PRICING OF LIQUIDITY

Study of the Stockholm Stock Exchange 1901-1919*

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Abstract

This paper studies the importance of liquidity in determining security returns. The study is conducted on the Stockholm Stock Exchange, 1901-1919, a market which at the time suffered from low market turnover. We find out-of-sample effects that liquidity levels are significant determinants of returns. Securities with lower liquidity levels earn, on average, higher returns than their liquid comparables.

The paper also includes an extensive description of the unique, and previously unexplored, dataset. Equally weighted and market capitalisation weighted indices for the market as a whole and for five separate sectors are reconstructed using three different methods. Time series for P/E ratios, market-to-book ratios, dividend yield and payout ratios are also constructed.

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Liquidity, or more precisely the expected future liquidity level, of an asset is an important investment characteristic. All things alike, an investor will always favour holding the more liquid security to the less liquid one. The reason is that investors prefer to have their wealth readily accessible should they suffer from a sudden cash deficit (where assets need to be converted to cash). Consequently, in order for an investor to hold a less liquid security that security needs to offer a higher expected return than its more liquid comparable – a liquidity premium.

In this paper we study the effect of liquidity levels on security returns. We use a unique and previously unexplored dataset from the Stockholm Stock Exchange (SSE) between 1901 and 1919. The SSE went through significant changes in 1901. A ”modern” framework inspired by the exchanges of Copenhagen and Berlin was introduced in November. The new format struggled to attract trading and the first five years were characterized by the lack thereof (see figure 1). Measures were taken to improve liquidity and gradually turnover reached and surpassed the record levels of late 19th century.

In theory liquidity is an important determinant of security returns. However, research has been inconclusive in determining the importance and role of liquidity in security pricing. In Amihud & Mendelson (1986), a central paper in liquidity research, a significant positive relationship between the bid-ask spread and security returns is found when studying US data between 1961-1980. In contrast to Amihud & Mendelson and most other liquidity papers we study a nascent and illiquid exchange. Our dataset exhibits notable differences in liquidity levels between securities with some trading regularly while others trade only a few times a year. This offers a natural setting for testing the effect of liquidity. The paper closest to ours is Moore & Sadka (working paper). Moore & Sadka study the Madrid and Zurich exchanges between 1902-1925 and find a significant negative relationship between liquidity and returns in in-sample tests. Our paper distinguishes itself from Moore & Sadka mainly in three ways. Firstly, we use two-year rolling liquidity measures whereas Moore & Sadka use static liquidity measures for the entire 23 year period. Secondly, we find expected out-of-sample effects and lastly we test on the Stockholm Stock Exchange.

In this paper we construct price return and total return indices for the period 1901-1919 on both the market as a whole and for five separate sectors[1]. We also construct yearly time series for P/E ratios, market-to-book ratios, payout ratios and dividend yields. Lastly, we calculate two measures of liquidity – the number of periods traded in relation to the number of periods listed and the relative size of a security's bid-ask spread. The liquidity measures are rolling on a two year basis, i.e. they reflect the liquidity information available to an investor at each respective point in time. The measures are then used to test for a liquidity premium. We test by performing Fama MacBeth cross-sectional regressions with returns as the dependent variable and the liquidity measures and market beta as the explanatory ones.

We find evidence that liquidity was an important factor in the pricing of securities. Both our liquidity measures are significant in testing on trade-to-trade returns including dividends, our most reliable return estimates. In contrast to Moore & Sadka we find significant out-of-sample effects. These, in many ways more intriguing results implies that investors with longer relative investments horizons are able to construct portfolios of illiquid securities and obtain higher returns. Moore & Sadka only find significant in-sample effects which in turn implies that investors will receive a higher return from holding illiquid securities but are not able to form portfolios based on this information as investors are only able to observe which securities are liquid ex post.

The remainder of the paper is organized as follows. Section 1 discusses the theoretical relevance and previous studies. Section 2 presents the dataset, the index and ratios construction as well as gives a brief description of the institutional framework. Section 3 presents our liquidity measures. Section 4 describes the methods used for testing and presents the results. Section 5 contains concluding remarks.

[1] The five sectors are: banking, insurance, industrials, transportation and shipping.

1 Theoretical framework

Market risk alone has been considered the main determinant of security returns historically. The Capital Asset Pricing Model (CAPM) presented by Sharpe (1964) has been widely acknowledge as the primary model for security pricing. Fama & Macbeth (1973) validated the CAPM when studying the New York Stock Exchange over the period 1926-1968. However, lately both the CAPM and the idea that market risk is the primary determinant in security returns has been challenged by a range of studies. Friend, Westerfield, & Granito (1978) find a significant relationship between returns and the idiosyncratic risk of securities. Banz (1981) and Reinganum (1981) both find a significant negative relationship between returns and size. Fama & French (1996) and Carhart (1997) show that market risk is not the only systematic risk factor affecting asset prices. Holmstrom & Tirole (2001) examine security pricing from a corporate finance perspective and construct a theoretical model which introduces new explanatory variables, e.g. wealth distribution within the corporate sector and between the corporate sector and consumers.

In theory, the expected future liquidity level of an asset is an important investment characteristic. Investors wish to smoothen their consumption over time and therefore invest the excess or lend the paucity in every given point in time using financial markets. In accessing financial markets investors will, cetris paribus, prefer to minimise their transactions costs. This means that investors will, all things alike, prefer to hold a security which can be readily converted into cash. In order to incentivise an investor to hold a less liquid security, that security needs to offer a higher expected utility than its more liquid comparable. The higher utility can derive from a higher expected return or from having risk-reducing characteristics on the investors overall portfolio.

Amihud & Mendelson (1986, 1989) study the effects of a security's liquidity level, in this case measured as the bid-ask spread, on its respective returns. They find a significant positive relationship between the relative size of the bid-ask spread and returns. In addition, Amihud & Mendelson reject the relationship between size and returns found by Banz (1981) and Reinganum (1981) arguing that it is rather a liquidity than a size effect. Eleswarapu (1997), in his study of Nasdaq between 1973-1990, proves an even stronger positive relationship between return and the relative size of the bid-ask spread. Kahl, Liu &

Longstaff (2003) and Longstaff (2003) construct theoretical models in which they impose trading restrictions on investors. Kahl, Liu & Longstaff conclude that liquidity significantly affects the optimal portfolio decisions made by investors. Longstaff in turn observes that, faced with illiquidity, investors abandon an optimal diversification strategy as other factors become increasingly important, e.g. investment horizon. Silber (1991) studies price discounts on restricted stock issues and finds that credit-worthy corporations need to offer discounts in excess of 30% in order to facilitate the sale of restricted stock.

Acharya & Pedersen (2005) construct a CAPM based, liquidity-adjusted model for security pricing in line with Amihud & Mendelson's (1986, 1989) findings. Moore & Sadka (working paper) study the exchanges of Madrid and Zurich between 1902-1925 and find that liquidity has a significant negative relationship with security returns. Moore & Sadka only observe the effect in in-sample tests and fail to find any liquidity effect in out-of-sample tests. However, some recent studies, Eleswarapu & Reinganum (1993), Chen & Kan (1996), Chalmers & Kadlec (1998) and Korajczyk & Sadka (2007), find no relationship between liquidity levels and security returns. Eleswarapu & Reinganum studies the NYSE between 1961-1990 and find a significant relationship in January but not in the remaining eleven months. Chalmers & Kadlec study Amex and NYSE from 1983-1992 and show that stocks with similar relative bid-ask spreads display remarkable differences in volume implying that bid-ask spreads may be an imperfect measure of liquidity. Chen & Kan construct the same portfolios as Amihud & Mendelson but use different testing methodologies and do not find a conclusive relationship between CAPM risk-adjusted returns and the relative bid-ask spread.

Other papers study liquidity as a systematic factor. Chordia et al. (2001) and Huberman & Halka (2001) show that liquidity is, in a sense, a systematic risk factor as the liquidity level of a single security varies with market liquidity. Pastor & Stambaugh (2003) study a security's sensitivity to market liquidity in security returns. They find that securities with high sensitivity to market liquidity annually earn 7.5% higher returns than stocks less sensitive over the period 1966-1999.

2 Data and institutional framework

2.1 INSTITUTIONAL FRAMEWORK

This section draws on information from Beije (1946), Belfrage (1917) and Kongl. Majestats nadiga reglemente (1901, 1907, 1909, 1917).

2.1.1 *Overview of the exchange*

The SSE was founded in 1862. At the time, trading took place only once a month and there were no regulations or guidelines as to which securities (or types of securities) that could be traded. The stock exchange made no effort to ensure that worthless or opaque securities were banned from trading. It was only nine years later (1871), when new rules were implemented, that securities had to be preapproved by a board of five. The SSE continued in this fashion (save some minor changes) until October 1895 when the exchange started trading four times a month. Turnover grew significantly after the decision to trade on a weekly basis. In 1890 turnover was 3.5 MSEK, in 1895 6.9 MSEK and in 1898 turnover reached an all-time high of 21.1 MSEK.

In 1901 things changed radically. On May 21st the SSE's newly formed board of directors met for the first time. The board decided to look to Berlin and Copenhagen for inspiration on how to improve the SSE's current framework. Five months later, on October 1st, a new framework was put in place. The framework was largely based on the Copenhagen Stock Exchange. The exchange continued as an auction market. This meant that trading was presided over by the head of the exchange who called out all stocks registered on the relevant list in a predetermined order. As the head of the exchanged called out a stock all market participants were able to state the levels at which they were willing to buy/sell (the bid and ask quotes). In the case of matching bid and ask levels, a trade was registered and the transaction completed.

Under the new framework, trading would solely be conducted on, by the board, preapproved and listed securities. The listings of securities were contingent on a successful written application containing detailed information on the security (e.g. articles of association and the latest audit report amongst other items), to the board. The new system also dictated that only brokers certified by the *Handels- och sjofartsnamnden* were allowed to broker deals on the exchange.

Trading would now take place as often as three times a week, Tuesdays, Wednesdays and Fridays. On Tuesdays and Fridays auctions would be held on all securities registered on the regular lists whilst Wednesday auctions only took place on securities (listed on the specific Wednesday list) where members had requested an auction no later than the preceding Monday. Members who requested an auction on the specific security were then required to participate as either buyer or seller at that auction.

The new stock exchange however proved a failure. Trading moved away from the stock exchange and the majority of transactions took place outside of it. Liquidity was remarkably low in the first six years (see figure 1) and this, to the demise of the new system's proponents, under flourishing market conditions. The main reason for the poor liquidity was however the lack of equity capital which in itself can be explained by two primary factors. Firstly, the exchange suffered early on from having very few members. Secondly, minimum transaction values were significant.

It was first in 1907 as commercial banks were allowed to become members and to trade on the exchange that liquidity started improving. That year 16 banks became members. Prior to 1907 there were only five brokers with access to the market. Gradually over the years additional members joined the stock exchange with an additional four in 1909 and another four in 1910. A decision was then taken in 1915 to increase the number of members to 30 in 1916. The number then grew to 36 in late 1916 and 40 in 1917 (see figure 1). The inflow of new members had a significant effect on the stock exchange's ability to attract transactions from outside of it.

Initially, in 1901, the minimum transaction value was SEK 5,000. This was then gradually lowered over the years to reach SEK 1,000 in 1903 and later SEK 2,000 in 1906. This also facilitated an improved overall liquidity.

2.1.2 *Historic setting*

The time period is characterized by geopolitical instability. This of course culminates in the later part of the period, ultimately reaching its pinnacle with the outbreak of the First World War. Domestically, Sweden faces a financial crisis in late 1907 resulting in the reconstruction and failure of several banks.

Key domestic events:

- 1907, financial crisis in Sweden – market drops 15% in November alone

Key global events:

- 1912, First Balkan War – market drops 11% in October
- 1914, World War I breaks out – the index drops 9% and trading is stopped for three months in an attempt to calm the markets
- 1918, World War I ceases – market drops 9%. A bear market ensues

Please see figure 10 for a market index chart annotated with major historic events, both global and domestic.

2.2 DATA

The dataset consists of two parts, price data and balance sheet data for the period 1901-1919.[2] The number of listed securities per sector and for the market as a whole are displayed in table 1. The average number of listed securities is 171.

The price data consists of weekly observations of bid/ask, close high/low, nominal value per share and dividend per share. It has been manually collected from newspapers and enriched with information from Stockholms fondborsnoteringar.

The balance sheet data consists of full balance sheets for on average around 25% of all listed companies and approximately 50% of all traded securities (see tables 2 and 9). The balance sheet data has been manually collected from the yearly issues of *Svenska aktiebolag och enskilda banker*.

[2] We would like to thank Daniel Waldenstrom for supplying the dataset.

In addition to the price and balance sheet data we construct market and sector indices and a selection of ratios.

2.2.1 *Price data*

The price data includes weekly bid/ask quotes, close high/low, dividend per share and the nominal price per share. In the first years the dataset includes bid/ask quotes and pay high/low for trades conducted both on and outside of the exchange. The weekly volume is recorded from 1915 and on. The volume observations however appear unreliable, e.g. we may observe a close in a security but no trade volume.

The dataset does not contain a final closing price for each respective week, rather we observe ”pay high” and ”pay low”. For the purpose of our indices, we set the closing price of the week to the average of ”pay high” and ”pay low”.

The trading over the period is scarce. The number of traded securities each year spans from 16 to 115. On average approximately 50% of all securities listed are traded each month (see table 2). Looking on a weekly basis, only 10-15% of all listed securities are traded. The average is however strongly influenced by the infrequent trading in early years (averages around 5%) combined with the large number of companies listed in those years.

The SSE was an auction market. This meant that we could use the formula provided by Roll (1984) in order to calculate bid-ask spreads. However, the SSE only registered bid and ask quotes if the difference in between the two was less than 3% of the bid quote. Consequently, irrationally or misleadingly large bid-ask spreads have been eliminated. We therefore consider the available bid-ask data to be relevant.

We do not have information on the exact timing of dividend payments (we only observe the year). Instead, we use monthly weights estimated by Moller (1962) using the same method as Ibbotson and Sinquefield (1989). Frennberg and Hansson (1990) check Moller’s weights by cross-checking using random sample from the 1980s to find little or no difference.[3]

[3] The weights are estimated by looking at the timing of dividend payments for all stocks listed on the SSE from 1959.

In order to calculate excess returns we have used the risk-free rate from Waldenstrom (2007). The rate is the base rate set by the Swedish Riksbank. This is the proxy available for the risk-free rate between 1901-1919.

2.2.2 *Balance sheet data*

The balance sheet data consists of full balance sheet information. As mentioned, balance sheet information is not available for all companies.

There is no issue available for 1903 and consequently no balance sheet data for fiscal year 1903. As a result some balance sheet ratios and measures cannot be calculated for 1903 or 1904 respectively.

Neither the stock data nor the balance sheet data explicitly gives the number of outstanding shares for each respective company. The number of outstanding shares per company is therefore reverse calculated by dividing the share capital by the nominal price per share for each month. The share capital is assumed constant for each fiscal year but the nominal share price may vary from month to month following splits. The nominal share price is often updated with a lag (in relation to the closing prices) of 2-3 months which has been manually adjusted for by the authors. Problems with this way of calculating the number of outstanding shares may arise if a company has more than one series of shares, e.g. A and B series, and where the two series have different nominal share prices. We have controlled for this by checking a random set of companies and found no differences in nominal share prices. It is assumed that this holds for all companies.

For 1903, where balance sheet information is missing, we have, for the purpose of the capital weighted index, assumed that share capital is constant for those companies where we observe no change in share capital from 1902 to 1904.

A significant part of all listed securities lack sufficient balance sheet data to be included in the capital weighted index. These securities are however traded extremely scarcely and would not be included in future tests due to their illiquidity. Figure 2 gives an overview of the number of listed companies and the number of companies with market capitalisation (as well as the aggregated market capitalisation of the exchange).

2.2.3 *Indices*

We construct both capital and equally weighted indices for the SSE. The indices are constructed using monthly returns rather than weekly due to the scarcity of observations. Returns for individual securities are calculated using the latest available close in each respective month. The capital and equally weighted indices are then in turn constructed using three different methods. Indices are constructed for the market as a whole (see figure 3 and 4) and capital weighted indices, trade-to-trade, are constructed for the five sectors: banking, insurance, industrials, transportation and shipping (see figure 5). The average returns for the capital weighted trade-to-trade indices are displayed in table 3. The best performing sectors are shipping and industrials. The market as a whole earns an average 3.9% return per year including dividends.

Capital weighted indices are calculated as:

Excluding dividends: $$R_{CW,t} = \sum_{i=1}^{n} w_{i,t} \frac{P_{i,t} - P_{i,t-1}}{P_{i,t-1}}$$

Including dividends: $$TR_{CW,t} = \sum_{i=1}^{n} w_{i,t} \frac{P_{i,t} + D_{i,t} - P_{i,t-1}}{P_{i,t-1}}$$

Where $$w_{i,t} = \frac{P_{i,t-1} S_{i,t-1}}{\sum_{j=1}^{n} P_{j,t-1} S_{j,t-1}}$$

Equally weighted indices are calculated as:

Excluding dividends: $$R_{EW,t} = \frac{1}{n} \sum_{i=1}^{n} \frac{P_{i,t} - P_{i,t-1}}{P_{i,t-1}}$$

Including dividends: $$TR_{EW,t} = \frac{1}{n} \sum_{i=1}^{n} \frac{P_{i,t} + D_{i,t} - P_{i,t-1}}{P_{i,t-1}}$$

Where: $R_{CW,t}$ is the return of the capital weighted index in time t; $TR_{CW,t}$ is the total return of the capital weighted index in time t ($R_{EW,t}$ and $TR_{EW,t}$ refers to the equally weighted indices' equivalents); $P_{i,t}$ is the closing price of security i in time t; $D_{i,t}$ is the dividend of security i in time t; $w_{i,t}$ is the weight of security i in time t; n is the number of shares included in the index; $S_{i,t-1}$ is the number of security i's shares at time t-1. The indices are based on monthly price and dividend observations and consequently subscript t refers to the month. As the dataset in itself contains weekly observations of closing prices, we use the latest observed closing price in each month. The composition of the ten largest companies, by market capitalisation, in, 1904, 1910 and 1916 are displayed in table 4. We can observe that the ten largest companies constitute a substantial part of the exchange, varying between 50-70% of the total exchange's market capitalisation.

The first method we use is a simple trade-to-trade method. Returns are only calculated on securities where we observe closing prices in two adjacent months. This method is referred to as T-T. The capital weighted T-T index excluding dividends is also the index that we refer to as the market index or market going forward unless otherwise specified.

The second method is a modification of the trade-to-trade method. This method allows for a time span of up to 12 months between two observed closing prices in order to calculate returns. This means that the entire, up to one year, return is registered in one month (the month that the second closing observation is observed). However, the security is not included in the index for the months between the two closing observations (i.e. it is not diluting the remainder of return observations by registering a zero return for those months). The index will capture securities that are traded infrequently. Using this method we include close to all observations in the dataset (98%) while the T-T method includes a mere 76%. However, both the additional number of return observations and the increased time span in between closing prices reduces reliability. The T-T method is therefore considered to be more reliable. The method is henceforth referred to as 12M.

The third and final method used is a common one for tackling infrequent trading. In this method we linearly interpolate closing prices for up to a maximum of twelve months. The number of underlying return observations using this method is significantly higher than the number of underlying return observations using the first two methods (see figure 6) but at the same time we will observe a "smoothening" of the market performance.

In addition to our three main methods of index construction we create what we refer to as a "classic index". The index shows the returns you would receive from holding a capital weighted basket of all listed securities in every period. This is the common most way of constructing indices today. The method however fails to properly capture the volatility in returns on exchanges with infrequent trading as we will suffer from a smoothening of returns. In this case we have an exchange with remarkably infrequent trading and the method is therefore not used in testing. See figure 7 for a side-by-side comparison to the capital weighted trade-to-trade index.

The indices all suffer from a survivorship bias as we are unable to determine whether discontinued trading is a consequence of bankruptcy or delisting. This is however not likely to have a significant impact on the index as the price of a security should reflect a looming bankruptcy. An additional problem is that we have not adjusted for any new share issues that occur during a year as we assume that the share capital is constant over each calendar year. However, the index used for the period 1906-1918 by Waldenstrom (2007) is adjusted for new share issues and displays little difference to our capital weighted trade-to-trade index (correlation coefficient of 0.82), indicating that our potential lag in taking new issuing into account has a minor effect. Waldenstrom uses the *Kommersiella meddelanden index* (KMI) and the adjusted KMI published by Ostlind (1945). Additional discrepancies can be explained by the KMI/adjusted KMI index using book values as weights while we use market values. See figure 8 for a side-by-side comparison to our capital weighted trade-to-trade index.

For the interested reader we include a comparison between the S&P500 and the capital weighted trade-to-trade index, see figure 9. The SSE is significantly more volatile, see table 10, and seems to exhibit a two month lag.

2.2.4 *Ratios*

We calculate yearly price/earnings ratios, market-to-book ratios, dividend yields and payout ratios for each company in the dataset where the required information is available.

Price/earnings ratios are calculated as the earnings attributable to common shareholders, i.e. net of preferred stockholders' dividends, divided by the market value of common stock at the end of the year. When calculating the market weighted average, the stock exchange's aggregated earnings attributable to common shareholders has been divided by the aggregated market capitalisation of the same firms. See table 5 for price/earnings ratios on a sector basis and for the market as a whole. The table also presents a side-by-side comparison to the S&P500.

The market-to-book ratio is calculated as the market value of firms' common equity at year end divided by the book value of equity at year end. The market weighted ratio is calculated as the aggregated market capitalisation divided by the aggregated book value of equity for the exchange. See table 6 for yearly market-to-book ratios on a sector basis and for the market as a whole.

Dividend yield is calculated as dividend per share divided by the price of the share at year end. We present the median, equally weighted and capital weighted dividend yields in table 7. Note that, with exception of 1901 and 1914, the capital weighted dividend yield for the entire market is always lower than the median and average indicating that larger companies do not pay as much dividend as smaller companies.

Payout ratio is defined as the dividend paid to common shareholders divided by last years earnings attributable to common shareholders. The earnings weighted ratio (EW) in table 8 is calculated as total dividends attributable to common stockholders for the entire stock exchange divided by last years total earnings attributable to common shareholders. In other words, it shows how much of the exchange's total earnings that are paid out to shareholders.

3 Liquidity measures

Liquidity levels vary significantly between securities. On the one end of the scale we find Stora Kopparberg Bergslagen which is traded every week from May, 1903, till the end of 1919. On the other end of the scale we find Brandforsakrings AB Victoria which doesn't register a single close despite being listed for the same time period.

The most common liquidity measure for a modern exchange is volume. Trading volume is however not available until 1915 and even then it is a seemingly unreliable measure. Instead, we use liquidity proxies which in some ways are better suited to our dataset than trading volume. Firstly, we look at the number of weeks in which a stock is traded in relation to the number of weeks in which a stock is listed. Given the infrequent trading and significant differences liquidity levels in between securities, this measure does give a rather nuanced picture of actual liquidity levels despite its seemingly simple and coarse setup – very few shares ever reach 100%, i.e. are traded in every week in which they are listed. In addition, we look at a classic liquidity measure, the relative size of the bid-ask spread. A liquid security would, all things alike, be expected to have a lower relative bid-ask spread than a less liquid one. The measures are constructed using weekly observations over the past 24 months, i.e. they are rolling measures reflecting the information available to an investor in any given point in time. Our two liquidity level measures:

1. The number of weeks in which a security is traded in relation to the number of weeks in which it is listed:

$$Liquidity1_i = \frac{\text{Number of weeks traded}_i}{\text{Number of weeks listed}_i}$$

2. The average bid-ask spread in relation to the average of the bid and ask quotes:

$$Liquidity2_i = \frac{\sum_{t=1}^{T} \frac{\text{ask}_{i,t} - \text{bid}_{i,t}}{0.5 \times \left(\text{ask}_{i,t} + \text{bid}_{i,t}\right)}}{\text{Number of weeks with observed bid and ask}_i}$$

The two liquidity measures are the same as the liquidity measures used by Moore & Sadka (working paper). In contrast to Moore & Sadka we use rolling measures while they use one static measure for the entirety of the 23 year sample period.

In our liquidity measures we include only securities where we observe at least six months with closing prices within the rolling two year window. Estimates based on fewer observations would be unreliable. The sample is as a consequence reduced to 108 securities in tests based on trade-to-trade returns and 130 securities in tests based on 12M returns.

Figures 11 and 12 illustrate the distribution of liquidity measures one and two (note that for illustrative purposes the figures are based on static measures, i.e. one measure per security for the entire time period). Figure 11 confirms that the exchange suffers from infrequent trading, close to half of the securities are traded in less than 20% of the weeks in which they are listed. Figure 11 also shows that few companies will tend to reach 100% in liquidity measure one, validating it as an appropriate liquidity proxy. However, figure 12 illustrates an issue with liquidity measure two. Even though we observe a significant dispersion in liquidity measure one, liquidity measure two seems to be rather condensed, much in line with what Chalmers & Kadlec (1998) found between volume and bid-ask spreads. One reason is that the SSE only registered bid and ask quotes should the difference be no more than 3% of the bid quote (this is no different from other exchanges, i.e. most papers that considers bid-ask spreads suffer from this problem). Given the characteristics of liquidity measure two, we expect to find a less significant relationship between bid-ask quotes and returns than we do from the relative number of periods traded.

Previous research has concluded that returns differ depending on size, e.g. see Banz (1981) and Reinganum (1981). We explore this by looking at how our liquidity measures relate to size. We analyse liquidity measure one and two's correlation with size and sectors and find a significant negative relationship between size and liquidity. This implies that, as is expected, larger firms are more liquid than smaller firms. In order to correct for this in our models we add a size variable. The size variable is calculated as the natural log of a company's latest observable market capitalisation.

We also investigate the overall market liquidity's effect on returns using a measure similar to liquidity measure one. The reasons for using this measure are much alike those for using liquidity measure one, i.e. the measure never reaches 100% and is able to capture any fluctuations in overall liquidity even though we fail to observe volumes. We estimate the market liquidity as the number of traded securities in relation to the number of listed securities using monthly observations:

$$Market\ liquidity_t = \frac{\text{Number of securities traded}_t}{\text{Number of securities listed}_t}$$

Figure 13 illustrates how the market liquidity and the market index have evolved over time. Market liquidity and market performance are positively correlated with a correlation coefficient of 0.43, in line with similar studies, e.g. Pastor & Stambaugh (2003) where the corresponding correlation coefficient is 0.49.

4 Results

4.1. LIQUIDITY RETURN CHARACTERISTICS

In an effort to create an overview of our liquidity measures and their relationship to returns and size, we construct four portfolios each month with portfolio one consisting of the least liquid securities and portfolio four of the most liquid ones. The liquidity of each security is measured using rolling two year data. In addition, we construct four portfolios based on the market capitalisation of each firm where portfolio one contains the smallest firms and portfolio four the largest. The average return and standard deviation of all portfolios can be seen in table 12 for returns both excluding and including dividends. As expected, we find that portfolios with low-liquidity securities exhibit higher returns (an indication of a liquidity premium). The average return for liquidity portfolio one is about one percentage point higher than that of portfolio four for all liquidity measures and for both excluding and including dividend returns. There seems to be an evident relationship between liquidity and returns, in general a higher liquidity portfolio will offer a lower average return. However, somewhat unexpectedly we do not observe a negative relationship between liquidity and the volatility in returns. The relationship seems to be inconclusive. The portfolios based on size display a negative relationship between size and returns. Also, we can observe that the returns of smaller stocks are more volatile than that of larger firms as was expected to find.

4.2 LIQUIDITY PRICING TESTS

To further analyse the effect of liquidity levels on security pricing we regress the monthly excess return of stocks on the performance of the market, the overall market liquidity and the liquidity level of that stock. Tests are performed on both including and excluding dividend returns where returns in turn are estimated using the trade-to-trade and 12M methodologies.

The lack of information on dividend timing poses a problem in our testing. In order to distribute dividends over the year, we use monthly weights (see section 2.2.1). This method will give rise to a positive liquidity premium bias in tests based on 12M returns as dividend payments occurring within two observed trades will be aggregated in the last period and consequently 'artificially' augmenting that period's return. In order to correct for this, all tests based on 12M returns including dividends only include the latest month's dividend payments. Tests on returns excluding dividends will not suffer from the same problem. You can argue that in testing on returns excluding dividend you will only have one inaccurate observation per year (the month that the dividend was actually distributed) as opposed to testing on returns including dividends where you will suffer from inaccurately distributing the dividends and consequently suffer from twelve inaccurate observations per year. Any tests based on returns excluding dividends will however pose a problem if a security's dividend yield is correlated with the liquidity level of the respective security. However, looking at correlations over years we do not find a relationship between our liquidity measures and dividend yield (see table 11). We do not expect this to be an issue when testing on returns excluding dividends.

We use the procedure of Fama & MacBeth (1973) for our tests. First, we estimate the market return and market liquidity shock betas by running time series regressions where the market liquidity shock is defined as the difference between the expected and actual market liquidity. We then run cross sectional regressions on one-factor, two-factor and four-factor models in which we include the estimated betas and our security specific liquidity and size measures.

Both our trade-to-trade and 12M returns suffer from being nonsynchronous as all returns are not applicable to the same time period, i.e. all closing prices are not necessarily attributable to the last trading day of the month. In order to handle the nonsynchronous data problem we use a model specified by Dimson & Marsh (1983) to estimate securities' market return and market liquidity shock betas. We use our trade-to-trade capital weighted index as the market index. We estimate market beta as:

$$R_{i,t_j}/\sqrt{d_{t_j}} = \alpha_{i,t_j}/\sqrt{d_{t_j}} + \beta_{i,m} \times R_{m,t_j}/\sqrt{d_{t_j}} + \epsilon_{i,t_j} \quad (1)$$

Where R_{i,t_j} is the excess return of security i over time period t_j. R_{m,t_j} is the excess market return over time period t_j. d_{t_j} is the time period between the trades measured in days. To estimate the excess market return over t_j, we need a daily market index. As we only have an index based on monthly observations we choose to linearly interpolate the market index between two monthly observations to obtain a synchronized market index observation. To study the sensitivity to market liquidity shocks we run the same regression with the exception that the market return is replaced by the sum of liquidity shocks over the period between trades (3). The market liquidity shock, γ_{t_j}, is the residual estimated by the model:

$$Market\ liquidity_t = \beta_{t,t-1} \times Market\ liquidity_{t-1} + \beta_{t,t-2} Market\ liquidity_{t-2} + \gamma_t \qquad (2)$$

$$R_{i,t_j} / \sqrt{d_{t_j}} = \omega_{i,t_j} / \sqrt{d_{t_j}} + \beta_{i,liq} \times \gamma_{t_j} / \sqrt{d_{i,t_j}} + \varepsilon_{i,t_j} \qquad (3)$$

(2) has an adjusted r-square of 0.98 which in turn implies that any residual will constitute a shock to market participants. We have simulated market liquidity using AR(1), AR(2), AR(3) and AR(4) models and found that the AR(2) model is the model with the highest adjusted r-square value. This is the same model used by Moore & Sadka. In theory, investors would prefer to hold securities with a negative correlation to market liquidity shocks since these securities will offset part of the negative liquidity effect.

The correlations between our explanatory variables can be seen in tables 13 and 14. We observe significant correlations between all our variables except between market beta and returns while liquidity measure one and market liquidity shock are significantly correlated under 12M and close to being significant under trade-to-trade.

Continuing on to our cross sectional regressions, we first run one-factor regressions for our two liquidity variables. These regressions are based on rolling liquidity measures estimated on two years of historic data. One reason for using rolling liquidity measures is that liquidity levels in stocks are not constant over the time period. The measure should be a good estimate of investors' views on a security's future liquidity level. As mentioned, investors are interested in the future liquidity level and are therefore likely to consider the current liquidity levels and that of recent rather than looking too far into the past. We assume that there is a negative log-linear relationship between liquidity measure one and returns, i.e. the marginal liquidity premium that an investor will be willing to pay for a security which is traded an additional week each year is diminishing. As an illustration, should a stock go from being traded twice a year to ten times a year we would expect to see greater effects than if a security goes from being traded 40 times a year to 48 times. We assume a negative linear relationship between liquidity measure two and returns. The bid ask spread should be seen as a cost and is stated in relation to the value of the security. In all tests where we include liquidity measure two, we need to correct for the bid-ask bounce identified by Bessembinder & Kalcheva (2007). We do this by performing weighted least squares regressions with the previous month's return plus one as weight. Figure 14 illustrates the relationship between liquidity measure one and liquidity measure two. In the graph we can observe what seems to be a log-linear relationship between our two measures. This is in line with our discussion and expectation.

We also run cross-sectional regressions for our estimated $\widehat{\beta_{\iota,m}}$, $\widehat{\beta_{\iota,l\iota q}}$ and our size variable:

$$R_{i,t_j} = \omega_{i,t_j} + \widehat{\beta_{\iota,l\iota q}} \times f_t + \varepsilon_{i,t_j} \quad (4)$$

$$R_{i,t_j} = \omega_{i,t_j} + \widehat{\beta_{\iota,m}} \times f_t + \varepsilon_{i,t_j}$$

$$R_{i,t_j} = \omega_{i,t_j} - ln\,(Liquidity1) \times f_t + \varepsilon_{i,t_j}$$

$$R_{i,t_j} = \omega_{i,t_j} + Liquidity2 \times f_t + \varepsilon_{i,t_j}$$

$$R_{i,t_j} = \omega_{i,t_j} + Size_{i,t} + \times f_t + \varepsilon_{i,t_j}$$

The results from (4) are displayed in table 15. We observe a negative relationship between return and liquidity. Liquidity measures one gives a significant positive coefficient. This is as we would expect and indicate that stocks with lower liquidity earn higher average returns. For liquidity measure two, we observe non-significant coefficients but of the expected sign. In addition, we find a significant negative relationship between size and returns in three of the four different return samples. This implies that shares of smaller firm earn higher returns than those of larger firms. The market liquidity shock factor is negative, as is expected, in all estimations, however not significant.

To further analyse the liquidity's importance for pricing we run multivariate cross-sectional regressions for each of our liquidity measures including $\widehat{\beta_{\iota,m}}$, $\widehat{\beta_{\iota,l\iota q}}$ and our size variable:

$$R_{i,t_j}/\sqrt{d_{t_j}} = \omega_{i,t_j}/\sqrt{d_{t_j}} + \beta_{i,m} \times R_{m,t_j}/\sqrt{d_{i,t_j}} + \beta_{i,liq} \times \gamma_{t_j}/\sqrt{d_{i,t_j}} + \varepsilon_{i,t_j} \quad (5)$$

$$R_{i,t_j} = \omega_{i,t_j} + \widehat{\beta_{\iota,m}} \times f_{1,t} + Liquidity \times f_{2,t} + \varepsilon_{i,t_j} \quad (6)$$

$$R_{i,t_j} = \omega_{i,t_j} + \widehat{\beta_{\iota,m}} \times f_{1,t} + \widehat{\beta_{\iota,l\iota q}} \times f_{2,t} + Liquidity \times f_{3,t} + Size_{i,t} \times f_{4,t} + \varepsilon_{i,t_j} \quad (7)$$

In (6) and (7) $\widehat{\beta_{\iota,m}}$ and $\widehat{\beta_{\iota,\iota\iota q}}$ are jointly estimated in a time series regression, see (5). Looking at the results from the two-factor regression model (6), see table 16, we find, as is expected, a significant positive relationship between liquidity measure one and returns using the trade-to-trade method. In addition, liquidity measure two is of expected sign in all four samples and significant in all but one (12M excluding dividends) where it is close to being significant. In tables 17 and 18, the regression results from the four-factor model (7) are displayed. Liquidity measure one is only significant in the test performed on trade-to-trade including dividend returns. In the three remaining methods it is of expected sign but not significant. Liquidity measure two, is of expected sign in all four-factor test and in addition also significant when testing on trade-to-trade including dividend returns. It is however not significant in the other tests. The market liquidity shock variable is of expected sign in all test but never significant. Size is significant in trade-to-trade including dividend tests. The coefficient is however positive which is surprising. The size variable is also positive in the trade-to-trade excluding dividends test, but negative in the 12M tests.

To conclude our empirical analysis, we have found supporting evidence that liquidity does affect the pricing of securities. In our one-factor models liquidity measure one was significant but not liquidity measure two. Both liquidity measures were significant in the two-factor models. However, in the four-factor models, when including market liquidity shock and size variables, the liquidity measures were only significant when testing on trade-to-trade returns on including dividends. The liquidity shock variable was never significant.

4.3 ECONOMIC SIGNIFICANCE OF LIQUIDITY

We find liquidity coefficients of the expected sign in all tests and using all four return estimates. However, the coefficients are predominately significant when testing on trade-to-trade returns including dividends. We quantify the magnitude of the liquidity effect for illustrative purposes by taking the estimated coefficients from the two-factor liquidity one regression model (6). These have been used to graphically illustrate the relationship between liquidity and returns (see figure 15). As we previously have stated the relationship is of a log-linear character and therefore the economic significance of improved liquidity changes depending on how liquid the security is to start with. Investing in the 25^{th} percentile of most illiquid securities will earn investors an extra 0.59% in monthly return compared to investing in the 75th percentile of most illiquid securities. This is a substantial amount and should be compared to the yearly compounded annual growth rate of the market between 1901-1919 of 4%, see table 3. The 0.59% is of significant economic importance. In annual terms this corresponds to and extra return per year of 7.2%.

5 Conclusions

We study the Stockholm Stock Exchange from October 1901 until December 1919. The exchange suffers from infrequent trading and liquidity varies both across securities and over time. We construct market indices on the previously unexplored dataset as well as time series over a number of key ratios. In addition, we construct two-year rolling liquidity proxies adapted to fit the available market information. We find evidence supporting that liquidity was an important factor in the pricing of securities. Our most representative and reliable returns estimates, trade-to-trade returns including dividends, conclusively show that both our liquidity measures, the relative number of periods in which a security is traded and the relative size of the bid-ask spread, are significant determinants of security returns. Investors that are willing to hold less liquid securities are compensated. The liquidity premium is illustrated in figure 15. In short, investing in the 25th percentile of most illiquid securities will earn investors an extra 0.59% in monthly return compared to investing in the 75th percentile. Interestingly, we find conclusive evidence of out-of-sample effects in contrast to Moore & Sadka (working paper). The indication of out-of-sample effects is clearly a much more intriguing conclusion than that of in-sample effects. The existence of out-of-sample effects in turn implies that investors who for different reasons have longer investment horizons can construct portfolios of less liquid securities in order to obtain higher returns.

As mentioned, the dataset is unexplored and continues to offer a lot of opportunities. From a liquidity point of view, it would be interesting to study liquidity effects on the relative pricing of stocks. An initial analysis conducted by us indicates that liquidity might be a significant determinant in both P/E ratios and market-to-book ratios. Additionally, it would be interesting to construct an index adjusted for new share issues and with the precise dividend distribution dates. We also believe that reconstructing a market index for the period 1893-1901 and linking it to the already reconstructed 1862-1892 index and to the index constructed in this paper would provide a historically important time series.

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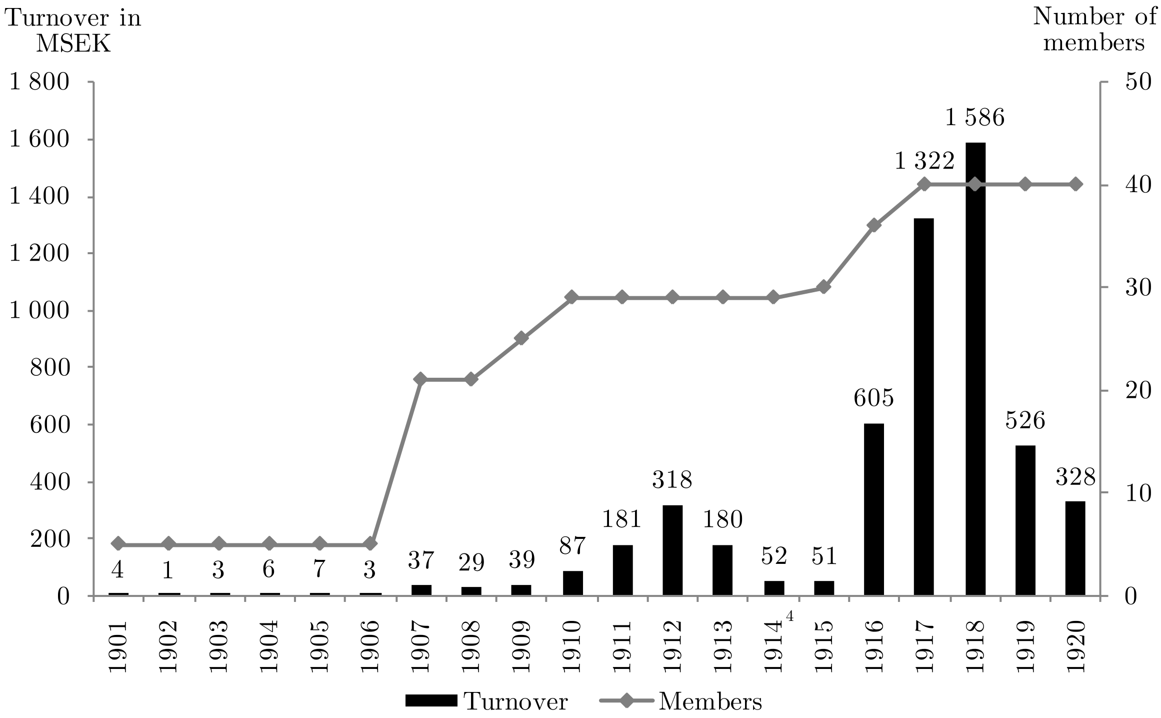
Figure 1

Turnover and the number of members on the Stockholm Stock Exchange

The graph below shows the total turnover in millions of Swedish kronor and the number of stock exchange members for the years 1901-1920. The data shows the aggregated turnover on the SSE, i.e. it includes other asset classes than pure equity (e.g. bonds and preferred stocks). The other asset classes however constitute a very small part of the total turnover. All numbers are in current prices. Turnover numbers are from Algott (1963) while the number of members are from Beije (1946).



[4] Note: The stock exchange was closed for three months, 3rd of August until 3rd of November, following the outbreak of the First World War.

Figure 2

Market capitalisation of the exchange

The graph below shows the aggregated market capitalisation of the Stockholm Stock Exchange. It also shows the number of companies with market capitalisation and the number of listed companies. Note that despite the drop in the number of listed companies from 1909-1910, the number of companies with market capitalisation increases over the same period. All numbers are in current prices.

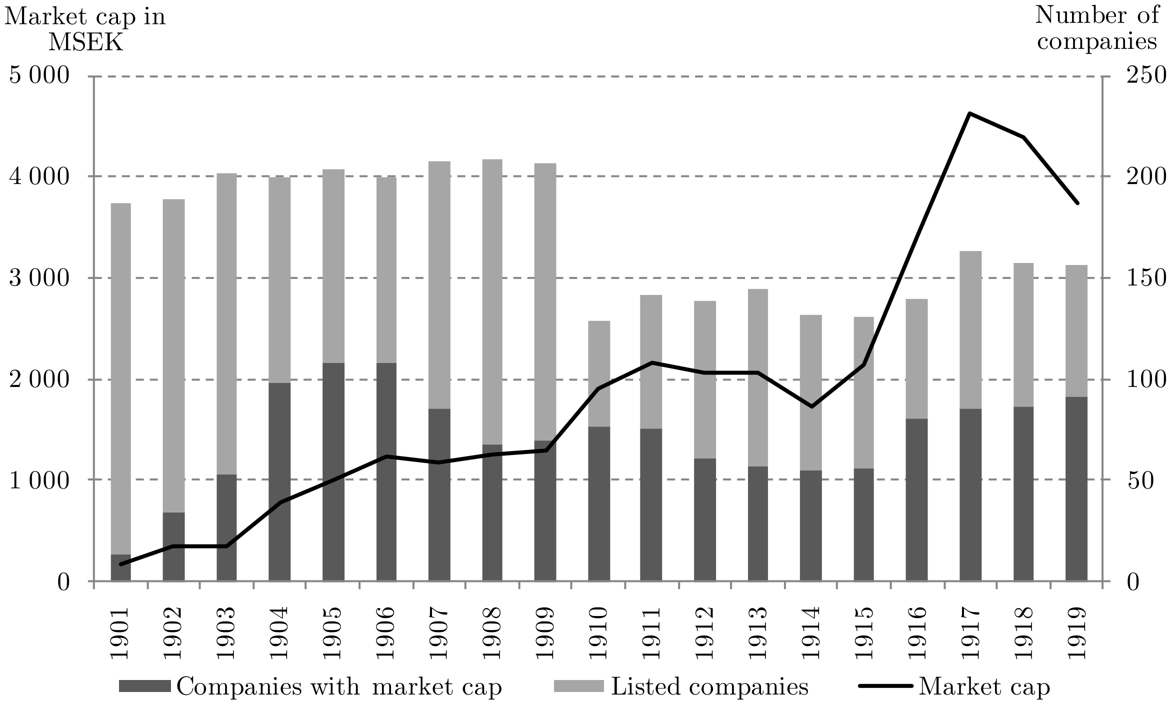
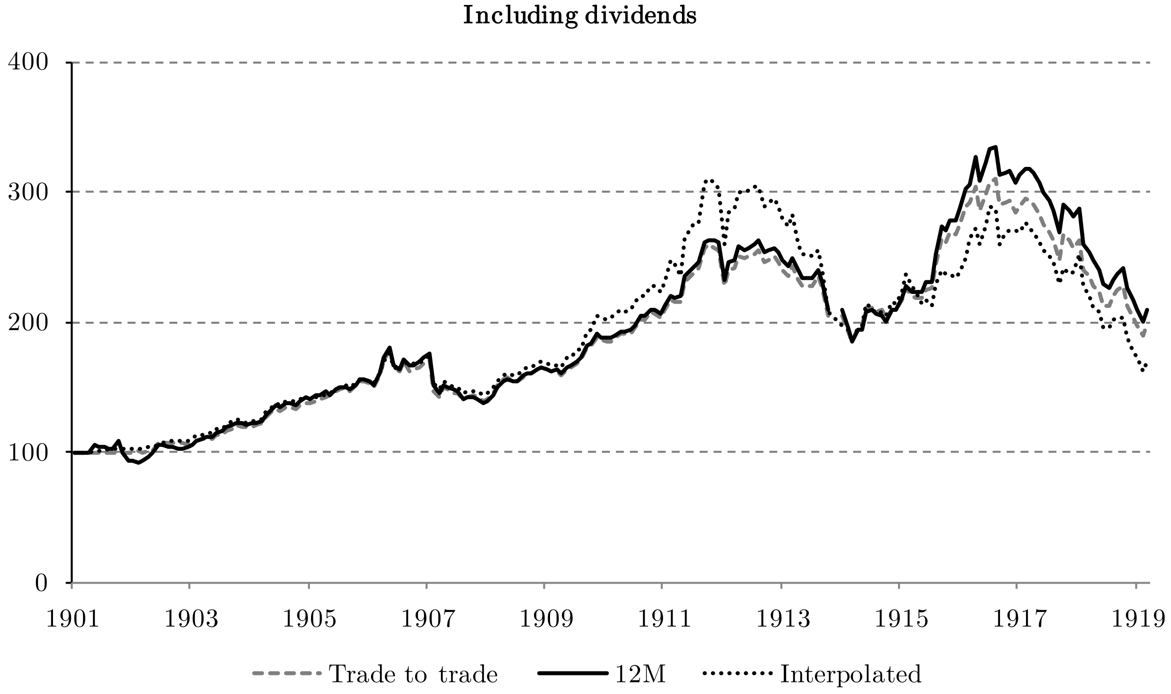


Figure 3

Capital weighted market indices

The graphs below show the sectors performances over the time period 1901-1919. They include the trade-to-trade index, 12M index and the interpolated index. The indices are weighted by market capitalisation. See figure 6 for the number of companies included in each respective index.



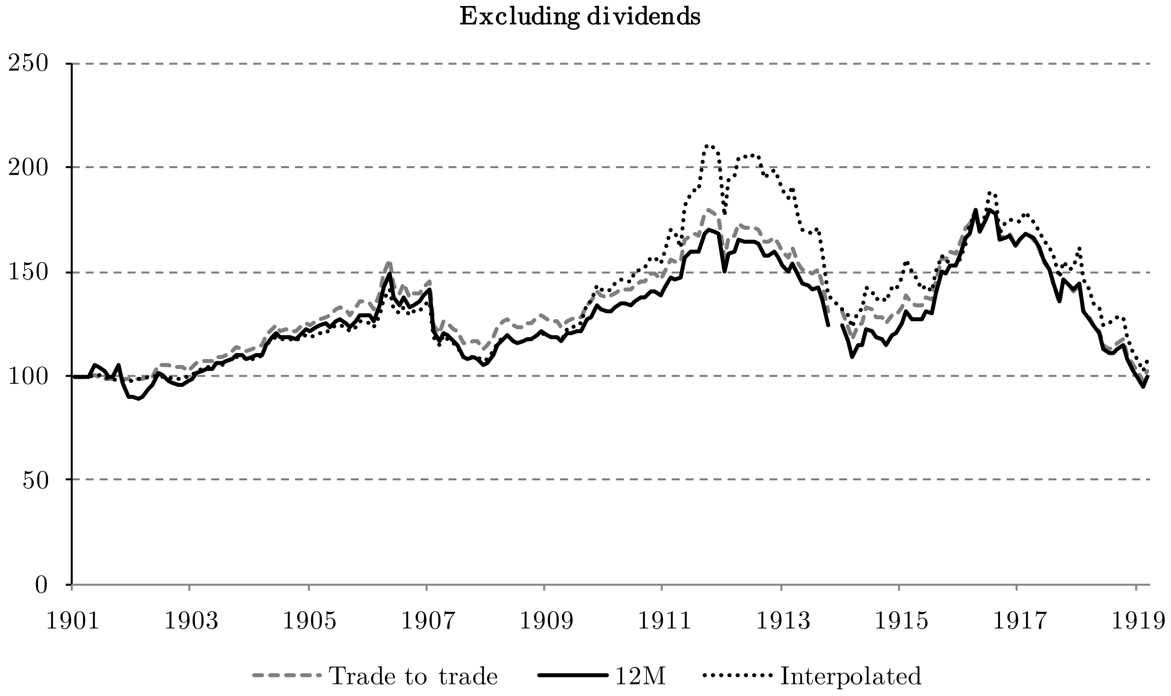
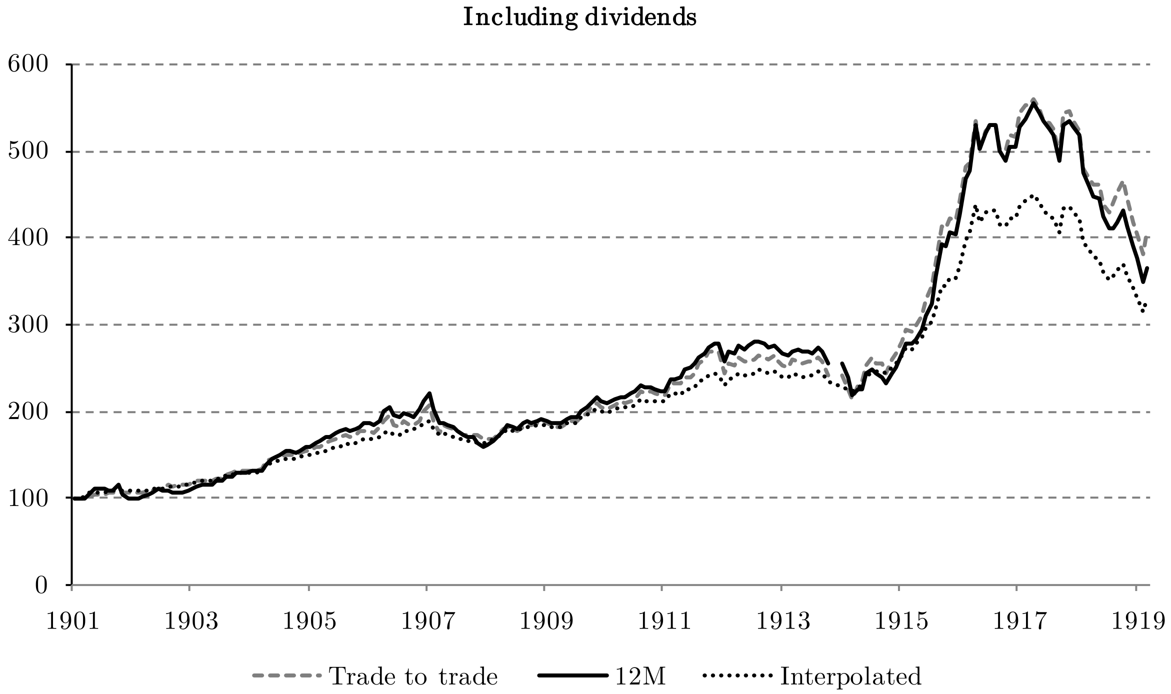


Figure 4

Equally weighted market indices

The graphs below show the Stockholm Stock Exchange's performance over the time period 1901-1919. They include the trade-to-trade index, 12 month index and the interpolated index. The indices are equally-weighted. See figure 6 for the number of companies included in the different indices respectively.



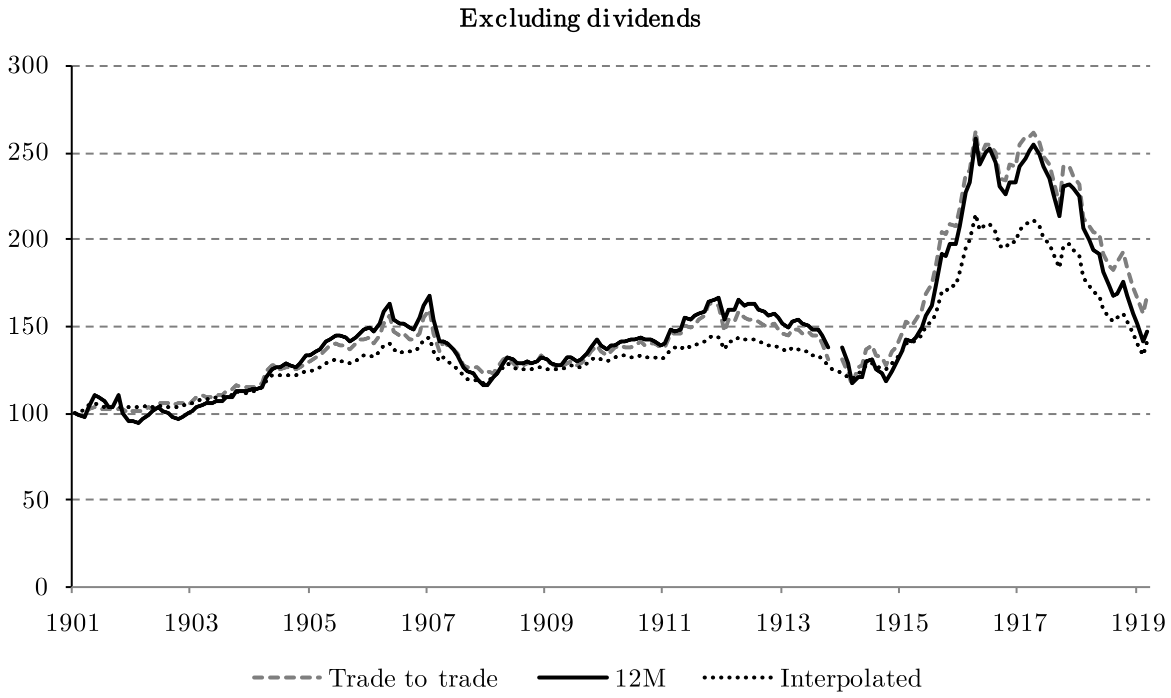
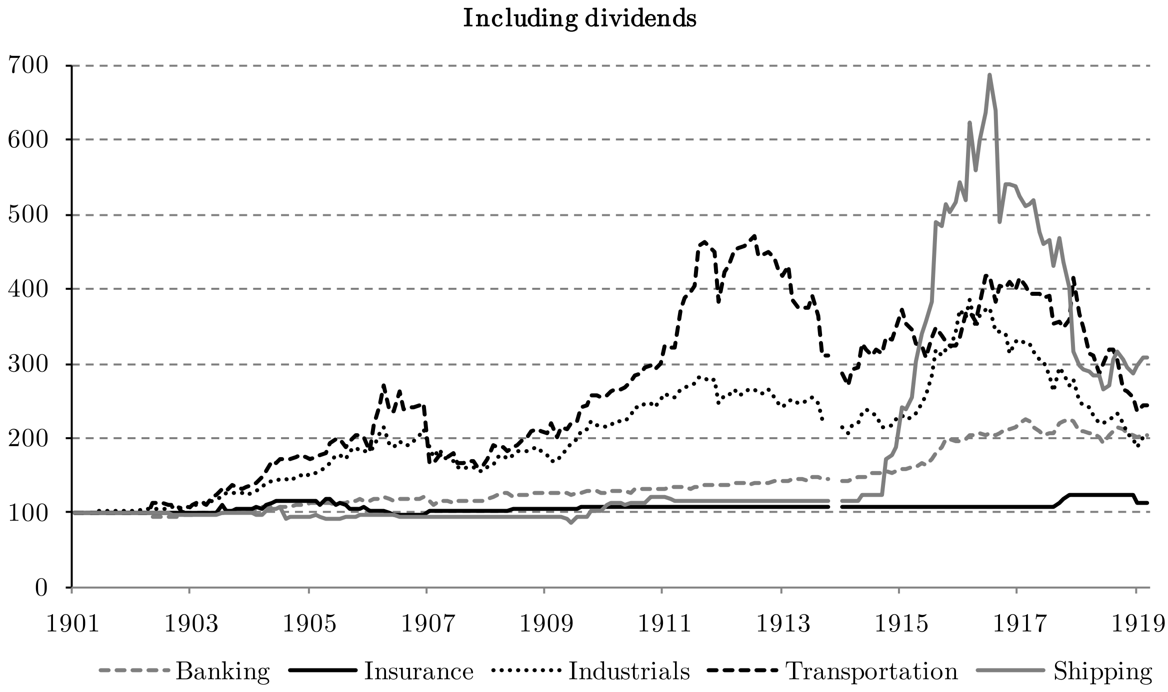


Figure 5

Capital weighted sector indices

The graphs below show the five sectors' performance over the time period 1901-1919. The indices are capital weighted and constructed using the trade-to-trade method. See table 2 for the number of traded companies.



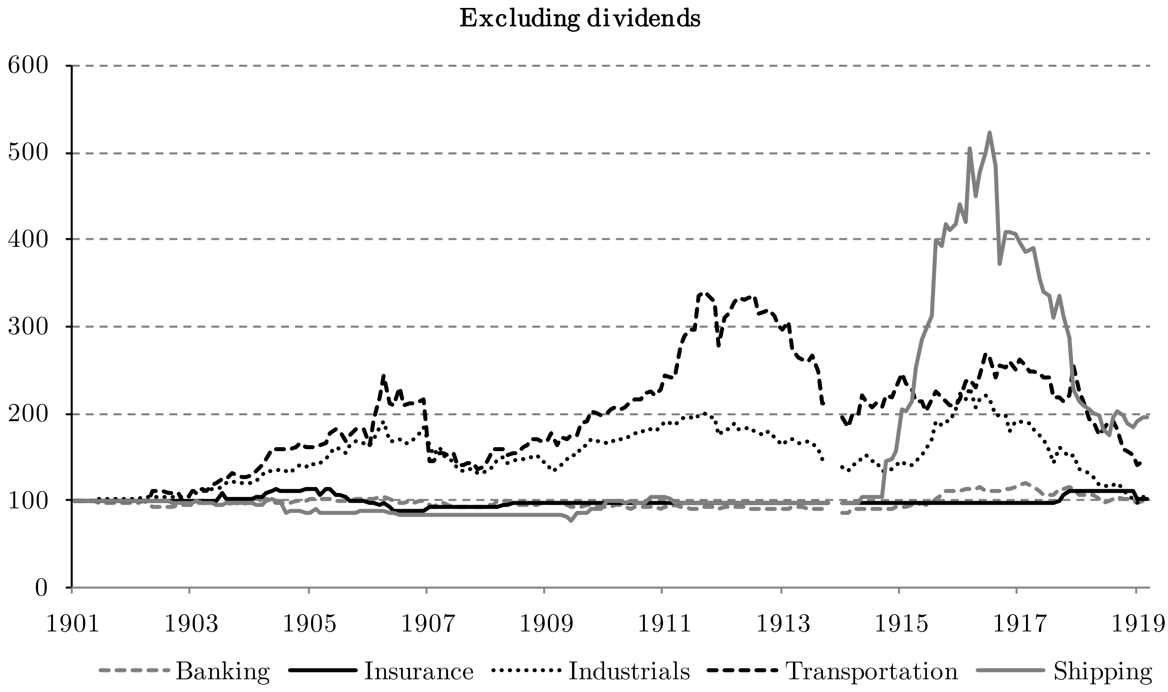
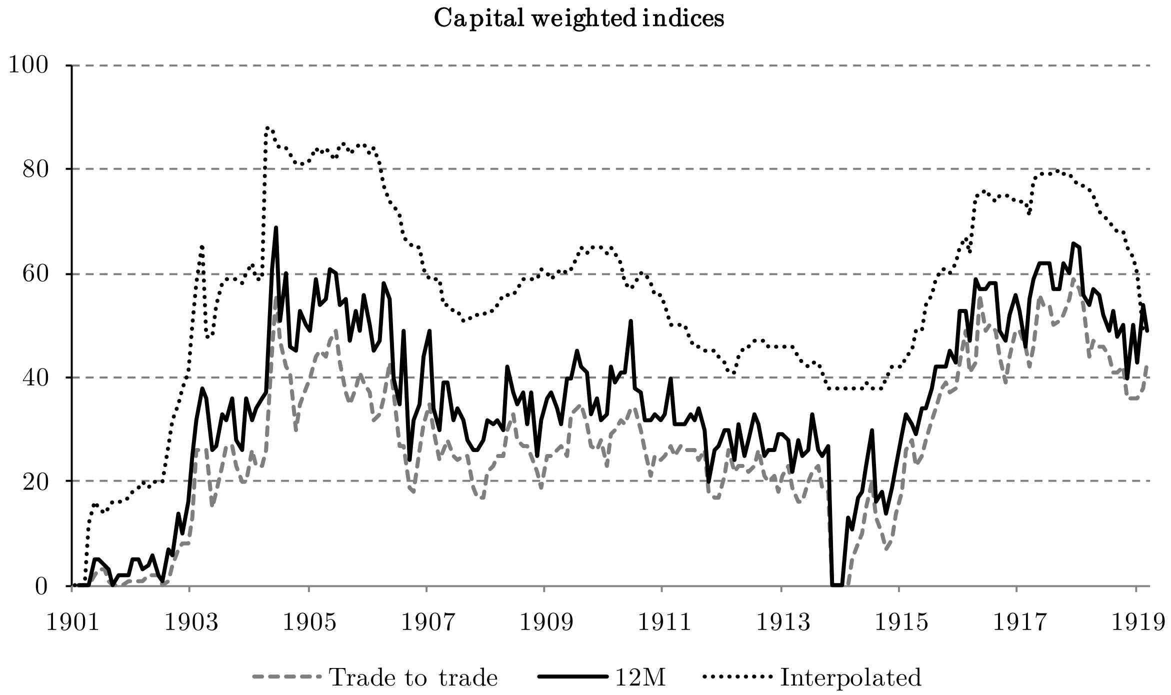


Figure 6

Number of companies included in indices

The graph below shows the number of companies included in capital weighted and equally weighted indices using the trade-to-trade, 12M and interpolated methods respectively.



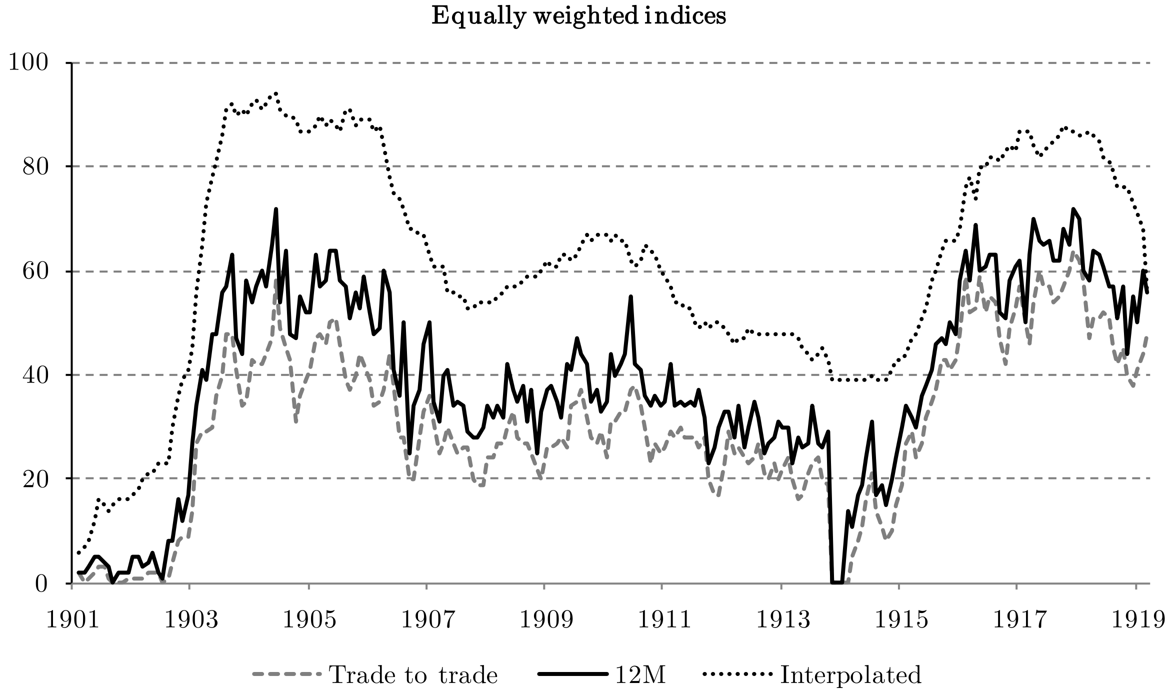
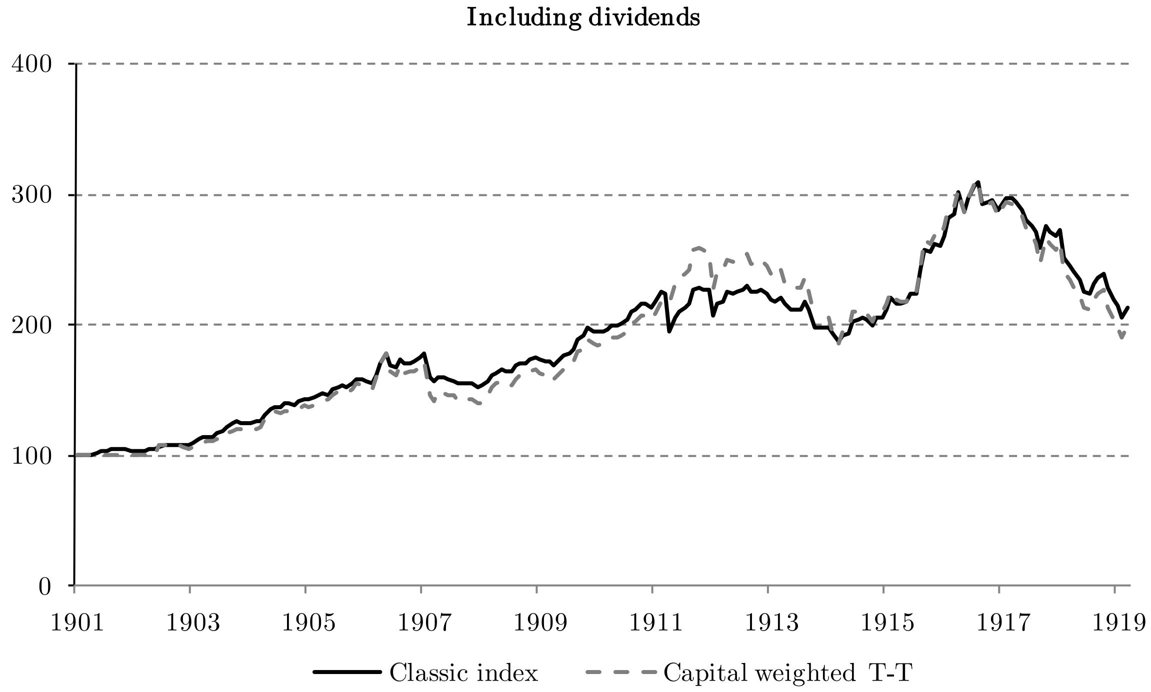


Figure 7

Capital weighted T-T index vs. the classic index method

The graph shows our capital weighted trade-to-trade index excluding dividends side by side with our, so called, classic index. The classic index reflects the effect of holding all securities in all periods in which they are listed.



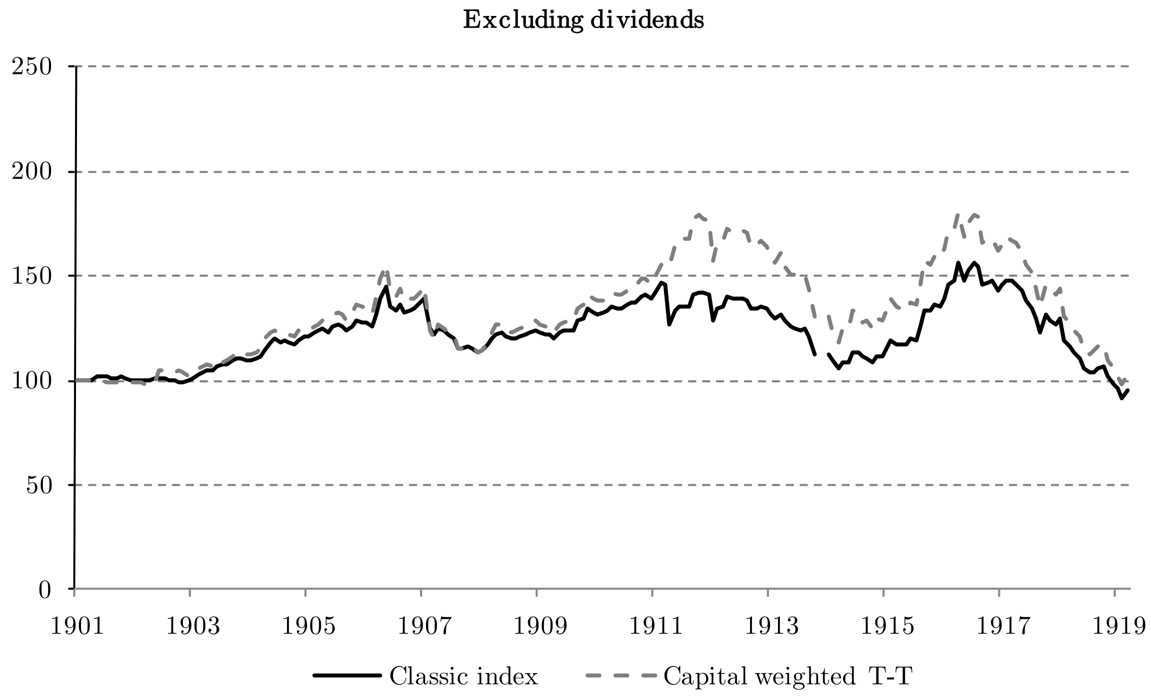


Figure 8

Capital weighted T-T index vs. the Kommersiella meddelanden index (KMI)

The graph shows our capital weighted trade-to-trade index excluding dividends side by the index presented in Waldenstrom (2007). Waldenstrom's index runs from January 1906 and is based on publications from the Stockholm based paper *Kommersiella meddelanden.* Discrepancies between adjusted KMI and our capital weighted trade-to-trade index can mainly be explained by different weights. KMI uses book values as weights while we use market values.

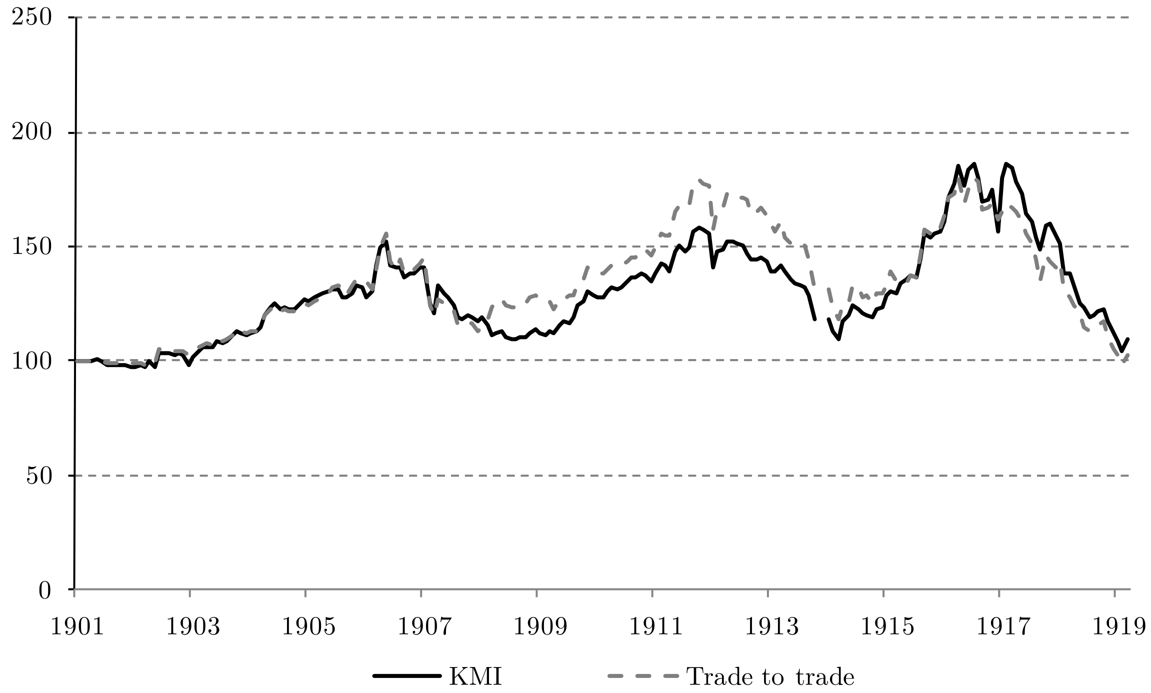


Figure 9

Capital weighted T-T index vs. S&P500

The graph below shows the SSE capital weighted T-T index side by side with the S&P 500, excluding dividends.

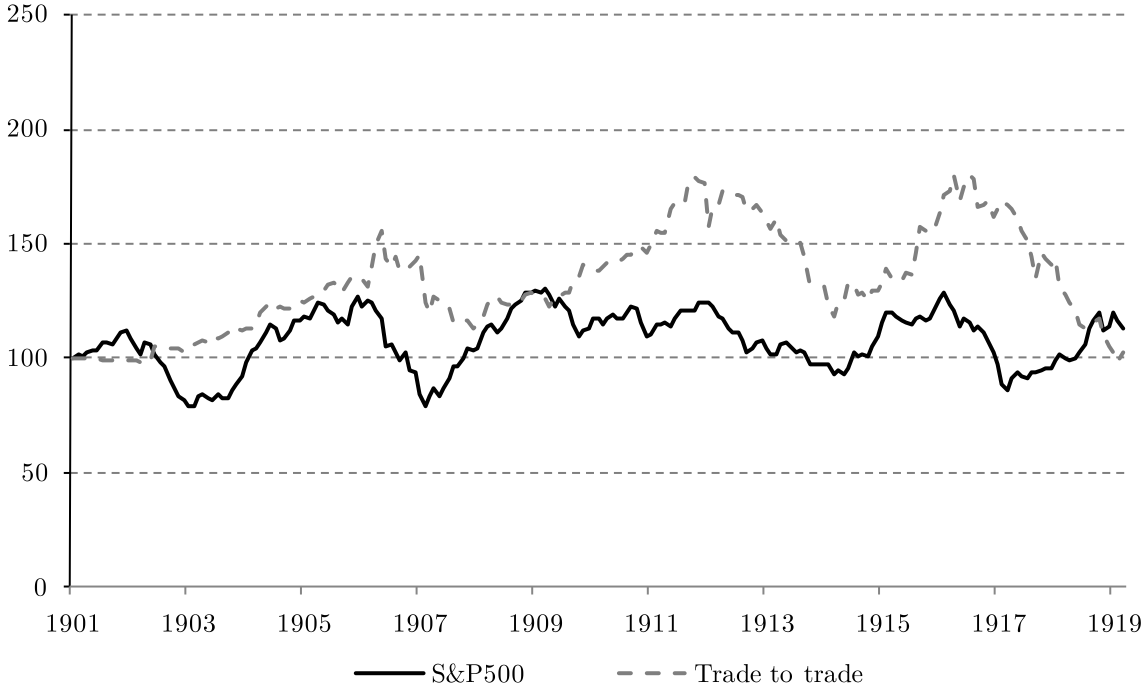


Figure 10

Annotated market index

The graph below shows the Stockholm Stock Exchange market index annotated with key historic events.

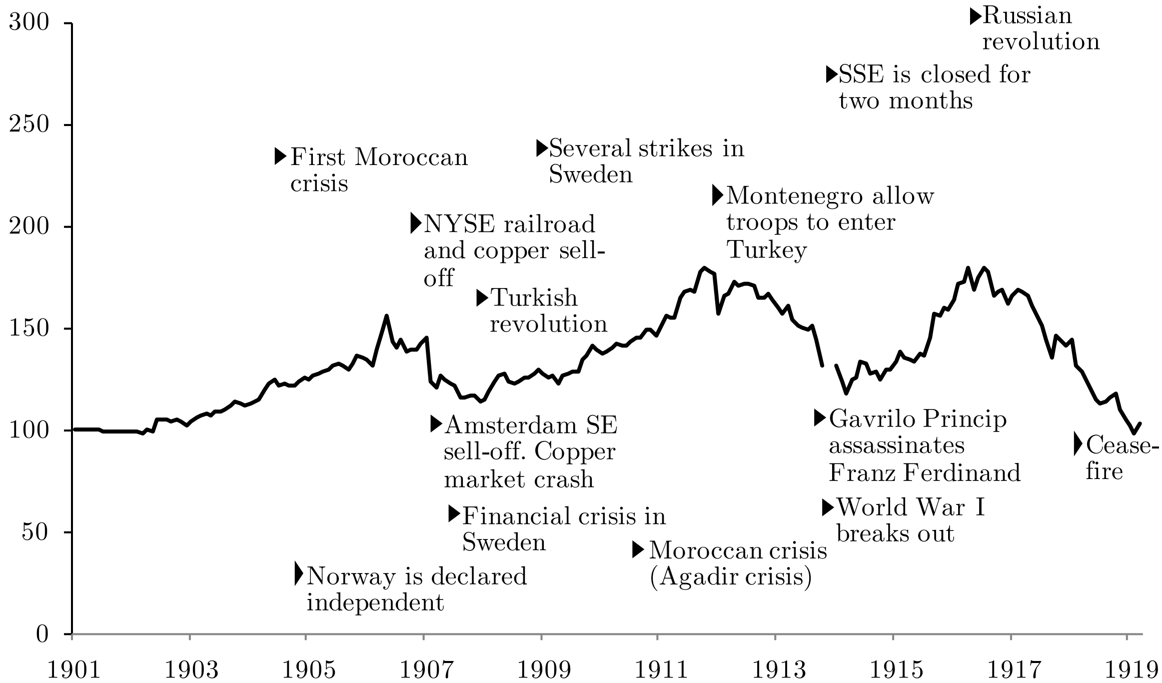


Figure 11

Distribution of liquidity measure one

The graph below shows the distribution of liquidity measure one. The measure is calculated as the number of weeks in which a security is traded in relation to the number of weeks in which it is listed. The measure is estimated over the entire time period, 1901-1919.

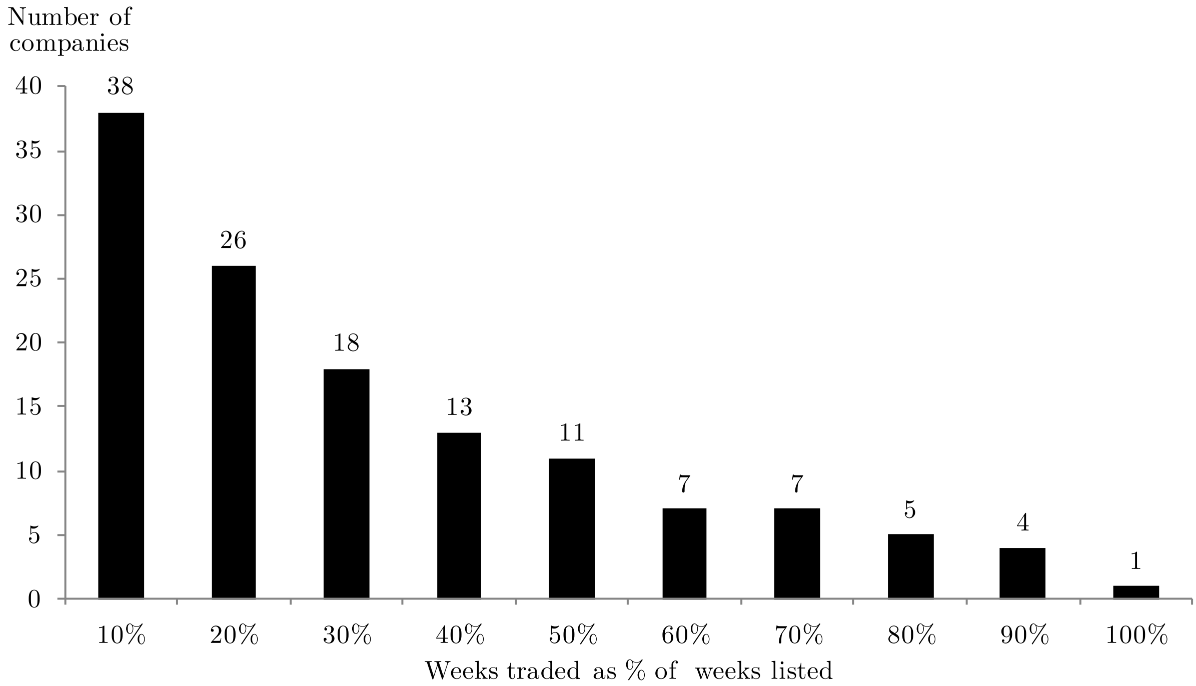


Figure 12

Distribution of liquidity measure two

The graph below shows the distribution of liquidity measure two. The measure is calculated as the average of the bid-ask spread divided by the average of the bid and ask quotes. The measure is estimated over the entire time period, 1901-1919.

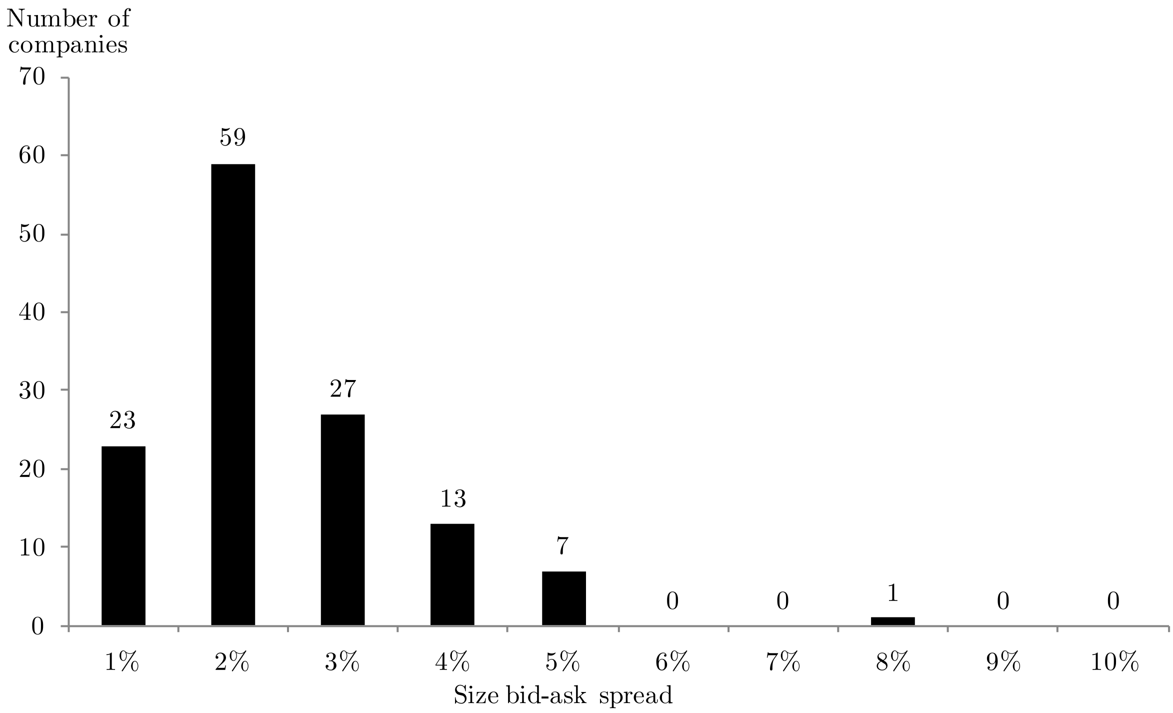


Figure 13

Market liquidity and market return

The figure illustrates the development of the market index together with market liquidity. Market liquidity is measured as the number of securities traded relative to the number of listed in any given month. The market development is illustrated by the capital weighted trade-to-trade index excluding dividends. The correlation between market return and liquidity is 0.43.

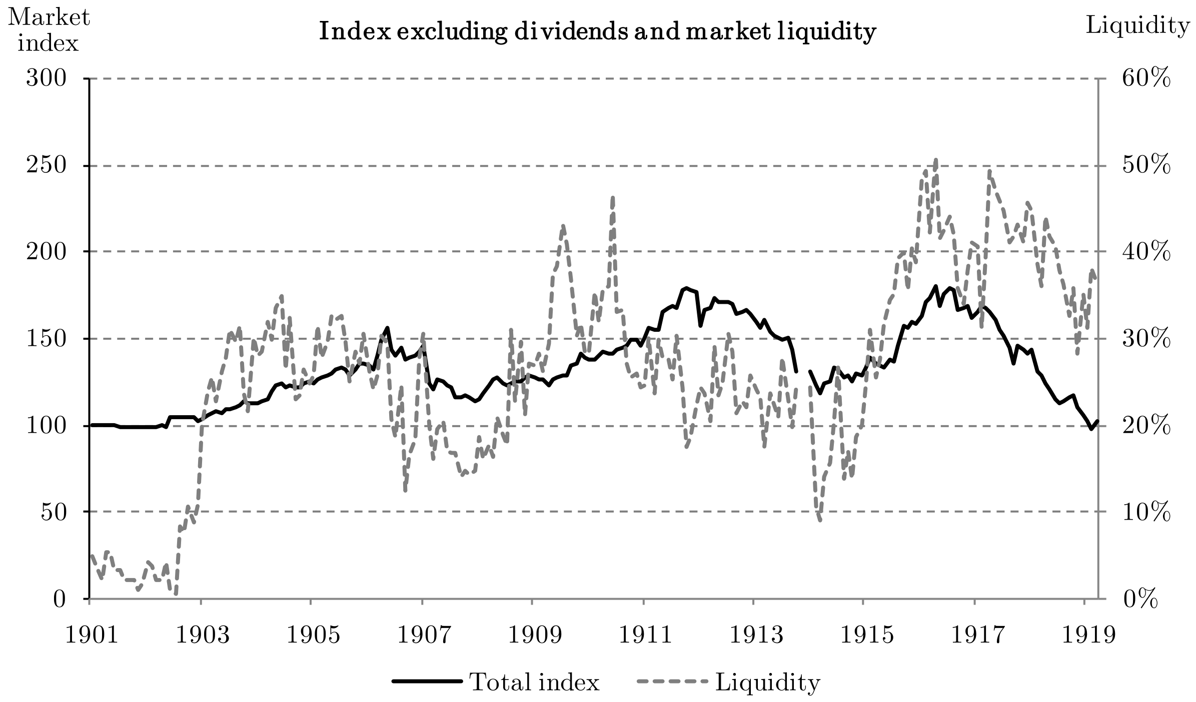


Figure 14

Security liquidity and dividend yield

The graphs illustrate the relationship between liquidity measures one and two. Liquidity measure one is measured as the number of weeks with observed trades in relation to the number of weeks listed. Liquidity measure two is the average of the size of the bid-ask spread divided by the average of the bid and ask quotes.

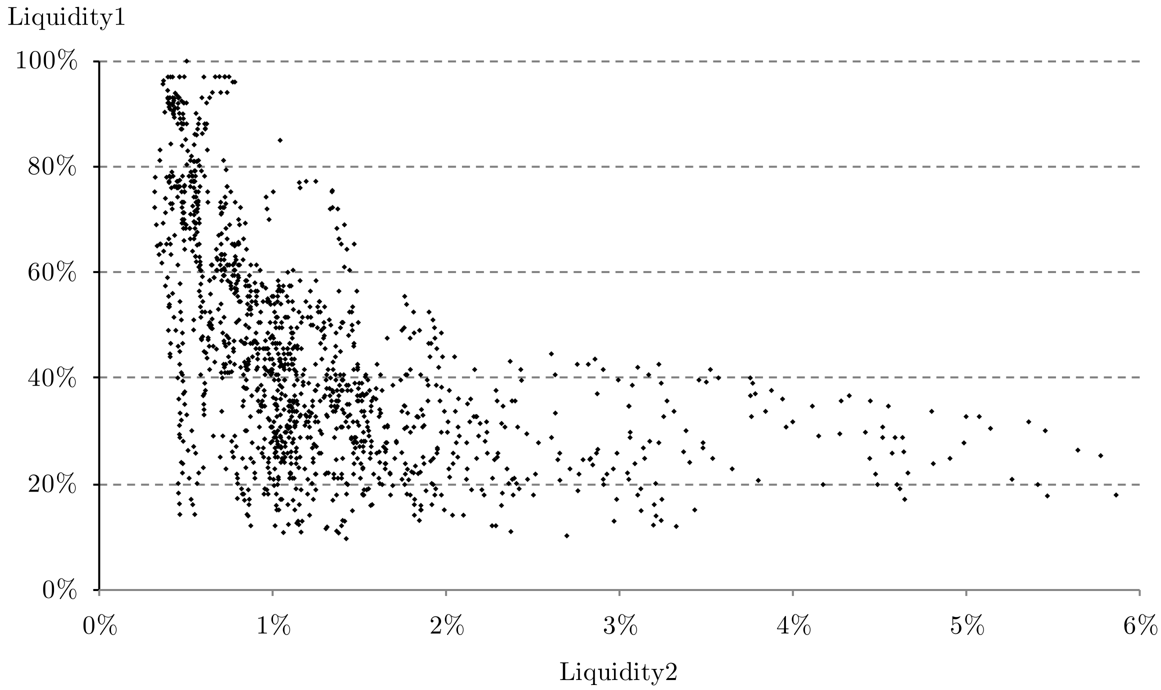


Figure 15

Security return and liquidity

The figure illustrates the relationship between the number of times a security is traded and its expected liquidity premium. The chart is based on the estimated coefficients from the multivariate liquidity one regressions displayed in table 16. These have been used to graphically illustrate the relationship between liquidity and returns. On the x-axis is the number of weeks with observed trades within the last two years for a security and on the y-axis is the estimated extra returned earned by holding that security.

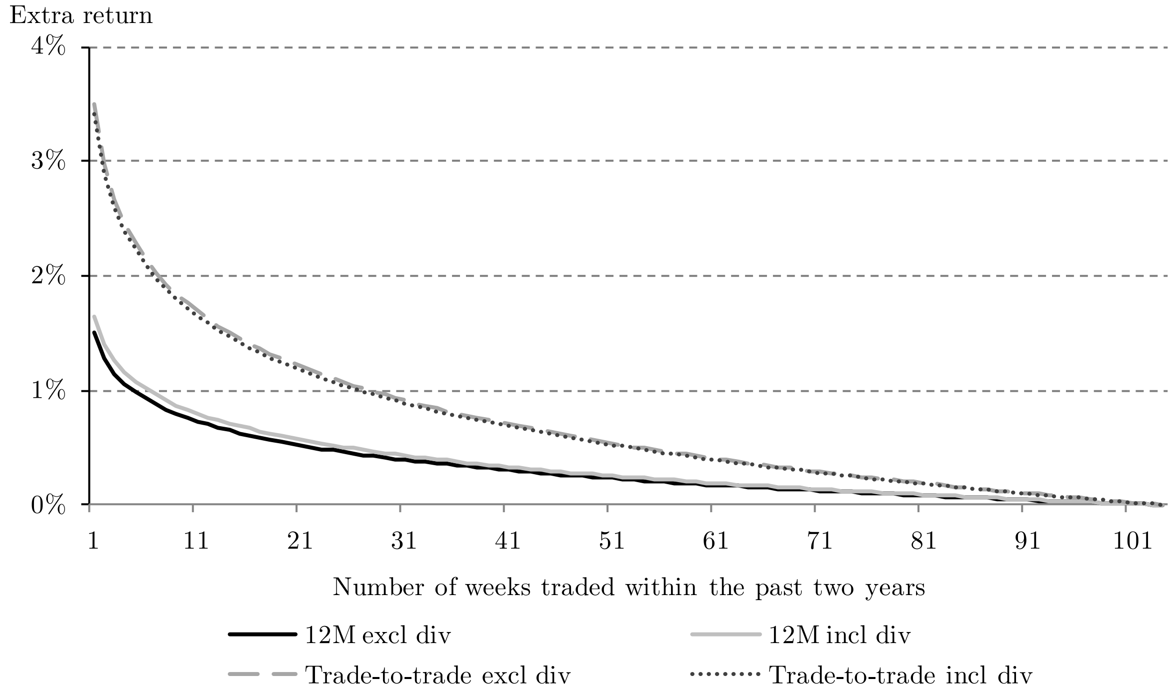


Table 1

Number of listed securities

The table shows the number of securities, divided by industry, listed on the primary list of the Stockholm Stock Exchange. The reason for the drop in the number of listed securities from 1909-1910 is that the SSE decided to delist several illiquid securities.

	Listed securities					
	Banking	Insurance	Industrials	Transportation	Shipping	Total
1901	47	20	67	29	23	186
1902	46	20	69	31	23	189
1903	50	23	73	33	23	202
1904	50	24	72	33	23	202
1905	50	24	74	35	24	207
1906	45	24	76	35	23	203
1907	49	23	84	37	22	215
1908	47	23	83	35	24	212
1909	46	23	81	38	24	212
1910	42	16	49	18	5	130
1911	43	15	59	17	6	140
1912	36	18	59	18	5	136
1913	36	16	55	25	6	138
1914	37	13	51	19	6	126
1915	33	13	56	19	6	127
1916	33	14	63	18	7	135
1917	32	18	78	19	9	156
1918	26	18	81	17	8	150
1919	24	17	87	14	7	149

Table 2

Number of traded securities

The table shows the number of securities, divided by industry, with at least one registered close in each respective year (both on and off the exchange). It also shows the corresponding percentage of listed companies that are traded. Note that the stock exchange opened in October 1901 and that the stock exchange was closed for two months in 1914.

Traded securities

	Banking		Insurance		Industrials		Transportation		Shipping		Total	
	Traded	% listed	Traded	% listed	Traded	% listed	Traded	% listed	Traded	% listed	Traded	% listed
1901	7	15%	1	5%	3	4%	5	17%	0	0%	16	9%
1902	16	35%	1	5%	14	20%	5	16%	2	9%	38	20%
1903	39	78%	7	30%	22	30%	14	42%	5	22%	87	43%
1904	45	90%	7	29%	35	49%	17	52%	8	35%	112	55%
1905	40	80%	9	38%	41	55%	14	40%	10	42%	114	55%
1906	39	87%	11	46%	44	58%	14	40%	7	30%	115	57%
1907	36	73%	6	26%	35	42%	12	32%	6	27%	95	44%
1908	34	72%	4	17%	26	31%	9	26%	3	13%	76	36%
1909	35	76%	3	13%	22	27%	9	24%	3	13%	72	34%
1910	33	79%	9	56%	28	57%	10	56%	3	60%	83	64%
1911	33	77%	7	47%	32	54%	12	71%	2	33%	86	61%
1912	25	69%	2	11%	28	47%	10	56%	1	20%	66	49%
1913	23	64%	1	6%	31	56%	7	28%	1	17%	63	46%
1914	27	73%	1	8%	25	49%	5	26%	1	17%	59	47%
1915	18	55%	1	8%	31	55%	6	32%	2	33%	58	46%
1916	27	82%	1	7%	47	75%	7	39%	5	71%	87	64%
1917	28	88%	2	11%	56	72%	5	26%	6	67%	97	62%
1918	23	88%	5	28%	63	78%	6	35%	6	75%	103	69%
1919	21	88%	6	35%	62	71%	5	36%	5	71%	99	66%
Average	29	72%	4	22%	34	49%	9	36%	4	34%	80	49%

Table 3

Average returns, trade-to-trade method

The table shows the average yearly returns for the five sectors and market respectively. The returns are calculated on a trade-to-trade basis.

Average returns

	Banking		Insurance		Industrials		Transportation		Shipping		Total	
	Ex div	Inc div	Ex div	Inc div	Ex div	Inc div	Ex div	Inc div	Ex div	Inc div	Ex div	Inc div
1901	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
1902	(2)%	(0)%	0%	0%	4%	5%	0%	0%	0%	0%	(1)%	0%
1903	(2)%	(1)%	(1)%	(0)%	6%	7%	12%	14%	(3)%	(3)%	8%	10%
1904	4%	9%	4%	6%	17%	20%	25%	29%	(2)%	1%	8%	11%
1905	2%	6%	3%	4%	12%	15%	17%	21%	(9)%	(5)%	11%	15%
1906	1%	5%	(10)%	(7)%	28%	32%	33%	37%	1%	3%	10%	14%
1907	(7)%	(3)%	(2)%	(1)%	(13)%	(10)%	(30)%	(28)%	(3)%	(2)%	(14)%	(11)%
1908	3%	7%	(1)%	(0)%	(9)%	(6)%	3%	7%	0%	0%	2%	7%
1909	(3)%	2%	4%	5%	(7)%	(3)%	2%	6%	0%	0%	3%	7%
1910	(3)%	2%	1%	1%	25%	31%	28%	32%	18%	18%	11%	16%
1911	0%	4%	0%	0%	10%	14%	17%	21%	(2)%	2%	11%	15%
1912	(2)%	3%	0%	0%	1%	5%	36%	40%	0%	0%	8%	12%
1913	(0)%	4%	0%	0%	(9)%	(5)%	(17)%	(15)%	0%	0%	(4)%	0%
1914	(3)%	1%	0%	0%	(17)%	(14)%	(27)%	(24)%	0%	0%	(27)%	(24)%
1915	5%	10%	0%	0%	0%	4%	15%	18%	118%	122%	14%	19%
1916	22%	27%	0%	0%	63%	70%	5%	7%	137%	146%	28%	33%
1917	4%	9%	0%	0%	(18)%	(15)%	4%	6%	(23)%	(18)%	(3)%	1%
1918	(11)%	(7)%	14%	16%	(30)%	(27)%	(22)%	(20)%	(47)%	(44)%	(23)%	(20)%
1919	(6)%	(2)%	(9)%	(9)%	(21)%	(16)%	(25)%	(22)%	(4)%	6%	(20)%	(15)%
1901-1919	(1)%	104%	1%	13%	4%	102%	46%	144%	97%	207%	3%	100%
CAGR	(0)%	4.1%	0.1%	0.7%	0.2%	4.0%	2.1%	5.1%	3.8%	6.4%	0.2%	3.9%

Table 4

The 10 largest companies by market capitalisation in selected years

The table lists the largest companies on the exchange in descending order for 1904, 1910 and 1916. In addition, the table shows each company's market capitalisation in relation to the exchange's total capitalisation. All numbers are stated in SEKm.

1904			1910			1916		
Trafik AB Grangesberg-Oxelosund	66	8%	Trafik AB Grangesberg-Oxelosund	401	21%	Trafik AB Grangesberg-Oxelosund	627	18%
Skandinaviska Kredit	57	7%	Separator	311	16%	Svenska Kullagerfabriken	302	8%
Skanes Enskilda Bank	45	6%	Skandinaviska Kredit	137	7%	Stora Kopparbergs Bergslags	169	5%
Stora Kopparbergs Bergslags	36	5%	Svenska Sockerfabriken	116	6%	Skandinaviska Kredit	146	4%
Goteborgsbanken	35	4%	Stockholms Allmanna Telefon	77	4%	Allmanna Svenska Elektriska	133	4%
Sankt Eriks Bryggeri	34	4%	Stockholms Handelsbank	70	4%	Separator	123	3%
Separator	33	4%	Stora Kopparbergs Bergslags	57	3%	Svenska Sockerfabriken	111	3%
Stockholms Handelsbank	23	3%	Stockholms Enskilda Bank	44	2%	Stockholms Handelsbank	105	3%
Stockholms Intecknings Garanti	23	3%	Goteborgsbanken	39	2%	Goteborgsbanken	97	3%
Hernosands Enskilda Bank	21	3%	Svensk-Dansk-Ryska Telefon	38	2%	Stockholms Enskilda Bank	94	3%
Top 10 total market value	373	47%	Top 10 total market value	1 289	67%	Top 10 total market value	1 906	54%
Total market cap. of the SSE	795	100%	Total market cap. of the SSE	1 917	100%	Total market cap. of the SSE	3 562	100%

Table 5

P/E ratios of the market and sectors

The table shows the median and market weighted (MW) P/E ratios for the five sectors and for the market. Please see table 9 for the number of underlying companies both in absolute number and as a % of listed securities.

P/E ratios

	Banking		Insurance		Industrials		Transportation		Shipping		Total		S&P500
	Median	MW	Median	MW	Median	MW	Median	MW	Median	MW	Median	MW	MW
1901	17.7x	17.2x	6.5x	6.5x	10.2x	10.2x	14.0x	14.2x	n.a.	n.a.	14.0x	14.4x	16.3x
1902	15.8x	15.9x	10.3x	10.3x	12.1x	10.5x	17.7x	14.5x	n.a.	n.a.	14.5x	14.2x	14.4x
1903	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	11.2x
1904	16.5x	15.0x	9.1x	15.4x	12.7x	13.2x	17.9x	18.6x	13.2x	12.1x	16.1x	15.3x	16.1x
1905	15.5x	10.2x	12.8x	12.1x	14.1x	14.4x	21.3x	24.4x	14.9x	17.4x	15.4x	13.7x	16.7x
1906	15.3x	12.8x	13.1x	13.1x	12.8x	14.7x	25.4x	27.0x	81.1x	34.1x	15.5x	16.0x	13.8x
1907	13.3x	7.3x	13.9x	14.1x	12.6x	14.9x	23.0x	21.2x	14.0x	13.8x	13.9x	11.3x	10.2x
1908	11.5x	8.6x	13.2x	15.8x	14.6x	14.9x	27.1x	26.8x	n.a.	n.a.	13.2x	13.2x	14.5x
1909	13.9x	10.9x	13.1x	10.8x	16.0x	15.6x	35.1x	37.4x	12.6x	12.6x	14.6x	17.2x	15.5x
1910	15.0x	17.7x	10.6x	9.1x	16.7x	25.1x	14.9x	23.0x	9.1x	6.7x	14.8x	22.0x	12.1x
1911	13.4x	16.3x	n.a.	n.a.	17.2x	25.0x	12.3x	21.9x	6.4x	6.4x	13.5x	22.3x	13.7x
1912	13.9x	14.6x	n.a.	n.a.	15.4x	15.6x	9.8x	25.8x	6.0x	6.0x	14.1x	18.2x	14.6x
1913	17.8x	18.2x	n.a.	n.a.	12.1x	14.4x	11.8x	23.0x	n.a.	n.a.	14.0x	18.1x	12.0x
1914	13.2x	11.4x	n.a.	n.a.	12.9x	16.5x	13.1x	24.5x	n.a.	n.a.	13.0x	16.3x	12.7x
1915	14.4x	14.0x	n.a.	n.a.	12.0x	12.8x	13.1x	35.9x	4.7x	4.7x	12.1x	16.5x	13.8x
1916	12.6x	12.3x	n.a.	n.a.	12.2x	12.1x	11.4x	32.6x	8.4x	6.3x	11.5x	14.1x	8.3x
1917	13.1x	15.7x	n.a.	n.a.	12.4x	12.9x	14.0x	35.6x	14.1x	16.8x	12.9x	16.5x	4.8x
1918	12.7x	11.8x	n.a.	n.a.	12.1x	12.9x	39.9x	59.3x	8.7x	8.2x	11.4x	15.2x	6.9x
1919	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	9.3x
Average	14.5x	13.5x	11.4x	11.9x	13.4x	15.0x	18.9x	27.4x	16.1x	12.1x	13.8x	16.1x	12.5x

Table 6

Market-to-book ratios of the index and sectors

The table shows the median and market weighted (MW) market-to-book ratios for the five sectors and for the market. There are on average 15% more observations underlying the market-to-book calculations than for the P/E ratio calculations (see tables 5 and 9).

Market-to-book ratios

	Banking		Insurance		Industrials		Transportation		Shipping		Total	
	Median	MW	Median	MW	Median	MW	Median	MW	Median	MW	Median	MW
1901	1.2 x	1.2 x	0.9 x	0.9 x	1.1 x	1.1 x	1.1 x	1.2 x	n.a.	n.a.	1.2 x	1.0 x
1902	1.1 x	1.2 x	0.4 x	0.4 x	1.0 x	1.1 x	1.1 x	1.1 x	n.a.	n.a.	1.1 x	1.0 x
1903	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1904	1.0 x	1.0 x	0.8 x	0.7 x	1.1 x	1.2 x	1.0 x	1.4 x	0.8 x	0.8 x	1.0 x	0.9 x
1905	1.2 x	1.2 x	1.2 x	0.9 x	1.3 x	1.3 x	1.5 x	2.0 x	0.9 x	0.8 x	1.2 x	1.1 x
1906	1.1 x	1.2 x	0.9 x	0.9 x	1.4 x	1.4 x	2.5 x	2.8 x	0.8 x	0.8 x	1.1 x	1.3 x
1907	1.0 x	1.0 x	0.8 x	0.7 x	1.3 x	1.6 x	1.4 x	2.4 x	0.7 x	0.7 x	1.1 x	1.1 x
1908	0.9 x	1.0 x	0.9 x	0.8 x	1.2 x	1.1 x	1.3 x	2.2 x	n.a.	n.a.	1.0 x	1.1 x
1909	1.0 x	1.0 x	0.8 x	0.7 x	1.3 x	1.2 x	1.0 x	2.4 x	0.4 x	0.4 x	1.0 x	1.1 x
1910	1.1 x	1.2 x	0.7 x	0.6 x	1.2 x	2.0 x	1.3 x	2.8 x	0.4 x	0.5 x	1.0 x	1.6 x
1911	1.0 x	1.2 x	n.a.	n.a.	1.2 x	2.2 x	1.4 x	3.2 x	0.9 x	0.9 x	1.0 x	1.9 x
1912	1.0 x	1.2 x	n.a.	n.a.	1.2 x	1.4 x	1.0 x	4.2 x	0.9 x	0.9 x	1.1 x	1.7 x
1913	1.0 x	1.2 x	n.a.	n.a.	1.1 x	1.3 x	1.1 x	4.0 x	n.a.	n.a.	1.1 x	1.7 x
1914	1.0 x	1.1 x	n.a.	n.a.	1.0 x	1.1 x	1.0 x	2.7 x	n.a.	n.a.	1.0 x	1.3 x
1915	1.1 x	1.1 x	n.a.	n.a.	1.2 x	1.3 x	1.0 x	3.4 x	1.3 x	1.3 x	1.1 x	1.6 x
1916	1.2 x	1.3 x	n.a.	n.a.	1.8 x	2.0 x	1.0 x	3.5 x	2.0 x	2.4 x	1.6 x	1.9 x
1917	1.3 x	1.4 x	n.a.	n.a.	1.8 x	1.9 x	1.3 x	3.6 x	2.5 x	3.8 x	1.7 x	2.1 x
1918	1.2 x	1.2 x	n.a.	n.a.	1.3 x	1.2 x	2.7 x	4.1 x	1.5 x	1.7 x	1.3 x	1.5 x
1919	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Average	1.1 x	1.2 x	0.8 x	0.7 x	1.3 x	1.4 x	1.3 x	2.8 x	1.1 x	1.3 x	1.1 x	1.4 x

Table 7

Dividend yield

The table shows the median, equally weighted and market weighted dividend yield for the five sectors and the market as a whole.

	Dividend yield (%)																	
	Banking			Insurance			Industrials			Transportation			Shipping			Total		
	M	EW	MW	M	EW	MW	M	EW	MW	M	EW	MW	M	EW	MW	M	EW	MW
1901	5.2	4.8	4.6	4.7	4.7	4.7	5.5	3.8	5.4	6.0	4.6	6.2	n.a.	n.a.	0.0	5.2	4.5	5.2
1902	5.1	4.6	4.3	2.4	2.4	2.4	5.4	6.0	3.9	4.7	4.7	5.3	5.4	5.4	5.3	5.1	5.1	4.3
1903	5.1	4.5	3.9	3.3	3.6	2.5	5.2	4.5	3.9	4.3	4.1	3.8	6.1	5.7	5.8	4.9	4.4	3.8
1904	5.0	4.7	4.7	4.5	3.7	3.0	5.1	4.7	3.9	3.8	3.8	4.0	6.0	5.3	6.1	4.9	4.6	4.3
1905	4.8	4.5	4.2	4.4	3.7	2.8	4.8	4.7	4.1	3.7	3.7	3.4	5.5	7.2	5.7	4.8	4.7	4.0
1906	4.8	4.5	4.2	4.6	5.4	3.9	4.2	4.1	3.3	3.6	3.8	2.8	5.4	4.5	5.5	4.6	4.4	3.6
1907	5.1	5.3	5.2	4.7	4.1	3.9	4.2	4.0	4.0	4.2	4.5	3.8	6.4	6.4	5.9	5.0	4.7	4.5
1908	5.7	5.6	4.9	4.0	3.7	2.4	5.4	4.9	4.4	5.0	5.2	4.1	6.7	7.0	6.3	5.5	5.2	4.5
1909	5.5	5.5	5.3	5.1	5.1	5.2	5.0	4.7	5.2	4.8	5.1	3.5	7.7	7.7	0.9	5.3	5.2	4.8
1910	5.5	5.6	5.2	4.9	4.9	5.0	5.0	5.2	4.2	3.7	4.7	3.2	0.0	3.3	2.5	5.2	5.2	4.3
1911	5.4	5.0	4.6	4.9	4.8	5.0	4.4	4.7	3.8	3.9	4.0	3.1	5.7	5.7	5.2	5.0	4.8	3.9
1912	5.5	5.5	5.3	5.4	5.4	5.4	4.4	4.0	4.4	4.2	4.3	3.1	5.6	5.6	5.6	5.0	4.7	4.2
1913	5.6	5.6	5.3	4.9	4.9	4.9	5.1	4.7	4.8	3.8	4.8	3.6	0.0	0.0	0.0	5.3	5.0	4.5
1914	5.9	5.8	5.7	7.7	7.7	7.7	6.0	6.0	6.0	4.8	5.7	6.5	8.9	8.9	8.9	5.9	6.0	6.0
1915	5.6	5.7	5.5	6.3	6.3	6.3	5.1	5.0	5.1	4.6	4.8	2.8	4.7	4.7	4.5	5.4	5.2	4.5
1916	5.1	5.0	4.7	4.1	4.1	4.1	3.5	4.0	3.4	4.6	4.7	2.0	2.8	3.2	2.8	4.3	4.3	3.5
1917	4.9	4.8	4.5	6.0	6.0	5.9	4.6	4.9	4.2	4.6	4.9	2.6	4.3	3.5	2.7	4.7	4.8	3.9
1918	5.5	5.4	5.4	4.9	5.3	6.0	6.0	6.1	6.0	5.2	5.6	2.8	7.7	7.5	7.2	5.9	6.0	5.3
1919	6.3	6.2	n.a.	6.3	6.7	n.a.	8.0	8.7	n.a.	5.0	5.1	n.a.	11.1	10.7	n.a.	7.4	7.9	n.a.
Average	5.3	5.1	4.9	4.8	4.8	4.5	4.9	4.8	4.4	4.4	4.6	3.7	5.2	5.4	4.5	5.1	4.9	4.4

Table 8

Payout ratio

The table shows the median and earnings weighted payout ratio for the five sectors and for the market.

Payout ratio

	Banking		Insurance		Industrials		Transportation		Shipping		Total	
	Median	EW	Median	EW	Median	EW	Median	EW	Median	EW	Median	EW
1901	70%	65%	119%	88%	65%	61%	90%	82%	n.a.	n.a.	72%	68%
1902	77%	63%	50%	48%	58%	52%	86%	83%	83%	50%	75%	64%
1903	78%	85%	24%	23%	66%	56%	74%	65%	84%	87%	70%	65%
1904	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1905	83%	73%	34%	47%	65%	58%	94%	91%	51%	61%	79%	72%
1906	91%	59%	25%	18%	69%	64%	107%	98%	87%	107%	83%	65%
1907	74%	62%	70%	70%	80%	69%	109%	117%	240%	116%	79%	75%
1908	72%	37%	31%	38%	65%	54%	111%	93%	n.a.	n.a.	72%	50%
1909	70%	43%	63%	63%	86%	91%	82%	39%	n.a.	n.a.	74%	53%
1910	77%	78%	65%	62%	88%	104%	128%	172%	194%	69%	88%	104%
1911	87%	93%	43%	31%	83%	109%	70%	84%	89%	54%	77%	95%
1912	75%	87%	n.a.	n.a.	79%	77%	54%	86%	42%	42%	77%	81%
1913	89%	78%	n.a.	n.a.	72%	75%	77%	98%	55%	55%	75%	83%
1914	101%	106%	n.a.	n.a.	78%	74%	62%	101%	n.a.	n.a.	87%	90%
1915	80%	67%	n.a.	n.a.	81%	110%	64%	84%	n.a.	n.a.	78%	86%
1916	92%	90%	n.a.	n.a.	62%	77%	62%	78%	27%	27%	72%	80%
1917	90%	97%	n.a.	n.a.	64%	66%	96%	93%	58%	41%	77%	73%
1918	112%	91%	n.a.	n.a.	67%	74%	85%	112%	77%	85%	72%	82%
1919	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Average	84%	75%	52%	49%	72%	75%	85%	93%	90%	66%	77%	76%

Table 9

Number of stocks with selected information

The table shows the number of companies where both net income and market capitalisation can be observed in each, respective year. The number of observed stocks is also the number of stocks underlying the P/E ratios in table 3. The dataset is scarcely populated as is illustrated in the bottom right corner below; on average 45% of all traded companies have both net income and market capitalisation data.

Stocks with market capitalisation and net income

	Banking		Insurance		Industrials		Transportation		Shipping		Total	
	No.	% traded	No.	% traded	No.	% traded	No.	% traded	No.	% traded	No.	% traded
1901	6	86%	1	100%	1	33%	2	40%	0	n.mf.	10	63%
1902	14	88%	1	100%	6	43%	4	80%	0	0%	25	66%
1903	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1904	20	44%	3	43%	8	23%	7	41%	4	50%	42	38%
1905	21	53%	3	33%	9	22%	7	50%	4	40%	44	39%
1906	23	59%	1	9%	9	20%	8	57%	3	43%	44	38%
1907	20	56%	3	50%	9	26%	7	58%	2	33%	41	43%
1908	20	59%	3	75%	12	46%	7	78%	0	0%	42	55%
1909	14	40%	3	100%	10	45%	8	89%	1	33%	36	50%
1910	11	33%	2	22%	11	39%	6	60%	2	67%	32	39%
1911	8	24%	0	0%	13	41%	6	50%	1	50%	28	33%
1912	11	44%	0	0%	14	50%	4	40%	1	100%	30	45%
1913	9	39%	0	0%	18	58%	4	57%	0	0%	31	49%
1914	12	44%	0	0%	18	72%	4	80%	0	0%	34	58%
1915	11	61%	0	0%	19	61%	4	67%	1	50%	35	60%
1916	8	30%	0	0%	23	49%	3	43%	4	80%	38	44%
1917	7	25%	0	0%	27	48%	3	60%	5	83%	42	43%
1918	7	30%	0	0%	29	46%	2	33%	5	83%	43	42%
1919	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Average	13	48%	1	31%	14	43%	5	58%	2	45%	35	47%

Table 10

Volatility

The table shows the monthly volatility for the five sectors in each year and for the period as a whole. The volatility has been calculated on equally weighted trade-to-trade returns.

	Listed securities						
	Banking	Insurance	Industrials	Transportation	Shipping	Total	S&P500
1901	n.a.	n.a.	n.a.	n.a.	n.a.	1.9%	2.7%
1902	2.4%	n.a.	1.0%	n.a.	n.a.	1.9%	2.3%
1903	2.3%	0.9%	2.4%	5.8%	4.8%	3.4%	3.4%
1904	4.2%	3.7%	4.3%	6.1%	1.8%	4.6%	2.8%
1905	2.9%	5.0%	7.3%	7.9%	7.1%	5.5%	2.6%
1906	3.6%	5.2%	6.5%	8.7%	2.7%	5.7%	3.2%
1907	5.2%	4.0%	10.7%	8.3%	3.7%	8.0%	4.9%
1908	9.7%	n.a.	6.2%	8.3%	n.a.	8.3%	3.1%
1909	2.9%	1.3%	8.7%	5.0%	n.a.	6.2%	1.9%
1910	3.8%	n.a.	6.6%	4.2%	6.3%	5.3%	3.1%
1911	2.7%	n.a.	5.8%	3.3%	3.7%	4.5%	2.8%
1912	2.3%	n.a.	8.2%	5.9%	n.a.	6.8%	1.9%
1913	2.0%	n.a.	4.1%	5.3%	n.a.	3.8%	2.3%
1914	2.5%	n.a.	7.0%	4.9%	n.a.	5.9%	2.5%
1915	2.5%	n.a.	7.6%	6.9%	15.6%	7.4%	2.9%
1916	5.5%	n.a.	9.2%	4.5%	16.6%	9.4%	2.3%
1917	4.5%	n.a.	10.3%	4.9%	12.2%	9.2%	3.2%
1918	5.3%	7.6%	9.2%	5.6%	9.7%	8.5%	2.5%
1919	4.7%	6.5%	7.9%	5.3%	6.8%	7.3%	3.9%
1901-1919	4.4%	4.9%	8.4%	6.7%	10.9%	7.2%	3.2%

Table 11

Correlation between the dividend yield and the liquidity measures

The table shows the regression coefficients for the different liquidity measures when explaining the dividend yield. Liquidity measure one is defined as the number of weeks a security is traded divided by the number of weeks listed. Liquidity measure two is defined as the average bid-ask spread divided by the average of the bid and ask quotes. The liquidity measures have been estimated over a rolling two year window. The table includes the average coefficient from the cross-sectional regression, its associated t-statistic and the average r-square. The tests are based on 1298 observations for liquidity 1 and 1331 observations for liquidity 2.

Liquidity 1			Liquidity 2		
Coeff	T-stat	r2	Coeff	T-stat	r2
0.000	0.233	0.017	0.018	0.313	0.018

Table 12

Liquidity return characteristics

The table includes the average monthly returns and standard deviation of returns for four different liquidity portfolios. The portfolios are equally weighted and comprised of securities with similar liquidity levels. Portfolio one includes the least liquid securities in the month and portfolio four the most liquid ones. Furthermore, we construct the same portfolios depending on firms' market capitalisation. In this case portfolio one includes the smallest firms and portfolio four the largest. The portfolios are reconstructed each month as securities' liquidity levels and the securities themselves change. Liquidity measure one is defined as the number of weeks a security is traded divided by the number of weeks listed. Liquidity measure two is defined as the average bid-ask spread divided by the average of the bid and ask quotes. The liquidity measures have been estimated in each period using two years of historic data. The size variable is defined as the natural log of market capitalisation at the start of the year. In the case of trade-to-trade returns, the samples consist of 6,232 observations distributed over 192 months. The corresponding numbers for 12M returns are 8,069 and 195.

Excluding dividends

Average Returns

	Trade-to-trade				12M			
	1	2	3	4	1	2	3	4
Liquidity 1	0.85 %	0.29 %	(0.05)%	(0.13)%	1.03 %	0.24 %	0.00 %	(0.21)%
Liquidity 2	0.85 %	0.09 %	0.13 %	(0.09)%	0.99 %	0.13 %	0.07 %	(0.03)%
Size	0.37 %	0.28 %	0.16 %	0.13 %	0.43 %	0.41 %	0.05 %	0.29 %

Standard deviation

	1	2	3	4	1	2	3	4
Liquidity 1	3.63 %	3.53 %	3.69 %	4.28 %	3.93 %	3.79 %	3.46 %	4.09 %
Liquidity 2	4.65 %	3.74 %	3.01 %	3.54 %	4.78 %	3.62 %	3.00 %	3.42 %
Size	4.14 %	3.92 %	3.90 %	3.48 %	4.40 %	3.50 %	3.76 %	3.36 %

Including dividends

Average Returns

	Trade-to-trade				12M			
	1	2	3	4	1	2	3	4
Liquidity 1	1.34 %	0.76 %	0.46 %	0.30 %	1.03 %	0.24 %	0.00 %	(0.21)%
Liquidity 2	1.32 %	0.59 %	0.59 %	0.39 %	0.99 %	0.13 %	0.07 %	(0.03)%
Size	0.93 %	0.73 %	0.73 %	0.57 %	0.43 %	0.41 %	0.05 %	0.29 %

Standard deviation

	1	2	3	4	1	2	3	4
Liquidity 1	3.58 %	3.55 %	3.73 %	4.33 %	3.93 %	3.79 %	3.46 %	4.09 %
Liquidity 2	4.62 %	3.74 %	3.11 %	3.58 %	4.78 %	3.62 %	3.00 %	3.42 %
Size	4.00 %	4.01 %	3.82 %	3.48 %	4.40 %	3.50 %	3.76 %	3.36 %

Table 13

Correlation matrices

The table displays the correlation between the explanatory variables used for the regression models. Liquidity measure one is defined as the number of weeks a security is traded divided by the number of weeks listed. Liquidity measure two is defined as the average bid-ask spread divided by the average of the bid and ask quotes. The liquidity measures have been estimated in each period using two years of historic data. The size variable is defined as the natural logarithm of the latest observed market capitalisation. The market liquidity shock and market return betas have been obtained from time-series regression models, see equations (1) and (3).

	Correlations table for trade to trade returns excluding dividends					
Variable	Return	Liquidity1	Liquidity2	Size	Market beta	Market liquidity shock beta
Return	1					
(sign)						
Liquidity1	0.112	1				
(sign)	0.000					
Liquidity2	0.052	0.522	1			
(sign)	0.000	0.000				
Size	-0.073	-0.517	-0.560	1		
(sign)	0.000	0.000	0.000			
Market beta	0.006	-0.190	0.136	0.043	1	
(sign)	0.687	0.000	0.000	0.002		
Market liquidity shock beta	-0.029	-0.027	-0.102	0.077	-0.284	1
(sign)	0.032	0.054	0.000	0.000	0.000	

Table 14

Correlation matrices

The table displays the correlation between the explanatory variables used for the regression models. Liquidity measure one is defined as the number of weeks a security is traded divided by the number of weeks listed. Liquidity measure two is defined as the average bid-ask spread divided by the average of the bid and ask quotes. The liquidity measures have been estimated in each period using two years of historic data. The size variable is defined as the natural logarithm of the latest observed market capitalisation. The market liquidity shock and market return betas have been obtained from time-series regression models, see equations (1) and (3).

	Correlations table for 12M returns excluding dividends					
Variable	Return	Liquidity1	Liquidity2	Size	Market beta	Market liquidity shock beta
Return	1					
(sign)						
Liquidity1	0.105	1				
(sign)	0.000					
Liquidity2	0.060	0.539	1			
(sign)	0.000	0.000				
Size	-0.075	-0.548	-0.595	1		
(sign)	0.000	0.000	0.000			
Market beta	-0.012	-0.191	0.140	0.048	1	
(sign)	0.314	0.000	0.000	0.000		
Market liquidity shock beta	-0.041	-0.024	-0.114	0.077	-0.273	1
(sign)	0.001	0.045	0.000	0.000	0.000	

Table 15

One factor regression models

The table includes the coefficients, their associated t-statistic and r-square values for the determinants of security returns. The dependent variable is excess security return. Liquidity measure one is defined as the number of weeks a security is traded divided by the number of weeks listed. Liquidity measure two is defined as the average bid-ask spread divided by the average of the bid and ask quotes. The liquidity measures have been estimated in each period using two years of historic data. The size variable is defined as the natural logarithm of the latest observed market capitalisation. Market liquidity shock and market return betas have been obtained using the Dimson & Marsh (1983) procedure. Market liquidity is defined by an AR(2) model and the error term is considered a liquidity shock. The market liquidity shock variable is estimated as the correlation between security returns and these shocks, see (2). In addition, we correct for the bid-ask bounce related to liquidity measure two by estimating that model using the weighted least squares method of Bessembinder & Kalcheva (2007). The weight is the previous period's return plus one. The equations of the one factor regression models can be seen in (4). For trade-to-trade, tests are based on 5307 observations distributed over 186 periods for 12M the corresponding figures are 6993 observations and 191 periods.

	Including dividend		Excluding dividend	
Variable	Trade-to-trade	12M	Trade-to-trade	12M
Liquidity 1	0.008	0.005	0.007	0.005
t-stat	3.062	2.741	2.961	2.573
r2	0.068	0.069	0.068	0.069
Liquidity 2	0.363	0.297	0.367	0.301
t-stat	1.809	1.863	1.831	1.884
r2	0.067	0.058	0.066	0.058
Market return	(0.002)	(0.002)	(0.001)	(0.002)
t-stat	(0.968)	(1.232)	(0.586)	(0.855)
r2	0.101	0.082	0.101	0.079
Market liquidity shock	(0.004)	(0.006)	(0.004)	(0.007)
t-stat	(0.920)	(1.421)	(0.906)	(1.519)
r2	0.070	0.066	0.071	0.068
Size	0.0001	(0.003)	(0.002)	(0.002)
t-stat	0.110	(2.781)	(2.294)	(2.407)
r2	0.055	0.053	0.056	0.053

Table 16

Liquidity measures one and two: two factor regression models

The table includes the coefficients, their associated t-statistic and r-square values for the determinants of security returns. We use a Fama MacBeth procedure. The dependent variable is excess security return. Liquidity measure one is defined as the number of weeks the security is traded compared to the number of weeks it is listed. Liquidity measure two is defined as the average bid-ask spread divided by the average of the bid and ask quotes. Both measures are estimated using a two year rolling window. Market return betas have been obtained using the Dimson & Marsh (1983) procedure, see equation (1). In addition, we correct for the bid-ask bounce related to liquidity measure two by estimating that model using the weighted least squares method of Bessembinder & Kalcheva (2007). The weight is the previous period's return plus one. The equations of the two factor regression models can be seen in (6). For trade-to-trade, tests are based on 5307 observations distributed over 186 periods for 12M the corresponding figures are 6993 observations and 191 periods.

	Including dividend		Excluding dividend	
Variable	Trade-to-trade	12M	Trade-to-trade	12M
Liquidity 1	0.007	0.004	0.008	0.003
t-stat	3.151	1.942	3.232	1.796
Market return	(0.0003)	(0.002)	0.0004	(0.001)
t-stat	(0.150)	(1.047)	0.227	(0.731)
r2	0.159	0.141	0.158	0.137

	Including dividend		Excluding dividend	
Variable	Trade-to-trade	12M	Trade-to-trade	12M
Liquidity 2	0.431	0.344	0.429	0.313
t-stat	2.117	2.110	2.097	1.924
Market return	(0.002)	(0.003)	(0.001)	(0.002)
t-stat	(1.017)	(1.465)	(0.684)	(1.165)
r2	0.164	0.141	0.163	0.137

Table 17

Liquidity measure one: four factor regression models

The table includes the coefficients, their associated t-statistic and r-square values for the determinants of excess security returns. Liquidity measure one is defined as the number of weeks the security is traded compared to the number of weeks it is listed. It is estimated using a two year rolling window. The size variable is defined as the natural logarithm of the latest observed market capitalisation. Market liquidity shock and market return betas have been obtained using the Dimson & Marsh (1983) procedure. Market liquidity is defined by an AR(2) model and the error term is considered a liquidity shock. The market liquidity shock variable is estimated as the correlation between security returns and these shocks, see (2). The equations of the four factor regression models can be seen in (7). For trade-to-trade, tests are based on 5307 observations distributed over 186 periods for 12M the corresponding figures are 6993 observations and 191 periods.

	Including dividend		Excluding dividend	
Variable	Trade-to-trade	12M	Trade-to-trade	12M
Liquidity 1	0.012	0.003	0.011	0.004
t-stat	2.413	1.491	1.704	1.556
Market return	(0.0002)	(0.003)	0.0004	(0.002)
t-stat	(0.094)	(1.589)	0.190	(1.274)
Market liquidity shock	(0.004)	(0.007)	(0.003)	(0.007)
t-stat	(0.889)	(1.264)	(0.732)	(1.315)
Size	0.004	(0.001)	0.002	(0.000)
t-stat	2.281	(0.504)	0.825	(0.143)
r2	0.270	0.238	0.267	0.233

Table 18

Liquidity measure two: four factor regression models

The table includes the coefficients, their associated t-statistic and r-square values for our determinants of excess security returns. Liquidity measure two is defined as the average bid-ask spread divided by the average of the bid and ask quotes. It is estimated using a two year rolling window. The size variable is defined as the natural logarithm of the latest available market capitalisation. Market liquidity shock and market return betas have been obtained using the Dimson & Marsh (1983) procedure. Market liquidity is defined by an AR(2) model and the error term is considered a liquidity shock. The market liquidity shock variable is estimated as the correlation between security returns and these shocks, see equation (2). In addition, we correct for the bid-ask bounce related to liquidity measure two by estimating that model using the weighted least squares method of Bessembinder & Kalcheva (2007). The weight is the previous period's return plus one. The equations of the four factor regression models can be seen in (7). For trade-to-trade, tests are based on 5307 observations distributed over 186 periods for 12M the corresponding figures are 6993 observations and 191 periods.

	Including dividend		Excluding dividend	
Variable	Trade-to-trade	12M	Trade-to-trade	12M
Liquidity 2	1.338	0.246	1.106	0.328
t-stat	2.556	1.274	1.468	1.695
Market return	(0.003)	(0.004)	(0.004)	(0.004)
t-stat	(1.482)	(1.870)	(1.175)	(1.679)
Market liquidity shock	(0.008)	(0.008)	(0.007)	(0.008)
t-stat	(1.791)	(1.484)	(1.493)	(1.657)
Size	0.005	(0.001)	0.002	(0.000)
t-stat	2.200	(0.727)	0.657	(0.233)
r2	0.273	0.235	0.269	0.231