Why do listed firms pay for market making in their own stock?

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Mar 2013

Abstract

A recent innovation in equity markets is the introduction of market maker services paid for by the listed companies themselves. We investigate what motivates the issuing firms to pay a cost for improving the secondary market liquidity of their listed shares. We show that a contributing factor in this decision is the likelihood that the firm will interact with the capital markets in the near future. The typical firm employing a designated market maker (DMM) is more likely to need more capital, or plans to distribute cash through stock repurchases, in the near future. It is also more likely to experience exit by its insiders. We also find significant reductions in liquidity risk and cost of capital for firms that hire a DMM. Firms that prior to hiring a DMM have high liquidity risk experience a reduction in liquidity risk down to a level similar to that of the larger and more liquid stocks on the exchange.

Keywords: Stock market liquidity, corporate finance, designated market makers, equity issuance, liquidity risk, share repurchase

JEL Codes: G10; G20; G30

*The views expressed are those of the authors and should not be interpreted as reflecting those of Norges Bank. We would like to thank Vegard Anweiler and Thomas Borchgrevink at the Oslo Stock Exchange for providing us with data on market maker arrangements for listed stocks at the Oslo Stock Exchange. We are grateful for comments from Gorm Kipperberg, Elvira Sojli, Carsten Tangaard, Wing Wah Tham, participants at FIBE 2010, AFFI 2010, Arne Ryde 2011 workshop, EFA conference 2011, the 9th International Paris Finance Meeting 2011, the 2012 Nordic Corporate Governance workshop in Reykjavik, and seminar participants at NHH, NTNU and the Universities of Mannheim and Stavanger. All remaining errors or omissions are ours.

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Abstract

A recent innovation in equity markets is the introduction of market maker services paid for by the listed companies themselves. We investigate what motivates the issuing firms to pay a cost for improving the secondary market liquidity of their listed shares. We show that a contributing factor in this decision is the likelihood that the firm will interact with the capital markets in the near future. The typical firm employing a designated market maker (DMM) is more likely to need more capital, or plans to distribute cash through stock repurchases, in the near future. It is also more likely to experience exit by its insiders. We also find significant reductions in liquidity risk and cost of capital for firms that hire a DMM. Firms that prior to hiring a DMM have high liquidity risk experience a reduction in liquidity risk down to a level similar to that of the larger and more liquid stocks on the exchange.

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Introduction

Historically, the typical trading structure for equities involved market makers with a responsibility for maintaining an orderly market in a stock, such as the specialist at the NYSE. With the evolution of market structures towards electronic limit order markets, where participants provide liquidity themselves, the traditional market maker seemed destined for the scrap heap. Recently, though, market makers have been reappearing. In several electronic limit order markets, market participants have appeared with promises to maintain an orderly market in a particular stock, for example by keeping the spread at or below some agreed upon maximum. The innovation of these Designated Market Makers (hereafter DMMs) is that they charge a fee to the firm that has issued the equity to keep an orderly market in the firm's stock. These innovations started in the European markets, but has now also been proposed for the second largest US market, Nasdaq. Writing in *Forbes*, A. Weinberg summarizes the Nasdaq proposal:[1]

> *"Unveiling its Market Quality Program, Nasdaq, a unit of Nasdaq OMX (NDAQ), has proposed allowing issuers to reward market makers for bids and asks. ... Nasdaq's proposal cuts out the middle man – itself – to allow for payments to market makers from issuers."*

The increased interest in this innovation to how markets operate means that it is important to understand how it affects investors, issuers, exchanges, and the market process itself. While previous studies have mainly focused on the effects of DMMs from the investor perspective, in this

[1] Ari I. Weinberg, Investing, `forbes.com`, 4/16/2012, *Nasdaq's Plan to Catch a Bid*.

paper we look at it from the perspective of the issuers. We identify what determines the firm's choice to hire a DMM from a corporate finance perspective, and quantify the value effects to the firm of having a DMM.

A *market maker* is a participant at the stock exchange which assumes a special obligation to *maintain a market* in the trading of a given stock. What is implied by this varies across markets. At the New York Stock Exchange (NYSE), market makers (specialists)[2] are responsible for ensuring a fair and orderly market in their stocks, and quote bid and ask prices valid for a minimal quantity. The NYSE is however a hybrid market structure, where the market makers and floor brokers also interact and compete with an electronic limit order book. In a pure limit order market there are no such market makers; all that is available for trade is the trading interest put in by market participants through limit orders. A limit order market can however have *effective* market makers, where a market participant simultaneously submits resting buy and sell orders that are continuously monitored and updated if market conditions change. We will in the following use *Designated Market Maker* (DMM) as the term for such a market participant, operating in a pure limit order market, and charging a fee to the company which has issued a stock. In return for the fee the DMM has a positive obligation to continuously maintain the possibility to trade small orders within a specified spread.

DMMs have appeared in several countries such as the Netherlands, France, Germany and Sweden, to mention a few, and there are several studies that empirically examine whether and how the hiring of a DMM affect market quality and price discovery. A consensus finding in this literature is that DMM contracts improve liquidity, that this improvement is particularly large for small illiquid stocks, that liquidity risk is reduced, and that companies engaging in a DMM contract experience a significant positive abnormal return around the event of the DMM hiring (see e.g. Nimalendran and Petrella (2003), Venkataraman and Waisburd (2007), Anand, Tanggaard, and Weaver (2009) and Menkveld and Wang (2013)).

Our analysis differs from the earlier literature along one important dimension. While the previous literature studies the effect of DMM contracts from the perspective of the participants in the secondary market, we study DMM contracts from the *perspective of the issuers*. More specifically, we ask the question of what motivate listed firms to enter into a contractual agreement with a DMM, and empirically examine the motives for corporations to pay a cost to have a DMM in place to improve the secondary market liquidity of their stock. For this purpose we use data on DMM hirings from the Oslo Stock Exchange (OSE) in Norway. At the OSE the possibility of hiring a

[2]The specialists at the NYSE were in October 2008 transformed into Designated Market Makers (DMM), see `www.nyse.com/pdfs/fact_sheet_dmm.pdf`. However, an important distinction between the DMMs studied in this paper and the NYSE DMMs is that there is no payment from the firms for the market making services provided by the DMMs at the NYSE. Instead the NYSE DMMs receive benefits such as being entitled to parity with incoming orders (as opposed to the old specialists obligation to yield to public orders) and other benefits that result in better access to capital, risk management tools which makes their operations more cost effective. In addition to the NYSE Designated Market Makers, two other important liquidity providers are the Trading Floor Brokers and the Supplemental Liquidity Providers (SLPs).

designated market maker was introduced in 2004, following the example of the Stockholm Stock Exchange. Since then, around a hundred firms have hired designated market makers at the Oslo Stock Exchange.

The improvements in secondary market liquidity can affect the firm in two ways. First, by changing future cash flows of the firm, and second, by changing the firm's discount rate. To address our main question of why firms enter into DMM contracts in the first place, we start by looking at *the cash flow channel*. For this purpose, we study the issuers need to access the secondary market by relating the likelihood of hiring a DMM to ex-ante measures of capital needs (Q) and planned repurchases (announcements of repurchase programs). We also relate the hiring DMMs to whether firms ex-post *actually* access the secondary market, by issuing capital or repurchasing shares. Using various empirical specifications we find that measures of capital needs and later interactions with the capital markets all predict a higher likelihood of hiring a DMM. Interestingly, we also find that firms with a DMM have a higher probability of exit by insiders.

Secondly, looking at the *discount rate channel*, we examine, in an asset pricing framework, the effect of hiring a DMM on liquidity risk. Since the DMM is paid by the firm to keep the spread below an agreed maximum, the DMM can not regain any losses to informed traders by increasing the spread above the agreed maximum. This means that the DMM potentially takes on some of the risks that otherwise would have been reflected in wider competitive spreads without a DMM in place. The presence of a DMM may thus in addition to the reduction in transaction costs also reduce the stock's liquidity risk. This is exactly what we find. In the sample of firms that hire a DMM, we find a significant drop in the loading on a liquidity risk factor in a two-factor asset pricing model. Firms that hire a DMM experience a drop in liquidity risk to a level that is comparable to that of the largest and most liquid stocks on the exchange. This result confirms the results in Menkveld and Wang (2013) who also show that a DMM contract reduces liquidity risk. However, for the purpose of our main question, we use these risk premium estimates to gauge the economic impact of DMM contracts on the cost of issuing new equity, and to examine whether the reduction in cost of capital is likely to exceed the cost of having a DMM.

Our analysis is also related to a recent theoretical paper by Bessembinder, Hao, and Zheng (2012), in which they show conditions under which it is is optimal for the firm to engage in a contract with a DMM to reduce the spread below the competitive bid ask spread. They show that having a DMM will maximize the firms net proceeds (net of the DMM fee) from issuing risky stock in an IPO. In our work we quantify the value effects associated with the liquidity improvement based on our liquidity risk estimates. We show that the reduction in liquidity risk implies a reduction in expected returns by about 3% on an annual basis (2% for the median firm), which suggest that hiring a DMM significantly reduces a firm's cost of raising capital. Moreover, this suggest that the cost associated with having a DMM is likely outweighed by the reduction in cost of capital experienced by firms that hire a DMM.

The structure of the paper is as follows. We first discuss the relevant literature, and place our questions in context. In section 2 we discuss the data and provide some descriptive statistics for the DMM contracts at the Oslo Stock Exchange. In section 3 we first show what happens to the stock around the DMM hiring, before, in section 4 we examine the central question of the paper; what affect the firm's decision to hire a DMM. In section 5 we examine the effect of DMMs on liquidity risk to provide an estimate of the effect on firms cost of capital, before we conduct a brief discussion of the economics of the results and conclude. We also provide two appendices: The first give a full list of the companies used in the analysis. The second contains a list of all variables used in the analysis, and detailed descriptions of them.

1 The problem

Theoretically, there are a number of ways the liquidity of a stock in the secondary market can affect the value of the underlying firm. The best known mechanism is the market microstructure argument of Easley and O'Hara (2004), which essentially is an argument about information production. Liquidity improvement will increase/improve the public information about the underlying firm. Improved information will lower the risk premium of the stock, and decrease the firm's cost of capital. Bessembinder et al. (2012) extend the Glosten and Milgrom (1985) model by introducing a DMM that maintains a maximum spread (K) that is lower than the competitive spread. For this service, the DMM is compensated by the firm with a fee that is set so that the market maker breaks even despite quoting a lower spread than the competitive spread. A key insight from Bessembinder et al. (2012) is that the competitive spread is not optimal for the firm, and that there exists a positive K that maximizes the value of the firm (net proceeds from issuing equity). This narrower spread will induce more uninformed investors to trade, but also trigger more information acquisition (a result also shown in Bessembinder, Hao, and Lemmon (2011)). One implication from their model that is of particular relevance for our question is that DMM contracts will be more value enhancing for firms that are likely to make capital investment decisions in the near future such as smaller, younger, and growth-oriented firms, as opposed to larger firms with higher proportions of assets-in-place.

In addition to a reduction in information asymmetry about future cash flow or asset value, an additional channel through which stock market liquidity can affect firm value is by changing firm cash flow directly. If the firm can raise capital at a lower implicit interest rate in the future, this cost saving will translate into a higher net present value of the firm.

These arguments map very naturally into the corporate finance valuation equation of the firm; the present value of future cash flows discounted at the appropriate cost of capital. An improvement in the secondary market liquidity of a firms listed shares may thus affect firm value through two channels:

- A direct channel – changes in future cash flows.
- An indirect channel – changes in the cost of capital.

Our paper will be organized around these two channels, and give empirical input to help understanding how these two channels enter into the firms decision to hire a DMM.

In the theoretical market microstructure literature, a market maker faces costs associated with keeping inventory (see e.g. Garman (1976) and Amihud and Mendelson (1980)) as well as a risk of being picked off by informed traders (Glosten and Milgrom, 1985). To adjust inventory and to regain expected losses to informed traders, the market maker adjusts quoted bid and ask prices and hence the spread. Intuitively, the market maker has two dimensions to play with: moving the price, and widening/narrowing the spread. Relative to the typical market maker a DMM does not have the same flexibility to widen the spread in times of adverse information shocks, due the contractual obligation to keep the bid-ask spread below an agreed maximum.[3] To minimize the costs of the DMM obligation, it becomes more important for the DMM to set the right price. One effect of a firm having a DMM may thus be more informative prices, since the market maker needs to exert more effort on adjusting the price in response to new information. In other words, the DMM is taking on costs and risks that otherwise would have been passed on to the traders in the secondary market.

Looking more specifically at the theory behind DMM's are two recent theoretical contributions, Bessembinder et al. (2011) and Bessembinder et al. (2012). One of their results is that the effect on the market of a DMM keeping a maximum spread may be more efficient pricing, and that there may be public good aspects of this, which one may want to encourage.

The solution used in a number of markets is to allow the listed firms to pay the provider of the DMM services directly. We ask what motivates a listed firm to pay for the presence of a DMM. The function of a DMM is to improve the quality of trading the firm's shares in the secondary market. On the face of it, this does not affect the firm's operations in any way. Why should then the firm do it? It may here be instructive to discuss this from a corporate valuation perspective, and relate DMM payments to the determinants of firm value. Let us take the simplest such case, and let current firm value V be the result of a perpetuity of future annual cash flows X discounted at the cost of capital r,

$$V = \frac{X}{r} \tag{1}$$

With this perspective, for any corporate action to affect firm value it will have to affect either future cash flows (X), the discount rate (r), or both. Now, a firm which pays for DMM services

[3] At most exchanges, a DMM has an option to suspend the contractual obligation to maintain a minimum spread for a short period of time if there are special circumstances, such as news releases from the company, but this needs to be justified, and may be reputationally costly for the DMM.

has a known cash outflow, the (annual) cost of DMM services. By that token,

$$V = \frac{X - \text{ Cost of DMM services}}{r}$$

would indicate a *lowering* of firm value. However, all empirical studies of DMM's have found a positive stock price reaction at the time of the announcement of the DMM hiring,[4] which imply an *increase* in firm value. To explain an increase in firm value we therefore have to look for either other cash flow consequences or a change in the cost of capital (or both):

$$V = \frac{X - \text{ Cost of DMM services} + \text{ Other cash flow consequences}}{r + \text{Change in cost of capital}}.$$

This basic corporate finance perspective is a useful way of structuring our analysis.

Let us start by asking how the hiring of a DMM to improve the liquidity of trading in the secondary market can affect future cash flow. If the firm never needs to go back to the capital market the improvement in market liquidity will not affect the firms cash flow in any material way. We therefore have to look at occasions with interactions between the firm and capital markets. The obvious ones are times when the firm issues new equity capital or repurchases equity, but there may be others.

What are the potential cash flows related to the firm's raising of new capital through e.g. seasoned equity offerings (SEO)? There is a direct channel, the direct cost of issuing new equity, either as a private placement or as a general issue to the firm's owners. In the more recent literature on SEO's, stock liquidity is found to affect the terms of issuance.[5] Firms with more liquid stock can therefore expect to have a lower cost of raising equity capital. There are also a number of more indirect effects related to capital structure. The choice between debt and equity is affected if the terms of raising equity changes. In fact Butler and Wan (2010) link debt issuance directly to the secondary market liquidity of the stock. It may also indirectly affect decisions related to dividends (Banerjee, Gatchev, and Spindt, 2007). Since the expected costs today are a product of the *probability* of the future capital event times the costs, when they occur, we would expect the firms that are more likely to need capital in the near future (higher probability) to care more about the market liquidity of the firm's stock. In a recent paper, Kedia and Panchapagesan (2011) show that firms that choose to move from Nasdaq to the New York Stock Exchange are more likely to raise external financing or engage in acquisition activity. They argue that the gains in visibility and liquidity associated with moving to the NYSE reduces the cost of capital of these firms. Along

[4]Such empirical investigations have been carried out by e.g. Anand et al. (2009) which looks at the Swedish case, Menkveld and Wang (2013) for Euronext, Hengelbrock (2008) for the German market, and Venkataraman and Waisburd (2007) for the Paris Bourse. The focus of these papers is the impact of DMM introductions on liquidity. A general finding is that liquidity improves following the DMM introduction, and that there is an increase in the stock price of DMM firms around the hiring date.

[5]See for example Ginglinger, Koenig-Matsoukis, and Riva (2009).

the same lines, the decision to hire a DMM should be positively related to the likelihood that the firm will need capital in the near future.

Another case where the firm interacts directly with the secondary market is the opposite of raising equity, namely stock repurchases. At these occasions corporations buy back some of its own shares. There is a large literature on repurchases. We refer to Vermaelen (2005) for a survey. In the literature, there is no consensus on the dominating motivation for share repurchases, and there there are many proposed explanations. For example, Jensen (1986) argues that repurchases can be used to pay out excess cash to mitigate agency costs of free cash flow. Consistent with this, e.g. Stephens and Weisbach (1998), Dittmar (2000) and Jagannathan, Stephens, and Weisbach (2000) all show that firms use repurchases to pay out excess cash flows that have a low probability of being sustainable as dividends, while dividend increases reflect higher expected permanent cash flows. Share repurchases may also be preferred to paying out cash as dividends, due to tax advantages for the owners if capital gains are taxed differently from dividends. Other proposed motivations for repurchases include takeover defense (Denis (1990)), undervaluation (e.g. Vermaelen (1981), Dann (1981), Comment and Jarrell (1991)), and countering dilution effects of employee options (Dittmar (2000)). One explanation that is particularly relevant for our analysis is the suggestion by Barclay and Smith (1988) who argue that the implicit costs of trading the stock in the market increases if the firm engage in stock repurchases. Their main argument is that the adverse selection component of the bid ask spread increases after the firm has announced a repurchase program due to the increased probability of trading with an informed trader, the repurchasing firm. Hiring a DMM may be a way for the firm to counter this effect.

No matter what the motivation for repurchases, improving secondary market liquidity in the stock will reduce spreads and lower the price impact when the firm buys back stock. This maps into the analysis of Brockman, Howe, and Mortal (2008) who argue that managers compare the tax and flexibility advantages of a repurchase to the liquidity cost. All else equal, higher market liquidity lowers the cost of repurchasing relative to paying cash dividends. In line with this, they find evidence that managers condition their repurchase decision on the level of market liquidity. Thus, if a firm is planning to initiate a repurchase program, this could be a potential motivation for improving the liquidity of its shares.[6]

The theoretical discussion above argues that the more likely that a firm plans to interact with capital markets in the near future, the more likely they are to care about the future negative cash flows (costs), and therefore more likely to employ DMM's. In our empirical work we test this prediction, by asking whether DMM hirings are linked to factors that we argued above are related to future cash flows.

Let us next turn to the second channel through which firm value can be affected, the discount

[6]The case for repurchases is actually not as clear cut as the case for secondary issues of securities. The problem is the underpricing motivation for repurchases. If a firm hires a DMM which sets a more efficient price, the underpricing may disappear.

rate. It is by now well accepted in the asset pricing literature that there is a priced liquidity component in the cross-section of stock returns (e.g. Pastor and Stambaugh (2003) and Acharya and Pedersen (2005)). An improvement in liquidity brought on by the DMM may therefore affect the required return of the stock, and therefore the discount rate.[7] We investigate this issue in our work by examining how firms' loadings on a liquidity risk factor change as a result of hiring a DMM, and investigate the implications of such changes for the cost of capital.

Hiring a DMM is only one of many ways in which a firm may pay a cost to achieve higher liquidity or better information production in the secondary market. There is a number of alternative mechanisms. For example, Brennan and Hughes (1991) argue that one argument for a stock split is the improved attention paid to the stock by stock analysts, while Bushee and Miller (2012) looks at the hiring of *Investor Relations* services. Both these are examples of costly actions taken by the firm to improve the liquidity conditions in the secondary market, and argued by the firm to improve its cost of capital.

A final issue we examine concerns the preferences of individual owners of a firm. The standard valuation equation (1) calculates the value as the consensus value of the firm in a world without transaction costs. It can be thought of as the value to an owner planning to keep her shares indefinitely. The picture is different for an owner that wants to sell (or buy) shares. Such an owner will have to adjust for transaction costs

$$\text{Value to trader} = \frac{X}{r} \times \text{fraction of company traded} - \text{transaction costs.}$$

The transaction cost is influenced by the liquidity of the stock; i.e. the better the liquidity, the lower the transaction costs (Harris, 2002). An owner planning to transact in the near future would clearly want the firm to do its best to improve liquidity. It is however not clear that the firm should do this on the owner's behalf. Why should the firm make it easier for your random owner to vote with his feet? But there are some owners for whom this may be a valid concern. In a recent study of the motivations for why firms want to pay the cost of becoming listed, Brau and Fawcett (2006) uses surveys to ask CFOs about these corporate motivations. According to their survey, the most important factor for becoming listed is to facilitate takeovers, either as a target or as an acquirer. For our purpose, however, the second most important reason is more interesting, namely that an IPO provides an exit opportunity for the founders, employees, venture capitalists, and other investors in the firm. This second motivation is clearly relevant for the DMM decision. If the firm wants to facilitate the exit by e.g. founding shareholders, they would want the stock to be as liquid as possible. In our empirical work we will also evaluate this explanation.

Let us summarize the empirical implications of the above discussion. When we view the firm as a whole, if we want to justify a change in firm value following a DMM hire we have to either identify

[7]For the asset pricing argument see the survey by Amihud, Mendelson, and Pedersen (2005). For the link to the firm's cost of capital see Easley and O'Hara (2004).

a change in future cashflows, a change in the cost of capital, or both. As potential cash flow items we identified costs of future equity and other capital issuance, and stock repurchases. A potential factor affecting the cost of capital is the liquidity premium in asset returns. If we move away from the "whole firm" view, and instead look at individual owners, these will naturally prefer to have the highest possible degree of liquidity. More specifically, we argued that exit for the original inside owners could be a motivation for the firm to improve liquidity, but not necessarily so as a general rule, due to the public good nature of the improved liquidity.

2 Institutional details and descriptive statistics

Our sample of stocks are listed at the Oslo Stock Exchange (OSE) in Norway. OSE is a medium-sized stock exchange by European standards, and has stayed relatively independent.[8] The current trading structure in the market is an electronic limit order book. The limit order book has the usual features, where orders always need to specify a price and is subject to a strict price-time priority rule. To illustrate the evolution of trading at the OSE in the period, in figure 1 we show time series of one common measure of liquidity, the relative spread, for the whole market and for stocks sorted by size. The liquidity is shown for the period 2000-2011. Spreads at the OSE had been gradually lowered in the 1990's and early 2000's, but by 2004 they had reached their lowest level. Spreads increased markedly during the 2008 financial crisis, and have not yet come back to their historical low. The spreads for size portfolios show clear differences in liquidity, the largest stocks on the OSE are very liquid with relative spreads below 1%, which seems largely unaffected by the financial crisis, while the smaller stocks have had spreads in the 3-7% range, with a clear worsening of liquidity during the crisis.

[Figure 1 about here.]

In 2004 the OSE introduced the possibility for financial intermediaries to declare themselves as Designated Market Makers (DMMs) in a firm's stock, where the firm pays the DMM for the market making service. Formally, the exchange does not oversee these DMM agreements, and has no say in them, but typically receives copies of the contracts.[9] When such a contract is entered into, it needs to be announced through the official notice board of the exchange, and the announcement is required to give some details about the purpose of the contract. OSE provides a standardized contract, where the DMM and the issuer agree on a percentage of the trading day that the bid and ask quotes should be available, the minimum volume that should be available at the bid and

[8] See Bøhren and Ødegaard (2001), Næs, Skjeltorp, and Ødegaard (2008) and Næs, Skjeltorp, and Ødegaard (2009) for some discussion of the structure of the exchange and descriptive statistics for trading at OSE.

[9] All firms that have a DMM agreement is included in the OB Match index, which is an index containing the most liquid stocks at the exchange. Due to this, the surveillance department at the exchange track the DMM activity in these stocks to ensure that the DMMs are fulfilling their obligations in accordance with the contract.

ask quotes, and finally the maximum level of the bid ask spread, typically specified as a percentage relative spread. The parties may add other contractual features.[10]

In the paper we are using data from the Oslo Stock Exchange data services, which provides daily price quotes, announcements, accounts, and so on. The announcements also contain details about trades by corporate insiders.

In Table 1 we show some details about the introduction of DMMs at the OSE. We list the number of new DMM deals and the total number of stocks with DMMs active. The number of DMM contracts is small relative to the total number of listed firms. At the most (in 2008) there were 58 firms (out of 292) with a DMM, which is about a fifth of the firms on the exchange.[11] The firms with DMM are typically smaller, as can be seen from the split into four size quartiles also shown in the table. In total over the sample period we observe 111 cases where firms hire DMMs, but some of these are cases where the same firm switches DMM or rehires a DMM after a pause.[12] Panel B of Table 1 shows the industry distribution of firms with a DMM. The industry distribution is typical for the OSE, with many firms in the Energy and Industry categories, which typically are oil related firms.

[Table 1 about here.]

In Table 2 we provide a number of summary statistics where we compare firms with a DMM in a given year with the others. Note that 2004 is atypical, in our discussion we concentrate on the later years.[13]

[Table 2 about here.]

We start by comparing firm magnitude, measured in both asset values and accounting income. We also look at some measures of firm health: sales growth and Q. We observe that the typical DMM firm is smaller than the average OSE firm. Also note that Tobin's Q for the DMM firms are higher than the average non-DMM firm across all years except for 2004. This is consistent with an explanation where firms that hire a DMM have higher growth opportunities, and are more likely to need capital to finance new projects. We are also interested in the behavior of the firm's owners,

[10] Unfortunately we do not have access to the actual contracts, but have been told by stock exchange officials that the "average" contract has a requirement of bid/ask quotes being available 85% of the trading day, a maximum relative spread requirement of 4% and a minimum lot size of the best bid and ask of 4, which typically amount to 400 shares.

[11] There were 14 financial institutions that were offering DMM contracts over the 2005–2010 period.

[12] Some of the switches are due to choices by the company, and some are due to financial firms stopping their DMM services. One example is the Icelandic bank Kaupthing, which had quite a number of DMM contracts, but closed down as a result of the Icelandic banking crisis. Another example is SEB Enskilda, who quit all their DMM engagements at the beginning of 2009.

[13] The OSE first allowed DMM agreements in October of 2004, this means that the number of firms in the DMM group for 2004 is low (seven firms), and statistics for the DMM group would only measure the difference for the last three months of 2004.

and show the trading by firm insiders. Since we are particularly interested in exit by individual insiders, our measure of insider trading counts the number of relatively large insider sales. We also look at the extent to which firms are active in the capital markets. To this end we estimate what fraction of the firms in the two groups issue new equity or repurchase stocks in the given year. With regard to repurchases we look at two definitions. First we count the number of firms that have announced a repurchase plan.[14] We also count the number of firms that ex post actually performed repurchases.

The market liquidity of a firm's stock is clearly important for the decision to hire a DMM. In the table we show averages of some common measures of stock liquidity: Quoted and relative spreads, LOT (an estimate of transaction costs introduced by Lesmond, Ogden, and Trzcinka (1999)) and ILR (the measure of price elasticity introduced by Amihud (2002)). We also consider two liquidity measures providing information about the trading activity in a given stock. The first is turnover, the fraction of a given stock's outstanding shares traded in a year. The second is a less common measure of liquidity: The number of days with trading activity. Since the stocks that are considered for DMM services are among the less liquid at the OSE, they are not necessary traded every day. To capture this property we simply count the number of days with any trading activity. To normalize this number we relate this to the number of all the possible dates, and measure the fraction of the trading year a given stock trades. We see that the average across all firms traded on the OSE varies between 70% and 90%. At the OSE there is a set of internationally well known stocks traded actively (e.g. Statoil, Hydro and Telenor), and certainly every day. Hence, this low number suggest that there is quite a number of stocks that trade seldom. We see clear differences in the mean liquidity across DMM and non-DMM firms. Since liquidity is very important for the DMM choice, we will look closer at the liquidity variables below.

The correlations between the variables are shown in Table 3. Note that these are contemporaneous correlations of annual aggregates. When we later study the determinants of the decision to hire a DMM we need to be careful about timing, so these numbers are not exactly the same as those used in the later empirical specifications. With that qualification in mind, it is still important to note that many of the potential explanatory variables are correlated.

[Table 3 about here.]

2.1 Liquidity and DMM choice

As just mentioned, the liquidity of a given stock is an important factor for the firm when deciding whether to hire a DMM or not. If liquidity is already high, there is no need for a DMM. But if the liquidity is very low, the cost for a potential DMM of keeping the spread at a maximum level may

[14] At the OSE firms have to get an approval of the annual meeting before they can repurchase shares. This approval is valid for a maximum of 15 months before it has to be renewed by the annual meeting. We therefore count as a planned repurchase when the firm has an approval by the annual meeting that allows it to repurchase.

be very high. This high cost must be passed on by the DMM to the hiring company through the fee for DMM services. If this fee is too high, the issuer will not want to pay it. We may therefore expect to see a nonlinear relation between liquidity and hiring of a DMM.[15]

[Figure 2 about here.]

If we only consider the mean difference across the two groups, we observe that there are some systematic differences. All of the quoted spread, relative spread (where we divide the quoted spread by the midpoint price), LOT, and the Amihud measures are systematically smaller for the group of firms that hire a DMM, indicating that these stocks are more liquid.[16] However, these averages may not be the right way of looking at these differences as they do not show the cross-sectional variation. For this purpose, we examine this relationship using the frequency distribution of two of the liquidity measures: Relative spread and fraction of year traded, shown in figure 2. In the figure we split the sample stocks into two: stocks that never hire a DMM, in Panels A and C, and stocks that at some point hire a DMM, in Panels B and D. Note that Panels B and D show the statistics before these firms hire a DMM. One thing to note is that the distributions are highly skewed, concentrated towards high liquidity (low relative spread, high fraction of the year traded). For companies in the region with the best liquidity there is little need for a DMM. If a stock trades every day, with a very low average spread (e.g 2%), it is unlikely that a firm would want to pay for a DMM to keep the spread low. We see that the distribution of firms that hire a DMM at some at some point later is less skewed, and on average have worse liquidity. For example, none of the firms in panel B have a relative spread less than 1% before they hire a DMM, while in panel A we see that there is a large number of observations of low relative spreads. Comparing the spread figures in Panel A (non-DMM firms) and Panel B (DMM firms), we see that while the non-DMM firms are even more concentrated towards the very liquid stocks, there is still a number of firms with very low liquidity (high spreads, low fraction of the year traded) that chooses *not* to hire a DMM. This is probably because the cost of hiring a DMM for these stocks is too high. Hence, the typical DMM stocks are neither the most liquid nor the least liquid ones.

3 What happens when a firm hires a DMM?

Let us now look at what happens to the trading in the secondary market for firms that hire a DMM. We will investigate two potential effects: Whether there is improvement in liquidity around the time of hiring a DMM, and whether there is a stock price reaction (increase) when the firm announces the hiring of a DMM.

[15] This nonlinear relationship was also shown in (Anand et al., 2009, pg. 1429).

[16] Comparing the quoted spread (NOK) and the relative spread, a notable feature is that the difference in quoted spread seem much larger in magnitude between DMM and non-DMM stocks than the comparable difference for relative spread. This is mainly due to a lower price level for DMM stocks.

3.1 Change in activity and liquidity around DMM hirings

We first look at measures of liquidity in the period around DMM hirings. Given that the firm is paying for a liquidity improvement, we expect to see such an improvement. To first just give a visual illustration of this, in figure 3 we show histograms of the distribution of relative spread and fraction of year traded, one year before and one year after the DMM contract starts.

[Figure 3 about here.]

The two figures on the right show the distribution of the liquidity measures for the year *after* the hiring of a DMM. Comparing this to the figures in panels A and B, which shows the liquidity of the same firms in the year before the DMM hiring, we see that in both cases there is a clear shift towards improved liquidity. The spread is lower, and the fraction of year traded higher, after the hiring of a DMM.

To examine more formally how liquidity change around DMM hirings, table 4 shows the change in five different liquidity measures for a one year and six month period before and after the initiation of the DMM contract and test for whether the change is significant. For the six month period, we see that the relative spread, LOT and Amihud measures decreases significantly after the DMM agreement has been initiated. For the one year window, the reduction in relative spread and Amihud measure remains significant, while the change in the LOT measure is rendered insignificant. Interestingly, turnover increases significantly for the one year horizon, and the fraction of the trading year with trades increases, both over the six month and one year horizon. This may indicate that the reduction in transaction costs due to the introduction of a DMM attracts new traders to the stock, causing trading activity to increase.[17]

[Table 4 about here.]

Overall, regarding the question of the effect of DMM initiations on liquidity, we see that there is an improvement in all liquidity measures around the DMM introduction, which is consistent with prior research on other markets. This is however a result which we *should* observe; i.e. it looks like the DMMs do what they are paid to do, improve liquidity. The more interesting observation is that the DMM initiation is also associated with an increase in trading activity, as measured by fraction of trading days and turnover. Thus, there may be liquidity externalities associated with the hiring of a DMM in the sense that "liquidity attracts liquidity."

[17] This test for difference in means assumes that there are no systematic market-wide changes in liquidity over the same period. This would particularly be a worry if there is a trend towards improved liquidity for the whole market in this period. However, as we saw in the time series of spreads shown in figure 1, there is no such long-time trend at the OSE in the period we are investigating. The liquidity, as measured by spread, has been relatively stable in the 2004-2012 period, with some worsening of liquidity during the 2008-2009 financial crisis which soon went back towards the earlier levels.

3.2 Stock price reaction to DMM hirings

To examine whether the market response to the hiring of DMMs is similar in the Norwegian market to what has been documented for other markets, we perform an event study of the market reaction at the date when the firm announces a DMM. The event study is illustrated in figure 4.[18] and detailed in Table 5. To test for significance we start 5 trading days before the event date and calculate the aggregate CAR for the next ten trading days. In aggregate there is a significantly positive reaction of about 1% just around the announcement date.

This positive market reaction is consistent with other research. For example, Anand et al. (2009) find a CAR around liquidity provider introduction of about 7% in their Swedish sample, and Menkveld and Wang (2013) find a CAR of 3.5% at Euronext. We thus confirm the effects on the market found in other studies, liquidity improves, and the market reacts positively to DMM introductions.

To further investigate these results we look at whether the size of the CAR is related to properties of the firms hiring DMM's. In panel B of Table 5 we regress the magnitude of the CAR on the liquidity, measured by the spread, of the stock before the DMM start, also controlling for the firm size. The regression shows a positive relationship between the spread and CAR. This means that the larger the spread before the DMM start, the bigger the reaction. The positive market reaction is thus largest for the least liquid stocks.

[Figure 4 about here.]

[Table 5 about here.]

4 The decision to hire a DMM – Do cash flows matter?

Let us now look at the decision by firms to pay the cost of hiring a DMM. We first ask whether expected future cash flows are important for the decision to the hire a DMM. We do this indirectly, by examining whether the factors we theoretically motivated earlier, capital needs and repurchases, are relevant for the decision to hire a DMM. In the empirical implementation we also consider the possibility of exit by founding shareholders, and control for other factors which affect the DMM decision, such as stock liquidity.

4.1 Empirical design

Our empirical design is motivated by our desire to model the *corporate decision* to hire a DMM. This is a binomial choice problem, either the firm hires a market maker, or it does not. The natural

[18] We exclude stocks that started trading simultaneously with the DMM initiation. There are quite a few cases where the firm hires a DMM at the same time as the firm's IPO. In several cases the DMM agreement is likely to be part of the IPO "package," where the underwriter also acts as a market maker to keep a liquidity market for the stock after the IPO. We also remove cases where we can not identify with certainty the announcement date.

empirical specification is to use a probit/logit model, and investigate the determinants of the firm's choice.[19] We choose to look at each calendar year as a primitive, and count as success if the firm has hired a DMM at some point during the year. We view this annual split into calendar year as natural since most of the corporate decisions we look at here, such as repurchasing and large capital issues, need approval from the annual meeting, which normally happens only once a year.

The explanatory variables of interest are related to the probability of the firm directly interacting with the capital markets in the near future, either due to capital needs, or repurchasing stocks. In the empirical analysis we use two approaches. The first is an *ex ante* approach, where we use only explanatory variables that are observable when the decision to hire a DMM is made. The second is more of an *ex post* analysis where we look at what actually happens to the firm after it has decided to hire a DMM.

As ex ante proxies for capital needs we use two variables. One is the firm's growth opportunities, measured by Tobin's Q. We assume that capital needs are increasing in growth opportunities, which implies that the probability of hiring a DMM is increasing in Q. As an alternative to Q, which has the problem that it may be open to other interpretations than growth potential, we also consider recent growth in the sales of the firm. We assume that a firm that is currently experiencing high growth in sales is more likely to need more capital for investments further on. An alternative to Q and growth opportunities is to look at this ex post: *Do* firms with a DMM actually raise new capital in the near future? To perform this test we use a dummy for whether the firm issues equity in the three years following the DMM hire. Under the hypothesis that firms want to improve liquidity before they raise capital we expect the probability of hiring a DMM to be increasing in this dummy variable.

We also look at repurchases. For this purpose we use two different measures of repurchases, one ex ante and one ex post. Our ex ante measure is motivated by the regulation of how repurchases must be performed by Norwegian firms. Before a given firm can repurchase shares, it must have approval by the annual meeting of shareholders to repurchase up to a given percentage of the firm's shares. This approval is valid for up to a maximum of fifteen months, and has to be renewed at the annual meeting. The ex ante measure we use is whether, in the year we analyze, the firm has gotten approval for a repurchase program. As our ex post measure we use a dummy for whether the firm actually repurchases shares within three years after the DMM hire.

We also include a potential third explanation for why a firm would want to hire a DMM; exit for the original owners. In motivations for IPO's one often mentions the desire for the original

[19] An alternative would have been a hazard model, which is the specification used in Anand et al. (2009). We choose the binomial choice specification as more appropriate, primarily because we are interested in corporate motivations, such as growth prospects, when the firm makes the decision to hire a DMM. If we were to use a hazard specification, we would need to continuously update a measure of the firm's growth prospects as input to the hazard estimation. This is not feasible, since such data is only estimable from accounting numbers, which are mainly available at annual frequencies. The use of a hazard model was more natural in Anand et al. (2009) since they were more focused on aspects of trading in the market. Such trading data is continuously updated.

owners to lower their stakes, for diversification or consumption purposes. These original owners often have a holdup period before they can start divesting their stakes. Improved liquidity of the firm's shares would lower the price impact at the time of such sales. Most such cases would be registered as insider trades, which we have access to. We therefore use the number of insider trades in the period after the DMM initiation to measure such cases. To proxy for the *exit* decision by insiders, we count the number of large[20] sales by insiders. This is an ex post measure. As an ex ante measure we believe that this explanation is most likely to be valid for recently listed firms, and use a dummy for whether the firm listed less than two years earlier.

There are however a number of additional factors that are likely to influence whether a firm hires a DMM. One is the current liquidity of the stock. If it is already liquid, there is no need to hire a DMM to improve liquidity. This feature of the data was discussed earlier, and illustrated by the histograms in figure 2, where we saw that for the firms traded every day, or with very low spreads, there were few DMM contracts. To account for this in our empirical specification we exclude firms which already have liquid stocks, and only consider those for which hiring a DMM is a relevant option. We choose to base the selection on the number of trading days: If the firm, in the year before the one we are considering, traded more than 90% of the days, we remove the firm from the sample.[21]

4.2 Results

We report the results of modeling the decision to hire a DMM as a probit regression.[22] We do the probit analysis for two slightly different specifications of the decision. In the first, we only look at the decision to hire a DMM; i.e. *the first time the firm hires a DMM*. Success in the probit is that the firm hires a DMM for the *first time* this year. The results for this formulation is shown in table 6. The alternative is that the firm does not have a DMM.[23] In the second specification, shown in table 7, we also include the decision to keep the DMM contract going for one more year as success in the probit, and contrast that to not having a DMM. Hence, here we do not distinguish between firms that already have had a DMM in the past and those that hire a DMM for the first time.

When reporting the results from the analysis we group the explanatory variable into those available *ex ante* (Q, planned repurchases, and listing age) and those only available *ex post* (Issuing equity, actual repurchases, and actual insider trades). In both tables, we split the results into separate panels for the ex ante and ex post analysis. Furthermore, in each panel we present

[20] We use insider transactions larger than 50 thousand NOK (About 10 thousand USD) in value.

[21] We could alternatively have based the exclusion on the relative spread, but we chose the number of trading days as less endogenous than the spread, which is the criterion the contract is written on. We have in unreported analysis also looked at a sample selection where we remove stocks with low spreads, and find similar results.

[22] We have in unreported estimations also considered a logit formulation. The overall conclusions from those regressions are similar to the ones with a probit formulation.

[23] In this formulation we remove the firms that have already hired a DMM sometime in the past.

various specifications, where each column contains the results for one specification. Starting on the left, we have a specification with most of the possible explanatory variables, and then have less comprehensive specifications moving to the right. Note that the number of observations change. This is due to differences in availability of some proxies, such as sales growth, for which we need accounts two years earlier. We choose to include the maximal number of observations in each Probit estimation.[24]

[Table 6 about here.]

[Table 7 about here.]

Let us first look at proxies related to future capital needs. Looking at the ex ante specifications (panel A) in tables 6 and 7, we see that Q is always positive and highly significant. A positive coefficient should be interpreted as increased probability of hiring a DMM. Since Q is commonly used as a measure of growth opportunities, this is supportive of our argument that firms that are more likely to need capital are those that hire a DMM. However, estimates of Q are noisy estimates of growth opportunities,[25] so this is not unambiguous support. We therefore also look at other proxies for this. As discussed earlier, we use as an alternative ex-ante variable sales growth in the year of the DMM initiation. Here we find, however, that sales growth is not significant. There may be several reasons for this. First, the number of observations is much lower in this estimation, due to the need to have a long sales history to estimate sales growth. Sales growth is also a more noisy variable, since it is based on year-to-year accounts. If we alternatively consider the ex post formulation, where we use the actual capital issuance as a proxy, we see that this is always positive and significant in the regression where we look at the first time hiring of a DMM.[26] It is similarly positive in the specification where we also include the rehiring of a DMM, but not always significant. The positive coefficient shows that firms that engage a DMM, also issue more equity in the following years, compared to those firms that do not have a DMM. Overall, the results support that capital needs are a significant determinant of the decision to hire a DMM.

Let us next look at stock repurchases. In all but one case the coefficient is positive, indicating that repurchasing firms are more likely to hire a DMM. The significance is however less than for capital needs. In particular the ex ante variable, that the firm has a repurchase program in place, is never a significant determinant for the first time hire of DMM, but is significant for the

[24] We could alternatively have done the analysis only on the subsample of firms for which we have all available data. We have done this in unreported analysis. While there are some differences in p-values and coefficients, due to the lower number of observations, the major picture from this analysis is similar to what we report in the paper.

[25] Q is typically estimated as stock market values divided by book values. For example would overvaluation of the stock push up Q. Another issue is that the book values rely on accounting choices that may be tax motivated. Accounting choices may also be systematically different across industries.

[26] This ex post result correspond to a result in a (Anand et al., 2009, page 1438), where in a hazard function formulation they find that a measure of changes to future equity (equity issuance/stock splits, etc) were a determinant of the propensity to hire a DMM, albeit only with a 10% p-value.

specification where we also include cases where the firm rehires DMM. This can be an indication that repurchases is a more important argument for keeping the DMM agreement going. These results are much clearer for the ex post variable, where we use actual repurchases. This can be due to the ex ante variable being more noisy. A firm may want to get the annual meeting's approval of a repurchase "just in case" they may want to repurchase, it is not a *commitment* to repurchase. The actual repurchases are therefore a better proxy. Overall, we do find that repurchases matter for hiring of DMM, and maybe stronger for *rehiring* a DMM.

Finally, we consider exit by founding shareholders. Here the ex ante proxy, the age of the firm, is never significant, although it is consistently positive. But as with repurchases, the ex ante proxy in this case is rougher than the ex post one. Just using the age has no information about the actual ownership structure at the first listing. Here the actual ex post insider sales should be a better indication. When we look at the results for this ex post variable, we find that it is always significantly positive for the first time hire, but only for one of the specifications when we include rehires in the sample.

Let us also comment on the control variable, liquidity. The coefficient on this is negative, firms with higher spreads are less likely to hire a DMM. Remember that we have removed the most liquid stocks from the sample. It therefore makes sense that the ones with relatively better liquidity *in this sample* are those that consider a DMM contract. The cost for the firms with the highest spread would probably be prohibitive.

Let us finally comment on one analysis we have *not* been able to do. In our sample we have a few cases of DMM terminations. Some of these were due to the firm choosing to stop paying for the service, other were due to the DMM firm terminating the service.[27] It would of course be very interesting to analyze these cases, but unfortunately there are not enough observations in our sample to do any reliable statistical inference using them, so we have had to forgo analysis of these events.

To conclude, in our indirect analysis we find evidence consistent with all three of our hypotheses, that future capital needs, plans for repurchases, and need for exit by founding shareholders, all increase the likelihood that a firm will hire (or rehire) a DMM. The strongest evidence is for the capital needs explanation.

5 Does hiring a DMM affect the firm's cost of capital?

Let us now look at the second potential channel through which the hiring of a DMM may affect firm value, cost of capital. We do this with an asset pricing approach. We estimate an asset pricing model that also include liquidity risk as a priced risk factor. In this setting we first ask whether the hiring of a DMM affect the loading on the liquidity risk factor, which we confirm. We then use

[27] The Icelandic bank Kaupthing is one example, they had quite a number of DMM contracts, which were terminated suddenly when Kaupthing went south in the Icelandic Banking Crisis.

a measure of the (per unit) risk premium associated with liquidity risk to estimate the magnitude of the effect on the cost of capital.

5.1 Liquidity as a risk factor at the OSE

To investigate liquidity risk we consider the following two-factor asset pricing model,

$$er_{it} = a_i + \beta_i^m er_{mt} + \beta_i^{liq} LIQ_t + e_t \tag{2}$$

where er_{it} is the excess return of stock i on day t. In this formulation the first terms: a_i a constant term, er_{mt}, the excess return on the market on day t, and β_i^m, stock i's loading on the market factor corresponds to the formulation of a standard CAPM single factor model. To measure liquidity risk we use a domestic liquidity factor, constructed in a similar way as the Fama and French size and book/market factors. The liquidity factor (LIQ) is constructed as a difference between the returns of a liquid portfolio (low spread) and a illiquid portfolio (high spread). This particular specification was shown in Næs et al. (2009) to do a good job in pricing the cross-section of Norwegian stocks. In fact the model using the market and liquidity factor (LIQ) did as well as the the more standard Fama-French three factor model in pricing the Norwegian cross-section. The domestic pricing factors (er_m) and (LIQ) are downloaded from the homepage of Bernt Arne Ødegaard.[28]

For our purposes, the interesting coefficient is β_i^{liq}, stock i's loading on the liquidity risk factor. In general, a large positive β_i^{liq} coefficient means that the stock has high liquidity risk, while a low (or negative) coefficient means that the stock has low liquidity risk. To illustrate the typical values for these loadings, in panel A of table 8 we show results for estimating the factor model (2) for liquidity-sorted portfolios for the whole exchange. Looking the liquidity beta estimates at the right of the table, we see that for these portfolios the liquidity risk loadings (β_i^{liq}) range from -0.63 to $+0.54$.

[Table 8 about here.]

In addition to coefficients on the LIQ factor, we need to look at the *liquidity risk premium* of the market as a whole. To estimate this we add the cross-sectional pricing restriction (3) to the set of asset by asset equations (2)

$$E[er_i] = \lambda_0 + \lambda_m \beta_i^m + \lambda_{liq} \beta_i^{liq} \tag{3}$$

For a set of assets/portfolios, estimating a system where one imposes both equations (2) and (3) jointly provides an estimate of the (per unit) price of liquidity risk, namely the coefficient λ_{liq}. In

[28] This is a data library similar to that of Ken French, but for the Norwegian Crossection. See the discussion of variables in appendix B.

panel B of Table 8 we present the risk premia estimates for this two factor model. The estimate of the liquidity risk premium, $\widehat{\lambda}_{liq}$, equals 0.012.

5.2 Changes in liquidity risk

Let us now turn to investigating what happens as a firm hires a DMM. In our asset pricing setting, if the presence of a DMM reduces the liquidity risk, we would expect the liquidity risk in the stocks of firms that hire a DMM to decrease after the DMM starts market making. If the presence of a DMM reduces the liquidity risk this would result in changes of the estimates of β^{liq}.

Panel A in Table 9 shows the average and median liquidity beta (β^{liq}) estimated using data one year before the firm hires a DMM ("Pre DMM"), and one year after the hiring ("post DMM"). Both the mean and median liquidity beta before the DMM contract is positive and is reduced after the DMM hiring. This drop in liquidity beta is highly significant both with respect to the mean as well as the median. Thus, in support of our conjecture, the stocks of firms that hire a DMM experience a significant reduction in liquidity risk.[29]

To further investigate how the liquidity risk changes, in panel B of Table 9 we split the DMM stocks into 10 portfolios of stocks based on their pre-DMM liquidity beta, with P1 being the portfolio with the lowest pre-DMM liquidity beta and P10 containing stocks with the highest pre-DMM liquidity beta. The table shows that liquidity betas of these portfolios vary in magnitude between -0.43 for P1 to $+1.34$ for P10. After the DMM hire we observe liquidity betas much more similar across portfolios, both with respect to sign and size. Interestingly, we also find that stocks that had the lowest (most negative) pre-DMM liquidity beta (stocks in P1), experience a significant increase in liquidity risk loading. With respect to the portfolios with higher pre-DMM liquidity risk, we see that these stocks generally experience a significant decline in the liquidity risk loading.

[Table 9 about here.]

[Figure 5 about here.]

To show that the results are robust also for the median firm, Figure 5 plots the pre-DMM (grey and white bars) average and median liquidity beta across stock groups and the post-DMM liquidity betas (solid and dotted lines). Overall, there seems to be strong support for the conjecture that hiring a designated market maker with a contractual obligation to keep the spread at or below a maximum level reduces the liquidity risk for these stocks.

5.3 Liquidity risk premium

Comparing the liquidity risk loadings for all stocks in Panel A of Table 8 with the loadings on the liquidity factor before and after the DMM hiring in Table 9, we see that the average pre-DMM

[29] As a robustness check of this result we have also performed the analysis using a Fama/French model augmented with the liquidity risk factor. We find a similar change in liquidity risk in that more comprehensive model.

liquidity beta (0.16) is similar to the loading for stocks in the upper range of liquidity portfolios (portfolios 7 and 8) in Table 8. However, after the firm has hired the DMM, the liquidity beta becomes negative and closer to what we find for the more liquid stocks on the exchange (portfolios 4 and 5), indicating a reduction in the liquidity risk of these firms. However, looking only at the risk loadings does not let us evaluate the economic significance associated with the reduction in liquidity risk for DMM stocks. To measure this significance we look at the pricing implications of the reduction in liquidity risk.

To get a measure of the economic magnitude of the liquidity effect, we can use the estimated liquidity risk premium $\hat{\lambda}_{liq} = 0.012$ to calculate the annual reduction in expected returns due to the hiring of a DMM. Combining the premium with the reduction of 0.21 in the loading on liquidity risk found in Table 9, we would calculate the change in required return as $(1+(0.012 \cdot 0.21))^{12} - 1 \approx 3\%$. In other words, on average the required return for firms that hire a DMM is reduced by about 3% in annualized terms. If we look at the median change, which would be more robust to outliers in our estimates, we would infer the drop in required return to be about 2% per year. This suggest that the hiring of a DMM has a significant impact on the firm's cost of raising equity capital which is large enough to justify the fee that the firm pays to the DMM.

6 The Economics of the Results and Managerial Implications

Let us now take stock of our results, and again look at them in terms of our original question. How can a firm justify paying a cash fee just to improve liquidity?

First, we have identified what looks like a link between future capital markets operations and the hiring of a DMM, but we did it in an indirect manner. One way to evaluate to what degree our results are reasonable is to ask whether it makes sense in terms of the economic magnitudes involved. Simply put, are the potential cost savings large enough? Let us look at one of these capital market events, issuing equity. How large are the potential cost savings? While these are not observable, we can do some back-of the envelope calculations of expected annual costs for a typical company at the Oslo Stock Exchange. First, given that a firm issues equity, what is the cost? We have some evidence on these costs in the Norwegian market, in Kvaal and Ødegaard (2011). If we for example look at targeted equity issues[30] in the 2000-2010 period, the typical equity issue is a 10% increase in the firm's equity capital. From the firm's point of view, the most important component of the costs of issuing equity is underpricing, new equity is issued at a lower price than the current stock price. For the period in question, the median underpricing was 7.2%. We do not know by how much this underpricing is lowered by having a DMM, but we can use the difference in underpricing between small and large companies to give an indication. For the same period, the median underpricing for the smallest half of companies at the OSE was 9.1%, while the same

[30] We do not include the rights issues, as the underpricing is not as clearly a cost. In a rights issue the underpricing is part of the compensation to the current shareholders.

number for the largest half of OSE companies was 5.3%. If we use the difference between these two as an estimate, a firm can lower the underpricing by 3.8 percentage points by hiring a DMM. What is this number in NOK terms? From table 2 we see that the median firm with DMM's have a value of 850 million NOK. The potential cost saving is in other words of the magnitude of NOK 850 mill $\times 10\% \times 3.8\% = 3.23$ mill.[31]

Now, this is the cost once the decision to issue has been made, but any given firm will only have expectations about whether it needs capital, and the expected cost in any given year is the probability of capital issue times the 3.2 million NOK we just estimated. We can also estimate this probability from the record of equity issuance at the OSE. In the ten year period we are looking at there were a total of 933 targeted equity issues at the OSE, or 93 issues a year. If we use the frequency of equity issuance as an estimate of the probability, we need to divide this number by the number of firms at the exchange each year. The typical cross-section at the OSE has about 250 listed shares, giving an estimated probability of a targeted equity issue of $\frac{93.3}{250} = 37\%$. With this probability we would estimate the expected annual cost of a new issue as NOK 3.2 mill $\times$ 37% = 1.2 million NOK.[32] When we compare this number with annual costs of keeping a DMM in the three hundred thousand region, the potential costs savings from having a DMM when issuing equity are clearly large enough to be of first order importance in the decision to hire a DMM.

Let us next look at the implications of our estimates of how improved liquidity changes the cost of capital. In fact, these seem to be too good to be true. Let us go back to the basic valuation equation. If we ignore the annual costs we would calculate the new value as,

$$V = \frac{X}{r - \text{liquidity premium decrease}}.$$

If for example the current cost of the capital r is 10%, a 2.5% lowering of the liquidity premium would indicate an increase in firm value by a third. Even though the typical cost of capital for these firms is higher than 10%, it still seems like a large valuation effect from a simple increase in the liquidity of the firm's equity. It also seem to run counter to the typical Miller Modigliani intuition that one needs to affect the firm's operations before changes to financing matters. However, it can be argued that a lowering of cost of capital is actually going to affect the firm's operations, as a lower cost of capital will make more positive NPV projects feasible.

If we take our result as given, a significant lowering in the liquidity premium, it would indicate that there are significant public benefits from improving liquidity, much above the costs paid by the firm. In fact, given the public goods nature of liquidity, our results indicate that it may be desirable to subsidize liquidity provision in equity markets.

[31] This is about half a million USD, the exchange rates in December 2010 were NOK/USD=6.15 and NOK/EUR=8.06.

[32] This is actually a lower limit, since firms that are likely to need capital have presumably higher probabilities of issuing equity than this average.

These "back of the envelope" calculations show the managerial implications of our results. Our estimates give the necessary inputs for managers to evaluate the tradeoff between paying a cost for hiring a DMM, and the benefits for the corporation in doing so. In particular we show that an important determinant of this decision for the corporation is its short-term capital needs, or other activity in the secondary market. The manager should be estimating such needs, calculate the present value of potential cost savings, and compare this to the quotes of cost from the DMM firms.

7 Conclusion

We have investigated what motivates firms to spend cash hiring designated market makers (DMM) to provide liquidity in the firm's stock. We argue that from a corporate finance view, this should primary be influenced by whether the firm expects to interact with the capital markets in the near future. Using data from the Oslo Stock Exchange we confirm this hypothesis, and show that measures relevant for the likelihood of the firm to go to the capital markets are significant determinants of firm's decisions to hire a DMM.

Liquidity in the trading of the firms stock is thus mainly valuable *to the firm* because of the stock markets primary role for the stock issuers, i.e. raising of new capital. Phrasing the result this way also show why the result of this paper has wider implications. If we go back to the literature on the interaction of corporate finance and the liquidity of a company's stock, the liquidity is shown to interact with the cost of capital of the firm. But this literature still have not faced the disconnect between the liquidity of trading in the secondary market (the stock market) – to the firm, all that happens is the replacing of one owner by another – and internal investment decisions in the firm, where the cost of capital is influenced by the liquidity of the stock. Our results points to an economic channel giving such results. What matters is the *potential* for raising capital through equity markets. Liquidity matters because it affects the terms at which new capital is raised.

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Appendices

A List of firms used

In this appendix we provide detailed lists of the companies used in the analysis. We show the periods during which the firms employ a DMM to make the market. We also provide the period through which the firms is listed, an indication of the size of the firm, and the industry of the firm. to show the size, we give the size quartile, where 1 is the quarter of the firms with lowest size, and 4 with highest size. Industry is indicated with one of the 10 different GICS classifications[33]

[33]GICS (Global Industry Classification Standard) (GICS) is an industry categorization developed by MSCI and Standard & Poor's.

Table A.1 List of firms employing a DMM.

	Date MM		Listing dates		Industry	Size
Company	start	end	first obs	last obs		quartile
24SevenOffice	1 oct 2008	30 mar 2010	22 jun 2007	–	45	1
Active 24	1 mar 2006	5 oct 2006	12 nov 2004	23 aug 2006	45	1
Active 24	1 apr 2005		12 nov 2004	23 aug 2006	45	2
AF Gruppen A	1 feb 2010		8 sep 1997	–	20	4
AF Gruppen A	3 feb 2005	31 jan 2010	8 sep 1997	–	20	3
Natural	6 sep 2005		27 jan 1998	–	35	2
Borgestad A	18 apr 2005		2 jan 1980	–	20	2
Algeta	1 oct 2007	1 aug 2010	27 mar 2007	–	35	2
Allianse	21 nov 2005	19 jun 2006	25 may 2005	22 jun 2006	45	2
Apptix	21 jul 2006		8 apr 2002	–	45	2
Artumas Group	10 may 2006	10 sep 2006	8 jul 2005	–	10	2
Aurskog Sparebank	1 apr 2010		12 aug 1998	–	40	1
Axxessit	27 jan 2005	7 sep 2005	4 jun 2004	2 aug 2005	45	2
Belships Co.	12 jan 2005		2 jan 1980	–	20	2
Biotec Pharmacon	2 jul 2007	25 jan 2009	4 nov 2005	–	35	2
Biotec Pharmacon	26 jan 2009	28 feb 2010	4 nov 2005	–	35	1
Bluewater Insurance	13 oct 2005	1 apr 2009	13 oct 2005	5 aug 2010	40	2
Bluewater Insurance	1 apr 2009	21 jun 2010	13 oct 2005	5 aug 2010	40	1
Borgestad A	1 oct 2008		2 jan 1980	–	20	2
Clavis Pharma	13 oct 2006		7 jul 2006	–	35	2
Clavis Pharma	20 dec 2007		7 jul 2006	–	35	2
Component Software Group	12 apr 2007		20 sep 2000	18 sep 2007	40	1
Comrod Communication	13 nov 2007		22 jan 2007	–	20	1
Confirmit	6 jul 2006	16 jul 2008	6 dec 2005	7 aug 2008	45	2
Conseptor	1 oct 2004		24 jun 2004	2 may 2007	30	3
ContextVision	6 jul 2005	25 jan 2009	17 mar 1997	–	35	1
ContextVision	13 jan 2009		17 mar 1997	–	35	1
Copeinca	3 aug 2009		29 jan 2007	–	30	2
DiaGenic	24 mar 2009		27 aug 2004	–	35	1
DiaGenic	27 feb 2006		27 aug 2004	–	35	2
Dockwise	4 sep 2008	5 mar 2009	2 oct 2007	–	10	4
Dolphin Interconnect Solutions	20 dec 2006	13 mar 2009	20 apr 2006	–	45	1
Eidesvik Offshore	23 may 2006		27 jun 2005	–	10	3
Teco Maritime	14 jun 2005		31 oct 1997	–	10	1
Teco Maritime	18 jul 2007		31 oct 1997	–	10	1
Exense	8 feb 2008	31 dec 2008	15 aug 2000	2 apr 2009	45	1
Exense	11 oct 2006	7 feb 2008	15 aug 2000	2 apr 2009	45	1
Expert	15 jul 2004	12 jul 2007	14 apr 2000	20 sep 2007	25	4
Fairstar Heavy Transport	3 aug 2009		17 nov 2006	–	20	1
Fairstar Heavy Transport	17 nov 2006	16 oct 2008	17 nov 2006	–	20	3
Fairstar Heavy Transport	27 oct 2008		17 nov 2006	–	20	2
Fara	4 jan 2010		16 dec 2005	–	45	2
Confirmit	6 jul 2006		6 dec 2005	7 aug 2008	45	2
Guinor Gold Corporation	10 sep 2004	3 apr 2006	4 may 2004	2 mar 2006	15	3
Haag	16 nov 2004	2 jan 2006	1 apr 1992	20 feb 2006	20	2
Hafslund Nycomed A-aksjer	1 mar 2010		2 jan 1980	–	55	4
Hafslund Nycomed B-aksjer	1 mar 2010		20 oct 1988	–	55	4
Hafslund Infratek	9 sep 2008	2 mar 2009	5 dec 2007	–	10	2
Norwegian Applied Technology	19 dec 2007		30 jan 1997	–	45	3
Hurtigruten	20 feb 2008	16 feb 2009	1 mar 2006	–	25	2
I.M. Skaugen	9 nov 2009		18 feb 1997	–	20	2
I.M. Skaugen	26 apr 2005	26 oct 2009	18 feb 1997	–	20	3
IMAREX	1 mar 2007	16 feb 2009	4 apr 2005	–	40	2
IMAREX	16 feb 2009		4 apr 2005	–	40	2
Indre Sogn Sparebank	10 may 2010		20 jan 1997	–	40	1
Hafslund Infratek	2 feb 2010		5 dec 2007	–	10	3

Table A.1 List of firms employing a DMM. (Continued).

Company	Date MM start	Date MM end	Listing dates first obs	Listing dates last obs	Industry	Size quartile
Inmeta	1 feb 2005	29 feb 2008	8 oct 1999	–	45	1
Intelecom Group	1 aug 2008	5 dec 2008	13 jun 2001	12 dec 2008	45	1
Sonec	4 apr 2005	1 mar 2006	16 jan 1998	–	45	2
Sonec	17 dec 2008		16 jan 1998	–	45	2
Kongsberg Automotive	29 nov 2007		24 jun 2005	–	25	3
London Mining	12 feb 2009		9 oct 2007	–	15	2
London Mining	30 jan 2008	10 oct 2008	9 oct 2007	–	15	3
Luxo	18 oct 2007	28 feb 2009	15 may 1998	18 may 2009	20	1
Mamut	15 nov 2006	20 may 2009	10 may 2004	–	45	2
Mamut	20 may 2009		10 may 2004	–	45	2
Norstat	10 oct 2005	3 may 2006	23 sep 2005	16 jan 2008	30	1
Norstat	26 jun 2006		23 sep 2005	16 jan 2008	30	1
Norstat	14 may 2007		23 sep 2005	16 jan 2008	30	1
NattoPharma	12 jun 2009		30 jan 2008	–	35	1
NattoPharma	30 jan 2008	30 sep 2009	30 jan 2008	–	35	1
Natural	6 sep 2005		27 jan 1998	–	35	2
Navamedic	31 mar 2006	1 dec 2008	31 mar 2006	–	35	1
NEAS	13 nov 2007	10 aug 2009	23 mar 2007	–	40	1
Nes Prestegjelds Sparebank	1 jan 2010		19 oct 1998	–	40	1
NorDiag	27 aug 2008	23 nov 2008	14 dec 2005	–	35	1
Nordic Mining	4 feb 2008	23 nov 2008	14 sep 2007	–	15	1
Norway Pelagic	14 jan 2009		24 jun 2008	–	30	1
Nutri Pharma	15 mar 2006		5 may 2000	–	35	2
Nutri Pharma	15 apr 2010		5 may 2000	–	35	1
Ocean HeavyLift	3 dec 2007	13 oct 2008	4 may 2007	30 dec 2008	10	3
Ocean Rig	16 nov 2004	31 mar 2008	7 jan 1997	1 jul 2008	10	3
Storli A	29 jun 2005		5 may 1986	–	20	4
Storli B	29 jun 2005		12 may 1989	–	20	4
Odfjell Invest	20 mar 2007	10 jul 2008	1 jun 2006	22 dec 2008	10	3
Office Line	1 feb 2005	24 may 2006	7 nov 2000	1 jun 2006	45	1
Photocure	24 sep 2007	28 feb 2009	29 may 2000	–	35	3
Photocure	24 sep 2009		29 may 2000	–	35	2
Polimoon	25 jul 2005	18 mar 2007	26 apr 2005	5 jan 2007	15	3
Powel	2 nov 2005	1 oct 2006	24 oct 2005	22 jan 2010	45	2
Profdoc	16 jan 2008		28 may 1998	8 jul 2008	35	2
Profdoc	26 may 2005	30 jan 2006	28 may 1998	8 jul 2008	35	2
Rieber & Son	4 oct 2004		2 jan 1980	–	30	4
RomReal	4 aug 2008	10 aug 2010	11 jun 2007	–	40	2
RomReal	8 jun 2007		11 jun 2007	–	40	2
Rygge-Vaaler Sparebank	18 may 2010		1 nov 2005	–	40	1
Scana Industrier	27 may 2009		4 dec 1995	–	10	3
Scandinavian Clinical Nutrition	5 jun 2008	5 may 2009	22 nov 2007	17 sep 2009	30	1
Siem Offshore	13 nov 2009		12 aug 2005	–	10	3
Simrad Optronics	9 jan 2009	7 jun 2010	7 jul 2005	5 jul 2010	20	1
Simtronics	8 jan 2007		5 jan 2007	–	20	1
Spits	21 nov 2006		12 dec 2006	5 jul 2007	25	1
SuperOffice	28 feb 2007	16 sep 2008	10 mar 1997	14 oct 2008	45	2
Synnve Finden	9 sep 2005	30 nov 2006	6 jul 1998	13 aug 2009	30	2
Synnve Finden	18 mar 2005	3 jan 2006	6 jul 1998	13 aug 2009	30	2
Synnve Finden	25 sep 2006		6 jul 1998	13 aug 2009	30	2
Teco Maritime	18 apr 2005		22 jun 2004	–	20	2
Toten Sparebank	1 feb 2010		18 dec 1995	–	40	2
Trefoil	5 dec 2005	14 jul 2008	20 dec 2005	8 aug 2008	10	3
Trolltech	12 jan 2007	7 apr 2008	5 jul 2006	6 jun 2008	45	2
TTS Technology	20 sep 2004		2 may 1995	–	20	2
VIA Travel Group	7 jul 2005	11 oct 2005	9 jun 2005	12 oct 2005	30	2
Vizrt	13 sep 2006		12 may 2005	–	45	3
Zoncolan	18 jun 2007		15 jun 2007	–	40	1

B Variable definitions

In this appendix we provide full definitions and descriptions of the variables employed in the analysis.

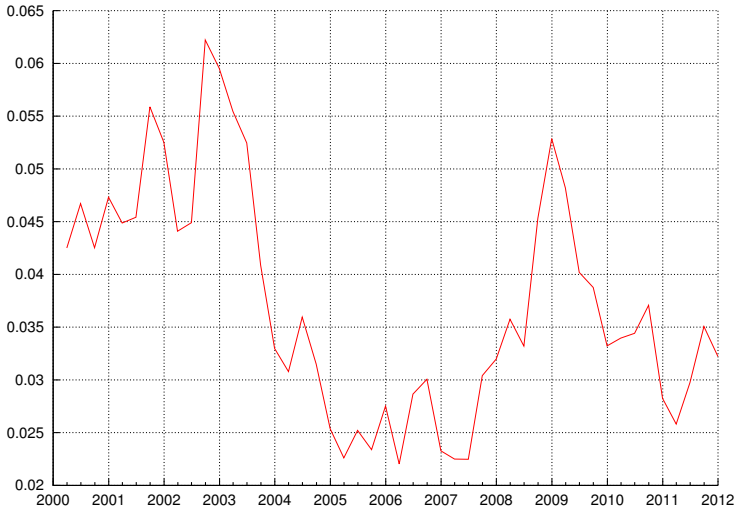
- β - Risk measure, sensitivity of asset returns to changes in pervasive risk factor.
  - β_i^m - Sensitivity of stock return to changes in asset returns, coefficient in regression $er_i = \alpha_i + \beta_i^m er_m + \cdots + \varepsilon_i$.
  - β_i^{LIQ} - Sensitivity of stock return to changes in asset returns, coefficient in regression $er_{i,t} = \alpha_i + \cdots + \beta_i^{LIQ} LIQ_t + \cdots + \varepsilon_{it}$.
- λ - Risk measure
  - λ_m - Estimated from crossectional restriction $E[er_i] = \lambda_m \beta_i^m + \cdots$
  - λ_{LIQ} - Estimated from crossectional restriction $E[er_i] = \cdots + \lambda_{LIQ} \beta_i^{LIQ}$
- **Amihud** is the Amihud (2002) illiquidity measure, estimating the *elasticity* of stock prices to volume. It is estimated as
$$Amihud = \frac{Vol}{|r|}$$
- **Equity issue** - Ask whether a company has made a Seasoned Equity Offering, raising new capital, within some given time period.
- $\mathbf{er_m}$ is the excess return on the market portfolio. The returns are available from the homepage of Bernt Arne Ødegaard at `http:///www1.uis.no/ansatt/odegaard`.
- **Firm size** is total value of the firm's assets at year-end.
- **Fraction of year traded** is the fraction of the trading year with trades in the stock. We count the number of days during a year when there was trading in the stock, and measure this relative to the maximal possible days this stock could have traded (If it e.g. was listed during the year, we only count the days the stock potentially could have traded).
- **GICS** - Classification system for industry, see S&P web pages for definitions.
- **Have DMM**. Dummy variable equal to one if a firm has had a DMM at some point during a given calendar year.
- **Hire DMM**. Dummy variable equal to one if a firm hires a DMM during a given calendar year.
- **Inside trades** - Equity trades made by the firm's legal insiders. These insiders include the CEO, members of the firm's top administration and members of the Company's Board. All such trades must be reported to the exchange. All these reports are collected and aggregated to find the trading by the firm's insiders. In some cases we only sum the *sales* by insiders.

- **LIQ** - Asset pricing factor constructed to measure exposure to liquidity risk. The factor is constructed similarly to the Fama and French factors, but as a difference between a high liquidity and a low liquidity portfolio. The factor is downloaded from the data library of Bernt Arne Ødegaard, available from his homepage.
- **Listing Period**. Time a stock has been listed on the Oslo Stock Exchange.
- **LOT** - The Lesmond et al. (1999) estimate of transaction costs. It estimates the implicit transaction cost consistent with the (lack of) price movement in a stock when the market moves. We estimate this using stock returns and an equally weighted market index for the OSE, using asset prices for a given time interval, such as a half year or a year.
- **Operating income** is the accounting income for the company.
- **Q** is an estimate of Tobins' Q, estimated as the market value of the firm's asset over the book value.
- **Relative Spread**: The Relative spread is measured as the difference between the best bid and best offer price, divided by the midpoint price (the average of the bid and offer price). The relative spread is measured every day at the closing of the Oslo Stock Exchange. In the paper we use averages of this spread over varying horizons, such as quarterly, biannually and annually.
- **Repurchase** - Measure repurchase activity during a given period. Two specifications:
  - *Planned Repurchasers* is the fraction of companies that have an active repurchasing plan at yearend,
  - *Actual repurchasers* is the fraction of companies that repurchases stock during the year
- **Sales growth** is the percentage change in the firm's operating income.
- **Size quartile**. We calculate the total value of the firm's equity at yearend. This is used as a ranking measure to group the firm's into four "size quartiles," where quartile 1 contains the smallest firms on the exchange, and quartile 4 the largest firms.
- **Spread**: The spread is measured as the difference between the best bid and best offer price (in Norwegian kroner, NOK) using the closing bid and ask price at the exchange.
- **Turnover** is the average fraction of the firms outstanding stock that is traded over the year. It is calculated as the daily turnover (trading volume/no shares outstanding that day) summed over all trading days of the year.

Figure 1
Time series of relative spreads at the OSE

The figures show time series of relative spreads. The relative spread is the difference between the best closing bid and offer at the OSE, divided by the quote midpoint. We calculate the relative spread for each stock traded at the OSE on each date. In the figures we use the quarterly average of the daily relative spreads. In Panel A we show the time series of the average quarterly relative spread for all firms at the Oslo Stock Exchange. In Panel B we first group the firms into quartiles sorted by the value of equity of each firm, and then take the average relative spread for each of the four quartiles. All averages are equally weighted. See appendix B for detailed definitions of the variables.

Panel A: Average for whole market



Panel B: Average spreads for four size groups

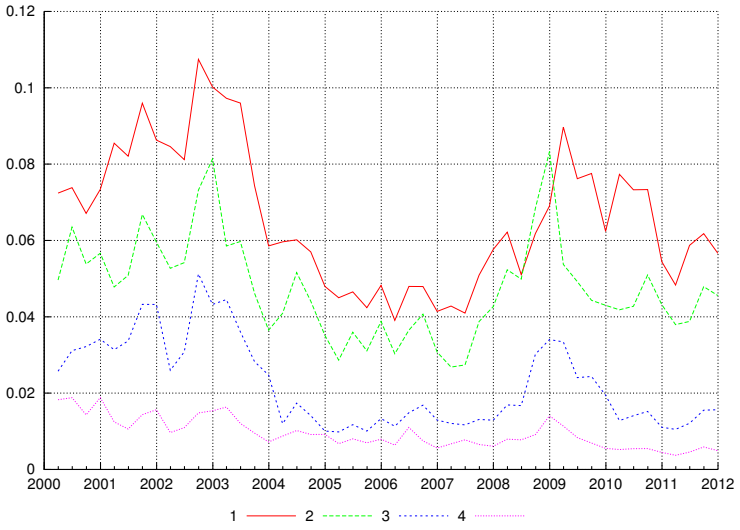
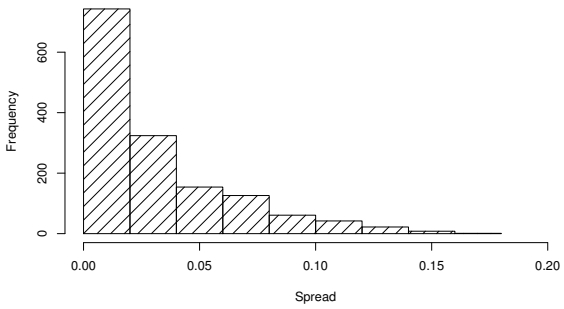


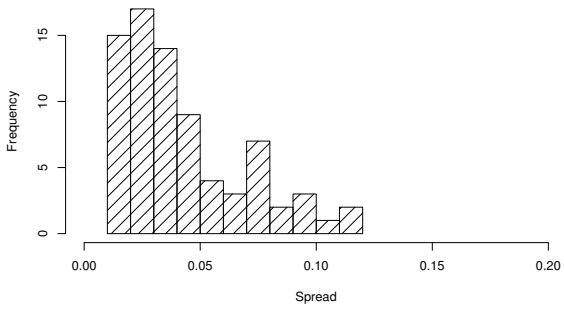
Figure 2
Distribution of liquidity for DMM and non-DMM stocks

The figures show histograms of the distribution of two measures of stock liquidity, average annual relative spread and fraction of year traded. The panels shows empirical probability distributions for two groups of firms. The lefthand panels (A and C) only use the firms on the exchange that do not have a DMM. The basis for the figure is firm years, each year we check whether the firm has had a DMM at some point during the year. If it has, this stock is in the group of DMM users, and removed from the sample. In righthand panels we instead only consider the firms which hire a DMM. For this sample we show the distribution of the liquidity using data for the one year period before the firm hired the DMM. We use the same x axis for the two pictures to make them more easily comparable. See appendix B for detailed definitions of the variables.

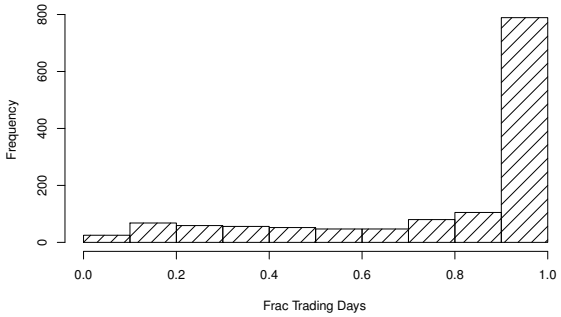
Panel A: Stocks without DMM



Panel B: DMM hirers (before hiring)



Panel C: Stocks without DMM



Panel D: DMM hirers (before hiring)

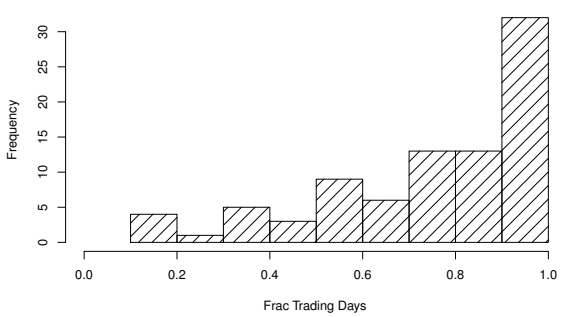
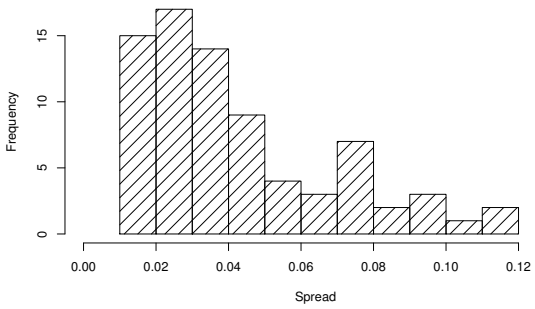


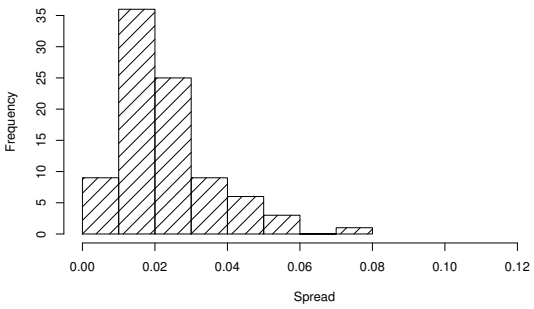
Figure 3
Changes in relative spreads around DMM hires

The figures show histograms illustrating the distribution of two liquidity measures: Relative spread and fraction of year traded. Panels A and C show the distribution one year before the DMM contract starts running, while panels B and D show the corresponding liquidity measure for the year after the initiation. In the sample we only use the first time the firm hires a DMM. In the calculation of the year after DMM initiation we remove periods without a DMM if the DMM services stops within that year. See appendix B for detailed definitions of the variables.

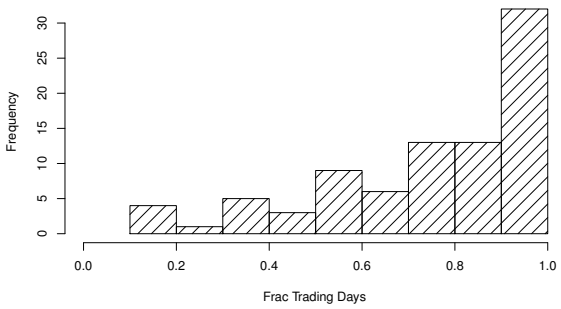
Panel A: Year before DMM start



Panel B: Year after DMM start



Panel C: Year before DMM start



Panel D: Year after DMM start

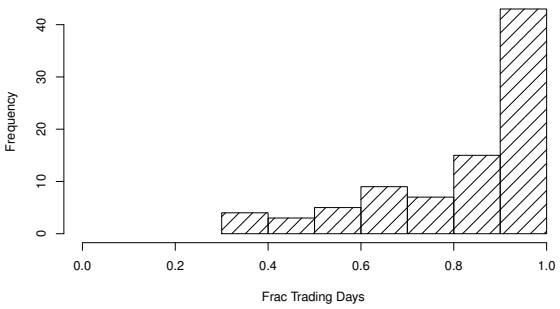


Figure 4

Event study, announcement date of DMM

The figure shows the results of an event study centered around the date when a DMM contract is announced. The figure plots the average cumulative abnormal return (CAR), where CAR is calculated relative to the market model. The event study is done using the standard methods, as for example exposited in Campbell, Lo, and MacKinlay (1997). Specifically, for each stock i and date t we calculate $AR_t = r_{it} - (\widehat{\alpha}_i + \widehat{\beta}_i(r_{mt} - r_{ft}))$, where AR is the abnormal return, r_{mt} the market return, and $\widehat{\alpha}_i$ and $\widehat{\beta}_i$ the estimated parameters. We use an equally weighted stock market index for the market. The figure shows the cumulative abnormal return (CAR) from 5 days before the DMM announcement (at t=0) to 5 days after the DMM announcement. We only use stocks for which we can identify the announcement date from the OSE news feed. See appendix B for detailed definitions of the variables.

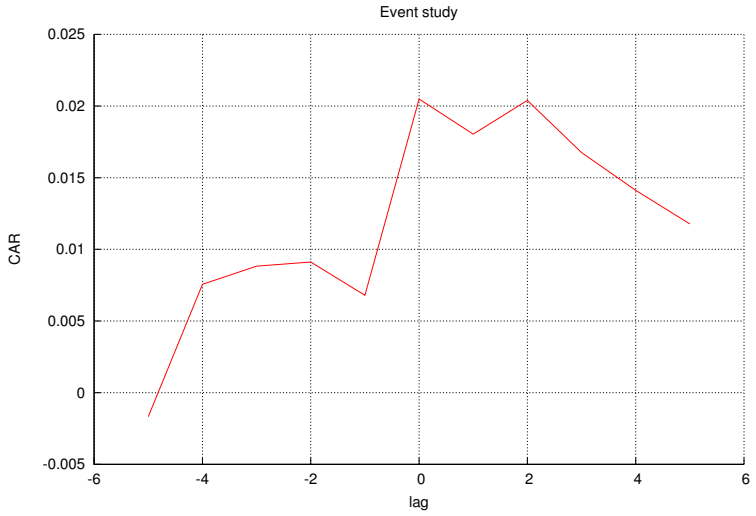


Figure 5
Pre- versus post-DMM liquidity beta

The figure shows the average and median of estimated liquidity beta before and after the firm having a DMM. We group stocks into ten portfolios based on their pre-DMM liquidity beta. The average pre-DMM betas are shown by the grey bars and the pre-DMM median liquidity betas are the white bars. The lines show the mean (solid) and median (dotted) post-DMM liquidity betas for the same groups of stocks.

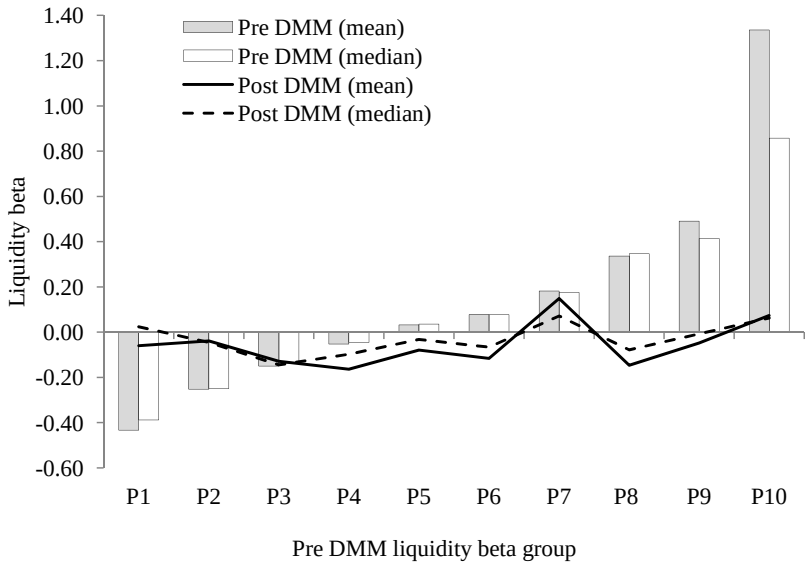


Table 1

Describing DMM deals at the OSE

The table in panel A describes the activity of DMMs at the OSE, by listing the total number of firms on the exchange during the year, together with the number of new DMM deals and the number of active DMM deals. We also show the number of DMMs in four size quartiles, which are constructed by splitting the firms into four groups based on the total value of the equity in the firm at the previous year-end. Firms in size quartile 1 are the 25% smallest firms, and firms in size quartile 4 are the 25% largest firms. In Panel B we give the distribution across the 10 GICS industries for the DMM using firms.

Panel A: Year by year number of DMM using firms

	2004	2005	2006	2007	2008	2009	2010
Total active stocks at OSE	207	240	260	294	292	274	264
Active DMM contracts	7	31	43	51	58	47	48
Of which in firm size quartile:							
1 (small)	0	5	12	19	25	31	11
2	2	16	19	14	18	11	13
3	3	5	8	14	11	5	12
4 (large)	2	5	4	4	4	0	12
New DMM contracts	7	24	17	20	16	15	11
Of which in firm size quartile:							
1 (small)	0	5	6	8	7	7	5
2	2	13	8	7	7	6	2
3	3	4	3	5	1	2	1
4 (large)	2	2	0	0	1	0	3

Panel B: Industry distribution of DMM using firms

GICS		Number of firms
10	Energy	11
15	Material	4
20	Industry	14
25	ConsDisc	4
30	ConsStapl	8
35	Health	12
40	Finan	11
45	IT	19
50	Telecom	0
55	Util	2

Table 2

Summary statistics, DMM firms vs Non-DMM firms

This table compares firms using DMMs with non-DMM firms, by calculating a number of descriptive statistics, and comparing their averages across the two groups. Each year, the first column shows the average for all firms *with* a DMM at some point during that year, while the second column shows the average for all the firms without a DMM in the respective year. *Firm size* is total value of the firm's assets at year-end. *Operating income* is the book income for that accounting year. *Q* is an estimate of Tobins' Q. *N inside trades* is the number of trades (large sales) by corporate insiders. *Fraction equity issuers* is the fraction of companies within each group that issues equity in a given year, *Fraction planned repurchasers* is the fraction of companies that have an active repurchasing plan at yearend, *Fraction actual repurchasers* is the fraction of companies that repurchases stock during the year, and *Sales growth* is the percentage change in operating income. *Spread* is the difference (in Norwegian kroner, NOK) between the closing bid and ask price at the exchange. The *Relative spread* is the NOK spread divided by the closing stock price. *LOT* is the Lesmond et al. (1999) estimate of transaction costs. *Amihud* is the Amihud (2002) illiquidity measure. *Turnover* is the average fraction of the firms outstanding stock that is traded over the year. *Frac trading year* is the fraction of the trading year with trades in the stock. See appendix B for detailed definitions of the variables.

	2004		2005		2006		2007		2008		2009		2010	
	with DMMs	other	with DMMs	other	with DMMs	other	with DMMs	other	with DMMs	other	with DMMs	other	with DMMs	other
Firm magnitude														
Firm Size (mill)														
Average	2544	8850	2339	9896	1865	12533	1627	12381	1094	7486	1613	9798	2321	11380
Median	850	1039	640	1446	707	2058	694	2193	307	1116	1265	1396	1034	1622
Operating Income (mill)														
Average	1601	6786	1543	7225	1268	9507	996	7543	1267	8603	1457	8011	2154	8460
Median	537	699	485	568	249	838	305	986	360	956	389	1160	332	940
Q	2.04	1.65	1.96	1.61	2.01	1.51	1.85	1.29	0.99	0.69	1.51	0.84	1.43	0.94
Sales growth(%)	6.9	13.5	36.4	21.4	19.2	52.4	23.4	42.0	29.8	35.0	8.7	15.6	17.1	7.1
Individual owners														
No inside trades	1.8	1.5	1.4	1.8	2.2	1.6	1.0	1.0	0.3	0.4	1.2	0.7	0.4	0.9
Equity market activity														
Fraction equity issuers(%)	57.1	31.5	25.8	38.3	37.2	32.3	37.3	34.2	27.6	25.2	40.4	30.4	31.2	29.6
Fraction planned repurchasers(%)	71.4	52.0	51.6	40.2	25.6	20.3	19.6	19.8	17.2	20.1	23.4	18.9	18.8	16.7
Fraction actual repurchasers(%)	42.9	31.0	48.4	33.0	48.8	34.6	39.2	31.3	32.8	35.9	29.8	25.1	29.2	26.9
Stock liquidity measures														
Spread (NOK)	0.7	2.2	0.8	2.4	0.8	2.5	0.8	2.5	0.7	2.7	0.7	1.4	1.0	1.1
Relative spread	0.031	0.029	0.019	0.023	0.022	0.023	0.022	0.026	0.034	0.042	0.040	0.044	0.033	0.033
LOT	0.047	0.045	0.032	0.037	0.030	0.036	0.031	0.034	0.055	0.056	0.059	0.071	0.042	0.045
Amihud	0.412	0.415	0.172	0.219	0.199	0.227	0.223	0.266	0.534	0.841	0.592	1.012	1.516	3.414
Annual Turnover	0.533	1.087	0.727	1.349	0.706	1.318	0.897	0.986	0.511	1.735	0.463	1.952	0.525	1.462
Frac trading year	0.757	0.801	0.853	0.838	0.807	0.834	0.854	0.818	0.770	0.742	0.730	0.747	0.794	0.817

Table 3
Correlations

The table shows (contemporaneous) correlations between annual observations of the following variables: *Relative Spread* is the difference between the best bid and ask price on each date with trades, divided by the last trade price, averaged over a year. *Firm size* is the value of the firm's assets, *Q* is Tobin's Q calculated as the market value to book value of firms assets, *Inside Sales* is the number of large inside sales during the year. *Issue equity* is a dummy variable equal to one if the firm issues equity during the next year. *Actual Repurchase* is a dummy variable equal to one if the firm repurchases shares during the next year. *Announced repurchases* is a dummy variable equal to one if the firm has an announced repurchase program. *Sales growth* is the percentage change in operating income. *Have DMM* is a dummy variable equal to one if firm has a DMM sometime during the year. *Hire DMM* is a dummy variable equal to one if firm hires a DMM sometime during the year. *Listed within 2 years* is a dummy variable equal to one if the time since the firm was listed is less than 2 years. *Frac trad days* (fraction trading days) is the number of days that the stock is traded divided by the days the stock is listed. Statistical significance is indicated by any number with a p-value below 5% being shown in bold. See appendix B for detailed definitions of the variables.

	Relative Spread	Firm Size	Q	Inside sales	Issue Equity	Repurchases Announced	Repurchases Actual	Sales Growth	Have DMM	Hire DMM	Frac trad days
Firm size	**-0.59**										
Q	**-0.14**	-0.02									
No inside trades	**-0.15**	**0.15**	**0.21**								
Issue equity next year	**-0.05**	**-0.19**	**0.14**	0.01							
Announced repurchases	**-0.17**	**0.20**	**0.07**	**0.14**	**-0.17**						
Repurchase next year	**-0.16**	**0.27**	**0.09**	**0.12**	**-0.17**	**0.31**					
Sales growth	**-0.05**	0.00	0.01	-0.00	**0.06**	**-0.08**	-0.04				
Have DMM	0.01	**-0.23**	**0.07**	-0.01	-0.03	-0.03	0.01	-0.03			
Hire DMM	0.00	**-0.14**	**0.09**	0.03	0.02	0.00	-0.01	0.00	**0.56**		
Frac trading days	**-0.85**	**0.40**	**0.11**	**0.10**	**0.17**	**0.05**	0.02	**0.06**	**-0.06**	-0.03	
Listed within 2 years	**0.10**	**-0.15**	**0.05**	-0.01	**0.11**	**-0.20**	**-0.12**	**0.08**	0.05	**0.11**	**-0.07**

Table 4

Liquidity measures before and after DMM agreements

We describe what happens after the market maker deals, by showing liquidity measures calculated using data for one year and six months before and after the market maker start. In these calculations we only include stocks where we have observations for the whole period, and leave out those cases where the DMM is hired at the same time that the stock is listed. The relative spread is the quoted spread divided by the quote midpoint. The LOT measure is the Lesmond et al. (1999) estimate of transaction costs and *Amihud* is the Amihud (2002) measure. *Fraction of year traded* is the number of days that the stock trades, divided by the number of days it is listed. *Monthly Turnover* is the fraction of the firms stock that is traded in a month. Numbers in parenthesis represent p-values from a test of whether the change in liquidity is significantly different from zero. See appendix B for detailed definitions of the variables.

	Period before		*Period after*		*t-test diff*				*n*
	1 year	6 months	6 months	1 year	6 months		1 year		
Rel Spread	0.039	0.039	0.024	0.026	-0.015	(0.00)	-0.013	(0.00)	100
LOT	0.045	0.044	0.034	0.038	-0.009	(0.02)	-0.006	(0.07)	100
Amihud	0.570	0.615	0.406	0.436	-0.186	(0.05)	-0.106	(0.19)	100
Monthly Turnover	0.042	0.043	0.051	0.058	0.007	(0.15)	0.015	(0.02)	100
Fraction of year traded	0.753	0.756	0.824	0.817	0.073	(0.00)	0.071	(0.00)	100

Table 5
Event study

The tables provide further information about the event study illustrated in figure 4. In Panel A we test the significance of the CAR's for the event study. The second column lists the average cumulative abnormal return (CAR) for the given lag, where CAR is calculated relative to the market model. Specifically, for each stock i and date t we calculate $AR_t = r_{it} - (\widehat{\alpha}_i + \widehat{\beta}_i(r_{mt} - r_{ft}))$, where AR is the abnormal return, r_{mt} the market return, and $\widehat{\alpha}_i$ and $\widehat{\beta}_i$ the estimated parameters. We use an equally weighted stock market index for the market. For each stock, CAR_i is the sum of abnormal returns, and the table lists the average of CAR_i for each lag. The next two columns provides the two standard tests for significance of the average CAR being different from zero, J_1 and J_2, as exposited in Campbell et al. (1997). These test statistics follow a t-distribution. In Panel B we show results of a regression where the CAR at a 10 day horizon is the dependent variable. In these regressions we look at two explanatory variables: Liquidity, measured by relative spread one year before the DMM initialization, and firm size, proxied by the log of operating income (OI). The regression is specified as $CAR_i = a + b_1 \text{Liquidity}_i + b_2 \ln(OI_i) + \varepsilon_i$. See appendix B for detailed definitions of the variables.

Panel A: Significance test of CAR's in event study

lag	$C\bar{A}R$	J_1	J_2
0	0.0205	7.337	8.310
1	0.0180	5.982	6.669
2	0.0204	6.324	6.631
3	0.0168	4.899	4.527
4	0.0141	3.917	3.650
5	0.0118	3.115	2.791

Panel B: Determinants of CAR

	coeff	(serr)	[pvalue]
Constant	-0.1637	(0.1163)	[0.16]
liqudity(rel spread)	1.5662	(0.9221)	[0.09]
ln(operating income)	0.0086	(0.0088)	[0.33]
n	62		
$\bar{R}^2$	0.06		

Table 6

Hiring a Designated Market Maker

The tables reports the results from probit regressions. For each specification we show the coefficient estimates, the p-values(in parenthesis), the number of firm-year observations (N) and the Pseudo R^2. The dependent variable in each regression is whether the firm hires a DMM in a given calendar year. Success in the probit is hiring of a DMM. In the tables below, each column gives results for a different probit regression. The regressions are grouped into two panels where the ones in panel A only use explanatory variables that are observable at the time the DMM contract is announced. We call this the *ex ante* specification. In panel B the explanatory variables includes corporate events after the hiring of a DMM. We term this the *ex post* specification. The "ex ante" specification includes the following explanatory variables: *Q last year* - The current estimate of Q (market/book value of firm), *Sales Growth* - Growth in accounting income previous two years, *Repurchase Program* - Whether the firm has a repurchase program in place and *Listed < 2 years* - Dummy variable equal to one if it is 2 years or less since the firm was listed. The "ex post" specification includes the explanatory variables: *Issue Equity* - Dummy variable equal to one if the firm issues equity the next three years, *Actual Repurchase* - Dummy variable equal to one if the firm actually repurchases equity the next three years, *Insider trades(sells)* - Number of cases with large insiders sells during the next three years. Common to both specifications is *Liquidity (RelSpread)* - The relative spread last year) For some of the accounting variables (e.g. sales growth) we lose observations because the firms has not been listed long enough. In the sample we remove all firms with an already existing DMM contract. Also, we only consider firms that traded less than 90% of the available days the year before. See appendix B for detailed definitions of the variables.

Panel A: Ex ante explanatory variables

Model	1	2	3	4
Liquidity (RelSpread)	-5.811^{**}	-16.485^{***}	.	.
	(0.05)	(0.00)	.	.
Q last year	0.259^{***}	.	0.261^{***}	0.268^{***}
	(0.00)	.	(0.00)	(0.00)
Sales growth	.	-0.032	.	.
	.	(0.81)	.	.
Repurchase program	0.063	-0.077	0.111	0.090
	(0.76)	(0.75)	(0.58)	(0.65)
Listed < 2 years	0.232	0.140	0.207	
	(0.18)	(0.54)	(0.20)	
Constant	-1.297^{***}	-0.303	-1.646^{***}	-1.570^{***}
	(0.00)	(0.24)	(0.00)	(0.00)
N	448	301	501	501
Pseudo R^2	0.086	0.089	0.067	0.063

Panel B: Ex post explanatory variables

Model	1	2	3
Liquidity (RelSpread)	-5.550^{*}	.	.
	(0.06)	.	.
Issue equity	0.446^{***}	0.302^{**}	0.248^{*}
	(0.01)	(0.03)	(0.06)
Actual repurchase	0.284^{*}	0.266^{*}	0.303^{**}
	(0.08)	(0.06)	(0.02)
Insider trades (sells)	0.055^{***}	0.055^{***}	.
	(0.01)	(0.00)	.
Constant	-1.312^{***}	-1.615^{***}	-1.520^{***}
	(0.00)	(0.00)	(0.00)
N	452	611	686
Pseudo R^2	0.079	0.045	0.017

Table 7

Having a Designated Market Maker

The tables reports the results from probit regressions. For each specification we show the coefficient estimates, the p-values(in parenthesis), the number of firm-year observations (N) and the Pseudo R^2. The dependent variable in each regression is whether the firm hires a DMM in a given calendar year. Success in the probit is hiring of a DMM. In the tables below, each column gives results for a different probit regression. The regressions are grouped into two panels where the ones in panel A only use explanatory variables that are observable at the time the DMM contract is announced. We call this the *ex ante* specification. In panel B the explanatory variables includes corporate events after the hiring of a DMM. We term this the *ex post* specification. The "ex ante" specification includes the following explanatory variables: *Q last year* - The current estimate of Q (market/book value of firm), *Sales Growth* - Growth in accounting income previous two years, *Repurchase Program* - Whether the firm has a repurchase program in place and *Listed < 2 years* - Dummy variable equal to one if it is 2 years or less since the firm was listed. The "ex post" specification includes the explanatory variables: *Issue Equity* - Dummy variable equal to one if the firm issues equity the next three years, *Actual Repurchase* - Dummy variable equal to one if the firm actually repurchases equity the next three years, *Insider trades(sells)* - Number of cases with large insiders sells during the next three years. Common to both specifications is *Liquidity (RelSpread)* - The relative spread last year) For some of the accounting variables (e.g. sales growth) we lose observations because the firms has not been listed long enough. In the sample we remove all firms with an already existing DMM contract. Also, we only consider firms that traded less than 90% of the available days the year before. See appendix B for detailed definitions of the variables.

Panel A: Ex ante explanatory variables.

Model	1	2	3	4
Liquidity (RelSpread)	-15.543^{***}	-25.388^{***}	.	.
	(0.00)	(0.00)	.	.
Q last year	0.243^{***}	.	0.270^{***}	0.271^{***}
	(0.00)	.	(0.00)	(0.00)
Sales growth	.	0.003	.	.
	.	(0.97)	.	.
Repurchase program	0.193	0.056	0.300^{**}	0.296^{**}
	(0.20)	(0.74)	(0.04)	(0.04)
Listed < 2 years	0.163	0.032	0.049	
	(0.23)	(0.86)	(0.69)	
Constant	−0.252	0.707^{***}	-1.083^{***}	-1.068^{***}
	(0.10)	(0.00)	(0.00)	(0.00)
N	539	381	593	593
Pseudo R^2	0.135	0.172	0.064	0.064

Panel B: Ex post explanatory variables.

Model	1	2	3
Liquidity (RelSpread)	-16.534^{***}	.	.
	(0.00)	.	.
Issue equity	0.288^{**}	0.118	0.107
	(0.02)	(0.27)	(0.30)
Actual repurchase	0.187	0.282^{***}	0.358^{***}
	(0.12)	(0.01)	(0.00)
Insider trades (sells)	0.026	0.039^{***}	.
	(0.12)	(0.01)	.
Constant	−0.046	-0.972^{***}	-0.995^{***}
	(0.77)	(0.00)	(0.00)
N	549	709	784
Pseudo R^2	0.106	0.020	0.015

Table 8

Liquidity risk at the Oslo Stock Exchange (1980-2011)

The tables shows results from factor model estimations on ten portfolios sorted by liquidity (relative spread). The estimation uses monthly data for the period 1980-2011. Panel A shows the factor loading estimates from a Black, Jensen, and Scholes (1972) analysis where we estimate the two-factor model

$$er_{it} = a_i + \beta_i^m er_{mt} + \beta_i^{liq} LIQ_t + e_t$$

Panel B shows the factor loading estimates from a GMM analysis where we estimate factor models jointly with a cross-sectional pricing restriction. The first model, the single factor case, is specified as:

$$E[er_{it}] = a_i + \beta_i^m er_{mt}$$

$$E[er_i] = \lambda_0 + \lambda_m \beta_i^m$$

The two factor model is specified as

$$E[er_{it}] = a_i + \beta_i^m er_{mt} + \beta_i^{liq} LIQ_t$$

$$E[er_i] = \lambda_0 + \lambda_m \beta_i^m + \lambda_{liq} \beta_i^{liq}$$

Here er_{it} is the excess return of portfolio i, a_i is a constant term, er_{mt} is the excess return on the market portfolio, β_i^m is portfolio i's loading on the market factor, LIQ_t is the liquidity factor, and β_i^{liq} is portfolio i's loading on the liquidity risk factor. The risk premia are λ_m and λ_{liq}. numbers in parenthesis are p-values associated with the coefficients. The (monthly) factor premia in Panel B are estimated by GMM. Numbers in parenthesis are p-values. The last row reports the χ^2 and the associated p-value from a J-test for over-identifying restrictions for the two factor model. See appendix B for detailed definitions of the variables.

Panel A: Market and liquidity risk loadings

	a		er_m		LIQ		R^2	n
1 (low spread)	-0.0003	(0.89)	0.9080	(0.00)	-0.6307	(0.00)	0.77	372
2	-0.0033	(0.04)	1.0040	(0.00)	-0.3412	(0.00)	0.83	372
3	-0.0007	(0.71)	1.0759	(0.00)	-0.2657	(0.00)	0.79	372
4	-0.0017	(0.31)	0.9118	(0.00)	-0.1651	(0.00)	0.76	372
5	-0.0018	(0.36)	0.9899	(0.00)	-0.0344	(0.37)	0.71	372
6	-0.0025	(0.16)	0.9660	(0.00)	0.0296	(0.40)	0.74	372
7	-0.0018	(0.37)	1.0099	(0.00)	0.2359	(0.00)	0.71	372
8	0.0004	(0.84)	1.0032	(0.00)	0.4235	(0.00)	0.68	372
9	0.0049	(0.03)	0.9744	(0.00)	0.4031	(0.00)	0.65	372
10 (high spread)	0.0077	(0.01)	0.9671	(0.00)	0.5379	(0.00)	0.54	372

Panel B: Risk premia estimates

$\lambda_1(er_m)$	0.0066	(0.04)
λ_2(LIQ)	0.0120	(0.00)
J	15.29	(0.64)

Table 9
DMM impact on liquidity risk

Panel A of the table shows the average and median of estimated liquidity beta (β^{liq}) across DMM stocks before (pre) and after (post) the DMM agreement. The liquidity beta is estimated using 1 year of daily data before and after the DMM contract is established using the following regression specification,

$$er_{it} = a_i + \beta_i^m er_{mt} + \beta_i^{liq} LIQ_t + e_t$$

where er_{it} denotes the excess return on day t for stock i, er_{mt} denotes the excess return on the market, and LIQ is the liquidity risk factor. The difference in liquidity beta is the difference between the post- and pre estimates of β_i^{liq}. The last two columns show the change in β_i^{liq} with the associated p-value from a t-test for the difference being significant. In the second row of Panel A, we report the medians of the distribution of liquidity betas estimated for the pre-DMM and post-DMM periods. We perform a Wilcoxon/Mann-Whitney test for the equality of medians between the pre-DMM and post-DMM distributions. ***, ** and * indicate a significant difference between the post- and pre-DMM liquidity beta at the 1%, 5% and 10% level, respectively. The last column provides the p-values from a test of whether the change in the average (median) liquidity beta is significantly different from zero. Panel B of the table shows the average liquidity beta for 10 subgroups of the sample firms grouped based on their pre-DMM liquidity beta. See appendix B for detailed definitions of the variables.

		Liquidity beta (β^{liq})		Test for difference	
	n	Pre DMM	Post DMM	Post-Pre	p-value
Panel A: All stocks					
All stocks, mean	100	0.16	-0.06	-0.21***	0.00
All stocks, median	100	0.06	-0.02	-0.15***	0.00
Panel B: Groups of stocks based on pre-DMM β^{liq}					
P1 (Low β^{liq})	10	-0.43	-0.06	0.37**	0.02
P2	10	-0.25	-0.04	0.21*	0.07
P3	10	-0.15	-0.13	0.02	0.80
P4	10	-0.05	-0.16	-0.11	0.29
P5	10	0.03	-0.08	-0.11**	0.05
P6	10	0.08	-0.12	-0.19***	0.00
P7	10	0.18	0.15	-0.03	0.72
P8	10	0.34	-0.15	-0.48***	0.00
P9	10	0.49	-0.05	-0.54***	0.00
P10 (High β^{liq})	10	1.34	0.07	-1.26***	0.00