Liquidity premia during the industrial breakthrough: Evidence from the Stockholm Stock Exchange, 1901–1919*

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Abstract

This paper analyzes the importance of liquidity in determining security returns for firms listed on the Stockholm Stock Exchange between 1901 and 1919. Using a new and detailed firm-level dataset with matching stock price and balance sheet information, we construct new stock return indices as well as firm-specific liquidity measures for our empirical analysis. Our main finding is that there was a substantial illiquidity effect on returns. Securities in the 25th percentile of the liquidity distribution earned, on average, a 0.59 percent higher monthly return than securities in the 75th percentile. This effect is comparable with estimates from modern stock markets and suggests that the liquidity premium is not solely a modern phenomenon but could be an inherent characteristic of financial markets.

Keywords: Stock markets, Liquidity, Stock return index, Financial history

JEL: G12, N23, N24

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1 Introduction

Liquidity refers to the ability to trade stocks quickly, and at a low cost. Investors typically like prefer to be able to implement their trading strategies whenever they want and therefore demand compensation—a liquidity premium—for holding relatively illiquid securities. Recent research of trading frictions in modern stock markets has also found ample evidence of such a liquidity premium in security returns. An early study by Amihud and Mendelson (1986) of the U.S. stock market during 1961–1980 established that stocks with higher bid-ask spreads—a measure of illiquidity—earned higher returns than other stocks. Subsequently, a number of studies have found similar results for various modern markets.[1] Pastor and Stambaugh (2003) have even found variations in liquidity to be of importance for security returns, being weighed by investors as a separate risk factor.

While illiquidity thus appears to be important for asset pricing in today's well-developed financial markets, much less is known about its role in financial markets during the era of industrialization a century ago. Early twentieth century stock markets emerged rapidly as a complementary source of industrial finance as well as an investment opportunity for capital owners. Yet these early stock markets were typically thin and poorly organized, and liquidity effects may therefore have been particularly strong (Rajan and Zingales 2003; Michie 2006; Cassis 2010).

In this study we use newly collected and previously unexplored data from the Stockholm Stock Exchange (SSE) during 1901–1919 to analyze the role of liquidity for stock returns during the Western industrial breakthrough. Liquidity levels differed greatly across securities in this market, with some companies being traded regularly while others were being traded only a few times a year. These conditions offer a natural setting for testing the effect of liquidity. Our analysis begins with merging stock-market price data along with firm balance sheet data collected from a different source. This process allows us to construct yearly observations for market-to-book ratios, dividend yields, price-earnings and payout ratios, as well as new monthly stock price and return indices for Sweden over the entire study period.

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[1] See, e.g., Eleswarapu (1997), Chalmers and Kadlec (1998), Acharya and Pedersen (2005), Longstaff (2009) and the review of Amihud, Mendelson and Pedersen (2005). Notably, Bekaert, Campbell and Lundblad (2007) find similar liquidity premiums in today's emerging market economies, which share several features of the historical markets of Western countries.

For our main empirical investigation of the effect of liquidity on security returns, 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 on a rolling 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 using Fama-MacBeth cross-sectional regressions with returns as the dependent variable and the liquidity measures and market beta as the explanatory variables. Our main finding is that liquidity was an important factor in the pricing of securities on the Swedish stock market in the early part of the twentieth century. This result holds for both of our proxies of liquidity that were tested on trade-to-trade returns, including dividends, our most reliable measure of stock returns.

Examinations of historical stock markets are on the rise, and in recent years, economic historians have assembled several new datasets. Previous studies looked specifically at liquidity premiums in the past, and these studies offer natural points of comparisons for our analysis. The papers closest to our study are those by Moore (2010a) and Burhop and Gelman (2010). Moore investigates financial trading at the stock exchanges in Madrid and Zurich during 1902–1925 and finds evidence of a positive liquidity premium. Burhop and Gelman, in contrast, find the opposite results in their analysis of daily returns and trading costs on the Berlin stock exchange between 1892 and 1913. Our paper distinguishes itself from these two studies in how we construct our proxies for liquidity and in the fact that we conduct the analysis on a different country, Sweden. While comparing the answers from modern financial markets to questions regarding, for example, the role of financial institutional development, contrasting our findings for the early Stockholm Stock Exchange with similar findings from other early stock markets both indicates the external validity of the results and offers insights into the role of stock markets during eras of industrialization.

2 Overview of the early twentieth century Stockholm Stock Exchange

At the beginning of the twentieth century, Sweden was beginning an era of unprecedented industrial expansion and economic development. In the wake of scientific advancements and macroeconomic stability due to the international gold standard, Sweden experienced its own "upstream industrialization" with a boost in the manufacturing, chemical, electrical and pulp and paper industries. During this period, several of the Swedish innovation-intensive firms became world leaders in their respective industries. Such examples include ASEA (electro-technology), LM Ericsson (telecommunication), SKF (ball bearing) and Separator (dairy).[2] Economic growth rates also increased, from an average level of between zero and one percent annually in the nineteenth century, to an average annual growth rate of around two percent in the first two decades of the twentieth century (Edvinsson, 2005). This was indeed an era of industrial breakthrough within the Swedish economy.

The Stockholm Stock Exchange was founded in 1863. During its first four decades of existence, the exchange was mainly a loosely organized venue for recurrent monthly or weekly securities auctions hosted by some of the appointed city brokers.[3] As the Swedish industrialization gradually expanded, new joint-stock companies emerged, and households grew richer; the need for an organized, designated market for securities trading arose. As a consequence, in 1901, the exchange was thoroughly reorganized. The trading structure on the new exchange was largely a copy of the structure of the Copenhagen Stock Exchange, except that the auctioning system already in place was kept, in contrast to Copenhagen's dealership market. Trading in Stockholm was presided over by the head of the exchange who called out all of the stocks registered in a predetermined order. As the head of the exchange 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). When a matching bid level and an ask level arose, a trade was registered, and the transaction was completed.

Under the new framework, trading would solely be conducted for listed securities. Listing securities was contingent on a successful written application submitted to the board of the stock exchange, containing detailed information on the security (e.g., articles of association and the latest audit report, among other items). The new system also dictated that only brokers certified by one of the city's commissions were allowed to broker deals on the exchange. Trading initially took take place three times a week, but by the end of the study period, auctions were held daily.

Table 1 presents some descriptive characteristics of the Stockholm Stock Exchange during the study period, and a full set of annual figures is presented in the Appendices. As indicated

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[2] See Schön (2010) for a representative overview of the Swedish economic history since 1800.

[3] Longer descriptions (in Swedish) of the development of the SSE during its early period can be found in Belfrage (1917), Beije (1946) and Algott (1962).

by most of the numbers in the table, the stock market activity was relatively low during the first decade and then increased markedly in the second. For example, the turnover rate increased from an average of 1.4 percent during the 1900s to almost 14 percent in the 1910s, while both the total market capitalization and the number of exchange members more than tripled. In fact, a possible reason for the initially low level of liquidity was that the exchange admitted too few members; up until 1907, when commercial banks were finally approved as members, there were only five members. Yet, another plausible reason for the limited amount of trading was the relatively high barrier of entry for most ordinary people to become stock investors. The exchange imposed sizable minimum transaction values; in 1901, the smallest allowed transaction value was SEK 5,000, an amount roughly ten times the average annual income at that point in time. The limit was gradually lowered over the years, and in 1906, it was a much lower value at SEK 200.

[Table 1 about here]

When the First World War broke out in 1914, Sweden left the international gold standard, and the Stockholm exchange closed down all activities for three months between August 3rd and November 3rd. Leaving the gold standard, combined with an initial boom in the export oriented domestic industry, made the rate of inflation rise in Sweden during the war. This inflation boom was one of the factors behind a remarkable increase in trading activity on the exchange during these years; stocks are normally one of the few forms of inflation-secure investments. This increased activity in the Swedish economy spurred increased volumes of new equity issues, which were at century-high levels (2–4 percent of total market capitalization) during this period (Waldenström, 2004). After the war, however, the spectacular wartime bull market gave way to a devastating market crash when Sweden joined the Gold Standard at prewar parity, which set off a deflationary spiral.[4]

How did the Stockholm Stock Exchange in the early twentieth century compare with other contemporary Western stock exchanges? In a recent study by Lyndon Moore, a new database that covers twelve stock exchanges in twelve countries during 1900–1925 is presented (Moore, 2010b). One of the most interesting points of comparison is the size of the market, measured as market capitalization in millions of British pounds. We calculate the market ca-

[4] For an account of the Swedish WWI economy and the deflation crisis, see Haavisto and Jonung (1995).

pitalization of the Stockholm market (see the next section for how this is done) and then convert it from Swedish kronors to British pounds using exchange rates in Edvinsson, Jacobson and Waldenström (2010). In terms of listed equity (i.e., excluding bonds), the market capitalization in Stockholm was 3.4 percent (on average) of that of the London Stock Exchange, 5.4 percent in comparison with the New York Stock Exchange, 16 percent in comparison with the Paris Bourse and 131 percent in comparison with the Madrid Bolsa.[5] Comparing the same markets according to their market capitalization as share of national GDP—a standard measure of the relative importance of financial markets in the overall economy—the picture is similar, but not identical. The large size of the London market is striking, averaging 124 percent of GDP during 1901–1919. The Stockholm market represented 45 percent of GDP; New York, 25 percent of GDP; Paris, 37 percent of GDP; and Madrid, 36 percent of GDP.[6] In other words, the relative importance of Sweden's secondary securities market to the overall economy was quite significant during this important era of Swedish industrialization.

Another informative comparison across countries is to see how the stock price indices evolved over the period of study. Figure 1 displays monthly composite stock return indices for the markets in London, New York and Stockholm. There is quite some co-movement across markets but also notable discrepancies, perhaps most visibly after the First World War when the Stockholm market plummeted while the London and New York stock returns soared. The correlation between Stockholm and New York is 0.77, and the correlation between Stockholm and London is 0.70 over the whole period; the correlations were much higher during the pre-war period, 0.86 and 0.94, respectively. As a point of reference, the correlation between the monthly stock return indices in New York and Stockholm during 1990–2006 was 0.97.

[Figure 1 about here]

[5] For the period 1990–2009, the percentages are 13 (London), 3 (New York), 26 (Paris) and 66 (Madrid).
[6] Note that we do not use the numbers for France/Paris presented in the well-known study by Rajan and Zingales (2003) as they exceed those of Moore (2010b) by an order of magnitude.

3 Description of data and measures

3.1 Stock prices, dividends and volumes

Firm-level stock price data were collected manually from weekly periodicals and reprints from the official price list of the SSE. Prior to 1912, the exchange did not publish an official price list; instead, several parallel entities supplied price information. We use the two most recognized sources from that period, *Arthur Mattssons fondnoteringar* for October 1901–April 1909, and a price list compiled by the largest Swedish commercial banks for May 1909–December 1911.[7] From 1912 onwards, we use the SSE's official price list.

These price lists contain information about bid and ask quotes, the close high/low (final close is the average of the high and the low), the dividend per share and the nominal price per share. Note that the bid and ask quotes reflect the final positions of buyers and sellers after the auctions ended and are not the type of bids and asks quoted by market makers in continuous dealership markets. The exchange in Stockholm only registered bid and ask quotes when the difference between them was less than three percent of the bid quote. Consequently, irrationally or misleadingly large bid-ask spreads were eliminated, and we consider the available bid-ask data to be relevant.[8]

Trading volumes are reported from 1915 onwards. These volumes refer to deals that were made during the main auction sessions, excluding deals made in the so-called "free exchange", which take place just after the auctions during which exchange members could trade freely with each other and, of course, only in off-exchange transactions. Overall, trading appears to have been fairly limited leading up to World War I. The turnover rate, i.e., the value of traded shares divided by market capitalization at year end was around four percent, which is roughly equal the level of exchanges in today's less-developed countries. In 1916–1919, turnover increased markedly to an average of 25 percent per year, which is roughly equal to the level in today's emerging markets.[9] Another method to assess trading activity is to examine how many of the listed securities that were regularly traded. As shown in Table 1, the

[7] The banks' list was published in a leading daily newspaper, *Svenska Dagbladet,* up to April 1910 and in the weekly periodical of the Swedish Bankers' Association, *Ekonomiska Meddelanden*, thereafter.
[8] Alternatively, one could use the bid-ask bounce concept proposed by Roll (1984), but we lack a sufficient amount of closing prices for that to be a viable option.
[9] According to data from 2009, the turnover rate was less than ten percent in Lima, Mauritius and Teheran, while it was around 20 percent in Bombay and 25 percent in Mexico (World Federation of Exchanges (2010, p. 114). Notably, the average turnover rate on the Stockholm Stock Exchange from 1987–1993 was 20 percent.

number of traded securities ranges from 16 to 115 over this period, and this represents roughly half of all listed securities.

Dividend payments are reported for the current year and the previous year, but we have no information about their exact monthly timing. Instead, we use monthly dividend payout-weights estimated for the Stockholm exchange in the 1950s by Möller (1962), thus assuming that the payout timing patterns did not change during the first half of the twentieth century.[10] Table 1 reports the average dividend yield, which was 4.4 percent. Excess returns are calculated using the minimum-lending rate, the discount rate, set by the Swedish Riksbank as a proxy for the risk-free rate.

3.2 Balance sheet data

Among our study's empirical contributions is the matching of market price data and balance sheet information assembled from separate sources. We use Key-Åberg's *Svenska aktiebolag och enskilda banker*, a yearly catalogue covering about half of Sweden's joint-stock companies. Standard balance sheet items regarding assets and liabilities are reported as are, in most cases, profit and loss accounts. Year 1903 is missing, and for the purpose of computing our capital-weighted stock return index, we assume that the share capital is constant for those companies where we observe no change in share capital from 1902 to 1904.

A number of firms appearing on the stock price lists are not covered in Key-Åberg's catalogues. For these firms, we consequently lack information about equity capital. The exact reasons for and consequences of this partial coverage are not clear, but we do not believe that it will have any meaningful influence on our results. We discovered that a great number of the companies appearing on the price lists were never traded or even allowed to be traded at the exchange. This is especially the case of the early price lists published before the exchange introduced its official listing in 1912.[11] Furthermore, most companies did not allow the public to take part in the initial public offerings of their shares; instead these shares remained in the

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[10] Möller uses the same method that Ibbotson and Sinquefield (1989) use later. Frennberg and Hansson (1992) check Möller's weights by cross-checking using a random sample from the 1980s to find little or no difference.
[11] Algott (1962, pp. 128–148) mentions how the board of the exchange noted at several occasions during 1901–1911 how the unofficial price lists (also those used in this study) included companies that were not on the board's "list of accepted companies".

hands of the individuals sitting on the companies' boards.[12] When assessing the balance sheet coverage among the firms for which we have recurrent price quotes, thus allowing for us to compute stock returns (a necessary condition for being included in the empirical analysis), roughly 90 percent also have balance sheet data (Table 1, row 10). Thus, it is primarily in the large group of listed but non-traded companies where the missing balance sheet information dominates. Due to this lack of data, we are unable to formally analyze whether this missing information is systemic with respect to background characteristics such as firm size or profitability. Nevertheless, we make an attempt at this analysis by examining whether there is some distinct pattern in industrial composition (we use five broad categories: banking, insurance, industrials, transport and shipping) across firms with and without balance sheet data. The result is that we do not find any apparent pattern distinguishing the two groups from each other. In both of them, about 40 percent of the companies are banks, 40 percent are industrials and the rest are divided almost equally among the remaining three groups.

We also examine the size distribution among the firms in our final dataset. Table 2 lists the ten largest companies in terms of market-valued equity capital and their shares of the total market capitalization in 1904 and 1916, two representative years in the sample. In 1904, the top-ten companies represent 47 percent of total market capitalization, and in 1916, they represents 54 percent. Whether these numbers are considered to be high depends on which point of reference one chooses; in 2005, the ten largest companies on the NYSE represented about 12 percent of total market capitalization, whereas the corresponding number that year for the Stockholm Stock Exchange was 56 percent.[13] Nonetheless, the early twentieth century Stockholm exchange was clearly dominated by a small number of large firms, at least in terms of the size of the firms' equity values.

[Table 2 about here]

3.3 Constructing stock return and price indices

Monthly stock returns and price indices at the Stockholm Stock Exchange are needed for the analysis. However, no such indices covering the entire study period exist. Therefore, we con-

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[12] Gårdlund (1942, pp. 205–211) cites contemporary sources that discuss and complain about this: "Will we ever see, as is often the case in other countries, that companies invite the public to purchase their newly issued shares?" (p. 211, our translation).

[13] Data for NYSE from www.nyxdata.com (2010-11-10) and for Stockholm Sveriges Riksbank (2006, p. 15).

struct new stock market indices using the new firm-level database. We use a monthly rather than weekly frequency due to the large numbers of missing weekly observations for most of the listed companies.

Two separate indices are computed: a stock *return* index and a stock *price* index, with the former also including dividend yields. Specifically, we denote the stock price and dividend of company i month t as P_{it} and D_{it}, respectively. Capital weighted indices are used because we believe that they better reflect the overall activity level of the exchange.[14] Equation (1) shows the capital weighted stock price index, which thus reflects the capital gains accruing from price changes between periods weighted by firm-specific equity weights:

$$R_t = \frac{1}{n}\sum_{i=1}^{n} w_{it}\frac{P_{it} - P_{it-1}}{P_{it-1}}\,. \tag{1}$$

Equivalently, the capital-weighted total returns index, i.e., when we sum capital gain and dividend yield, is calculated as follows:

$$TR_t = \frac{1}{n}\sum_{i=1}^{n} w_{it}\frac{P_{it} - P_{it-1} + D_{it}}{P_{it-1}}\,. \tag{2}$$

Weights, computed for each firm and period, are defined as

$$w_{it} = \frac{P_{it-1}S_{it-1}}{\sum_{j=1}^{n} P_{jt-1}S_{jt-1}}\,, \tag{3}$$

where S_{it} is the number of outstanding shares of company i at month t. These two indices are displayed in Figure 2.

[Figure 2 about here]

The returns are calculated using a so-called "trade-to-trade" method. In using this method, returns are calculated only for those securities for which we observe closing prices in two

[14] We have evaluated our capital weighted index against an equally weighted index for which we also have also run the entire analysis, with only small differences in the findings (available from the authors upon request).

consecutive months.[15] One problem with these returns is that they may correspond to different holding periods when, for example, the two closing prices do not necessarily come from the last trading day in the month. The solution to this non-synchronous data problem is to use the method of Dimson and Marsh (1983), by which excess returns are scaled according to the square root of the trading days' (in 28-day units) between closing prices.

Our capital-weighted indices suffer from a potential survivorship bias, as we are unable to determine whether discontinued trading is a consequence of bankruptcy or of delisting. The impact on our indices should, however, be limited because 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 from 1906–1918 by Waldenström (2004) is adjusted for new share issues and displays little difference in comparison to our capital-weighted trade-to-trade index (correlation coefficient of 0.82), indicating that our potential lag in taking new share issuing into account has but a minor effect.[16]

3.4 Measuring liquidity

Liquidity is a multifaceted concept. It refers to the ease with which investors can sell an asset, but there are many different sources that give rise to illiquidity. Among the most important sources are transaction costs (e.g., brokerage fees and transfer taxes), market depth (i.e., how much the price changes when a sell order is placed) and information asymmetries (in which some party has an information advantage that could incur losses for other parties, who accordingly demand a premium in order to make a trade).[17]

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[15] We have also run the main analysis using returns calculated somewhat differently, allowing for a time span of up to 12 months between two observed closing prices. Using this method we include almost all observations in the dataset (98 percent) while the trade-to-trade method includes a mere 76 percent. However, the longer time span between closing prices reduces the reliability in the estimated returns. The results (available upon request) using this alternative returns measure confirm the main message of Table 4, i.e., the existence of a significant liquidity premium.

[16] Waldenström uses as its main source the contemporary financial magazine *Kommersiella meddelanden* and an adjusted variant of it published by Östlind (1945). Additional discrepancies can be explained by the fact that the KMI index used book values as weights, while we use market values.

[17] Glosten and Milgrom (1985) explain how adverse selection problems in stock trading can give rise to bid-ask spreads. Additional sources of illiquidity that are commonly referred to in the literature (see, e.g., Amihud, Mendelson and Pedersen, 2005) are search frictions (costs arising when sellers search for willing buyers) and inventory risks (typically born by market makers).

Although the meaning of liquidity is typically intuitive, it can be a difficult concept to measure empirically. Amihud, Mendelson and Pedersen (2005) point to the need for detailed high-frequency data, but even with such data at hand, they emphasize that all measures are imperfect proxies of liquidity because they can never capture all of the different sources at the same time. Among the most common proxies for liquidity (or illiquidity) are the bid-ask spread, the trading volume, the turnover rate (number of traded shares over the total number of outstanding shares) or variants of these.[18] For historical eras, liquidity measures will show more variance for a number of reasons, such as a relatively low data frequency and scarce knowledge of important market features, such as order depth. Yet, the liquidity proxies used in this study are quite similar to the ones used in more contemporary analyses, and the results are broadly comparable in most relevant aspects.

Our empirical investigation relies on two preferred proxies of liquidity and a third one used for the purpose of robustness. The first proxy, called $LIQ1$, is a measure of trading intensity that we calculate as the number of weeks in which a stock is traded in relation to the number of weeks in which it is listed over the past 24 months.

$$LIQ1_i = \frac{Number\ of\ weeks\ traded_i}{Number\ of\ weeks\ listed_i}\ . \tag{4}$$

We only include securities with at least six months of closing prices within the rolling two-year window. Estimates based on fewer observations would be unreliable. As a consequence, the sample is reduced to 108 securities.

The second proxy is the average relative bid-ask spread over the past 24 months. Spreads reflect a number of illiquidity sources, including processing costs and information asymmetries, and we calculate them as the spread between the price that a stock can be sold for (the bid price) and the price it costs to purchase it (the ask price). Although it is really a projection of illiquidity rather than liquidity, we call it $LIQ2$ for convenience and calculate it as follows:

[18] Examples of other common proxies are illiquidity discounts estimated from initial public offerings or restricted stock offerings (see Amihud, Medelson and Pedersen, 2005).

$$LIQ2_i = \frac{\sum_{t=1}^{T} \frac{ask_{it} - bid_{it}}{0.5 \times (ask_{it} + bid_{it})}}{Number\ of\ weeks\ with\ observed\ bid\ and\ ask_i} \ . \qquad (5)$$

For the purpose of robustness, we also compute a third proxy of liquidity: the average value of traded shares. We do not include this measure in our main analysis because trading volumes were unfortunately not reported in the Stockholm price lists until 1915. We define *LIQ*3 as the value of a company's traded stocks divided by the number of weeks the company was listed over the past 24 months:

$$LIQ3_i = \frac{Value\ of\ traded\ shares_i}{Number\ of\ weeks\ listed_i} \ . \qquad (6)$$

In Figure 3, we display the distribution of liquidity (and illiquidity) across individual securities, grouped in size classes, for each of the three measures. Liquidity levels vary significantly between securities. On one end of the scale, we find Stora Kopparberg Bergslagen, which is traded every week from May 1903 to the end of 1919. On the other end of the scale, we find Brandförsäkrings AB Victoria, which does not register a single close despite being listed over the whole period. A majority of the listed firms did not see their shares being traded very often over the period studied. For example, two thirds of the companies had their shares traded for less than 30 percent of the weeks during which they appeared on price lists. However, the three panels provide a consistent view of the liquidity distribution across firms; the correlation coefficients are –0.61 (*LIQ*1 and *LIQ*2), 0.77 (*LIQ*1 and *LIQ*3) and 0.38 (*LIQ*2 and *LIQ*3).

[Figure 3 about here]

The use of a rolling 24-month window when calculating security-specific liquidity levels is primarily motivated by the fact that liquidity levels do not remain constant over time. Ideally, this measure should reflect investors' views on a security's future liquidity level. It is plausible to imagine that investors consider current and recent liquidity levels when forming their expectations and that they update their considerations as the realized liquidity changes. As a result, one could also imagine that securities contain a set of inherent characteristics associated with their liquidity level and that these characteristics only change very slowly. In such cases, a more appropriate strategy would be to estimate liquidity levels over the whole study period instead of over rolling two-year windows. We therefore rerun the analysis using constant firm liquidity levels and present the results in the robustness section below.

In addition to estimating firm-specific liquidity levels, we investigate the evolution of overall market liquidity and its potential impact on security returns. This analysis is conducted by defining *Market liquidity*, following the reasoning for our first proxy above, as the number of traded securities divided by the number of listed securities:

$$Market\ liquidity_t = \frac{Number\ of\ securities\ traded_t}{Number\ of\ securities\ listed_t} \ . \qquad (7)$$

Figure 4 illustrates how the market liquidity and the market price index have developed over time. Market liquidity and market performance are positively correlated with a correlation coefficient of 0.43, which is in line with similar studies, i.e., Pastor and Stambaugh (2003) for which the corresponding correlation coefficient is 0.49.

[Figure 4 about here]

4 Results

4.1 A first look at the data

In an initial effort to create an overview of our liquidity measures and their relationship to returns and firm size, we construct four portfolios for each month, with portfolio one consisting of the least liquid securities and portfolio four consisting of the most liquid securities. The liquidity of each security is measured using the last two years' worth of observations. In addition, we construct four portfolios based on the market capitalization of each firm, where portfolio one contains the smallest firms and portfolio four contains the largest firms. The average return and standard deviation of all portfolios can be seen in Table 3, both excluding and including dividends.

[Table 3 about here]

As expected, we find that portfolios with low-liquidity securities exhibit higher returns (an indication of a liquidity premium). The average return of the securities listed in liquidity portfolio one is about one percentage point higher than that of portfolio four for all liquidity measures, which holds true when either excluding or including dividend returns. There is 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 of returns. The relationship seems to be inconclusive. The portfolios that are based on size display a negative relationship between size and returns. Also, we can observe that the returns of smaller firms' stocks are more volatile than those of larger firms, as we expected.

4.2 The impact of liquidity and liquidity risk on returns

There are two main channels through which liquidity should theoretically influence securities returns. The first channel is the *liquidity level* effect. Due to higher transaction costs, demand pressures and information asymmetries, illiquid securities are relatively costly to sell, and investors, therefore, require some sort of compensation—an illiquidity premium—for holding them. According to this logic, there should be a negative relationship between liquidity and stock returns. The second channel is *liquidity risk* as a risk factor that investors wish to price. Liquidity changes over time, which gives rise to uncertainty about the size of future transactions as well as higher price fluctuations (given that liquidity influences price levels). Accordingly, stocks that are sensitive to liquidity shocks should yield a return premium in order to compensate investors for the additional liquidity risk.

The starting point for the empirical analysis is the two-step procedure suggested by Fama and MacBeth (1973). This is a well-known method for assessing a stock's price sensitivity towards the market risk premium that is based on the predictions of the Capital Asset Pricing Model. We introduce liquidity to the Fama-MacBeth procedure by adding a liquidity risk premium as previously suggested in a number of studies. Furthermore, we follow Moore (2010a) and construct a variable, a market liquidity shock, which captures the difference between the expected market liquidity and the actual market liquidity. The shock is estimated as the residual (ϑ) in an autoregressive model with two lags: $Market\ Liquidity_t = \alpha_1 Market\ Liquidity_{t-1} + \alpha_2 Market\ Liquidity_{t-2} + \vartheta_t$.[19] Investors

[19] The market liquidity equation has an adjusted R^2 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 has the highest adjusted r-square value. In theory, investors would prefer to

are expected to prefer holding securities with a negative correlation to market liquidity shocks because these securities will offset part of the negative liquidity effect.

The first step of the augmented Fama-MacBeth procedure is to estimate security-specific time series regressions. Specifically, we regress the excess security return, i.e., the return minus the risk-free rate, on the market excess return, the market liquidity shock, a constant and a random error term. This gives us estimates of the market beta, $\hat{\beta}_i$, and the market liquidity risk, $\hat{\lambda}_i$:

$$R_{it} - r_t^f = \omega_{it} + \beta_i\left(R_{mt} - r_t^f\right) + \lambda_i \vartheta_t + \varepsilon_{it} \quad . \tag{8}$$

[20]

In the second step, cross-section regressions are estimated across all securities, one month at a time. The dependent variable is still the securities' excess returns, but on the right hand side we now include the estimated factor sensitivities for market risk ($\hat{\beta}_i$), liquidity risk ($\hat{\lambda}_i$) and the level of liquidity (*LIQ*). Furthermore, we also include additional controls. One such control is size of the firm, measured as the market value of equity (*size*) following the widespread evidence of a correlation between market value and stock returns (Banz, 1981). Another is the book-to-market ratio, i.e., the ratio of companies' equity values according to their books in comparison to their market values (*BTM*). A relatively high *BTM* signals that companies have low market prices because they typically have low earnings on assets. The resulting second-pass regression then becomes:

$$R_{it} = \gamma_{0t} + \gamma_{1t}\hat{\beta}_i + \gamma_{2t}\hat{\lambda}_i + \gamma_{3t}LIQ_i + \gamma_{4t}Size_i + \gamma_{5t}BTM_i \quad . \tag{9}$$

[21]

Parameters γ_{1t} and γ_{2t} represent market risk and liquidity risk premiums, respectively, and are both expected to be positive. Parameter γ_{3t} is the cross-sectional impact of liquidity on excess returns, and according to the standard liquidity-augmented asset pricing models, we

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hold securities with a negative correlation to market liquidity shocks because these securities will offset part of the negative liquidity effect.

[20] All variables in equation 8 (and the subsequent equation 9) are scaled by the inverse square root of the number of trading days between quoted prices in units of 28 days following the method of Dimson and Marsh (1983) for correcting non-synchronous trading data.

[21] Furthermore, in all tests in which we include liquidity measure two (the relative bid-ask spread), we need to correct for the bid-ask bounce identified by Bessembinder and Kalcheva (2010). We do this by performing weighted least squares regressions with the previous month's return plus one as weight.

expect it to be negative for liquidity proxies $LIQ1$ (average trading intensity) and $LIQ3$ (volume) and positive for $LIQ2$ (relative bid-ask spread).

The gamma estimates in equation (9) are calculated as arithmetic averages across all securities for each time period. Standard errors are calculated as the standard deviations divided by the square root of the sample size. But because the betas used as independent variables are not observed to be random variables (rather, they are imputed estimates), there is a potential errors-in-variables problem in the Fama-MacBeth methodology, which could reduce standard errors. A well-known correction for this errors-in-variables bias, suggested by Shanken (1992), is to multiply the standard error $\sigma(\hat{\gamma})$ with an adjustment factor $(1+(\hat{\gamma}/\hat{\sigma})^2)$. All results are reported using Shanken-corrected standard errors.[22]

Our main results from the multifactor Fama-MacBeth specifications are presented in Table 4. The upper panel is based on total returns, including dividends, while the lower panel uses stock price returns. The results are presented for the two full-period proxies of liquidity, $LIQ1$ (share of listed weeks traded) and $LIQ2$ (the relative bid-ask spread). Overall, there are fairly strong indications of a liquidity level effect on the early Swedish stock market. The estimated coefficients for $LIQ1$ are significantly negative, and for $LIQ2$, they are significantly positive in the one-, three- and four-factor models for returns, both including and excluding dividends. In contrast, we find no evidence of a liquidity risk premium; the coefficients are mostly negative (wrong sign) but with large standard errors so that they should be regarded as being virtually zero in all specifications. In other words, while investors seem to have priced the liquidity level, they did not do so regarding the exposure to an increased overall risk of higher liquidity.[23]

There are, however, some signs of instability in the measured effects. First, the coefficient of $LIQ2$ in the four-factor model is more than three times as large as in the one- and three-factor models. Controlling for the variation coming from firm size, hence, seems to boost the liquidity premium, indicating that firm size and liquidity level are interrelated. Yet, when also controlling for the book-to-market ratio, the liquidity-level effect disappears entirely; even the

[22] The exact magnitude of the errors-in-variables bias is, however, uncertain. According to Jagannathan and Wang (1998), it is even zero in the Fama-MacBeth procedure whenever standard errors are heteroskedastic.
[23] The results are not sensitive to the extremely weak activity levels in the first two years of the sample period. When we exclude them and rerun the main analysis, the results (available upon request) are basically the same.

coefficient turns negative (but insignificantly different from zero). The cause of this deviation from the other models is not clear. The book-to-market ratio reflects several firm characteristics such as actual and expected earnings as well as dividend policies. Regardless of which, this factor apparently overlaps with a great deal of the liquidity-return association found in the other models.

Do the estimated liquidity premiums hold any economic significance? How do they compare in the light of previous findings in the asset price liquidity literature? Let us begin with the first question. Increasing the relative bid-ask spread by one percentage point, which is roughly one standard deviation, raises the required monthly return by about 0.4 percent (based on coefficients in columns 5–6 in Table 4). At the annual level, this reflects a 4.9 percent increase, which is quite large given that the compounded total return over the entire period was 3.9 percent. As a further illustration, consider the estimated coefficient of the *LIQ*1 variable in Table 4's four-factor models. As previously stated, the relationship is of a log-linear character; therefore, the economic significance of improved liquidity changes depending on how liquid the security is to begin with. Investing in the 25th percentile of the most illiquid securities will earn investors an extra 0.59 percent in monthly returns, 7.2 percent annualized, compared to investing in the 75th percentile of most illiquid securities, representing a difference of about one and a half standard deviations in liquidity.

[Table 4 about here]

Our findings of a fairly significant liquidity premium, but no clear liquidity risk premium, are partially supported in previous liquidity studies. For example, in their studies of postwar NYSE returns, Brennan, Chordia and Subrahmanyan (1998) and Acharya and Pedersen (2005) derive liquidity premiums of 3.5 percent per year, while Amihud and Mendelson (1986) find it to be smaller, about 1.8 percent. In other words, our estimated premiums from the early Stockholm market are large relative to modern estimates.

Looking at other historical stock markets, there are a couple of previous investigations similar to ours. Moore (2010a) studies the early stock markets in Spain and Switzerland using a new monthly database for 1900–1925. He finds positive and significant liquidity premiums that are also somewhat lower than ours; annual premiums for shifting from high to low liquidity portfolios are about 3.6 percent in Madrid and 3.9 percent in Zurich. Burhop and Gelman

(2010) study daily German returns for the period of 1892-1913, but they find a significantly negative liquidity premium of 2.8 percent at the annual level. Notably both of these two studies use the same econometric strategy as we do, namely multifactor Fama-MacBeth estimations. What differs is the exact method by which the measures of liquidity are constructed, as well as data frequency in the German case. Until these details are fully accounted for, it is difficult to draw comprehensive conclusions from this historical comparison except that the Stockholm results do not extend readily to other contemporary European markets.

5 Robustness analysis

This section presents the different robustness checks of the main analysis. In the first check, we rerun the analysis using our third liquidity proxy, *LIQ*3, which is the average trading volume over the previous 24-month period. Recall that this variable is only available from 1915 onwards. We expect this variable to have a negative relation to excess returns, which is what the results in Table 5 show. In all specifications, *LIQ*3 initially is negative and has a magnitude that is in line with the other two liquidity measures, but the standard errors are too large to allow for any wide-ranging conclusions. With respect to the main analysis, however, using *LIQ*3 as a measure of liquidity does not raise any red flags.

[Table 5 about here]

Another sensitivity check refers to the potential impact of World War I. As described above, the war greatly affected the Swedish economy and, in particular, the stock market due to an export-led boom that boosted corporate profits, trading volumes and stock prices. We assess the potential impact on the liquidity-return relationship by rerunning our main specifications but restricting the sample to the World War I period. The results are displayed in the upper panel of Table 6, and they corroborate our main findings. If anything, the liquidity level effect on stock returns was reinforced during the war, with estimated liquidity premiums around 10 percent annually. One part of this premium can be readily explained by increased securities transactions taxes (before 1909 they were zero; in 1919, they were 0.6 percent of the transfer) as well as tightened rules for security-backed lending.

Yet another sensitivity check is to alter the way in which firm-specific liquidity is measured. Specifically, we have so far assumed that investors form conjectures of firms' liquidity characteristics by observing current and past liquidity levels over a rolling 24-month window. But if changing liquidity levels primarily reflect business cycle variations and if a company's liquidity status is closely related to some set of inherent characteristics that do not change over time, then a constant measure is preferred. Consequently, we compute period-constant versions of our *LIQ*1 and *LIQ*2 measures and rerun the Fama-MacBeth regressions. The results in the lower panel of Table 6 raise some questions for the main analysis, as there are no evident signs of any liquidity premium when a constant liquidity measure is being used. Standard errors are large throughout, and in two cases for *LIQ*1, the estimated coefficients sometimes have the wrong sign. These results are problematic with respect to our main findings, but we are still not convinced that such a constant liquidity characteristic is appropriate given the profound changes in the structure, conduct and performance of the Swedish stock market during this time period.

[Table 6 about here]

A fourth robustness check is to include controls for other firm characteristics that may interact with liquidity or returns, affecting the examined liquidity premiums. In Table 7, we replace the size and book-to-market controls with three other firm-specific variables taken from the balance sheet data that are commonly used in stock valuation decisions: *dividend yield* (the annual dividend divided by the stock's market price), *price/earnings ratio* (the stock price divided by the past year's actual earnings per share) and the *payout ratio* (the share of net earnings paid out as dividends). The negative liquidity level effect is largely sustained when using these new controls and the *LIQ*1 proxy, but when using *LIQ*2, the premium vanishes. As for the liquidity risk effect, the results are equal to those in the main analysis, which means minimal variances from zero.

[Table 7 about here]

Finally, we split the listed firms into four groups according to the size of their market capitalization. This is a complementary analysis to the inclusion of firm size as a factor in the main return equations, and its primary motivation is that firm value is both a potential return determinant and an outcome variable. Table 8 shows the results from this sample-split exercise, and neither liquidity level nor liquidity risk appears to exhibit any clear pattern or connection with firm size.[24] In other words, the liquidity-return relationship found earlier does not seem to be predominant among only certain subgroups of firms, e.g., large or small firms. Rather, the liquidity premium is prevalent throughout the domain of listed firms during this early era.

[Table 8 about here]

6 Conclusion

In this study, we examine the relationship between liquidity and stock returns in an early stock market, the Stockholm Stock Exchange during 1901–1919. This period was the heyday of Swedish industrialization, and the market for private credit and investments was expanding rapidly. Although the stock market was still in its infancy, an increasing number of companies decided to float their shares on the exchange, and trading occurred continuously throughout the period. An adequate pricing of shares must have been vital in order for the exchange to fulfill its purposes, and in this study, we examine whether the liquidity within the market influenced the value and thus returns of listed firms.

Our most important finding is that liquidity was indeed an important factor in the pricing of securities. This finding is robust in measuring liquidity as the relative number of periods in which a security is traded or as the relative size of a security's bid-ask spread, as well as in determining whether returns should include dividends. There are some indications that the liquidity premium may be affected by other factors; when we control for firm-specific book-to-market ratios, the liquidity effect disappears. Yet, whether this represents a serious problem or whether it is rather an indication of underlying interrelationships that are unaccounted for, we cannot tell. Overall, it seems that investors who were willing to hold less liquid securities were compensated in the form of higher returns. Our illustrative calculations of the liquidity premium show that the premium was large: investing in the 25th percentile of most illiquid securities earned an extra 0.59 percent in monthly returns, compared with the returns from investing in the 75th percentile of illiquid securities.

Our findings appear to be in line with most of the previous studies of liquidity premiums, although we find the premium to be somewhat larger than authors have found when using

[24] We have also run the estimations including a firm size control in the first-pass regression and found similar results.

more recent data collected from modern markets. This agreement suggests that liquidity premiums are not solely a modern phenomenon, but that they may even be an inherent characteristic of secondary securities markets. A century ago, liquidity premiums were even potentially larger than they are today, which raises questions about the role of institutional financial development. Yet, there are still few studies of stock market liquidity premiums in Europe during the industrialization time period, and some of these analyses even find negative liquidity premiums. One should therefore be cautious when extrapolating the evidence from the Stockholm Stock Exchange and marrying the results to other historical markets until we know more about what is driving the premiums as well as their different sizes across early European stock markets.

References

ACHARYA, V. V., and PEDERSEN, L. P. (2005). Asset pricing with liquidity risk. *Journal of Financial Economics* **77**, pp. 375–410.

ALGOTT, S. (1963). *Stockholms fondbörs 100 år*. Stockholm: Nordisk Bokhandel.

AMIHUD, Y., and MENDELSON, H. (1986). Asset pricing and the bid-ask spread. *Journal of Financial Economics* **15**, pp. 223–49.

AMIHUD, Y., and MENDELSON, H. (1989). The effect of beta, bid-ask spread, residual risk and size on stock returns. *Journal of Finance* **44**, pp. 479–486.

AMIHUD, Y., MENDELSON, H., and PEDERSEN, L. H. (2005). Liquidity and asset prices. *Foundation and Trends in Finance* **4**, pp. 269–364.

BANZ, R. W. (1981). The relationship between return and market value of common stocks, *Journal of Financial Economics* **9**, pp. 3-18.

BEIJE, R. (1946). *Medens börshandbok*, Stockholm, Medens Förlag.

BEKAERT, G., CAMPBELL, H., and LUNDBLAD, C. (2007). Liquidity and expected returns: Lessons from emerging markets, *Review of Financial Studies* **20**, pp. 1783–1831.

BELFRAGE, K. (1917). *Stockholms fondbörs*, Stockholm, Stockholms Fondbörs.

BESSEMBINDER, H., and KALCHEVA, I. (2010). Liquidity biases in asset pricing tests, *Journal of Financial Economics* **96**, pp. 215–237.

BURHOP, C. and GELMAN, S. (2010). Transaction costs, liquidity and expected returns at the Berlin Stock Exchange, 1892–1913. Working Paper, Max Planck Institute, Bonn.

CASSIS, Y. (2010). *Capitals of Capital. The Rise and Fall of International Financial Centres, 1780–2009*, Cambridge: Cambridge University Press.

CHALMERS, J. M. R., and KADLEC, G. B. (1998). An empirical examination of the amortized spread, *Journal of Financial Economics* **48**, pp. 159–188.

CHEN, N. F., and KAN, R. (1996). Expected return and the bid-ask spread, in K.S.S. Saitou and K. Kubota, eds.: *Modern Portfolio Theory and Applications* (Gakujutsu Shuppan Center, Osaka, Japan).

DIMSON, E. and MARSH, P. (1983). The stability of UK risk measures and the problem of thin trading, *Journal of Finance* **38**, pp. 753–783.

EDVINSSON, R. (2005). *Growth, Accumulation, Crisis: With New Macroeconomic Data for Sweden 1800–2000*, Ph.D. Dissertation, Stockholm University.

EDVINSSON, R., JACOBSOn, T., and WALDENSTRÖM, D. (2010). *Exchange Rates, Prices and Wages, 1277–2008: Historical Monetary and Financial Statistics for Sweden*. Stockholm: Sveriges Riksbank and Ekerlid förlag.

ELESWARAPU, V. R. (1997). Cost of transacting and expected returns in the Nasdaq market. *Journal of Finance* **52**, pp. 2113–2127.

FAMA, E. F. and MACBETH, J. (1973). Risk, return and equilibrium: empirical tests. *Journal of Political Economy* **81**, pp. 607–636.

GLOSTEN, L. R. and MILGROM, P. (1985). Bid, ask, and transaction prices in a specialist market with heterogeneously informed traders. *Journal of Financial Economics* **14**, pp. 71–100.

GÅRDLUND, T. (1942). *Industrialismens samhälle*. Stockholm: Victor Petterssons AB.

HAAVISTO, T., and JONUNG, L. (1995). Off gold and back again: Finnish and Swedish monetary policies 1914–1925. In Feinstein, C. (ed.). *Banking, Currency, and Finance in Europe between the Wars*. Oxford, UK: Clarendon.

HANSSON, B. och FRENNBERG, P. (1992). Computation of a monthly index for Swedish stock returns 1919–1989. *Scandinavian Economic History Review* **20**, pp. 3–27

IBBOTSON, R. and SINQUEFIELD, R. (1989). *Stocks, Bonds, Bills and Inflation: Year by year historical returns 1926–1987*. Ibotsson Associates.

JAGANNATHAN, R. and WANG., Z. (1998). A note on the asymptotic covariance in Fama-MacBeth regression. Journal of Finance **53**, pp. 799-801

KAHL, M., LIU, J. and LONGSTAFF, F. (2003). Paper millionaires: how valuable is stock to a shareholder who is restricted from selling it?, *Journal of Financial Economics* **67**, pp. 385–410.

KEY-ÅBERG, K. Various years, *Svenska aktiebolag och enskilda banker*, Stockholm: Norstedt & Söner.

KORAJCZYK, R. and SADKA, R. (2008). Pricing commonality across different measures of liquidity. *Journal of Financial Economics* **87**, pp. 45–72.

LONGSTAFF, F. (2009). Portfolio claustrophobia: asset pricing in markets with illiquid assets. *American Economic Review* **99**, pp. 1119–1144.

MITCHIE, R. (2006). *The Global Securities Market: A History*, Oxford; Oxford University Press.

MÖLLER, B. (1962). *Svensk aktiemarknad*, Ph.D. Dissertation, Gothenburg University.

MOORE, L. (2010a). Financial market liquidity, returns and market growth: evidence from Bolsa and Börse, 1902–1925. *Financial History Review* **17**, pp. 73–98.

MOORE, L. (2010b). World financial markets, 1900–1925, Mimeo, University of Montreal.

PASTOR, L. and STAMBAUGH, R. (2003). Liquidity risk and expected stock returns. *Journal of Political Economy* **111**, pp. 642–685.

ROLL, R. (1984). A simple implicit measure of the effective bid-ask spread in an efficient market. *Journal of Finance* **39**, pp. 1127–1139.

RAJAN, R. and ZINGALES, L. (2003). The great reversals: the politics of financial development in the twentieth century. *Journal of Financial Economics* **69**, pp. 5–50.

ROSS, S. (1976). The arbitrage theory of capital asset pricing. *Journal of Economic Theory* **13**, pp. 341–360

SCHÖN, L (2010). *Sweden's Road to Modernity: An Economic History*, Stockholm: SNS.

SHANKEN, J. (1992). On the estimation of beta-pricing models, *Review of Financial Studies* **5**, pp. 1–33.

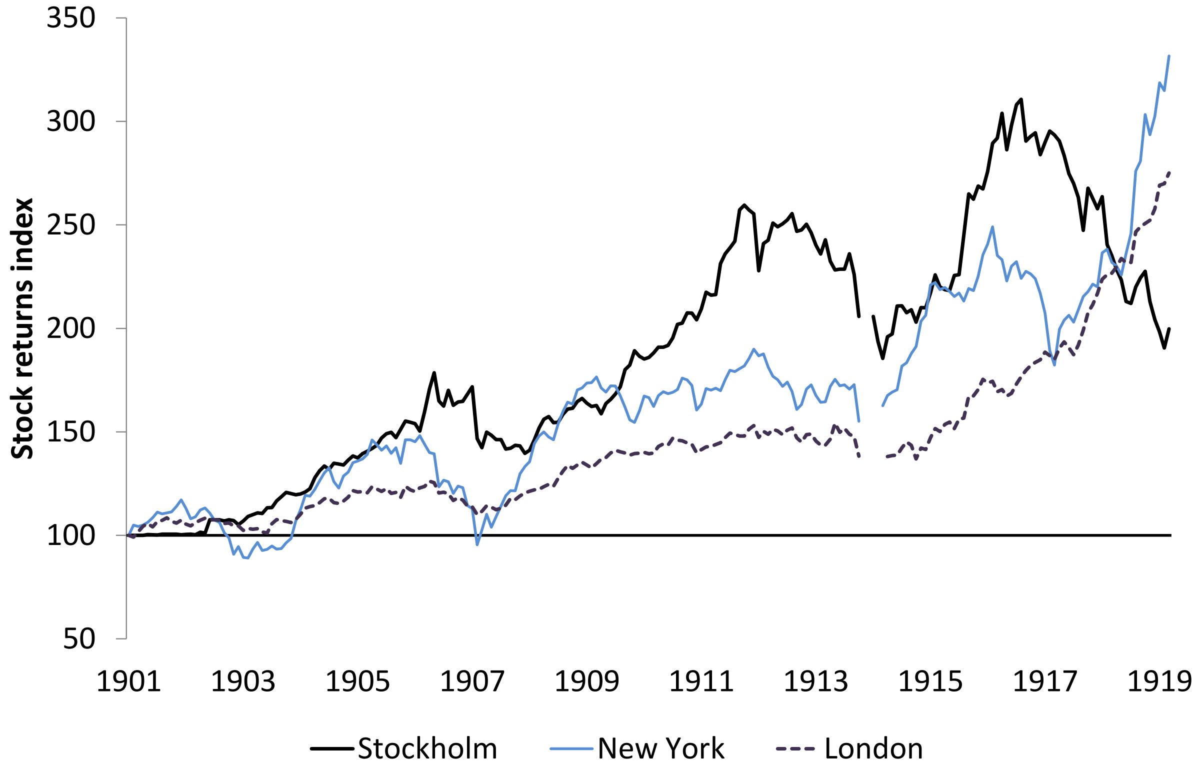
SILBER, W. L. (1991). Discounts on restricted stock: the impact of illiquidity on stock prices. *Financial Analysts Journal* **47**, pp. 60–64.

SVERIGES RIKSBANK (2006). *The Swedish Financial Market 2006*, Sveriges Riksbank, Stockholm.

WALDENSTRÖM, D. (2004). Taxing emerging stock markets: a beneficial policy? Evidence from the Stockholm Stock Exchange, 1907–1939. *Explorations in Economic History* **39**, pp. 29–45.

WORLD FEDERATION OF EXCHANGES (2010). *Annual report and statistics 2009*, World Federation of Exchanges, Paris.

Figure 1: Stock returns in London, New York and Stockholm, 1901–1919



Source: London and New York returns are from Moore (2010b) and Stockholm returns are from this paper.

Figure 2: Swedish stock price and total return indices, 1901–1919

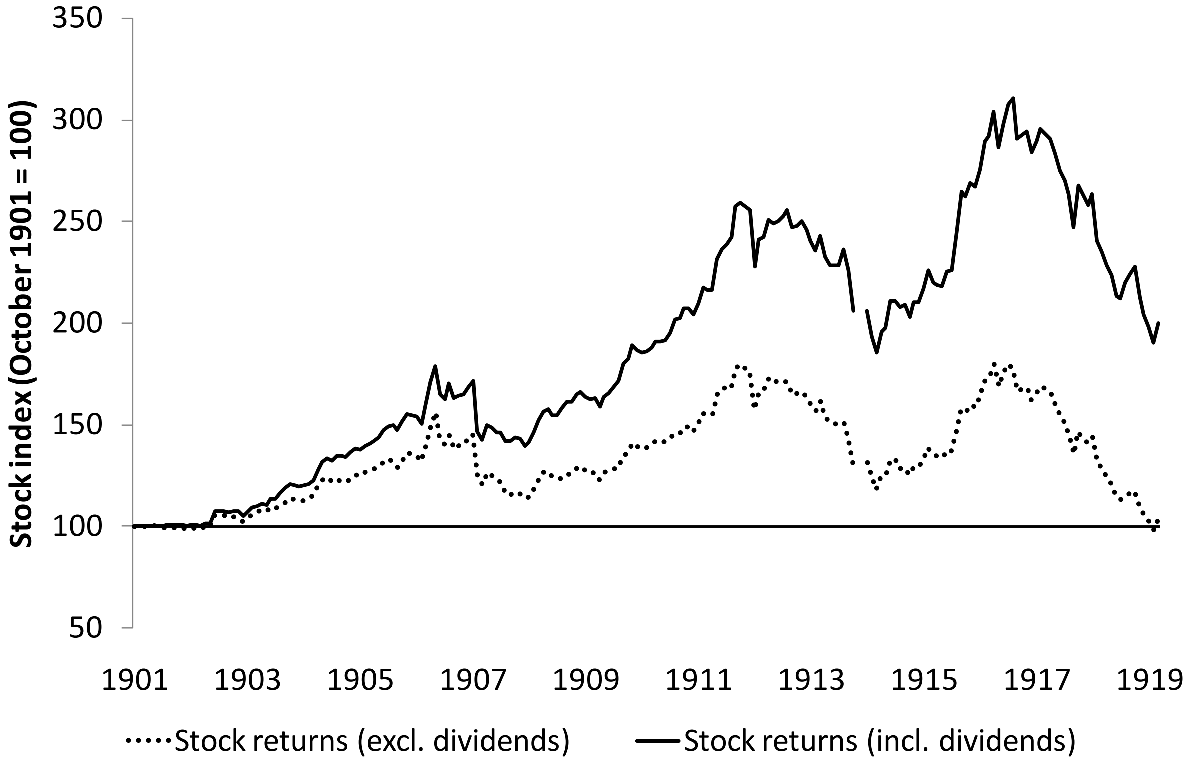
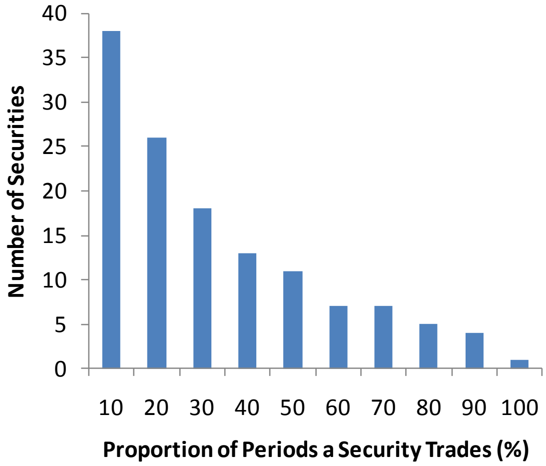
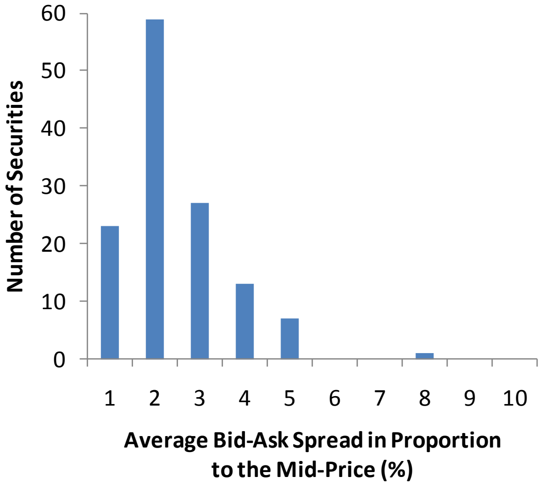


Figure 3: Liquidity measures and their distribution across stocks

*LIQ*1 (Share of weeks when traded)



*LIQ*2 (Relative bid-ask spread)



*LIQ*3 (Average volume traded)

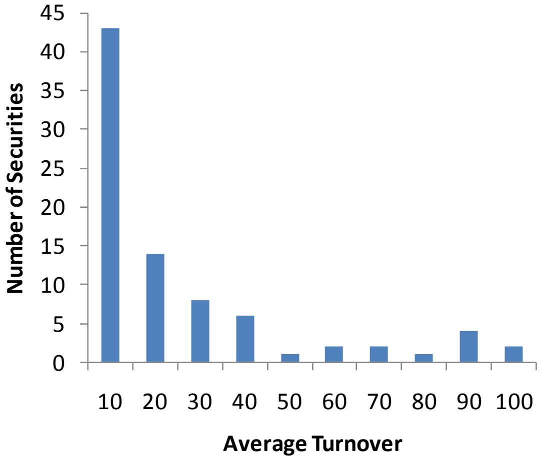
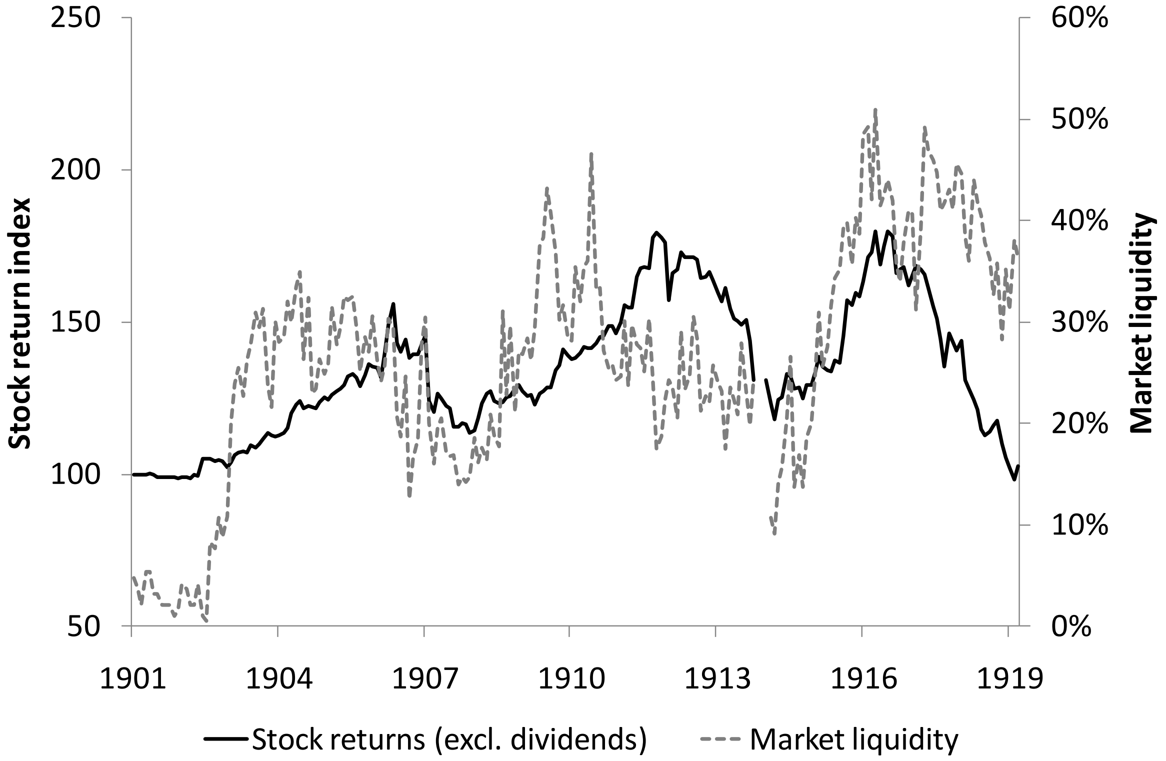


Figure 4: Market liquidity and market return



Note: 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 listed in any given month. The market development is illustrated by the capital weighted index excluding dividends. The correlation between market return and liquidity is 0.43.

Table 1: Descriptive statistics for the Stockholm Stock Exchange

Variable	Unit	1901–1919	1901–09	1910–19
1. Market capitalization	SEK×10^6	1,888	846	2,826
2. Market capitalization /GDP	%	42.8	30.6	53.9
3. Trading volume	SEK×10^6	265	14	491
4. Turnover rate (3/1)	%	8.0	1.4	13.9
5. Stock exchange members	N	23	11	33
6. Listed securities	N	171	201	143
7. Traded securities	N	80	81	80
8. Shares with capital	N	72	71	73
9. Annual price return	%	0.2	1.3	–1.1
10. Annual total return	%	3.9	2.7	1.1
11. Risk-free rate	%	5.3	5.1	5.4
12. Book-to-market ratio (BTM)		0.71	0.93	0.59
13. Dividend yield	%	4.4	4.3	4.5
14. Price/Earnings		16.1	14.4	17.7
15. Payout ratio	%	75.7	64.0	86.0
16. *LIQ*1 (share of traded weeks)	%	28.1		
17. *LIQ*2 (relative bid-ask spread)	%	1.9		
18. *LIQ*3 (average volume)	SEK×10^3	84.5		

Note: Cells show annual averages within the specified yearly intervals. GDP comes from Edvinsson (2005).

Table 2: The ten largest listed firms on the Stockholm Stock Exchange, 1904 and 1916

Company name	Industry	Market cap (SEKm)	Share of total (%)
1904			
1. Trafik AB Grängesberg-Oxelösund	Industrial	66	8
2. Skandinaviska Kredit	Banking	57	7
3. Skånes Enskilda Bank	Banking	45	6
4. Stora Kopparbergs Bergslags	Industrial	36	5
5. Göteborgsbanken	Banking	35	4
6. Sankt Eriks Bryggeri	Industrial	34	4
7. Separator	Industrial	33	4
8. Stockholms Handelsbank	Banking	23	3
9. Stockholms Intecknings Garanti	Banking	23	3
10. Hernösands Enskilda Bank	Banking	21	3
Sum of top-10 companies		373	47
Total market capitalization of the SSE		795	100
1916			
1. Trafik AB Grängesberg-Oxelösund	Industrial	627	18
2. Svenska Kullagerfabriken	Industrial	302	8
3. Stora Kopparbergs Bergslags	Banking	169	5
4. Skandinaviska Kredit	Banking	146	4
5. Allmänna Svenska Elektriska (ASEA)	Industrial	133	4
6. Separator	Industrial	123	3
7. Svenska Sockerfabriken	Industrial	111	3
8. Stockholms Handelsbank	Banking	105	3
9. Göteborgsbanken	Banking	97	3
10. Stockholms Enskilda Bank	Banking	94	3
Sum of top-10 companies		1,906	54
Total market capitalization of the SSE		3,562	100

Table 3: Liquidity-return characteristics

	Average return and standard deviations in ranked portfolios			
	Including dividends			
Ranked variable:	Bottom quartile	2nd quartile	3rd quartile	Top quartile
*LIQ*1	1.34	0.76	0.46	0.30
	[3.58]	[3.55]	[3.73]	[4.33]
*LIQ*3	1.32	0.59	0.59	0.39
	[4.62]	[3.74]	[3.11]	[3.58]
Size	0.93	0.73	0.73	0.57
	[4.00]	[4.01]	[3.82]	[3.48]
	Excluding dividends			
	Bottom quartile	2nd quartile	3rd quartile	Top quartile
*LIQ*1	0.85	0.29	0.05	0.13
	[3.63]	[3.53]	[3.69]	[4.28]
*LIQ*3	0.85	0.09	0.13	0.09
	[4.65]	[3.74]	[3.01]	[3.54]
Size	0.37	0.28	0.16	0.13
	[4.14]	[3.92]	[3.90]	[3.48]

Note: The table includes the average monthly returns and standard deviation (in brackets) of returns for four different liquidity portfolios. The portfolios are equally weighted and are comprised of securities with similar liquidity levels. Portfolio one includes the least liquid securities in the month and portfolio four the most liquid securities. Furthermore, we construct the same portfolios depending on firms' market capitalization. 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 capitalization at the start of the year. The sample consists of 6,232 observations spread over 192 months

Table 4: Main results on the liquidity and liquidity risk effects

	*LIQ*1: Share of traded weeks				*LIQ*2: Relative bid-ask spread			
Incl. dividends	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Liquidity	–0.008***	–0.007***	–0.012**	0.022	0.366*	0.410*	1.341**	–1.080
	(0.003)	(0.003)	(0.005)	(0.039)	(0.205)	(0.21)	(0.542)	(1.812)
Liquidity risk		–0.003	–0.004	0.012		–0.003	–0.008	–0.005
		(0.005)	(0.005)	(0.014)		(0.004)	(0.005)	(0.006)
Market return		–0.001	0.000	0.002		–0.003	–0.003	–0.009
		(0.002)	(0.002)	(0.007)		(0.002)	(0.002)	(0.006)
Size			0.004	0.003			0.005	–0.001
			(0.002)	(0.002)			(0.002)	(0.005)
BTM				0.016				0.002
				(0.014)				(0.004)
R^2	0.068	0.213	0.270	0.493	0.067	0.216	0.274	0.495
Excl. dividends:								
Liquidity	–0.007***	–0.007***	–0.011*	0.007	0.367*	0.407*	1.105	–1.573
	(0.003)	(0.003)	(0.007)	(0.019)	(0.204)	(0.212)	(0.762)	(1.729)
Liquidity risk		–0.004	–0.003	0.002		–0.003	–0.007	0.004
		(0.004)	(0.004)	(0.006)		(0.004)	(0.005)	(0.008)
Market return		0.000	0.000	–0.001		–0.002	–0.004	–0.004
		(0.002)	(0.002)	(0.005)		(0.002)	(0.003)	(0.005)
Size			0.002	0.000			0.002	–0.005
			(0.002)	(0.002)			(0.003)	(0.005)
BTM				0.005				–0.001
				(0.008)				(0.004)
R^2	0.068	0.212	0.267	0.492	0.066	0.214	0.270	0.497

Note: The dependent variable is excess security return. We use the Fama-MacBeth (1973) two-step methodology as specified in equations (8) and (9). *LIQ*1 is the average trading weeks over listed weeks, and *LIQ*2 is the relative bid-ask spread. Both are estimated using a two-year rolling window. Liquidity risk and market return are obtained using the Dimson and Marsh (1983) procedure to correct for non-synchronous trading. Size is defined as the natural logarithm of the latest available market capitalization. BTM denotes book-to-market ratio. We correct for the bid-ask bounce related to liquidity measure two by estimating a weighted least squares model suggested by Bessembinder and Kalcheva (2007) with weights equal to a previous period's return plus one. Standard errors in parenthesis are Shanken (1992)-corrected. ***, ** and * represent statistical significance at the 1, 5 and 10 percent levels, respectively.

Table 5: Using volume as proxy for liquidity

	*LIQ*3: Volume traded							
	Including dividends				*Excluding dividends*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Liquidity	–0.008*	–0.005	–0.011	–0.009	–0.007	–0.005	–0.037	–0.005
	(0.004)	(0.005)	(0.009)	(0.007)	(0.004)	(0.005)	(0.037)	(0.007)
Liquidity risk		0.002	0.035	–0.004		0.000	0.137	–0.004
		(0.006)	(0.038)	(0.012)		(0.006)	(0.142)	(0.012)
Market return		–0.004*	–0.008	–0.002		–0.004	–0.012	–0.002
		(0.003)	(0.005)	(0.004)		(0.003)	(0.009)	(0.004)
Size			0.003	0.001			0.019	–0.005*
			(0.006)	(0.003)			(0.026)	(0.003)
BTM				0.009*				0.003
				(0.005)				(0.005)
R^2	0.073	0.177	0.216	0.379	0.073	0.176	0.225	0.374

Note: Liquidity proxy *LIQ*3 is defined as the average value of traded shares. For a further description, see Table 4.

Table 6: Results restricted to WWI-period or constant firm liquidity measures

	*LIQ*1: Share of traded weeks				*LIQ*2: Relative bid-ask spread			
WWI period:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Liquidity	–0.012***	–0.010*	–0.012*	–0.020**	0.754	0.906*	0.940*	0.828
	(0.005)	(0.006)	(0.006)	(0.01)	(0.493)	(0.524)	(0.58)	(0.642)
Liquidity risk		0.003	0.001	0.011		0.003	0.000	0.007
		(0.006)	(0.006)	(0.007)		(0.006)	(0.006)	(0.006)
Market return		–0.004	–0.003	–0.003		–0.006**	–0.006**	–0.004
		(0.003)	(0.003)	(0.003)		(0.003)	(0.003)	(0.003)
Size			0.001	0.005			0.001	0.005
			(0.002)	(0.004)			(0.003)	(0.004)
BTM				0.013**				0.014**
				(0.006)				(0.006)
R^2	0.061	0.170	0.204	0.309	0.068	0.176	0.219	0.319
Constant firm-level liquidity:								
Liquidity	–0.003	0.002	0.004	–0.008	0.211	0.183	1.093	0.085
	(0.005)	(0.006)	(0.01)	(0.009)	(0.174)	(0.168)	(1.096)	(0.373)
Liquidity risk		–0.009	–0.011**	–0.008		–0.004	–0.001	–0.007
		(0.006)	(0.005)	(0.007)		(0.005)	(0.005)	(0.007)
Market return		–0.002	–0.002	–0.004		–0.003	–0.003	–0.004
		(0.002)	(0.002)	(0.004)		(0.002)	(0.002)	(0.004)
Size			0.000	0.003**			0.004	0.002
			(0.001)	(0.002)			(0.003)	(0.002)
BTM				0.005				0.004
				(0.004)				(0.004)
R^2	0.066	0.208	0.263	0.486	0.054	0.206	0.265	0.495

Note: All estimations are made on returns including dividends. Estimations in the upper panel use returns during the WWI period only, while estimations in the lower panel are based on data where firms' liquidity is constant over the entire study period (instead of over a rolling 24-month window). For a further description, see Table 4.

Table 7: Controlling for dividend yield, price/earnings and payout ratio.

	*LIQ*1: Share of traded weeks			*LIQ*2: Relative bid-ask spread		
Incl. dividends	(1)	(2)	(3)	(4)	(5)	(6)
Liquidity	–0.006**	–0.021	–0.010***	0.340	–1.229	–0.637
	(0.003)	(0.015)	(0.003)	(0.251)	(1.249)	(0.85)
Liquidity risk	–0.006	–0.040	0.010	–0.006	–0.011	–0.050
	(0.007)	(0.038)	(0.006)	(0.007)	(0.011)	(0.06)
Market return	0.000	0.017	0.000	0.000	–0.001	–0.013
	(0.002)	(0.02)	(0.003)	(0.002)	(0.005)	(0.011)
Dividend yield	0.218**			0.211**		
	(0.087)			(0.09)		
Price/Equity		–0.007			0.176**	
		(0.144)			(0.051)	
Payout ratio			–0.001			–0.008
			(0.004)			(0.006)
R^2	0.278	0.470	0.356	0.283	0.483	0.357

Note: Estimations same as in Table 4 except for the fact that liquidity is defined over the entire study period (1901–1919) instead of over a rolling 24-month window.

Table 8: Robustness: Split sample

	*LIQ*1: Share of traded weeks				*LIQ*2: Relative bid-ask spread			
	Gr. 1	Gr. 2	Gr. 3	Gr. 4	Gr. 1	Gr. 2	Gr. 3	Gr. 4
Liquidity	–0.014*	0.001	–0.016	0.119	–8.792	2.890	0.117	–0.928
	(0.008)	(0.015)	(0.012)	(0.122)	(9.431)	(4.442)	(0.825)	(0.773)
Liquidity risk	0.003	0.007	–0.010	–0.001	–0.112	0.028	–0.024	–0.208
	(0.018)	(0.014)	(0.029)	(0.023)	(0.136)	(0.032)	(0.028)	(0.193)
R^2	0.671	0.608	0.603	0.566	0.698	0.596	0.592	0.556

Note: Estimations are of the Fama-MacBeth type (as in Table 4, Col. 2) estimates for market return beta. Returns include dividends. Groups consist of firms ranked according to market-valued equity size, with Group 1 containing the largest firms and Group 4 the smallest.

Appendix table: Annual summary statistics

	Market cap. (SEKm)	Market cap./GDP (%)	Trading volume (SEKm)	Turnover rate (3/1) (%)	Number of members	Listed securities	Traded securities	Stock return index	Stock price index	Risk-free rate (%)	Book-to-market	Dividend yield	Price/ Earnings	Payout ratio
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
1901	163	7	4	2	5	187	16	100.0	100.0	5.46	1	5.2	14.4	68
1902	352	16	1	0	5	189	38	100.2	98.6	4.88	1	4.3	14.2	64
1903	343	14	3	1	5	202	87	110.0	106.9	4.50	*n.a.*	3.8	*n.a.*	*n.a.*
1904	792	33	6	1	5	200	112	122.6	115.0	4.61	1.1	4.3	15.3	65
1905	991	40	7	1	5	204	114	140.6	127.2	4.73	0.9	4.0	13.7	72
1906	1,240	44	3	0	5	200	115	159.6	139.7	5.16	0.8	3.6	16.0	65
1907	1,178	38	37	3	21	208	95	142.4	120.4	6.10	0.9	4.5	11.3	75
1908	1,255	41	29	2	21	209	76	151.9	123.2	5.88	0.9	4.5	13.2	50
1909	1,301	42	39	3	25	207	72	162.8	126.3	4.69	0.9	4.8	17.2	53
1910	1,917	58	87	5	29	129	83	188.1	140.0	4.63	0.6	4.3	22.0	104
1911	2,173	65	181	8	29	142	86	216.1	154.7	4.57	0.5	3.9	22.3	95
1912	2,059	58	318	15	29	139	66	242.6	167.3	4.81	0.6	4.2	18.2	81
1913	2,061	53	180	9	29	145	63	242.8	161.3	5.50	0.6	4.5	18.1	83
1914	1,730	44	52	3	29	132	59	185.5	118.1	5.24	0.8	6.0	16.3	90
1915	2,135	47	51	2	30	131	58	220.1	135.2	5.51	0.6	4.5	16.5	86
1916	3,430	60	605	18	36	140	87	291.9	172.9	5.24	0.5	3.5	14.1	80
1917	4,624	70	1,322	29	40	163	97	293.4	167.4	5.68	0.5	3.9	16.5	74
1918	4,392	50	1,586	36	40	157	103	235.1	128.1	6.93	0.7	5.3	15.2	82
1919	3,734	34	526	14	40	156	99	199.7	102.9	6.38	*n.a.*	*n.a.*	*n.a.*	*n.a.*
Average	1,888	43	268	8	23	171	80	184.5	131.9	5.29	0.7	4.4	16.1	76