2010 | 12

Working Paper

Research Department

Why do firms pay for liquidity provision in limit order markets?

By Johannes A. Skjeltorp and Bernt Arne Ødegaard

NB NORGES BANK

Working papers fra Norges Bank, fra 1992/1 til 2009/2 kan bestilles over e-post:
servicesenter@norges-bank.no
eller ved henvendelse til:
Norges Bank, Abonnementsservice
Postboks 1179 Sentrum
0107 Oslo
Telefon 22 31 63 83, Telefaks 22 41 31 05

Fra 1999 og fremover er publikasjonene tilgjengelig på www.norges-bank.no

Working papers inneholder forskningsarbeider og utredninger som vanligvis ikke har fått sin endelige form. Hensikten er blant annet at forfatteren kan motta kommentarer fra kolleger og andre interesserte. Synspunkter og konklusjoner i arbeidene står for forfatternes regning.

Working papers from Norges Bank, from 1992/1 to 2009/2 can be ordered by e-mail:
servicesenter@norges-bank.no
or from Norges Bank, Subscription service,
P.O.Box. 1179 Sentrum
N-0107Oslo, Norway.
Tel. +47 22 31 63 83, Fax. +47 22 41 31 05

Working papers from 1999 onwards are available on www.norges-bank.no

Norges Bank's working papers present research projects and reports (not usually in their final form) and are intended inter alia to enable the author to benefit from the comments of colleagues and other interested parties. Views and conclusions expressed in working papers are the responsibility of the authors alone.

ISSN 1502-8143 (online)
ISBN 978-82-7553-562-5 (online)

Why do firms pay for liquidity provision in limit order markets?

Johannes A Skjeltorp and Bernt Arne Ødegaard*

June 30, 2010

Abstract

In recent years, a number of electronic limit order markets have reintroduced market makers for some securities (Designated Market Makers). This trend has mainly been initiated by financial intermediaries and listed firms themselves, without any regulatory pressure. In this paper we ask why firms are willing to pay to improve the secondary market liquidity of their 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, either because they have capital needs, or that they are planning to repurchase shares. We also find some evidence of agency costs associated with the initiation of a market maker agreement as the probability of observing insider trades increases when liquidity improves.

Keywords: Market liquidity, Corporate Finance, Designated Market Makers, Insider trading

JEL Codes: G10, G20

Introduction

Historically, the typical trading structure for equities involved market makers with 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 market maker seemed destined for

*Skjeltorp is at Norges Bank. Ødegaard is at University of Stavanger and Norges Bank. Emails: johannes.a.skjeltorp@norges-bank.no and bernt.a.odegaard@uis.no. 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, Wing Wah Tham, participants at the 2010 FIBE conference, AFFI 2010 conference and seminar participants at the Universities of Mannheim and Stavanger. All remaining errors or omissions are ours.

the scrap heap. Recently, though, markets 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 (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.

In addition to the Norwegian stock market, DMMs have appeared in several other countries such as the Netherlands, France, Germany and Sweden. The DMM introductions have been studied for all these markets, where the main question examined is whether liquidity improves following the initiation of DMM agreements. A consensus finding in this research is that liquidity improves, and the improvement in liquidity is particularly large for small illiquid stocks. While these results are interesting, they are not particularly surprising. A DMM have a contractual agreement with the firm to improve its secondary market liquidity against a fee, so if this agreement is not honored they may have problems justifying the fee.

In this paper we look at the hiring of DMMs from a different perspective relative to the existing literature. More specifically, we investigate the motives for corporations to pay a cost to improve the secondary market liquidity of the firm's stock. While improved market liquidity clearly is beneficial to short term traders, at the face of it, this seems to be a cost with little benefit to the firm.

The typical microstructure argument for a link between the secondary market liquidity and firm value works through the cost of capital, i.e. an improvement in liquidity lowers the "liquidity premium" in the discount rate. Such an argument is hard to reconcile with the typical Miller and Modigliani intuition, that you need to affect a firm's cashflows to affect its value. We argue that changing the liquidity of the firm's stock may actually change the firms future cashflows, because secondary market liquidity affects the cost of raising *new* capital. If capital is cheaper, the set of profitable future investment opportunities may increase, *directly* affecting firm value. In other words, a reduction in the required rate of return at which expected future project cash-flows are discounted, potentially increases the number of projects that yield a positive net present value to the firm.

Looking at cases where the firm voluntarily pays a cost to improve liquidity is a perfect way to empirically investigate the plausibility of such arguments. If the firm uses the DMM to improve liquidity for purposes of raising capital, we should see that firms that choose to hire a DMM are firms more likely to need capital. That is exactly the investigation we perform in the paper, by using a decision theoretic framework we can ask whether proxies for future capital needs are relevant for firms decisions to hire DMMs.

In this investigation we also control for two alternative explanations. The first is the opposite of raising capital, namely stock repurchases. Here too the lower transaction costs for the firm's future stock repurchases can justify the out of pocket cost for the DMM contract. A second, somewhat different explanation for DMM deals, stems from a potential agency problem. The decision to hire a DMM is made by the firms management. Improved liquidity in the stock of the corporation is also a direct benefit to the firms management if members of management plan to do any trading in the corporations stock (inside trades). Therefore, we also investigate whether the frequency of inside trades influences the decision to hire a DMM.

In the analysis we use data from the introduction of DMM's at the Oslo Stock Exchange (OSE) to look at this question. The possibility of hiring a designated market maker was introduced at the OSE in 2004, following the example of the Stockholm Stock Exchange. Since 2004 around a hundred firms have hired (or rehired) designated market makers to improve the liquidity of the firm's stock.

In the first part of the paper we show that, similarly to other markets, the secondary market liquidity of a company's shares improves following the hiring of a DMM, and that it is mainly the smaller firms on the exchange that enter into DMM agreements. Consistent with what is found in other markets, we also find that there is a positive announcement effect associated with firms announcing DMM agreements. Having established that the market liquidity effect of DMM agreements is similar in our sample to what is found at other exchanges, the second part of the paper asks the more novel question of why firms enter into DMM agreements. Using a probit framework we find that firms with higher growth opportunities (measured by Tobins Q), or that are planning to execute open market repurchases in the near future, are more likely to hire a DMM to improve the market liquidity of its shares. Finally, our results also suggest that firms that hire a DMM has a higher probability of experiencing insider trades in the following year.

The structure of the remainder of the paper is as follows. We first discuss the relevant literature, and place our questions in a context. In section 2 we provide some descriptive statistics for the DMM contracts at the Oslo Stock Exchange, before we look at the effects on the market of DMM introductions in section 3. Finally, in section 4, we examine the central question of the paper, what affects firm's decisions to hire a DMM, before we conclude.

1 Literature

This paper intersects a number of somewhat disjoint literatures. The first is the market microstructure literature. In the theoretical market microstructure, the role of the market maker has always been central, from the theoretical models of Glosten and Milgrom (1985), Kyle (1985) and onwards. In these models the informational and price-setting role of market makers are central. Typically, in these models, the market maker uses his informational advantage to generate revenue Harris and Panchapagesan (2005). Empirically, in the world's stock markets we have seen a move away from markets with market making, towards (electronic) limit order markets. This lead Glosten (1994) to theoretically discuss the inevitability of limit order markets, and events in the markets seemed to bear out this prediction. Recently, though, several stock markets have introduced the possibility of "Designated Market Makers," financial intermediaries which have a special role in maintaining an orderly market in the trading of the company's stock, and charge the listed firm for these services. The appearance of such intermediaries has lead to theoretical reappraisal of the role of market making in electronic limit order markets,[1] as well as empirical investigations of the actual cases where firms hire DMM. Such empirical investigations have been carried out by Anand *et al.* (2009) which looks at the Swedish case, Menkveld and Wang (2009) 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.

Another, more recent strand of the market microstructure literature looks directly at the link between stock liquidity and corporate finance. An important early contribution to this literature is Easley and O'Hara (2004), which points out that liquidity should be relevant for the firm's cost of capital. The driving feature of their model is the degree of private information about the firm. The lower the private information, the lower the cost of capital. A logical conclusion of this result is that actions that lower the degree of private information about a corporation's value will lower its cost of capital and increase the value of the firm.

These arguments have been used as a basis for empirical investigations of links between liquidity and corporate finance decisions. For example, Lipson and Mortal (2009) examine whether market liquidity affect firms' capital structure, and find that the least liquid firms have higher debt to equity ratios. Their results suggest that firms with a more liquid market in their stock rely more on equity financing. Similarly, Banerjee *et al.* (2007) find that owners of less liquid common stock are more likely to receive cash dividends.

[1] See for example Nimalendran and Petrella (2003), Bessembinder *et al.* (2007) and Anand and Subrahmanyam (2008).

However, a typical feature of the literature that builds on the Easley and O'Hara (2004) intuition, is that the underlying uncertainty of the stock is exogenous. An improvement in liquidity may reduce the asymmetric information about the stock, but the underlying properties of the stock remains the same. We argue that this view of the link between corporate finance and liquidity is too narrow. It ignores that changes in liquidity may actually change the properties of the underlying firm. Recall the typical issues in Miller and Modigliani type discussions. Here, one distinguishes between changes that affect the real operations of the firm, such as the investment schedule, and changes to the other side of the balance sheet, such as whether the firm is financed with debt or equity. If the basis for the link between liquidity and corporate finance is an exogenous property of the firms equity, this would imply that we are *only* looking at the right hand side of the balance sheet, without thinking about the asset side. If, in such a setting, we argue that changing the liquidity of the stock affects firm value, this seems to run counter to the typical Miller-Modigliani intuition; i.e. that we need to affect the firm's investments to affect its value.[2]

We argue that one way we can reconcile these conflicting arguments is by simply allowing liquidity to affect the firms cash flows. An obvious channel is by saying that if the cost of capital of the firm changes, its investment opportunities will change. If the cost of capital is lower, the firm may be able to produce more positive NPV projects. The same argument holds if one lowers the *direct* costs of raising new capital. If one has access to cheaper capital, one can sustain more positive NPV projects. This is the argument we will study in our paper.

We are not the first to point out the endogenous nature of liquidity and corporate finance decision, that they may be interrelated. In a study that looks at the link between capital structure and the liquidity of a firms stock, Frieder and Martell (2006), looks on the causal relation between the two and considers a joint determination of these two variables.

The innovation of our study is that it looks at cases which are perfect laboratories for studying the possible interrelationship between the firm's financing and liquidity, cases with *endogenous* decisions by firms to change the liquidity of the firm's stock. Our study is purely empirical, we posit a number of plausible factors that may affect this decision,

[2]What we are pointing out is analog to a problem with the classical intuition in the Amihud and Mendelson (1986). In that model, there is a link between the asset returns and liquidity, measured by spread, because there is heterogeneity in the holding periods of a firms owners. Owners with longer holding periods select firms with higher bid/ask spreads because they can distribute the cost of holding these stocks over longer time periods. The model is static; i.e. one can not change the properties of the firm by changing the holding periods of owners. So, if we want to have a situation where one can change the properties of the firm's equity by changing it's liquidity, the "self selection" type of argument can not be used.

and perform a decision theoretic analysis of the decision to hire a DMM, asking whether the posited factors are relevant for this decision.

Let us therefore take a look at this decision. Why is the firm willing to pay money to maintain an orderly market? How does improving liquidity benefit the firm? This is not a trivial question. Most of the arguments for liquidity affecting stock prices really are arguments about the preferences of individual stock owners. These owners may be willing to pay a liquidity premium if they are guaranteed that they can sell their stake in the company quickly. Thus, from the owners' perspective, an improvement in liquidity would be beneficial if there is a risk premium associated with illiquidity, since an improvement in liquidity would increase the market value of their shares (see e.g. Fang *et al.* (2009)). However, from the issuing company's point of view such transactions in the secondary market are irrelevant, once the corporation has raised the cash it needs. All stock trades do, is to replace one owner by another. So why should the firm be willing to pay good money just to improve the trading in the company's stock?

One can make the argument that since the company is acting on the behalf of its owners, and the owners value liquidity, the company should be willing to pay for liquidity provision if market liquidity is low. However, even this is not a convincing argument. If for example a majority of the firm's owners are long term owners that are not planning to sell their stakes anytime soon, why would the firm pay (which imposes the cost equally on all the owners) to improve liquidity so that short term traders can get out of their positions more cheaply? Unless the firm is willing to subsidize short term traders, there must be other benefits to the firm for improving it's market liquidity.

We argue that paying for DMM services only makes sense if the firm is planning to interact with the capital market in the near future. Two obvious times when a firm interacts with capital markets is when it raises new capital or perform open market repurchases. DMM agreements looks like a reasonable alternative for small illiquid firms to effectively improve the market liquidity of their shares.

There is a limited literature which looks at capital issuing and repurchases and relate them to liquidity. For example, with respect to the cost of raising capital, Butler *et al.* (2003) find a strong relationship between investment banks' fees, for facilitating seasoned equity offerings, and stock liquidity. They argue that their results suggest that firms have an incentive to promote the market liquidity of their equity. In relation to the question of raising new capital, Ginglinger *et al.* (2009) provide two main findings. First, they confirm the relationship between flotation costs and market liquidity in Butler *et al.* (2003). In addition, they show that stock market liquidity is an important determinant of the choice of flotation method when comparing uninsured rights, standby rights and public offerings. Finally, Lipson and Mortal (2009) show that firms with more liquid

equity have lower leverage and prefer equity financing when raising capital. Thus, the results in these studies provides one potential motivation for why firms would want to hire a DMM.

Another important time when firms access the capital market is when they do open market repurchases. Brockman *et al.* (2008) argue that managers compare the tax and flexibility advantages of a repurchase to the liquidity cost. All else equal, higher market liquidity encourages the use of repurchases rather than 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.

There are also other ways that firms can improve their market liquidity. One possibility is cross-listing. Surveying the literature on cross-listing, Karolyi (1998) shows that there is strong empirical support that firms that cross-list experience an improvement in market liquidity. Another significant empirical result is that firms that cross-list experience a decrease in the cost of capital. While, cross-listing offers many advantages for the listing firms, there are also costs. These relate to enhanced disclosure requirements, registration costs with regulatory authorities, and listing fees. However, these costs may be too large for small firms to make cross-listing a viable alternative to improve liquidity.

To summarize, we argue that if the firm's management acts to maximize firm value, they should look at the costs of maintaining a DMM relationship, and ask whether this cost is lower than the expected cost savings of future interactions with the capital market, be it repurchases or capital issuance.

From the management's point of view, there is however another potential reason for hiring a DMM, which is not necessarily value maximizing from the point of the view of the firm. If members of firm management are planning to trade the firm's stock, either buying or selling (inside trades), it is of course in their interest to minimize the price impact of their trades. This is a possible agency cost, and in our empirical investigations we investigate this alternative explanation, by using measures of insider trading as additional explanatory variables.

2 The Oslo Stock Exchange and the data

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.[3] The current trading structure in the market is an electronic limit order book. The

[3]See Bøhren and Ødegaard (2001), Næs *et al.* (2009) and Næs *et al.* (2008) for some discussion of the exchange and some descriptive statistics for trading at OSE.

limit order book has the usual features, where orders always need to specify a price, a part of the order can be hidden, some of the trades are directly routed from the internet, etc.

In 2004 the OSE introduced the possibility for financial intermediaries to declare themselves as Designated Market Makers for a firm's stock, where the firm pay the DMM for the market making service. Formally, the exchange does not oversee these DMM agreements, and have no say in them, but the exchange typically receive copies of the contracts.[4] 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 detail about the purposes of the contract. OSE provides a standardized contract. Although there may be other contractual features, we are told that the standard contract is the typical one. The DMM obligations in the standard contract is that the bid and ask quotes should be available at least 85% of the trading day, the minimum volume at both the bid and ask quotes should equal 4 lots, and finally that the relative spread should not exceed 4%.

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

In table 1 we show some details about the introduction of DMMs at the OSE. We show the number of new DMM deals and the total number of deals active in a given year. We see that the number of DMMs are small, at the most (in 2008) there were 57 firms that had a DMM, out of 286 stocks on the OSE in total, or about a fifth of the firms on the exchange. 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 we observe 111 cases where firms hire DMMs, but some of these are examples of the same firm switching DMM or hiring an additional DMM.[5]

To give some perspectives on the firms which employ DMMs, table 2 calculates a number of summary statistics where we compare those firms with a DMM in a given year with the stocks that does not have a DMM. We first show a number of common liquidity measures, Spread (NOK) and Relative spread, LOT (an estimate of transaction costs introduced by Lesmond *et al.* (1999)), ILR (the measure of price elasticity introduced by Amihud (2002)), and finally monthly turnover.[6] We also compare the size of the firms

[4] 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.

[5] In appendix A.1 we give a detailed list of the firms used in our study.

[6] All the liquidity measures we use here are calculated from daily (closing) observations. We do

Table 1
Describing DMM deals at the OSE

The table 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.

	2004	2005	2006	2007	2008	2009
Total active stocks at OSE	207	238	258	292	286	261
New DMM contracts	7	23	17	20	16	15
Active DMM contracts	7	30	42	50	57	47
of which in firm size quartile 1	0	4	11	17	24	32
of which in firm size quartile 2	2	16	19	15	18	9
of which in firm size quartile 3	3	5	8	14	11	6
of which in firm size quartile 4	2	5	4	4	4	0

(average and median market capitalization), estimated Q, and the number of trades by corporate insiders during a year. Finally, we estimate what fraction of the firms in the two groups issue new equity or repurchase stocks in the given year.

Comparing the liquidity of the two groups, we observe that there are some systematic differences between the groups. First of all, note that since the OSE first allowed DMM agreements from October 2004, this means that the number of firms in the DMM group for 2004 is low (seven firms), and the statistics for the DMM group only capture the effect for the last three months of 2004. Looking at the quoted spread (NOK) first, one notable feature is that it is much lower for the DMM group compared to the non-DMM group (referred to as "other" in the table). This is likely to be mainly due to the lower price level (size) of the the DMM stocks. On the other hand, both the relative spread (where we standardize the spread to the price level), LOT, and the Amihud measures are also systematically smaller for the DMM group. This suggest that the DMMs are actively making the market more liquid. With respect to the average monthly turnover, we see that the DMM firms have lower turnover than the non-DMM firms, which reflect that the typical firm that hires a DMM, is smaller than and less frequently traded than non-DMM firms. Thus, without a DMM agreement, one would expect these types of firms to be less liquid (higher spread, LOT and Amihud measure). With respect to the firm characteristics, the typical DMM firm is much smaller than the other OSE firms, both with respect to the mean and median size. Interestingly, the Tobin's Q for the DMM

unfortunately not have transactions level data for this recent period at the OSE, otherwise we would have looked at more detailed microstructure measures of liquidity. For details about how the liquidity measures are calculated see Næs *et al.* (2008) or Næs *et al.* (2010).

Table 2

Summary statistics, DMM firms vs other exchange firms

This table compares DMM firms with other firms, by calculating a number of descriptive statistics, and comparing their averages across the two groups. Each year, the column titled "with DMMs" shows the average for all firms *with* a DMM at some point during that year, the other column, titled "other", shows the average for all the other stocks. The *spread* is the difference (in kroner) between the closing bid and ask price at the exchange. The Relative spread is the kroner spread divided by the closing stock price. The LOT measure is the Lesmond *et al.* (1999) estimate of transaction costs, *Amihud* is the Amihud (2002) measure, *Turnover* is the fraction of the firms stock that is traded during the year, the *firm size* is the total value of the firm's equity at year-end, *Q* is an estimate of Tobins' Q. *No inside trades* is the number of trades by corporate insiders, *Fraction equity issuers* is the fraction of companies that issues equity in a given year, and *Fraction repurchasers* is the fraction of companies that repurchases stock during the year.

	2004		2005		2006		2007		2008		2009	
	with DMMs	other	with DMMs	other	with DMMs	other	with DMMs	other	with DMMs	other	with DMMs	other
Spread (NOK)	0.7	2.2	0.9	2.5	0.8	2.5	0.8	2.5	0.7	2.8	0.7	1.4
Relative spread	0.031	0.029	0.019	0.023	0.022	0.023	0.022	0.026	0.034	0.043	0.040	0.044
LOT	0.047	0.056	0.032	0.048	0.030	0.036	0.031	0.034	0.051	0.077	0.071	0.107
Amihud	0.412	0.415	0.172	0.216	0.202	0.227	0.227	0.267	0.537	0.856	0.612	0.926
Monthly Turnover	0.533	1.230	0.722	1.482	0.689	1.275	0.851	0.943	0.528	0.882	0.454	0.813
Average Firm size (mill)	1269	4472	1442	5869	1504	7822	1493	10243	1260	10415	608	4605
Median Firm size (mill)	928	536	362	822	462	1245	621	1689	592	1713	257	441
Q	1.41	2.01	3.25	2.41	2.93	2.58	3.16	2.58	2.77	2.28	1.16	1.05
No inside trades	6.8	5.5	9.1	5.9	7.5	5.3	4.5	5.6	4.9	4.3	0.0	0.0
Fraction equity issuers	0.57	0.31	0.27	0.38	0.38	0.31	0.36	0.33	0.21	0.20	0.40	0.28
Fraction repurchasers	0.43	0.30	0.50	0.33	0.50	0.34	0.40	0.31	0.30	0.32	0.30	0.26

firms are higher than the average non-DMM firm across all years except for 2004. This is an indication that firms that hire a DMM have higher growth opportunities, and are more likely to access the capital market to finance new projects. The fraction of equity issuers for the two groups substantiate this as we see that there is, for most years, a larger fraction of firms within the DMM group that actually issue equity compared to the non-DMM group. Finally, we see that there is also a larger fraction of firms that repurchase shares in the DMM group.

3 The effect of hiring a DMM

In this section, we take a look at DMM introductions and their effects on liquidity and other properties of the market. The main purpose is to examine whether the results found for DMM introductions in other markets also holds in our sample for the OSE. First, we examine whether different measures of liquidity improve after DMM introductions, and then we look at the market reaction to DMM announcements using an event study methodology.

3.1 Does liquidity change?

We answer this question in a very simple manner, by comparing the liquidity before and after the introduction of DMMs. In table 3 we look at the four different liquidity measures for the year, and six month period, before and after the initiation of the DMM agreement.

Table 3
Liquidity measures before and after DMM agreements

We describe what happens after the market maker deals, by showing the average relative spread 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. This explains that n, the number of observations, is lower than the total of 111 DMM hires. The *spread* is the difference (in kroner) between the closing bid and ask price at the exchange. The Relative spread is the kroner spread divided by the closing stock price. The LOT measure is the Lesmond *et al.* (1999) estimate of transaction costs, *Amihud* is the Amihud (2002) measure, *Turnover* is the fraction of the firms stock that is traded.

	Period before		Period after		t-test diff				n
	1 year	6 months	6 months	one year	6 months		1 year		
Rel Spread	0.037	0.038	0.024	0.025	-0.01	(0.00)	-0.01	(0.00)	88
LOT	0.041	0.040	0.034	0.037	-0.01	(0.01)	-0.00	(0.17)	88
Amihud	0.524	0.568	0.265	0.299	-0.30	(0.00)	-0.21	(0.01)	88
Monthly Turnover	0.045	0.045	0.053	0.060	0.01	(0.25)	0.01	(0.03)	88

For the six month period, we see that both the relative spread, the LOT and Amihud measures fall significantly after the DMM agreement has been initiated. With respect to turnover, we find that it increases, although not significantly. For the one year window, we see that the reduction in relative spread and Amihud measure remains significant at the 1% level, while the change in the LOT measure is rendered insignificant. Interestingly, the increase in turnover becomes significant at the one year horizon. This may indicate that the reduction in transaction costs attracts traders to the stock causing turnover to increase.

One interesting observation is that the average relative spread *before* DMM contracts are initiated is 3.7% for the year before. This is actually lower than the default contractual obligation to keep the spread below 4%. This may suggest that the cost to the Designated Market Maker of maintaining a spread of 4% may be relatively low.

Overall, regarding the question of the effect of DMM initiations on liquidity, we see that there is a significant improvement in all liquidity measures around the DMM introduction, which is consistent with 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 also causes turnover to increase. Thus, there seems to be an additional liquidity effect from hiring a DMM as "liquidity attracts liquidity". In other words, as DMMs provide improved quotes relative to what other market participants are willing to trade at, the reduction in trading costs induces more trading activity.

3.2 Market reaction

A more open question is whether the market believes that there is any value to the DMM contracts. To answer this question we perform an event study, where the date when the firm announces a DMM is the "event date." The market reaction is measured by the cumulative abnormal return at the date when the DMM agreements are announced to the market. There is, however, some uncertainty as to when this information was known to the market. In many cases it is announced simultaneously with the DMM start, but in other cases it was announced to the market some days before the start. In the following event study we only use cases where we have isolated the actual announcement of the DMM contract. However, there is some uncertainty about how "surprising" these announcements was to the market since it is not unlikely that firms "shopped around" for DMM services, or that there is information leakages about an ongoing negotiation between a DMM and the firm. This may lead the market to expect firms to announce DMM initiations and price this in prior to the announcement. We also 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 figure 1 (a) we show the results of this event study, where we start 20 trading days (about one month) before the event date, and plot the aggregate CAR for the next forty trading days (about two months in total). In aggregate there is a positive reaction of about 3% just after the announcement, however, we see some signs of reversals later, so much of this effect may not be permanent.[7] In in figure (b) we show the CAR from 10 days before through 10 days after the announcement, where we see that the announcement day abnormal return is about 1.5%.

The results of this event study is consistent with other research. For example, Anand *et al.* (2009) find a CAR around liquidity provider introduction of about 7%, and Menkveld and Wang (2009) find a CAR of 3.5%. We thus confirm the effects on the market found in other studies, liquidity improves, and the market reacts positively to DMM introductions.

4 The decision to hire a DMM

We now turn to the corporate finance aspects of this study, and shifts focus from effects on the trading in the stock market to the links between the firm and the microstructure of trading. What affects the decisions by firms to hire DMM's? This is the central question we investigate in this paper. If, as we argued before, a source of the value of liquidity to the firm is that it makes it cheaper to raise new capital, or cheaper to repurchase stock, we would expect measures of future capital needs, or likelihood of repurchases, to affect the decision to hire a DMM. This is the question we investigate formally in a decision theoretic framework. We ask whether proxies of need for capital and the likelihood of repurchase affect the decision to hire a DMM.

Specifically, we model the decision to hire a DMM as a logit regression.[8] The variables of interest in this paper 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. As 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 should be increasing in Q. An alternative to (current) growth opportunities is to look at this ex post: *Does* firms hiring a DMM raise new capital in the near future. We use a dummy for whether the firm issues equity. Under the hypothesis that firms want to improve liquidity

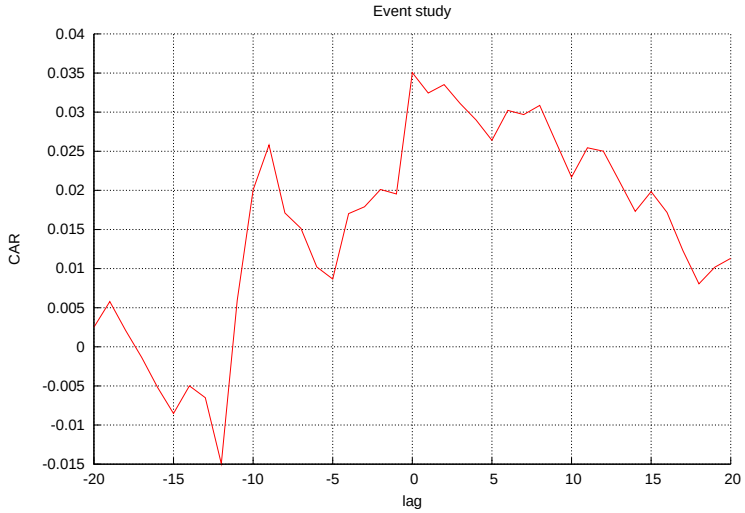
[7] There is some noise in the period before the event data, which is partly due to one stock with a very high return, of about 20%, 10 trading days before it hired a DMM.

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

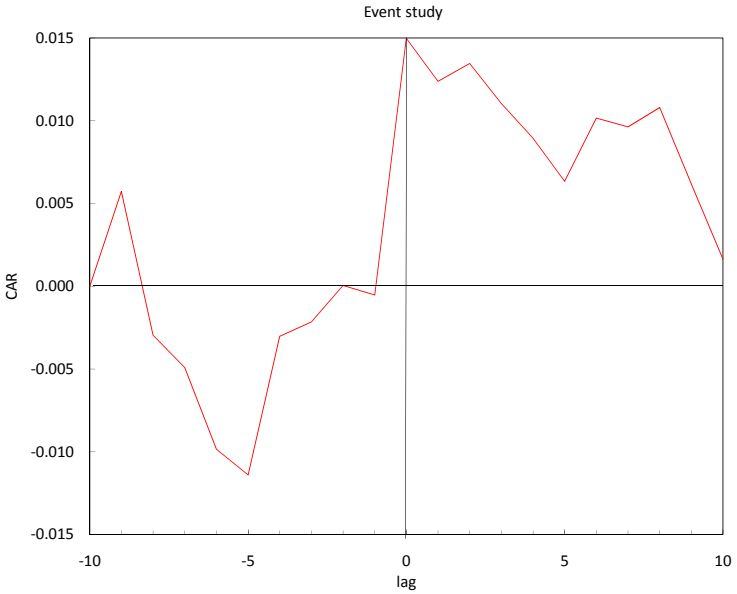
Figure 1

Event study, announcement date of DMM

The event study is done using the standard methods, as for example exposited in Campbell *et al.* (1997). The figures plot average cumulative abnormal return (CAR), where CAR is calculated relative to the CAPM. Specifically, for each stock i and date t we calculate $AR_t = r_{it} - (r_{ft} + \beta_{it}(r_{mt} - r_{ft}))$, where AR is the abnormal return, r_{ft} the risk free rate, r_{mt} the market return, and β_{it} the estimated beta. We use short term treasury rates for the risk free rate, an equally weighted stock market index for the market, and beta is the Scholes and Williams (1977) estimate of beta. Figure (a) shows the cumulative abnormal return (CAR) covering 20 days surrounding the DMM announcement (at t=0), and figure (b) shows the CAR covering the period from 10 days before to 10 days after the DMM announcement.



(a) CAR from t=-20 to 20



(b) CAR from t=-10 to 10

before they raise capital we expect the probability of hiring a DMM to be increasing in this dummy variable.

We also look at repurchases. If a firm wants to do a repurchase of the company's stock in the near future, improved liquidity in the firm's stock will reduce the price impact when the firm is repurchasing, and lower the cost when executing the repurchase. We use a dummy for whether the firm repurchases this or next year. Note that, similarly to the dummy for whether the firm issues capital or not, this is an ex post measure, not observable to an outsider when the decision to hire a DMM is made.

As mentioned in the theoretical discussion, we also point to a potential third explanation for why a firm would want to hire a DMM; the desire for management to lower price impact on their inside trades. To proxy for this we count the number of announced inside trades within the next sixteen months relative to the DMM initiation.

There are however a number of additional factors that are likely to influence whether a firm is likely to hire 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. We therefore employ a measure of liquidity as a control variable. We report results using the relative spread as a liquidity measure.[9] To avoid spurious effects related to overall market liquidity changing over time,[10] we subtract the average liquidity within the size quartile that the stock is in.

The liquidity of a stock is related to firm size. Generally, the larger the firm, the more active the market for the stock, and the better the liquidity. This was confirmed in the earlier descriptive tables, where we saw that DMM stocks were mainly in the below median sized stocks on the exchange. We therefore also control for firm size. We do this two ways. First we use (log) firm size directly as a control variable. Since firm size is very correlated with liquidity we also split the sample and only use the smallest half of the firms on the OSE, without firm size as an explanatory variable.

4.1 Hiring a DMM

We first look at results where a firm enters into a *new* DMM contract. The results when we look at all stocks are given in table 4. For our purposes, the two most interesting coefficients are the coefficient on investment opportunities, proxied by Q, and repurchases. Looking first at panel A in the table, where we use Tobin's Q as a proxy for future capital needs, we see that a higher Q significantly increases the probability of hiring a DMM. Also, with respect to repurchases, we find a significant positive coefficient. Thus, both

[9] In unreported investigations we have used ILR as an alternative liquidity measure. These results are available upon request.

[10] As show in e.g. Næs *et al.* (2008) and Skjeltorp and Ødegaard (2009) liquidity at the OSE has a time varying component.

increases in investment opportunities and repurchase activity increases the probability of a firm hiring a DMM. We also see that the firm-size control variable is significantly negative, which reflects that larger firms are less likely to hire a DMM. With respect to insider trades, we find a positive, but insignificant, coefficient. Somewhat surprisingly, liquidity is not a significant determinant. This is probably due to the fact that the firms that use DMM's are not those with the very lowest liquidity, as we saw in the descriptive statistics, the average liquidity among the DMM users is comparable to the non-DMM users. Since the very largest, most liquid firms generally do not employ DMM's, there must be a significant number of very illiquid firms that do not employ DMM. So there is not a monotone relationship between liquidity and DMM use.

In panel B, of table 4 we show the estimation results when we instead of using an ex ante measure of investment opportunities (Q), uses an ex-post measure of actual capital issuance (dummy) during the year following the DMM initiation. The coefficient for this variable is not significant and negative, which is the opposite sign to what we would expect. There are two things that may explain this. First, the sample period is relatively short. Second, the sample period contains the financial crisis starting in 2008. During the crisis period there was very little capital issuance, which may be behind the non-significance of the variable. With respect to the negative sign, it is important to point out that this is an ex-post measure. Thus, firms that hired a DMM in any given year might have been planning to issue more equity, but may have chosen not to due to exogenous events occuring after the DMM is in place. For example, even though a firm hired a DMM in 2007 with the intention to raise more external capital, the large change in market conditions during 2008 was likely to make the firm change their mind.

Interestingly, the coefficient for insider trades is positive, although only significant at the 6% level. This is consistent with a potential agency issues, where the mangers of the firm is planning to buy or sell shares in their own company, and hire a DMM to reduce their costs. However, it should be noted that also this is an ex-post variable. The positive coefficient may therefore also reflect that insiders just respond to a price effect caused by the DMM initiation, while they were not necessarily planning to trade ex-ante. Similar to the ex-post capital issuance variable, this result may also be related to the crisis, where insiders in DMM firms were buying or selling stocks for various reasons, unrelated to whether the firm hired a DMM, during the crisis.

In table 5 we perform a similar analysis as in table 4, but restrict the sample to only contain firms with size less than the median sized firm. Thus, we do not control for firm size in these estimations. The results are very similar to the results when we used all firms, and most notably the coefficients for Tobin's Q and repurchases remain significant and positive.

Table 4

Decision to hire a Designated Market Maker - all stocks

The table reports the results from a logit regression, where the dependent variable is the decision to hire a DMM in this year. In the estimation we include all stocks in the sample. The explanatory variables in panel A are: Liquidity (relative bid/ask spread last year), firm size (ln equity value end of last year), Q (end of last year), whether the firm actually repurchases shares this or next year and the number of insider trades within a year after the DMM agreement is initiated. In panel B we replace Tobin's Q with an ex-post measure of actual capital issuance the year following the DMM initiation. Note that firms which have started market making before the current year are left out of the analysis.

Panel A: Tobin's Q as a proxy for probability of issuing capital

Variable	coeff	pvalue
liquidity last year (spread)	-0.08	(0.10)
ln(firm size)	-0.50	(0.00)
q last year	0.19	(0.01)
repurchase within a year	0.72	(0.01)
no inside trades within a year	0.02	(0.17)
constant	6.48	(0.00)
n	1023	
Pseudo R^2	0.105	

Panel B: Ex post actually issue capital next year

Variable	coeff	pvalue
liquidity last year (spread)	-0.14	(0.02)
ln(firm size)	-0.49	(0.00)
issue capital within a year	-0.57	(0.07)
repurchase within a year	0.64	(0.02)
no inside within a year	0.03	(0.06)
constant	6.89	(0.00)
n	1023	
Pseudo R^2	0.097	

Table 5

Decision to hire a Designated Market Maker - small stocks

The table reports the results from a logit regression, where the dependent variable is the decision to hire a DMM in this year. The results in the table report the results when we only include stocks in the two first size quartiles (i.e. the 50% smallest stocks at the exchange). The explanatory variables in panel A are: Liquidity (relative bid/ask spread last year), firm size (ln equity value end of last year), Q (end of last year), whether the firm actually repurchases shares this or next year and the number of insider trades within a year after the DMM agreement is initiated. In panel B we replace Tobin's Q with an ex-post measure of actual capital issuance the year following the DMM initiation. Note that firms which have started market making before the current year are left out of the analysis.

Panel A: Tobin's Q as a proxy for probability of issuing capital

Variable	coeff	pvalue
liquidity last year (spread)	-0.06	(0.24)
q last year	0.27	(0.00)
repurchase within a year	0.64	(0.05)
no inside withing a year	0.03	(0.15)
constant	-3.23	(0.00)
n	435	
Pseudo R^2	0.090	

Panel B: Ex post actually issue capital next year

Variable	coeff	pvalue
liquidity last year (spread)	-0.13	(0.05)
issue capital within a year	-0.22	(0.53)
repurchase within a year	0.67	(0.04)
no inside trades within a year	0.04	(0.06)
constant	-2.60	(0.00)
n	435	
Pseudo R^2	0.055	

4.2 Maintaining a DMM

We have also investigated a similar formulation, but where we look at the "hire or keep" decision. Instead of only viewing the decision about hiring a market maker when one currently do not have one, we also look at the dependent variable: "Have a market maker in the current year." In other words, we do not *only* look at the time when the firm starts a DMM relationship, we also look at cases where the firm keeps their existing DMM relationship going one more year. The estimation results when using all stocks on the exchange with this definition of the dependent variable are shown in table 6. Similarily, table 7 shows the results when using only the 50% smallest firms on the exchange, and not controlling for firm size. Although there are some minor differences, the significantly positive coefficients on Q and repurchases remain.

5 Conclusion

We have investigated what motivates firms to spend cash hiring "Designated Market Makers" for the trading of 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, we show that measures relevant for the likelihood of the firm to issue capital in the near future are significant determinants of firm's decisions to hire DMM's.

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, 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 the economic channel giving such results. What matters is the *potential* for raising capital through either debt and equity markets. Liquidity matters because it affect the terms at which new capital is raised.

Table 6

Decision to hire or keep a Designated Market Maker - all stocks

The table reports the results from a logit regression, where the dependent variable is the decision to hire or keep DMM in this year. The explanatory variables in panel A are: Liquidity (relative bid/ask spread last year), firm size (ln equity value end of last year), Q (end of last year) and whether the firm actually repurchases shares this or next year. In panel B we replace Tobin's Q with an ex-post measure of actual capital issuance the year following the DMM initiation.

Panel A: Tobin's Q as a proxy for probability of issuing capital

Variable	coeff	pvalue
liquidity last year (spread)	-0.17	(0.00)
ln(firm size)	-0.38	(0.00)
q last year	0.09	(0.05)
repurchase within a year	0.78	(0.00)
no inside trades within a year	0.00	(0.89)
constant	5.42	(0.00)
n	1137	
Pseudo R^2	0.092	

Panel B: Ex post actually issue capital next year

Variable	coeff	pvalue
liquidity last year (spread)	-0.22	(0.00)
ln(firm size)	-0.39	(0.00)
issue capital within a year	-0.62	(0.00)
repurchase within a year	0.70	(0.00)
no inside within a year	0.01	(0.51)
constant	5.96	(0.00)
n	1137	
Pseudo R^2	0.099	

Table 7

Decision to hire or keep a Designated Market Maker - small stocks

Panel A of the table reports the results from a logit regression, where the dependent variable is the decision to hire a DMM in this year. The explanatory variables are: Liquidity (relative bid/ask spread last year), firm size (ln equity value end of last year), Q (end of last year) and whether the firm actually repurchases shares this or next year. In panel B we replace Tobin's Q with an ex-post measure of actual capital issuance the year following the DMM initiation.

Panel A: Tobin's Q as a proxy for probability of issuing capital

Variable	coeff	pvalue
liquidity last year (spread)	-0.18	(0.00)
q last year	0.16	(0.01)
repurchase within a year	0.33	(0.14)
no inside withing a year	0.02	(0.30)
constant	-1.92	(0.00)
n	513	
Pseudo R^2	0.074	

Panel B: Ex post actually issue capital next year

Variable	coeff	pvalue
liquidity last year (spread)	-0.24	(0.00)
issue capital within a year	-0.38	(0.11)
repurchase within a year	0.34	(0.13)
no inside trades within a year	0.03	(0.10)
constant	-1.53	(0.00)
n	513	
Pseudo R^2	0.066	

References

Amihud, Y. (2002). 'Illiquidity and stock returns: Cross-section and time-series effects'. *Journal of Financial Markets* **5**, 31–56.

Amihud, Y. and Yakov Mendelson (1986). 'Asset pricing and the bid/ask spread'. *Journal of Financial Economics* **17**, 223–249.

Anand, A. and Avindhar Subrahmanyam (2008). 'Information and the intermediary: Are market intermediaries informed traders in electronic markets'. *Journal of Financial and Quantitative Analysis* **43**(1), 1–28.

Anand, A., Carsten Tangaard and Daniel G. Weaver (2009). 'Paying for market quality'. *Journal of Financial and Quantitative Analysis* **44**, 1427–1457. Forthcoming Journal of Financial and Quantitative Analysis.

Banerjee, S., Vladimir A. Gatchev and Paul A. Spindt (2007). 'Stock market liquidity and firm dividend policy'. *Journal of Financial and Quantitative Analysis* **42**, 369–398.

Bessembinder, H., Jia Hao and Michael L. Lemmon (2007). Why designated market makers? affirmative obligations and market quality. Working paper.

Bøhren, Ø. and Bernt Arne Ødegaard (2001). 'Patterns of corporate ownership: Insights from a unique data set'. *Nordic Journal of Political Economy* **27**, 55–86.

Brockman, P., John S. Howe and Sandra Mortal (2008). 'Stock market liquidity and the decision to repurchase'. *Journal of Corporate Finance* **14**, 446–459.

Butler, A. W., Gustavo Grullon and James P. Weston (2003). Stock market liquidity and the cost of raising capital. Working paper.

Campbell, J. Y., Andrew W Lo and A Craig MacKinlay (1997). *The econometrics of financial markets*. Princeton University Press.

Easley, D. and Maureen O'Hara (2004). 'information and the cost of capital'. *The Journal of Finance* **59**, 1553–1583.

Fang, V. W., Thomas H. Noe and Sheri Tice (2009). 'Stock market liquidity and firm value'. *Journal of Financial Economics* **94**, 150–169.

Frieder, L. and Rodolfo Martell (2006). On capital structure and the liquidity of a firm's stock. Working paper.

Ginglinger, E., Laure Koenig-Matsoukis and Fabrice Riva (2009). Stock market liquidity and the rights offer paradox. Working paper.

Glosten, L. (1994). 'Is the electronic limit order book inevitable?'. *Journal of Finance* **49**, 1127–61.

Glosten, L. and P Milgrom (1985). 'Bid, ask and transaction prices in a specialist market with heterogenously informed traders'. *Journal of Financial Economics* **14**, 71–100.

Harris, L. E. and Venkatesh Panchapagesan (2005). 'The information content of the limit orde book: evidence from NYSE specialist trading decisions'. *Journal of Financial Markets* **8**, 25–67.

Hengelbrock, J. (2008). Designated sponsors and bid-ask spreads on xetra. Working paper.

Karolyi, G. A. (1998). 'Why do companies list shares abroad?: A survey of the evidence and its managerial implications'. *Financial Markets, Institutions and Instruments* **7**, 1–60.

Kyle, A. (1985). 'Continous auctions and insider trading'. *Econometrica* **53**, 1315–35.

Lesmond, D. A., J. P. Ogden and C. Trzcinka (1999). 'A new estimate of transaction costs'. *Review of Financial Studies* **12**, 1113–1141.

Lipson, M. L. and Sandra Mortal (2009). 'Liquidity and capital structure'. *Journal of Financial Markets* **12**, 611–644.

Menkveld, A. J. and Ting Wang (2009). How do designated market makers create value for small-cap stocks. Working paper.

Næs, R., Johannes Skjeltorp and Bernt Arne Ødegaard (2008). Liquidity at the Oslo Stock Exchange. Working Paper Series, Norges Bank, ANO 2008/9.

Næs, R., Johannes Skjeltorp and Bernt Arne Ødegaard (2009). What factors affect the Oslo Stock Exchange?. Working Paper, Norges Bank (Central Bank of Norway).

Næs, R., Johannes Skjeltorp and Bernt Arne Ødegaard (2010). Stock market liquidity and business cycles. Forthcoming Journal of Finance.

Nimalendran, M. and Giovanni Petrella (2003). 'Do thinly-traded stocks benefit from specialist intervention'. *Journal of Banking and Finance* **27**, 1823–1854.

Scholes, M. and J Williams (1977). 'Estimating betas from nonsynchroneous data'. *Journal of Financial Economics* **5**, 309–327.

Skjeltorp, J. and Bernt Arne Ødegaard (2009). The information content of market liquidity: An empirical analysis of liquidity at the oslo stock exchange. Working paper.

Venkataraman, K. and Andy Waisburd (2007). 'The value of the designated market maker'. *Journal of Financial and Quantitative Analysis* **42**(3), 735–758.

A Appendix

A.1 Detailed list of companies

We show details about what companies at the OSE have or have had a DMM agreement in the period investigated.

Table 8

Companies with MM deals

We list the securities involved in DMM deals, the duration of DMM deals, the stock listing periods, industries and firm size quartile. Industries and quartiles are estimated at the previous year-end. If the firm is listed during the year we use the end of the listing year. Note that 20090630 is the last date for which we have data, it is not the last listing date.

	Date MM		Listing dates		Industry	Size
Company	start	end	first obs	last obs		quartile
Active 24	20050401		20041112	20060823	45	2
Active 24	20060301	20061005	20041112	20060823	45	1
AF Gruppen A	20050203	20100131	19970908	20091230	20	3
AF Gruppen A	20100201		19970908	20091230	20	2
Artumas Group	20060510	20060910	20050708	20091230	10	2
Natural	20050906		19980127	20091230	35	2
Algeta	20071001		20070327	20091230	35	2
Allianse	20051121	20060619	20050525	20060622	45	2
Apptix	20060721		20020408	20091230	45	2
Axxessit	20050127	20050907	20040604	20050802	45	2
Belships Co.	20050112		19800102	20091230	20	2
Biotec Pharmacon	20070702	20090125	20051104	20091230	35	2
Biotec Pharmacon	20090126	20100228	20051104	20091230	35	1
Bluewater Insurance	20051013		20051013	20091230	40	2
Borgestad A	20050418		19800102	20091230	20	2
Borgestad A	20081001		19800102	20091230	20	2
Clavis Pharma	20061013		20060707	20091230	35	2
Clavis Pharma	20071220		20060707	20091230	35	2
Conseptor	20041001		20040624	20070502	30	3
Comrod Communication	20071113		20070122	20091230	20	1
Future Information Research Manage	20060706	20080716	20051206	20080807	45	2
Copeinca	20090803		20070129	20091230	30	2
ContextVision	20050706	20090125	19970317	20091230	35	1
ContextVision	20090113		19970317	20091230	35	1
Norsk Vekst Forvaltning	20070412		20000920	20070918	40	1
DiaGenic	20060227		20040827	20091230	35	2
DiaGenic	20090324		20040827	20091230	35	1
Dockwise	20080904	20090305	20071002	20091230	10	4
Dolphin Interconnect Solutions	20061220	20090313	20060420	20091230	45	1
Eidesvik Offshore	20060523		20050627	20091230	10	3
Teco Maritime	20050614		19971031	20091230	10	1
Teco Maritime	20070718		19971031	20091230	10	1
Exense	20061011	20080207	20000815	20090402	45	1
Exense	20080208	20081231	20000815	20090402	45	1
Expert	20040715	20070712	20000414	20070920	25	4
Fairmount Heavy Transport	20061117	20081016	20061117	20091230	20	3
Fairmount Heavy Transport	20081027		20061117	20091230	20	2
Fairmount Heavy Transport	20090803		20061117	20091230	20	1
Fara	20100104		20051216	20091230	45	1
Future Information Research Manage	20060706		20051206	20080807	45	2
Guinor Gold Corporation	20040910	20060403	20040504	20060302	15	3
Haag	20041116	20060102	19920401	20060220	20	2
Norwegian Applied Technology	20071219		19970130	20091230	45	3
Hafslund Infratek	20080909	20090302	20071205	20091230	10	2
Hurtigruten Group	20080220	20090216	20060301	20091230	25	2
International Maritime Exchange	20070301	20090216	20050404	20091230	40	2
International Maritime Exchange	20090216		20050404	20091230	40	2
I.M. Skaugen	20050426	20091026	19970218	20091230	20	3
I.M. Skaugen	20091109		19970218	20091230	20	2
Office Systems	20050201	20080229	19990713	20001115	45	
Consorte Group	20080801	20081205	20010613	20081212	45	1

Table 8 (continued)

Company	Date MM start	Date MM end	Listing dates first obs	Listing dates last obs	Industry	Size quartile
Sonec	20050404	20060301	19980116	20091230	45	2
Sonec	20081217		19980116	20091230	45	2
Kongsberg Automotive	20071129		20050624	20091230	25	3
London Mining	20080130	20081010	20071009	–	15	3
London Mining	20090212		20071009	–	15	2
Luxo	20071018	20090228	19980515	20090518	20	1
Mamut	20061115	20090520	20040510	20091230	45	2
Mamut	20090520		20040510	20091230	45	2
Media & Research Group	20051010	20060503	20050923	20080116	30	1
Media & Research Group	20060626		20050923	20080116	30	1
Media & Research Group	20070514		20050923	20080116	30	1
NattoPharma	20080130	20090930	20080130	–	35	1
NattoPharma	20090612		20080130	–	35	1
Navamedic	20060331	20081201	20060331	20091230	35	1
NEAS	20071113	20090810	20070323	20091230	40	1
Nordic Mining	20080204	20081123	20070914	–		1
NorDiag	20080827	20081123	20051214	20091230	35	1
Norway Pelagic	20090114		20080624	20091230	30	1
Natural	20050906		19980127	20091230	35	2
Nutri Pharma	20060315		20000505	20091230	35	2
Ocean Rig	20041116	20080331	19970107	20080701	10	3
Storli A	20050629		19860505	20091230	20	4
Storli B	20050629		19890512	20091230	20	4
Office Line	20050201	20060524	20001107	20060601	45	1
Ocean HeavyLift	20071203	20081013	20070504	20081230	10	3
Odfjell Invest	20070320	20080710	20060601	20081222	10	3
PhotoCure	20070924	20090228	20000529	20091230	35	3
PhotoCure	20090924		20000529	20091230	35	1
Polimoon	20050725	20070318	20050426	20070105	15	3
Powel	20051102	20061001	20051024	20091230	45	2
Profdoc	20050526	20060130	19980528	20080708	35	2
Profdoc	20080116		19980528	20080708	35	2
Rieber & Son	20041004		19800102	20091230	30	4
RomReal	20070608		20070611	–	40	2
RomReal	20080804		20070611	–	40	2
Scana Industrier	20090527		19951204	20091230	10	3
Scandinavian Clinical Nutrition	20080605	20090505	20071122	–	30	1
Synnøve Finden	20050318	20060103	19980706	20090813	30	2
Synnøve Finden	20050909	20061130	19980706	20090813	30	2
Synnøve Finden	20060925		19980706	20090813	30	2
Simtronics	20070108		20070105	20091230	20	1
Siem Offshore	20091113		20050812	20091230	10	3
	20090109		19830413	20000921	20	
Spits	20061121		20061212	20070705	25	1
SuperOffice	20070228	20080916	19970310	20081014	45	2
Teco Coating Services	20050418		20040622	20091230	20	2
24SevenOffice	20081001		20070622	–	45	1
Trefoil	20051205	20080714	20051220	20080808	10	3
Trolltech	20070112	20080407	20060705	20080606	45	2
TTS Technology	20040920		19950502	20091230	20	2
Bluewater Insurance	20051013	20090401	20051013	20091230	40	2
Bluewater Insurance	20090401		20051013	20091230	40	1
VIA Travel Group	20050707	20051011	20050609	20051012	30	2
Vizrt	20060913		20050512	20091230	45	3
Zoncolan	20070618		20070615	–	40	1