **C** | **0,02** | **0,01** | **0,01** |
| Prob. | 0,00 | 0,00 | 0,01 |
| **RM** | **1,36** | **1,30** | **1,16** |
| Prob. | 0,00 | 0,08 | 0,00 |
| **SMB** | **0,16** | **-0,02** | **-0,14** |
| Prob. | 0,05 | 0,07 | 0,01 |
| **LMH** | **-0,11** | **-0,20** | **-0,13** |
| Prob. | 0,13 | 0,06 | 0,00 |
| **IMV** | **-0,43** | **0,04** | **-0,05** |
| Prob. | 0,00 | 0,08 | 0,47 |

| MHM | 2001-2003 | 2004-2007 | 2008-2010 |
|---|---|---|---|
| Variable | Coefficient | Coefficient | Coefficient |
| **C** | **0,02** | **0,02** | **0,01** |
| Prob. | 0,00 | 0,00 | 0,00 |
| **RM** | **1,41** | **1,41** | **1,21** |
| Prob. | 0,00 | 0,00 | 0,00 |
| **SMB** | **-0,13** | **-0,29** | **-0,28** |
| Prob. | 0,07 | 0,00 | 0,00 |
| **LMH** | **-0,12** | **-0,17** | **-0,18** |
| Prob. | 0,08 | 0,00 | 0,00 |
| **IMV** | **-0,28** | **0,05** | **0,00** |
| Prob. | 0,00 | 0,46 | 0,93 |

| BHM | 2001-2003 | 2004-2007 | 2008-2010 |
|---|---|---|---|
| Variable | Coefficient | Coefficient | Coefficient |
| **C** | **0,02** | **0,01** | **0,01** |
| Prob. | 0,00 | 0,00 | 0,01 |
| **RM** | **1,36** | **1,30** | **1,16** |
| Prob. | 0,00 | 0,00 | 0,00 |
| **SMB** | **-0,18** | **-0,36** | **-0,47** |
| Prob. | 0,03 | 0,00 | 0,00 |
| **LMH** | **-0,11** | **-0,20** | **-0,13** |
| Prob. | 0,13 | 0,00 | 0,00 |
| **IMV** | **-0,43** | **0,04** | **-0,05** |
| Prob. | 0,00 | 0,63 | 0,47 |

| SHI | 2001-2003 | 2004-2007 | 2008-2010 |
|---|---|---|---|
| Variable | Coefficient | Coefficient | Coefficient |
| **C** | **0,02** | **0,01** | **0,00** |
| Prob. | 0,01 | 0,00 | 0,22 |
| **RM** | **1,30** | **1,18** | **1,11** |
| Prob. | 0,00 | 0,07 | 0,00 |
| **SMB** | **0,12** | **0,02** | **-0,22** |
| Prob. | 0,20 | 0,06 | 0,00 |
| **LMH** | **-0,17** | **-0,25** | **-0,07** |
| Prob. | 0,06 | 0,05 | 0,10 |
| **IMV** | **-0,18** | **0,22** | **0,20** |
| Prob. | 0,13 | 0,07 | 0,01 |

| MHI | 2001-2003 | 2004-2007 | 2008-2010 |
|---|---|---|---|
| Variable | Coefficient | Coefficient | Coefficient |
| **C** | **0,02** | **0,01** | **0,01** |
| Prob. | 0,00 | 0,00 | 0,01 |
| **RM** | **1,36** | **1,29** | **1,16** |
| Prob. | 0,00 | 0,00 | 0,00 |
| **SMB** | **-0,17** | **-0,25** | **-0,36** |
| Prob. | 0,02 | 0,00 | 0,00 |
| **LMH** | **-0,17** | **-0,22** | **-0,12** |
| Prob. | 0,02 | 0,00 | 0,00 |
| **IMV** | **-0,03** | **0,24** | **0,24** |
| Prob. | 0,74 | 0,00 | 0,00 |

| BHI | 2001-2003 | 2004-2007 | 2008-2010 |
|---|---|---|---|
| Variable | Coefficient | Coefficient | Coefficient |
| **C** | **0,02** | **0,01** | **0,00** |
| Prob. | 0,01 | 0,00 | 0,22 |
| **RM** | **1,30** | **1,18** | **1,11** |
| Prob. | 0,00 | 0,00 | 0,00 |
| **SMB** | **-0,22** | **-0,31** | **-0,55** |
| Prob. | 0,02 | 0,00 | 0,00 |
| **LMH** | **-0,17** | **-0,25** | **-0,07** |
| Prob. | 0,06 | 0,00 | 0,10 |
| **IMV** | **-0,18** | **0,22** | **0,20** |
| Prob. | 0,13 | 0,00 | 0,01 |

## Table 6b

| SMV | 2001-2003 | 2004-2007 | 2008-2010 | MMV | 2001-2003 | 2004-2007 | 2008-2010 | BMV | 2001-2003 | 2004-2007 | 2008-2010 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Variable | Coefficient | Coefficient | Coefficient | Variable | Coefficient | Coefficient | Coefficient | Variable | Coefficient | Coefficient | Coefficient |
| **C** | **0,01** | **0,01** | **0,00** | **C** | **0,02** | **0,01** | **0,01** | **C** | **0,01** | **0,01** | **0,00** |
| Prob. | 0,05 | 0,00 | 0,31 | Prob. | 0,00 | 0,00 | 0,03 | Prob. | 0,05 | 0,00 | 0,31 |
| **RM** | **1,25** | **1,26** | **1,12** | **RM** | **1,31** | **1,37** | **1,17** | **RM** | **1,25** | **1,26** | **1,12** |
| Prob. | 0,00 | 0,07 | 0,00 | Prob. | 0,00 | 0,00 | 0,00 | Prob. | 0,00 | 0,00 | 0,00 |
| **SMB** | **0,09** | **-0,04** | **-0,17** | **SMB** | **-0,20** | **-0,31** | **-0,32** | **SMB** | **-0,24** | **-0,37** | **-0,50** |
| Prob. | 0,36 | 0,06 | 0,01 | Prob. | 0,01 | 0,00 | 0,00 | Prob. | 0,02 | 0,00 | 0,00 |
| **LMH** | **0,08** | **0,03** | **0,05** | **LMH** | **0,08** | **0,05** | **0,00** | **LMH** | **0,08** | **0,03** | **0,05** |
| Prob. | 0,38 | 0,05 | 0,28 | Prob. | 0,29 | 0,24 | 0,94 | Prob. | 0,38 | 0,61 | 0,28 |
| **IMV** | **-0,49** | **-0,09** | **-0,19** | **IMV** | **-0,34** | **-0,08** | **-0,15** | **IMV** | **-0,49** | **-0,09** | **-0,19** |
| Prob. | 0,00 | 0,07 | 0,02 | Prob. | 0,00 | 0,23 | 0,03 | Prob. | 0,00 | 0,18 | 0,02 |

| SMM | 2001-2003 | 2004-2007 | 2008-2010 | MMM | 2001-2003 | 2004-2007 | 2008-2010 | BMM | 2001-2003 | 2004-2007 | 2008-2010 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Variable | Coefficient | Coefficient | Coefficient | Variable | Coefficient | Coefficient | Coefficient | Variable | Coefficient | Coefficient | Coefficient |
| **C** | **0,01** | **0,01** | **0,01** | **C** | **0,02** | **0,01** | **0,01** | **C** | **0,01** | **0,01** | **0,01** |
| Prob. | 0,01 | 0,00 | 0,02 | Prob. | 0,00 | 0,00 | 0,00 | Prob. | 0,01 | 0,00 | 0,02 |
| **RM** | **1,30** | **1,38** | **1,17** | **RM** | **1,36** | **1,49** | **1,22** | **RM** | **1,30** | **1,38** | **1,17** |
| Prob. | 0,00 | 0,08 | 0,00 | Prob. | 0,00 | 0,00 | 0,00 | Prob. | 0,00 | 0,00 | 0,00 |
| **SMB** | **0,13** | **-0,08** | **-0,09** | **SMB** | **-0,16** | **-0,35** | **-0,24** | **SMB** | **-0,20** | **-0,41** | **-0,42** |
| Prob. | 0,12 | 0,07 | 0,13 | Prob. | 0,03 | 0,00 | 0,00 | Prob. | 0,01 | 0,00 | 0,00 |
| **LMH** | **0,13** | **0,08** | **-0,01** | **LMH** | **0,13** | **0,11** | **-0,06** | **LMH** | **0,13** | **0,08** | **-0,01** |
| Prob. | 0,09 | 0,06 | 0,83 | Prob. | 0,05 | 0,06 | 0,12 | Prob. | 0,09 | 0,19 | 0,83 |
| **IMV** | **-0,41** | **0,05** | **-0,11** | **IMV** | **-0,26** | **0,07** | **-0,06** | **IMV** | **-0,41** | **0,05** | **-0,11** |
| Prob. | 0,00 | 0,08 | 0,14 | Prob. | 0,01 | 0,35 | 0,31 | Prob. | 0,00 | 0,49 | 0,14 |

| **SMI** | **2001-2003** | **2004-2007** | **2008-2010** |
|---|---|---|---|
| Variable | Coefficient | Coefficient | Coefficient |
| **C** | **0,04** | **0,02** | **0,01** |
| Prob. | 0,00 | 0,00 | 0,04 |
| **RM** | **1,84** | **1,82** | **1,58** |
| Prob. | 0,00 | 0,11 | 0,00 |
| **SMB** | **0,12** | **-0,05** | **-0,20** |
| Prob. | 0,41 | 0,10 | 0,06 |
| **LMH** | **0,11** | **0,02** | **0,10** |
| Prob. | 0,41 | 0,08 | 0,21 |
| **IMV** | **-0,23** | **0,36** | **0,20** |
| Prob. | 0,23 | 0,11 | 0,12 |

| **MMI** | **2001-2003** | **2004-2007** | **2008-2010** |
|---|---|---|---|
| Variable | Coefficient | Coefficient | Coefficient |
| **C** | **0,02** | **0,01** | **0,01** |
| Prob. | 0,00 | 0,00 | 0,03 |
| **RM** | **1,31** | **1,37** | **1,17** |
| Prob. | 0,00 | 0,00 | 0,00 |
| **SMB** | **-0,20** | **-0,31** | **-0,32** |
| Prob. | 0,01 | 0,00 | 0,00 |
| **LMH** | **0,08** | **0,05** | **0,00** |
| Prob. | 0,29 | 0,24 | 0,94 |
| **IMV** | **-0,01** | **0,26** | **0,19** |
| Prob. | 0,91 | 0,00 | 0,01 |

| **BMI** | **2001-2003** | **2004-2007** | **2008-2010** |
|---|---|---|---|
| Variable | Coefficient | Coefficient | Coefficient |
| **C** | **0,01** | **0,01** | **0,00** |
| Prob. | 0,05 | 0,00 | 0,31 |
| **RM** | **1,25** | **1,26** | **1,12** |
| Prob. | 0,00 | 0,00 | 0,00 |
| **SMB** | **-0,24** | **-0,37** | **-0,50** |
| Prob. | 0,02 | 0,00 | 0,00 |
| **LMH** | **0,08** | **0,03** | **0,05** |
| Prob. | 0,38 | 0,61 | 0,28 |
| **IMV** | **-0,16** | **0,24** | **0,14** |
| Prob. | 0,21 | 0,00 | 0,08 |

## Table 6c

| SLV | 2001-2003 | 2004-2007 | 2008-2010 |
|---|---|---|---|
| Variable | Coefficient | Coefficient | Coefficient |
| **C** | **0,02** | **0,01** | **0,00** |
| Prob. | 0,01 | 0,00 | 0,22 |
| **RM** | **1,30** | **1,18** | **1,11** |
| Prob. | 0,00 | 0,07 | 0,00 |
| **SMB** | **0,12** | **0,02** | **-0,22** |
| Prob. | 0,20 | 0,06 | 0,00 |
| **LMH** | **0,17** | **0,08** | **0,26** |
| Prob. | 0,06 | 0,05 | 0,00 |
| **IMV** | **-0,52** | **-0,11** | **-0,13** |
| Prob. | 0,00 | 0,07 | 0,06 |

| MLV | 2001-2003 | 2004-2007 | 2008-2010 |
|---|---|---|---|
| Variable | Coefficient | Coefficient | Coefficient |
| **C** | **0,02** | **0,01** | **0,01** |
| Prob. | 0,00 | 0,00 | 0,01 |
| **RM** | **1,36** | **1,29** | **1,16** |
| Prob. | 0,00 | 0,00 | 0,00 |
| **SMB** | **-0,17** | **-0,25** | **-0,36** |
| Prob. | 0,02 | 0,00 | 0,00 |
| **LMH** | **0,16** | **0,11** | **0,21** |
| Prob. | 0,02 | 0,02 | 0,00 |
| **IMV** | **-0,37** | **-0,09** | **-0,09** |
| Prob. | 0,00 | 0,17 | 0,11 |

| BLV | 2001-2003 | 2004-2007 | 2008-2010 |
|---|---|---|---|
| Variable | Coefficient | Coefficient | Coefficient |
| **C** | **0,02** | **0,01** | **0,00** |
| Prob. | 0,01 | 0,00 | 0,22 |
| **RM** | **1,30** | **1,18** | **1,11** |
| Prob. | 0,11 | 0,00 | 0,00 |
| **SMB** | **-0,22** | **-0,31** | **-0,55** |
| Prob. | 0,09 | 0,00 | 0,00 |
| **LMH** | **0,17** | **0,08** | **0,26** |
| Prob. | 0,09 | 0,12 | 0,00 |
| **IMV** | **-0,52** | **-0,11** | **-0,13** |
| Prob. | 0,12 | 0,13 | 0,06 |

| SLM | 2001-2003 | 2004-2007 | 2008-2010 |
|---|---|---|---|
| Variable | Coefficient | Coefficient | Coefficient |
| **C** | **0,02** | **0,01** | **0,01** |
| Prob. | 0,00 | 0,00 | 0,01 |
| **RM** | **1,36** | **1,30** | **1,16** |
| Prob. | 0,00 | 0,08 | 0,00 |
| **SMB** | **0,16** | **-0,02** | **-0,14** |
| Prob. | 0,05 | 0,07 | 0,01 |
| **LMH** | **0,22** | **0,13** | **0,20** |
| Prob. | 0,00 | 0,06 | 0,00 |
| **IMV** | **-0,43** | **0,04** | **-0,05** |
| Prob. | 0,00 | 0,08 | 0,47 |

| MLM | 2001-2003 | 2004-2007 | 2008-2010 |
|---|---|---|---|
| Variable | Coefficient | Coefficient | Coefficient |
| **C** | **0,02** | **0,02** | **0,01** |
| Prob. | 0,00 | 0,00 | 0,00 |
| **RM** | **1,41** | **1,41** | **1,21** |
| Prob. | 0,00 | 0,00 | 0,00 |
| **SMB** | **-0,13** | **-0,29** | **-0,28** |
| Prob. | 0,07 | 0,00 | 0,00 |
| **LMH** | **0,21** | **0,16** | **0,15** |
| Prob. | 0,00 | 0,01 | 0,00 |
| **IMV** | **-0,28** | **0,05** | **0,00** |
| Prob. | 0,00 | 0,46 | 0,93 |

| BLM | 2001-2003 | 2004-2007 | 2008-2010 |
|---|---|---|---|
| Variable | Coefficient | Coefficient | Coefficient |
| **C** | **0,02** | **0,01** | **0,01** |
| Prob. | 0,00 | 0,00 | 0,01 |
| **RM** | **1,36** | **1,30** | **1,16** |
| Prob. | 0,00 | 0,00 | 0,00 |
| **SMB** | **-0,18** | **-0,36** | **-0,47** |
| Prob. | 0,03 | 0,00 | 0,00 |
| **LMH** | **0,22** | **0,13** | **0,20** |
| Prob. | 0,00 | 0,02 | 0,00 |
| **IMV** | **-0,43** | **0,04** | **-0,05** |
| Prob. | 0,00 | 0,63 | 0,47 |

| SLI | 2001-2003 | 2004-2007 | 2008-2010 |
|---|---|---|---|
| Variable | Coefficient | Coefficient | Coefficient |
| **C** | **0,02** | **0,01** | **0,00** |
| Prob. | 0,01 | 0,00 | 0,22 |
| **RM** | **1,30** | **1,18** | **1,11** |
| Prob. | 0,00 | 0,07 | 0,00 |
| **SMB** | **0,12** | **0,02** | **-0,22** |
| Prob. | 0,20 | 0,06 | 0,00 |
| **LMH** | **0,17** | **0,08** | **0,26** |
| Prob. | 0,06 | 0,05 | 0,00 |
| **IMV** | **-0,18** | **0,22** | **0,20** |
| Prob. | 0,13 | 0,07 | 0,01 |

| MLI | 2001-2003 | 2004-2007 | 2008-2010 |
|---|---|---|---|
| Variable | Coefficient | Coefficient | Coefficient |
| **C** | **0,02** | **0,01** | **0,01** |
| Prob. | 0,00 | 0,00 | 0,01 |
| **RM** | **1,31** | **1,29** | **1,16** |
| Prob. | 0,00 | 0,00 | 0,00 |
| **SMB** | **-0,20** | **-0,25** | **-0,36** |
| Prob. | 0,01 | 0,00 | 0,00 |
| **LMH** | **0,08** | **0,11** | **0,21** |
| Prob. | 0,29 | 0,02 | 0,00 |
| **IMV** | **-0,01** | **0,24** | **0,24** |
| Prob. | 0,91 | 0,00 | 0,00 |

| BLI | 2001-2003 | 2004-2007 | 2008-2010 |
|---|---|---|---|
| Variable | Coefficient | Coefficient | Coefficient |
| **C** | **0,02** | **0,01** | **0,00** |
| Prob. | 0,01 | 0,00 | 0,22 |
| **RM** | **1,30** | **1,18** | **1,11** |
| Prob. | 0,00 | 0,00 | 0,00 |
| **SMB** | **-0,22** | **-0,31** | **-0,55** |
| Prob. | 0,02 | 0,00 | 0,00 |
| **LMH** | **0,17** | **0,08** | **0,26** |
| Prob. | 0,06 | 0,12 | 0,00 |
| **IMV** | **-0,18** | **0,22** | **0,20** |
| Prob. | 0,13 | 0,00 | 0,01 |

***The autocorrelation test*** *performed is the Breusch Pagan LM test of serial correlation including three lags. The null hypothesis is "No autocorrelation". A p-value of less than 5 percent means that the null is rejected using a 95 percent confidence interval.*

***The Ramsey reset test*** *is used to test for misspecification. two fitted terms are included and the null hypothesis is that they are jointly equal to zero. A p-value of less than 5 percent means that the null is rejected using a 95 percent confidence interval and hence the model is misspecified.*

*The Agumented Dickey-Fuller test is used as a* ***test of stationarity****. The null hypothesis is that there is a unit root. This is the same as saying that the series is non-stationary. A p-value of less than 5 percent means that the null is rejected.*

## Table 8

| Year | Number of firms in the sample | Average market value | | | Average price-to-book value | | | Average illiquidity value | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Sample size | S | M | B | H | M | L | I | M | V |
| 2001 | 245 | 120,8 | 821,2 | 33313,4 | 11,4 | 2,7 | 1,0 | 20,4 | 2,2 | 0,1 |
| 2002 | 262 | 67,4 | 535,0 | 24897,2 | 7,4 | 2,1 | 1,0 | 24,3 | 0,9 | 0,1 |
| 2003 | 266 | 56,9 | 411,6 | 17840,6 | 7,8 | 1,9 | 0,9 | 25,2 | 1,5 | 0,1 |
| 2004 | 257 | 75,9 | 558,1 | 21083,8 | 3,9 | 1,5 | 0,7 | 8,2 | 0,4 | 0,0 |
| 2005 | 256 | 77,6 | 641,4 | 26210,1 | 6,2 | 2,1 | 1,1 | 9,2 | 0,4 | 0,0 |
| 2006 | 285 | 84,9 | 730,7 | 28946,7 | 6,8 | 2,2 | 1,1 | 9,7 | 0,3 | 0,0 |
| 2007 | 308 | 74,7 | 775,3 | 30663,7 | 9,9 | 2,7 | 1,2 | 6,7 | 0,3 | 0,0 |
| 2008 | 365 | 54,6 | 577,1 | 26668,5 | 10,0 | 3,0 | 1,4 | 7,5 | 0,6 | 0,0 |
| 2009 | 363 | 25,4 | 260,4 | 13861,2 | 7,9 | 2,3 | 1,1 | 24,7 | 1,8 | 0,1 |
| 2010 | 369 | 30,3 | 391,6 | 23208,0 | 6,6 | 1,7 | 0,8 | 17,0 | 0,9 | 0,0 |

* ILLIQ measure is scaled up by 1000

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