# Scale Economies in Liquidity Provision: Evidence from Designated Market Makers*

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**Abstract**

Stock markets in emerging economies often suffer from severe illiquidity. Exploiting a Chilean tax regulation, we identify a large negative causal effect of designated market maker (DMM) adoption on bid–ask spreads. A novel intraday spread distribution analysis shows that the improvement is roughly split between the DMM's binding spread obligation and equilibrium spillovers. These spillovers arise from economies of scale in liquidity provision: tighter spreads increase trading volume, lowering liquidity suppliers' average operating costs and enabling further tightening.

Key-words: liquidity, designated market maker, public policy

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# 1 Introduction

Stock markets in emerging economies often suffer from severe and persistent illiquidity. A potential explanation is the self-reinforcing nature of illiquidity: low liquidity discourages trading, and low trading volume in turn discourages liquidity provision (Pagano, 1989b; Admati and Pfleiderer, 1988; Cespa and Vives, 2015). Designated Market Makers (DMMs), financial intermediaries contracted and compensated by the listed firm or the exchange to provide continuous quotes, may play a crucial role in breaking this spiral. By committing to maintain a maximum quoted spread, a DMM might trigger a positive feedback loop between tighter spreads and higher trading volume and shift the market to a better equilibrium.

To study the impact of DMMs on market liquidity, we exploit a Chilean regulation that subsidized DMM contracts. The DMM in Chile is required to maintain a maximum bid–ask spread of 300 basis points and a quoted depth of USD 25,000, in exchange for a fixed monthly fee paid by the issuing firm. The DMM receives no trading privileges or fee rebates from the exchange, and contract terms are standardized by regulation.

We find that engaging a DMM sharply narrows bid–ask spreads. A novel analysis of the intraday spread distribution shows that half of this effect is mechanically driven by the binding cap, while the remainder reflects equilibrium spillover effects. We evaluate several potential mechanisms and find evidence most consistent with economies of scale in liquidity provision, driven by large fixed operational costs faced by liquidity suppliers and trading demand that is highly sensitive to spreads (dating back to Demsetz (1968)). Under this mechanism, lower spreads stimulate trading activity, which in turn reduces liquidity suppliers' per-trade operating costs and allows for further spread tightening. This scale-economy mechanism is particularly relevant in markets with very low trading activity and helps explain the large magnitudes we document relative to the existing literature.

The 2012 policy introduced a plausibly exogenous shock: some firms received a tax benefit when engaging a DMM, while others did not, enabling causal identification of liquidity provision contracts. Specifically, Chilean stocks qualify for a capital gains tax exemption if they maintain "exchange presence." Before 2012, this required at least USD 10,000 in daily trading volume on at least 25% of the past 180 trading days. The reform expanded eligibility by allowing firms to qualify through a DMM contract, while also raising the threshold for direct qualification to USD 50,000. We focus on firms that met the old but not the new threshold. These "lost-status" firms faced strong incentives to hire a DMM to regain tax-exempt status, largely due to investor pressure.[1]

Using a daily panel dataset, we instrument DMM adoption with the interaction of two indicators: one for the post-reform period and another for lost-status firms. The first stage is strong—lost-status firms became 50 percentage points more likely to adopt a DMM after the regulation. Prior to the regulation, liquidity trends for lost- and non-lost-status firms were similar, supporting the parallel-trends assumption. Identification also depends on the exclusion restriction: losing exchange presence affects liquidity only through DMM adoption. The instrument's validity rests on two features: fixed turnover thresholds and a predetermined implementation date. The threshold change limits self-selection based on firm conditions, while the fixed date curbs concerns about strategic timing.[2] Further, exchange presence is based on a slow-moving six-month volume average, which limits concerns of potential manipulation.

Our first key finding is that DMMs significantly improve daily liquidity measures, as captured by the second-stage instrumental variable estimates. These effects are an order of magnitude larger than those found in the existing literature: the reduction

[1]Chile's largest investors, pension funds, are restricted from investing in companies without exchange presence. Additionally, other investors, accustomed to the tax exemption, were reluctant to forgo its benefits, prompting them to pressure firms to regain their tax advantage.

[2]Firms expecting larger liquidity gains are more likely to engage a DMM. DMMs are especially valuable during events like equity offerings or buybacks (Skjeltorp and Ødegaard, 2015), which leads to strategic timing of DMM adoption.

in the effective half-spread is 55.7 basis points, which represents nearly half of the pre-regulation average of 119 basis points for firms that lost exchange presence. The impacts on the realized half-spread and quoted spread are also large, with reductions of 69.9 and 179 basis point, respectively.

Our second key finding stems from a novel analysis of how DMM adoption affects the intraday distribution of quoted spreads. We divide intraday spreads into eight intervals and use the daily share of time the spread falls within each interval as the dependent variable in our instrumental-variables model. This is a novel liquidity measure that shows how a treatment affects the whole distribution of spreads—not just the average—and is therefore of general interest. As a first validation, we confirm the direct effect of the DMM's presence: the probability of spreads exceeding 300 basis points is virtually eliminated, meaning DMMs fulfill their contractual obligation.

More interestingly, the intraday spread analysis allows us to distinguish between the direct effect of a DMM—enforcing the regulatory cap—and spillover effects to other market participants. If the DMM only enforced the 300 basis point cap, spreads would cluster just below this threshold. Instead, we observe large improvements at much lower spread levels: the share of spreads in the 20–40 basis point interval more than quadruples, and the 40–100 interval more than doubles. Assuming the cap is a binding constraint, these increases at low spread levels reflect behavioral changes by investors other than the DMM. Decomposing the total reduction in average quoted spreads (179 basis points), we find that the direct effect and broader equilibrium spillovers each account for roughly half of the improvement.

The third key finding is evidence suggesting spillovers arise from economies of scale effects, driven by high fixed operating costs of liquidity providers and price-sensitive demand (Demsetz, 1968; Cohen et al., 1981).[3] This theory predicts the DMM's tighter

[3]In practice, fixed costs are large: for example, US-based electronic market maker Virtu Financial had an approximate 60% operational leverage in 2013 (see Appendix Table A.8).

quote obligation narrows spreads, boosts trading, and triggers a feedback loop as market makers recover fixed costs over a larger transaction base. Empirically, we find DMM adoption increases trading volume by 74%, but this effect largely vanishes once we control for spreads—consistent with demand responding primarily to lower trading costs. DMM adoption also *raises* aggregate market-making revenues by about one-third of a standard deviation,[4] indicating that tighter spreads are sustainable because higher turnover preserves revenues. Additional tests rule out mechanisms proposed by the literature on DMMs, including channels of adverse selection, imperfect competition, and inventory management. Instead, our results point to scale economies as the dominant friction addressed by DMMs in thin markets.

Our findings carry policy implications beyond the specific design of DMM programs. The scale-economy mechanism is a classical idea in industrial organization and in market microstructure, yet empirical confirmation has remained elusive. Confirming this channel in thinly traded securities suggests liquidity may be further unlocked by other interventions, targeting either the fixed operational costs or the spread-volume relation. For example, important reductions in fixed costs include co-location, connectivity and market data fees, and balance sheet capital requirements; while volume can be stimulated by reductions in trading fees or transaction taxes.

Our paper builds on recent research examining the causal impact of DMMs on stock market liquidity (Clark-Joseph et al., 2017; Bessembinder et al., 2019; Bellia et al., 2024b; Foley et al., 2020). Clark-Joseph et al. (2017) study market outages due to technological failures, and find that liquidity is severely harmed only when an outage eliminates an exchanges with a DMM. Bessembinder et al. (2019) show that stronger contractual obligations for DMMs at the New York Stock Exchange improve liquidity by enhancing strategic interactions among liquidity providers. Bellia et al. (2024b) find that incentives offered to DMMs on the NYSE Euronext Paris increase liquidity by

[4]We proxy market maker gross trading revenues by multiplying the realized spread by dollar turnover.

intensifying competition between market makers. Foley et al. (2020) document that a Toronto Stock Exchange initiative bundling market-making responsibilities between large and small stocks leads to substantial liquidity gains for smaller stocks.

Our paper contributes to this literature in two main ways. First, we highlight a different economic mechanism based on economies of scale in liquidity provision. This channel is particularly important in illiquid markets, where fixed operating costs are large relative to trading activity. Our setting therefore complements the existing literature which mainly focused on already liquid markets, and helps explain why the liquidity effects of DMM adoption are substantially larger in our setting. Second, we introduce a novel liquidity measure with the intraday distribution of quoted spreads. This approach allows us to separate the direct effect of the DMM's spread obligation from broader equilibrium spillovers to other market participants.

# 2 Data and Summary Statistics

## 2.1 Data sources

Our analysis covers all 160 publicly listed firms on the Santiago Stock Exchange from January 2011 to December 2013. The primary data source is Tick Data Market, which provides intraday trade and top-of-book quote data. Each trade and quote update, defined as a change in the best bid or offer price or quantity, is time-stamped at the microsecond level. Using these data, we compute daily measures of liquidity, prices, trading volumes, trade counts, electronic message counts, and variance ratios.

In addition, we use the Economatica database to obtain data on outstanding shares and market capitalization of each firm. The website of the Bolsa de Santiago Stock Exchange contains announcements on when firms signed market maker agreements. Our sample includes 160 unique firms, and we construct the main panel dataset at the stock-day level.

We restrict our sample to stock-days with at least one trade. This selection is necessary because calculating liquidity measures for the regressions (such as spreads and volatility) requires trade data. Since zero-trade day observations cannot be included in the regressions, we apply this filter throughout the paper to ensure a consistent panel in all analyses. The original dataset contains 114,441 observations, of which 46.8% are stock-days without trades. We proceed with the remaining 60,883 observations.[5]

## 2.2 Summary Statistics

We estimate a variety of standard liquidity measures (see Appendix A for exact variable definitions). Each measure is calculated daily for each stock and, in the full panel, is winsorized at the 1st and 99th percentiles to mitigate the impact of outliers. Intraday, we impose an assumed maximum bid-ask spread of 500 basis points (5%), to ensure that extremely illiquid periods do not bias our main results. One rational is that most investors can trade via a broker-dealer or investment bank directly even when the order book is extremely thin—a 5% cost of such operation seems reasonable.[6]

Table 1 presents the summary statistics for the full panel. The average (median) firm in the sample has a market capitalization of approximately USD 3 billion (1 billion).[7] For context, in 2012, the average market cap of an S&P 400 mid-cap index stock was USD 4 billion, compared to USD 1 billion for an S&P 600 small-cap index stock.

Daily trading activity is low. The average daily turnover is approximately USD 2 million, which corresponds to an annual turnover of 16.6% of market capitalization.

[5]To assess the impact of a DMM on zero-trade days, we collapse the daily panel into two stock-level observations—pre- and post-regulation—and compute changes in zero-trade days and other variables. Appendix Table A.1 shows that DMM adoption has no significant effect on either the number or percentage of zero-trade days.

[6]As a robustness check, we also run the main analysis using a 10% threshold and all results hold (Appendix Table A.2).

[7]We use the 2012 exchange rate of CLP 500 = USD 1 throughout the paper, and convert all relevant values to USD.

The median number of trades per day is 28 and the median number of messages is 68 (defined as any trade or update to the best bid or offer in the order book). The low ratio of messages to trades indicates minimal algorithmic trading activity. The average trade size is USD 30,000. There is significant variation in stock prices, with a mean price of USD 23 and a standard deviation of USD 576 (the minimum price of 0 in the table is due to rounding in the exchange rate).

The Chilean stock market is illiquid, with an average time-weighted quoted bid-ask spread of 186 basis points. Recall that this number incorporates an imposed upper intraday limit of 500 basis points, replacing even larger spreads observed during periods of extreme order book thinness. The quoted depth is also low, with the average close the average trade size. This suggests that a single market order often eliminates all shares offered at the best price in the order book.

The average effective half-spread is 66 basis points—about one-third lower than the quoted half-spread of 93 basis points—indicating that investors tend to trade at times when markets are relatively liquid. A decomposition of the effective spread shows a five-minute price impact of 16 basis points and a realized spread of 50 basis points. The price impact, only a quarter of the effective spread, reflects adverse selection and informed trading. The high realized spread compensates liquidity suppliers' inventory and monitoring costs, along with potential rents from limited competition. These costs are likely high due to low volumes and strong order flow directionality: the average absolute order imbalance ratio is 0.58,[8] suggesting frequent one-sided pressure.

As a proxy for market efficiency, the median five to 30-minute variance ratio is 1.03, which is close to one which holds when prices follow a random walk. However, the distribution is strongly right-skewed, with an average variance ratio of 1.7. The absolute variance ratio, measuring the distance from one, is 0.78 on average, suggesting

[8] The ratio is defined as $\frac{|B-S|}{B+S}$ for daily buyer (B) and seller (S) initiated market order volume. An imbalance ratio of 0.58 occurs when 79% of volume is buyer or seller originated.

that both high-frequency momentum and reversals are frequent. Both measures are likely influenced by microstructure noise and the high levels of intraday illiquidity (e.g., wide spreads), which directly impact the midpoint returns used in the variance ratio calculation. The trade-based realized volatility is low on average, with the 25th percentile being zero. This happens on days when the few trades execute at the same price, resulting in no price variation.

## 2.3 Intraday liquidity

If liquidity and trading volume are self-reinforcing, we expect extended periods of illiquidity and low trading volume to alternate with relatively liquid periods where most trading volume takes place. This association is informative about how a DMM may affect market outcomes. We measure it by classifying the quoted spreads into eight intervals (bins) and computing the proportion of the trading day in which the spread falls within each interval. We then measure the dollar turnover corresponding to each bin.

Table 2 presents summary statistics on the distribution of quoted spreads across the eight intervals. On average, for all stocks and days, the spread is between 0 and 20 basis points only 13% of the trading day. However, the standard deviation of 21% is substantial, indicating significant variation in the prevalence of highly liquid periods. Similarly, spreads in the 20-40 basis point interval occur 12% of the time and in the 40–100 basis points interval 21% of the time. At the other extreme, spreads exceeding 500 basis points occur 18% of the average trading day, with a notably high standard deviation of 33%, highlighting the large variability in extreme illiquidity between stocks and days.

The association between trading volume and spreads is strongly negative (column 3), consistent with a self-reinforcing relation. Notably, the two most liquid spread intervals (below 40 basis points) account for only 25% of the time, yet contribute to 50% of total trading volume. In contrast, the four most illiquid categories (spreads exceeding 200 basis points) account for 36% of the time but contribute less than 2.5% of total volume.

# 3 Identification Strategy

In this section, we outline the institutional context and Regulation No. 327, which are essential for constructing an instrument to capture plausibly exogenous variation in the firms' decision to engage a DMM. We then detail the empirical model and identifying assumptions.

## 3.1 Institutional Setting

We begin by defining "exchange presence," which plays a key role in Chile's capital gains tax treatment, and then describe the regulatory change that introduced a new path to achieve it through DMM engagement.

### 3.1.1 Exchange presence

In Chile, stocks classified as having exchange presence are granted a capital gains tax exemption.[9] For firms lacking exchange presence, investors must pay capital gains taxes at the moment they realize profits, at their progressive personal income tax rate reaching up to a maximum of 40%.[10]

The Chilean Securities Regulator traditionally defines the exchange presence based on stock turnover. Specifically, a stock must have a minimum daily transaction value of 200 Unidades de Fomento (UF), equivalent to approximately USD 10,000,[11] on at least

[9] This exemption was introduced in 2001 as part of broader capital market reforms aimed at improving investor participation, market depth, and liquidity in the stock market (Agostini and Siravegna, 2014).

[10] Institutional investors, such as pension funds, are always exempt from capital gains taxes, regardless of whether the stocks they hold have exchange presence.

[11] During 2012, the exchange rate of UF 1 = CLP 22,500 = USD 50,00, approximately.

25% of the last 180 trading days. Thus,

$$\text{Exchange Presence}_{it} = \begin{cases} 1 & \text{if } \%\text{DaysAboveTreshold}_{it} \geq 0.25 \\ 0 & \text{otherwise} \end{cases} \tag{1}$$

where:

$$\%\text{DaysAboveTreshold}_{it} = \frac{1}{180} \sum_{\tau=t-180}^{t-1} \mathbb{1}_{i\tau}^{\text{turnover}_{i\tau} > \text{USD10,000}} \tag{2}$$

#### 3.1.2 The Regulatory Change and DMM contract details

In January 2012, the Securities Regulator introduced Regulation No. 327 to enhance stock market liquidity by expanding the criteria of exchange presence.[12] The new rule introduced two changes. First and foremost, firms could achieve exchange presence not only through the stock turnover criteria but also by engaging a designated market maker:

$$\text{Exchange Presence}_{it} = \begin{cases} 1 & \text{if } \%\text{DaysAboveTreshold}_{it} \geq 0.25 \quad \text{or firm engages DMM} \\ 0 & \text{otherwise.} \end{cases} \tag{3}$$

A firm chooses to enter into a DMM contract with a large broker-dealer and negotiates a monthly compensation. The arrangement is overseen by the stock exchange under a self-regulatory framework, rather than being formally co-signed by the exchange. The contract specifies standardized obligations for the DMM, including maintaining a maximum quoted bid-ask spread of 300 basis points (3%) and a minimum quoted depth of 500 UF on the bid and ask side (approximately USD 25,000). These obligations end on each trading day once the DMM has bought and sold a total of USD 25,000. In addition, the contract lasts for a minimum of six months, after which the DMM must reveal her trading activity to the firm, and the parties may decide to renovate the contract. All these requirements apply uniformly to all DMM contracts and are part of the policy

[12] Regulation No. 327 (in Spanish).

design, trading off the liquidity benefits with the cost for society through foregone tax revenues.[13] The DMM in Chile does not have special status, privileges, or trading costs advantages,[14] and simply submits her quotes to the public limit order book as any other investor.

The second regulatory change raised the turnover-based criteria from USD 10,000 to USD 50,000 (200 UF to 1,000 UF). The new threshold is as follows:

$$\%\text{DaysAboveTreshold}_{it}^{Post} = \frac{1}{180} \sum_{\tau=t-180}^{t-1} \mathbb{1}_{i\tau}^{\text{turnover}_{i\tau} > \text{USD50,000}} \tag{4}$$

Just before the regulation took effect, 48% of the firms met the old stock turnover criteria. Following its implementation, this percentage dropped to 41%, indicating that a significant number of firms no longer met the new stricter standard. We note that some firms already had DMM contracts in place before the regulation in 2012. However, these maintained laxer standards in terms of liquidity provision and did not grant Exchange Presence status.[15]

## 3.2 The Instrument

The regulatory increase in the turnover threshold for exchange presence is central to our identification strategy. We define a cross-sectional dummy variable set to one for firms that lost status on the regulation's implementation date, February 1, 2012.[16] Specifically, we identify firms that met the old turnover criterion of turnover exceeding USD 10,000 on at least 25% of the last 180 trading days but did not meet the new criteria with a

[13]This standardization contrasts European regulation (MiFID II, 2018), which stipulates that any firm using a market-making strategy must enter a formal DMM agreement with the exchange, but under contract terms that are potentially individually negotiated.

[14]In contrast, NYSE DMMs enjoy execution priority relative to same-priced limit orders by public investors; and both NYSE and NASDAQ DMMs typically enjoy lower trading fees.

[15]In Appendix Table A.3, we add to the main IV specification a dummy variable for the presence of an old-style DMM agreement, which does not meaningfully alter the first- or second-stage coefficients.

[16]Note that *Lost-status*$_i$ is a permanent characteristic, and does not change if a firm subsequently hires a DMM to maintain Exchange Presence.

USD 50,000 threshold:

$$\text{Lost-status}_i = \begin{cases} 1 & \text{if } \%\text{DaysAboveTreshold}^{\text{Post}}_{i,\text{Feb1,2012}} \leq 0.25 \\ & \text{and } \%\text{DaysAboveTreshold}^{\text{Pre}}_{i,\text{Feb1,2012}} > 0.25 \\ 0 & \text{otherwise} \end{cases} \tag{5}$$

On the day the regulation took effect, ten out of 153 firms lost status due to stricter volume requirements. Eventually, 25 firms engaged a DMM, including seven of the ten that lost status (compliers). To estimate the impact of a DMM on stock market liquidity, we use $\text{Lost-status}_i \times \text{Post}_t$ as an instrument for the (endogenous) decision of a firm to engage a DMM. $\text{Post}_t$ is a dummy variable equal to one after the implementation date.

The loss of exchange presence status created strong incentives for firms to engage a market maker and retain the designation. Two key factors drove this pressure. First, Chile's largest institutional investors, pension funds, are legally restricted to investing only in stocks with Exchange Presence.[17] Losing this status would force pension funds to divest, cutting off a critical and stable capital source. In addition, other investors, having benefited from the tax exemption in the past, were unwilling to relinquish these advantages and pushed firms to restore their tax-exempt status.

Importantly, on the implementation date, 78 firms in the sample had never met the exchange presence requirements, while 65 had always met them. The lost-status firms lie squarely in the middle of the trading volume distribution. This intermediate position is advantageous for identification, as it allows a balanced comparison group with both higher- and lower-volume firms.

Figure 1 shows the monthly evolution of DMM adoption for the full sample (green solid line), and the breakdown into lost-status and non-lost status firms (which we discuss in the subsection below). The average DMM adoption rate increases rapidly to

[17] See Investment Regime of Chilean Pension Funds.

12% within six months of the regulation. Afterwards, there is minor fluctuation in the fraction due to some firms engaging a DMM only temporarily, as well as some firms listing and delisting from the stock exchange.

Table 3 replicates the key summary statistics from Table 1, disaggregating lost-status and other firms before and after regulation implementation. Lost-status firms have low turnover by international standards, although in our sample there are ample firms with both higher and lower levels. Due to the presence of a few very large firms, the average market capitalization and turnover of lost-status firms are about ten times smaller than those of the average firm. Accordingly, spread measures for lost-status firms are approximately 50% larger.

### 3.3 Identification Assumptions

We conduct a difference-in-differences instrumental variables (DiD-IV) analysis. It is a difference-in-differences framework in which endogenous treatment is instrumented using the policy shock, allowing for causal identification among compliers. We estimate the following model:

$$\text{DMM}_{it} = \gamma_1 \text{Lost-status}_i \times \text{Post}_t + \gamma_2' \text{Controls}_{it} + \delta_i + \eta_t + \epsilon_{it}, \tag{6}$$

$$Y_{it} = \beta_1 \widehat{\text{DMM}}_{it} + \beta_2' \text{Controls}_{it} + \mu_i + \nu_t + \varepsilon_{it}. \tag{7}$$

Equation (6) is the first-stage regression, where $\text{DMM}_{it}$ is a dummy equal to one if firm $i$ has an active DMM contract on day $t$. Equation (7) is the second-stage regression, where $Y_{it}$ denotes a liquidity measure. $\widehat{\text{DMM}}_{it}$ is the predicted value from the first stage. Both regressions include firm and time fixed effects and control for standard liquidity determinants: log market capitalization, log dollar turnover, realized volatility, and the inverse of the share price. All standard errors are clustered at the firm and date level.

One concern is that the instrument Lost-status$_i$ $\times$ Post$_t$ has little variation in the time-series when using daily data, potentially inflating statistical significance. While we apply two-way clustering in all analyses, we further address this concern by collapsing the panel into a single pre- and post-regulation average and then re-estimating the IV model. Results remain robust (Appendix Table A.4), confirming that our findings are not artificially inflated by using a daily panel.

Identification in a DiD-IV framework rests on three core assumptions: instrument relevance, exclusion restriction, and parallel trends. We examine each in turn in the next subsections.

### 3.3.1 Instrument Relevance

Figure 1 showed that the full sample average DMM adoption rate rose rapidly to 12% within six months of the regulation. More importantly, the rate among lost-status firms jumped to 60%, visually reinforcing that losing status is a strong predictor of DMM adoption.

To assess instrument relevance formally, Column 1 of Table 4 shows the results of the first-stage regression of Equation (6). Following the regulatory change, firms that lost their exchange presence status were $\gamma_1 = 50$ percentage points more likely to engage a DMM, rising from an unconditional probability of 12% to 62%. This substantial increase highlights the strong incentive these firms faced to regain status and preserve the associated tax benefit. Most DMM adoptions occurred within six months of the implementation of the regulation (Figure 1).

The first-stage Kleibergen-Paap Wald F-statistic is 14.19, which exceeds the conventional threshold of 10 and thus satisfies the standard criterion for instrument relevance (Stock et al., 2002). While the statistic is not exceptionally large—partly due to the limited number of compliers (i.e., lost-status firms that engage a DMM)—we are not overly concerned about weak instrument issues. This is because the reduced-form effect of the instrument on liquidity is large and highly significant.[18] Provided that the exclusion restriction holds (as argued in 3.3.3), this effect must operate only through DMM adoption, supporting the instrument relevance. Lastly, we find highly similar results when we expand the treatment group to include all firms who obtain exchange presence by adopting a DMM (i.e., the lost-status firms and those which never had exchange presence). This sample includes a much large group of 82 treated firms, and the economic magnitudes are similar or larger (see Appendix Table A.5).

### 3.3.2 Parallel Trends

The next identifying assumption is the standard parallel trends assumption in difference-in-differences estimation: absent the regulation, liquidity outcomes for lost-status ("treated") and non-lost-status ("control") firms would have evolved similarly. Figure 2 shows monthly trends in effective spreads (top panel) and quoted spreads (bottom panel) for both groups. Before the regulation, the trajectories of lost-status and non-lost-status firms are closely aligned, lending support to the parallel trend assumption.[19]

### 3.3.3 Exclusion Restriction

The exclusion restriction assumes that the loss of exchange presence affects liquidity exclusively through its impact on DMM adoption. The credibility of this assumption rests on four key arguments.

First, the instrument, lost-status×post, is determined by predefined regulatory turnover thresholds, which are exogenous to firm-specific market conditions. This mitigates concerns about self-selection, where firms expecting the greatest liquidity gains would be most likely to adopt a DMM. Because the thresholds are fixed and externally imposed, they are not subject to manipulation by firms deciding whether to engage a DMM.

[18] Table A.7 shows the reduced-form results.

[19] Appendix Figure B.1 displays the same trends after applying the controls from Equation (7). The results remain unchanged: pre-regulation trends remain similar across groups.

Second, the regulation took effect on a fixed implementation date, reducing concerns about strategic timing. This, for example, rules out firms preemptively appointing a DMM in anticipation of major corporate events, such as an equity issuance. Our identification strategy exploits only the variation in DMM engagement triggered by the policy's effective date.

Third, exchange presence is determined by trading volume over the preceding 180 trading days, a relatively slow-moving metric. This limits the potential for manipulation in anticipation of the regulatory change. For instance, even if investors attempted wash trading to boost volume and preserve the tax exemption, such last-minute actions would have little effect on the six-month average used to calculate exchange presence.

Fourth, some investors may sell their holdings in anticipation of a firm losing exchange presence to realize capital gains while still exempt from taxes. However, this is not a major concern. Such behavior would temporarily increase trading volume before DMM adoption, biasing our postive estimates downward and leading us to underestimate the true effect of DMMs on trading activity.

# 4 Impact of a DMM on Liquidity

This section examines how DMM adoption affects market liquidity. We first analyze changes in average daily liquidity, and then assess the impact on the full intraday distribution of spreads—a novel analysis that allows us to separate equilibrium spillovers from direct contractual effects.

## 4.1 Impact on Average Daily Liquidity

Table 4 presents the results of the IV model from Equation (7), showing the causal effect of DMM adoption on key liquidity outcomes. We include the effective spread, price impact, realized spread, quoted spread, quoted depth, variance ratio, and absolute variance ratio.

Engaging a DMM reduces the effective spread by 55.3 basis points (column 2), an economically very large effect equal to nearly half of the pre-regulation average of 119 basis points for lost-status firms (Table 3). Due to high illiquidity in Chile, these results are an order of magnitude larger than those obtained in U.S. and European markets (Bessembinder et al., 2019; Theissen and Westheide, 2023; Bellia et al., 2024b). Decomposition of the effective spread shows that this improvement stems entirely from the five-minute realized spread, which declines by 70.5 basis points (column 4). Assuming the realized spread proxies for the gross profits of liquidity providers, the decline could reflect either lower marginal cost of liquidity supply or more aggressive competition among in the presence of a DMM.

By contrast, the price-impact component *rises* by 15.2 basis points, relative to a pre-regulation average of 12 basis points (column 3).[20] This increase is consistent with the theoretical predictions of Olivier (2025), who shows that tighter spreads, such as under DMMs, induce greater information acquisition, leading to more informed trading and stronger adverse selection. Consistent with this interpretation, we find that the introduction of a DMM enhances price efficiency. The variance ratio—which equals one under a random walk, implying fully efficient prices—reduces from a pre-event average of 1.41 to 1.13 under a DMM (column 7). Column 8 further shows that the absolute deviation of the variance ratio from one declines by 0.21, a substantial improvement relative to the pre-event average deviation of 0.47.

Column (5) indicates that a DMM reduces the quoted spread by 179 basis points, representing more than one-half of the pre-regulation average of 315 basis points observed for lost-status firms. This effect is very large and partly reflects the binding DMM obligation to maintain quoted spreads below 300 basis points, thereby eliminating episodes

[20]The decomposition into adverse-selection and inventory components can break down when inventory effects are persistent, in which case the price-impact term reflects both inventory and information effects. Our findings are not affected by this issue, as the largest magnitude is the decline in the realized spread.

of extreme order book thinness. Comparing the quoted *half* spread coefficient to that of the effective half spread, we note the former is 60% larger in magnitude. The difference arises from the variable definitions: the quoted spread is a time-weighted intraday average that incorporates prolonged intervals of severe illiquidity, whereas the effective half-spread is trade-weighted and therefore smaller, given that few trades occur during very illiquid periods.

Column (6) shows no significant impact on quoted depth. Although the DMM contract mandates a total bid and offer volume of USD 25,000, this requirement reduces dynamically as the DMM trades. For example, after purchasing USD 10,000, the DMM's bid can decrease to USD 15,000, reflecting partial fulfillment of her obligation.

All results remain highly similar when changing the treatment and control group definitions. In Appendix Table A.5, we expand the treatment group to include all firms eligible for the tax exemption when engaging a DMM—both lost-status and low-volume firms without prior exchange presence. The control group consists of high-volume firms that always had exchange presence and thus were unaffected by the regulation. In Appendix Table A.6, we keep the original treatment of lost-status firms, but use as control group only the unaffected high-volume firms. Appendix Table A.7 reports the reduced-form estimates: the average impact of losing exchange presence status post regulation, regardless of whether they adopt a DMM. Reduced form estimates rely on fewer identifying assumptions than the IV model.[21]

## 4.2 Impact on Intraday Spread Distribution

We have shown that introducing a DMM improves average daily liquidity. We now introduce a novel liquidity measure that analyzes the whole distribution of spreads—not

[21]Estimating the causal effect of DMM adoption via two-stage least squares requires three assumptions: instrument relevance, the exclusion restriction, and parallel trends. In contrast, the reduced-form estimates rely solely on the parallel trends assumption.

just the average—and is therefore of interest to the general empirical microstructure literature.

Using the eight spread categories defined in Section 2.3, we compute the proportion of time per day a stock spends in each category and use these shares as dependent variables in our IV model. Since all shares sum to one we capture the distribution, so this approach allows us to trace how DMM adoption shifts probability mass across spread chategories. Methodologically, it provides a simple yet powerful framework to study the impact of a treatment on the entire distribution of spreads, and requires only standard intraday quote data.

In our setting, this distributional framework allows us to separate the purely direct effect of a DMM—only enforcing the regulatory cap—from spillover effects to other investors. Indeed, if the DMM effect is purely direct, the probability mass of quoted spreads exceeding the regulatory threshold of 3% should disappear and concentrate just below it. On the other hand, if equilibrium effects are also present, the DMM should increase the proportion of time with spreads narrower than the threshold. Implicitly, to separate these effects we assumes the DMM's spread obligation is a binding constraint, which is natural since if quoting even narrower spreads were profitable, she would have already done so before assuming the role of DMM. Accordingly, any increase in the proportion of time with spreads narrower than the obligation must reflect spillover effects of the DMM on the behavior of other market participants.

Table 5 reports the results. We confirm a strong direct effect: the DMM's maximum spread obligation virtually eliminates periods with spreads exceeding 300 basis points. Specifically, for the 300-400, 400-499, and 500+ basis point categories, columns 6-8, a DMM reduces probabilities by 9.7, 7.5, and 36 percentage points, respectively. Given pre-regulation averages of lost-status firms of 10.5%, 8.4%, and 32% for these categories, we observe that extreme illiquidity was common but can be nearly eliminated by a

DMM.

We also find strong evidence of positive equilibrium effects. The percentage of time the spread falls within the 20–40 basis point range increases significantly by 4.8 percentage points (column 2), an economically large increase relative to the full sample average of 12% (Table 2). The increase is even greater for the next intervals: 22 percentage points for the 40-100 basis point range (volumn 3) and 20 percentage points for the 100-200 basis point range (volumn 4). Despite the DMM's spread obligation at 300 basis points, its presence substantially increases the prevalence of periods with much tighter spreads. This is consistent with theoretical predictions on coordination issues and multiple equilibria in liquidity provision.[22]

Notably, we do not observe significant clustering of spreads just below the 300 basis point ceiling. Column (5) shows an increase of 9.2 percentage points in the 200-300 basis point range,[23] but this is statistically insignificant and much smaller than the 53 percentage point reduction in spreads above 300 basis points (sum of coefficients in columns 6-8). Thus, the majority of this probability mass shifts to intervals much tighter than the obligatory threshold.

Our definition of direct and spillover effects allows for a simple decomposition of the overall effect of a DMM on the average spread of 179 basis points (Table 4). Specifically, we identify the direct effect by assuming that the probability mass of the three categories with spreads exceeding 300 basis points shifts to 300, and the indirect effect as further spread improvements below 300 basis points. Using the changes in probability mass of each category due to the DMM, we find that the direct effect impact is 88.1 basis points out of the total 179 average spread improvement (49.2%), leaving 50.8% to spillovers.[24]

[22]See, among others, Admati and Pfleiderer (1988); Pagano (1989a); Cespa and Vives (2015).

[23]Due to the price discreteness and tick sizes, spreads generally cannot equal exactly 300 bps. To be conservative, we opt for a wide interval of 200-300 bps to measure clustering below the binding threshold.

[24]Using the IV coefficients of Table 5, we calculate the direct impact on the average spread as

$$0.097 \times (350 - 300) + 0.075 \times (450 - 300) + 0.36 \times (500 - 300) = 88.1 \text{ basis points}$$

# 5 Economies of Scale in Liquidity Provision

The previous section shows that the introduction of a DMM improves liquidity and generates large spillover effects to other market participants. This section investigates the mechanism behind these spillovers. We argue that thin markets are affected by economies of scale in liquidity provision and that DMMs can alleviate this friction. We first describe this mechanism and present supporting evidence, and then evaluate alternative DMM channels proposed by the the literature and show that they are not consistent with the data.

## 5.1 Scale Economies in Liquidity Provision

We argue that the central friction behind the spillover effects in Section 4.2 are economies of scale: liquidity providers face large fixed operating costs while investors exhibit price-sensitive demand (an idea dating back to Demsetz, 1968; Cohen et al., 1981). Two empirical facts motivate this setup. First, trading activity is strongly negatively correlated with quoted spreads (Table 2), consistent with price-sensitive demand. Second, fixed costs can be substantial for liquidity providers. Although detailed data are scarce, a clear illustration is provided by Virtu Financial Inc., a U.S.-based proprietary high-frequency trading firm primarily engaged in liquidity provision, for which fixed costs accounted for roughly 60% of total operating expenses around our sample period.[25] Chilean market makers likely face even higher operational leverage due to lower trading volumes, so this benchmark is a lower bound of the fixed cost component.

When liquidity suppliers face fixed operating costs and traders exhibit price-sensitivity, economies of scale arise via a simple feedback mechanism:[26]

We assume the spread within each category is uniformly distributed. The remaining improvement in average spreads are due to spillovers.

[25] Appendix Table A.8 reports a snapshot of Virtu's income statements for 2013–2015 based on its Form 10-K filings.

[26] This mechanism is explicitly formalized in Hendershott and Mendelson (2000), in a general setup

1. a binding DMM obligation reduces spreads;

2. tighter spreads stimulate volume;

3. fixed costs are diluted over increased volume, allowing further spread compression

From a theoretical perspective, the DMM provides the necessary commitment to generate spillover effects by credibly maintaining tighter quotes, which coordinates expectations across voluntary liquidity providers and investors.

## 5.2 Evidence Consistent with the Scale-Economy Mechanism

Table 7 tests for price sensitivity by using log dollar turnover as dependent variable in the IV model. DMM adoption increases turnover by 74% (column 2), although the effect is only marginally significant. Once we control for quoted spreads (column 3), the coefficient shrinks to 5.7%, indicating that the rise in turnover operates almost entirely through lower trading costs—consistent with price-sensitive demand.

We next examine a necessary condition for the mechanism: tighter spreads must not reduce overall market-making revenues used to cover fixed operational costs. We proxy aggregate revenues by multiplying the daily realized spread by dollar turnover.[27] Column (4) shows that DMM adoption *increases* standardized daily gross revenue by 0.33 ($t$-stat = 2.6), relative to a mean and standard deviation of $2,000 and $4,300, respectively. The magnitude slightly increases after controlling for spreads and the order imbalance ratio (column 5).

Thus, while the DMM strongly reduces quoted and realized spreads, overall market-making revenues still increase because of higher turnover. This allows liquidity providers

where the equilibrium dealer spread covers fixed, inventory, and adverse selection costs. They, however, do not consider DMMs.

[27]The realized spread is a standard proxy for gross profits of liquidity suppliers, which we aggregate across trades to obtain a market-wide dollar measure. Our sample predates the algorithmic trading era, which distorts the realized spread as a proxy for liquidity supplier profits.

to recover their fixed and variable operating costs over a large base of trades, generating liquidity spillovers of the DMM contract.

## 5.3 Alternative Mechanisms

### 5.3.1 Adverse Selection and Informed Trading

Information asymmetry is arguably the most important trading friction, yet it is not obvious how a DMM would directly affect it, nor how it would generate the observed spillovers in quoted spreads. A more indirect channel is that narrower spreads induced by the DMM encourage information acquisition by speculators, raising adverse selection (Olivier, 2025). Consistent with this mechanism, we find that DMM adoption increases both price impact and price efficiency (Table 4). However, this channel alone cannot account for the strong rise in tight-spread intervals. If informed trading intensifies, we would expect the likelihood of such intervals to *decline*, not increase.

### 5.3.2 Inventory Frictions

A second source of illiquidity stems from inventory risk of liquidity suppliers and the difficulty of unwinding positions. The introduction of a DMM may alter these dynamics by acting as a buffer: by maintaining guaranteed quotes, the DMM offers voluntary liquidity suppliers an option to unwind, reducing their marginal inventory cost. This hypothesis, suggested by Bessembinder et al. (2019), predicts that DMM presence should generate stronger spillovers for stocks facing more severe inventory management frictions.

A first refutation of the inventory channel was shown in Table 7, that a DMM *raises* aggregate market-making revenues. This is inconsistent with the inventory buffer hypothesis, under which the DMM reduces the required compensation for inventory risk and thus predicts a decline in revenues.

To further test the inventory channel, we follow Chordia et al. (2002); Bogousslavsky and Collin-Dufresne (2023) and use the daily order imbalance ratio (OIR) as a proxy for inventory pressure, with high values indicating one-sided order flow and difficult market-making conditions. We examine whether (i) controlling for OIR attenuates the DMM effect on spreads, and (ii) pre-regulation OIR levels explain differences in direct and spillover effects. Column (1) of Table 6 shows that contemporaneous OIR strongly predicts illiquidity, yet the IV coefficient on DMM remains virtually unchanged at -180 basis points (versus -179 in the baseline). If inventory frictions were the channel through which DMM adoption generates spillovers, then by controlling for OIR the DMM coefficient should attenuate. The absence of any change implies that the DMM effect operates independently of inventory dynamics.

In columns (2)-(4) we explore whether pre-regulation heterogeneity in OIR explains differences in direct versus spillover effects. If a DMM reduces inventory frictions, we should expect the largest spillovers for stocks with severe inventory frictions and high levels of pre-regulation OIR. We find the opposite. Specifically, we split lost-status firms by above- and below-median OIR, with dummy $D_{OIR} = 1$ for the high group. We estimate an IV model with $DMM$ and $DMM \times D_{OIR}$ as endogenous variables, instrumented with *Lost-status* $\times$ *Post* and *Lost-status* $\times$ *Post* $\times$ $D_{OIR}$. The results in Table 6 show that spillover effects dominate for low-OIR firms: while these firms spend only 19 percentage points of the time in the 300+ basis points category, the DMM increases the time in the 0-200 category by 26 percentage points. In contrast, high-OIR firms show a balanced mix: the additional 53 percentage points of time spent above 300 basis points, is distributed roughly equally between the 0-200 and 200-300 basis point categories. This pattern is opposite to the predictions of the inventory channel, where spillovers should be largest in the sample of high-OIR stocks.

Two caveats qualify this test. First, the Sanderson-Windmeijer multivariate F-statistic are 23.94 for $DMM$ and only 5.42 for $DMM \times D_{OIR}$, indicating weak identification of the interaction term. We therefore treat the heterogeneity results as suggestive rather than conclusive. Second, OIR may also proxy for adverse selection rather than inventory pressure.[28] However, this interpretation too cannot explain why spillovers are largest for low-OIR stocks.

#### 5.3.3 Competition Between Liquidity Suppliers

A third potential channel is that DMM regulation spurred entry by new liquidity providers, raising competition and reducing spreads, as found in Bellia et al. (2024b) and Theissen and Westheide (2023). In our setting, however, this mechanism is unlikely at play. DMMs are established investment banks that already participated in the market, so no new entrants emerged. Moreover, contracts are negotiated at a fixed monthly fee directly with the issuer, providing no marginal cost advantage in liquidity provision. DMMs in Chile also lack the privileges enjoyed in other countries, such as order book priority or fee discounts. Hence, the nature of competition has not changed meaningfully with the regulation as neither the number of market makers nor their marginal cost of liquidity provision has altered.

Further, Table 7 showed that a DMM *raises* aggregate market-making revenues. This is inconsistent with tightened competition between liquidity suppliers which predicts lower aggregate revenues.

## 6 Conclusions

This paper shows that designated market makers (DMMs) can play a critical role in enhancing stock market liquidity in illiquid markets. Exploiting a Chilean regulatory reform that offered a tax incentive to firms hiring DMMs, we provide causal evidence

[28]When informed traders share a common signal they trade in the same direction, raising order imbalance.

that engaging a DMM strongly reduces bid-ask spreads and increases trading volume. Our novel analysis of intraday spreads reveals that these improvements stem equally from the direct contractual obligations of the DMM and from indirect spillover effects.

The evidence is most consistent with a setting in which liquidity providers face sizable fixed operating costs and investors exhibit price-sensitive demand. A DMM's tighter quoting obligation initiates a feedback loop: narrower spreads attract higher trading activity, which in turn allows liquidity providers to recover fixed costs over a larger base of transactions, reducing spreads beyond the DMM's obligation. Consistent with this mechanism, we find that liquidity demand responds strongly to trading costs and that aggregate market-making revenues actually increase with introduction of a DMM, as reduced per-trade margins are offset by greater trading volume.

Economies of scale mechanism seem an important source of illiquidity in thinly-traded securities. This finding suggests other tools that target either the fixed operating costs or the volume-liquidity feedback may further unlock liquidity. The mechanism further explains why we find such large economic magnitudes relative to the related literature on DMM's, which focusses on liquid markets where scale economies have already materialized.

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**Figure 1: Designated Market Maker Adoption Rate**

This figure shows the monthly share of firms engaging a DMM following the regulatory change (Feb 1, 2012), presented for the full sample as well as separately for lost-status and non-lost-status firms.

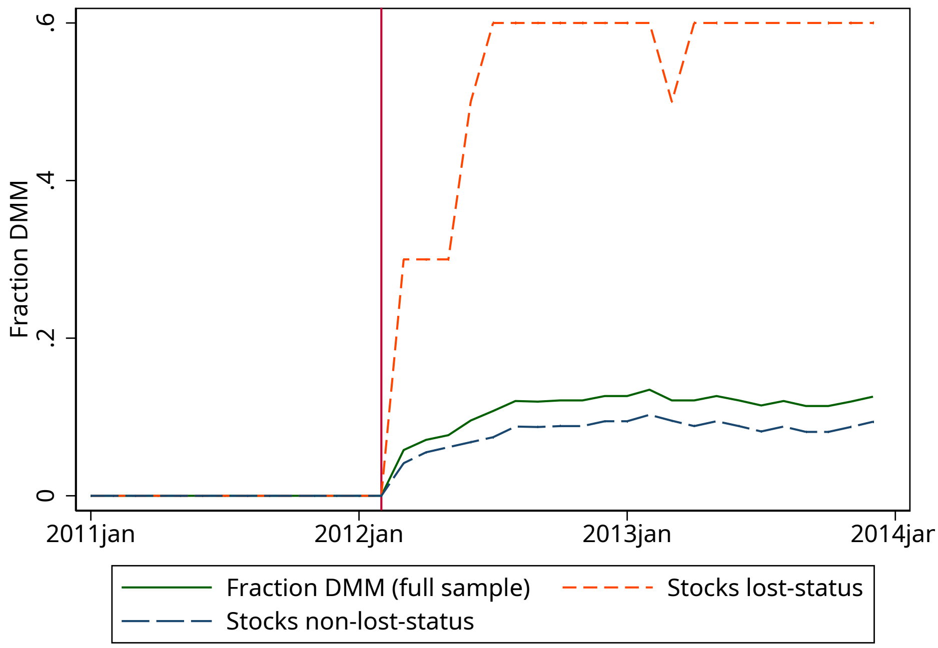
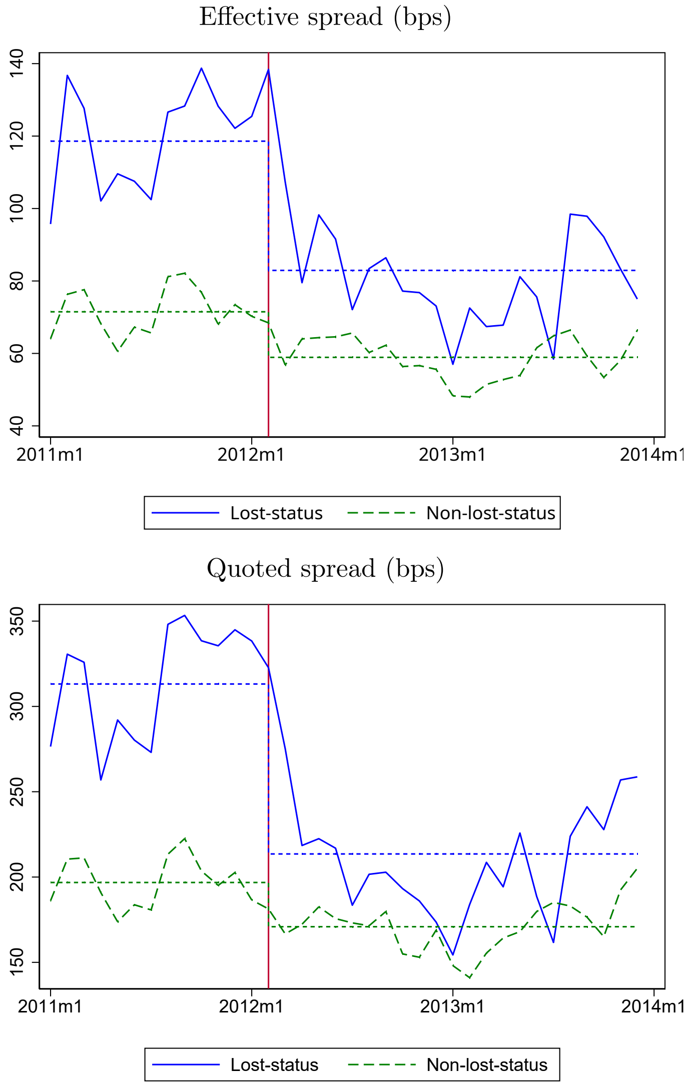


**Figure 2: Liquidity Trends: Lost-status versus non-lost-status Firms**

This figure plots monthly averages of the effective spread (top panel) and the quoted spread (bottom panel) over time, separately for firms that lost status on February 1, 2012 and those that did not. The dotted lines show average pre and post event (Feb 1, 2012), indicated by the red vertical line.



## Table 1: Summary Statistics for the Full Sample

This table presents summary statistics for the full daily panel. The liquidity measures are defined in Appendix Section A. Most variables are self-explanatory; variable Messages is a daily count of the number of observations in the raw data, representing changes to the best bid or offer and trades. Absolute Variance Ratio is the absolute of the deviation of the Variance Ratio from 1.

| | Full sample (2011-2013) | | | | | | |
|---|---|---|---|---|---|---|---|
| | Mean | SD | Min | P25 | P50 | P75 | Max |
| Price (usd) | 23 | 576 | 0.00 | 0 | 1 | 17 | 52,600 |
| Market cap (millions usd) | 3,037 | 4,691 | 1 | 98 | 1,190 | 10,949 | 27,800 |
| Turnover (1000s usd) | 2,076 | 9,498 | 0 | 22 | 267 | 5,578 | 1,030,000 |
| Volume (in 1000 shares) | 9,510 | 212,000 | 0 | 22 | 226 | 7,807 | 34,500,000 |
| Trade size (1000s usd) | 30 | 334 | 0 | 3 | 9 | 34 | 40,000 |
| Trade count | 96 | 166 | 1 | 4 | 28 | 280 | 4,759 |
| Messages | 210 | 356 | 1 | 14 | 68 | 594 | 7,055 |
| Bid ask spread (bps) | 186 | 156 | 14 | 59 | 129 | 491 | 500 |
| Effective spread (bps) | 66 | 80 | 0 | 20 | 39 | 147 | 500 |
| Price impact (bps) | 16 | 28 | -22 | 0 | 7 | 45 | 161 |
| Realized spread (bps) | 50 | 83 | -161 | 6 | 21 | 137 | 500 |
| Quoted depth (1000s usd) | 34 | 28 | 0 | 14 | 28 | 69 | 151 |
| Order Imb Ratio | 0.58 | 0.35 | 0 | 0.25 | 0.58 | 1.00 | 1.00 |
| Realized volatility (bps) | 5.35 | 11.79 | 0 | 0 | 1.42 | 13.16 | 80.10 |
| Var Ratio 30 min | 1.70 | 1.76 | 0.56 | 0.97 | 1.03 | 3.03 | 11.89 |
| Abs Var Ratio 30 min | 0.78 | 1.73 | 0 | 0.03 | 0.17 | 2.03 | 10.89 |
| Count | 60,883 | | | | | | |

**Table 2: The Intraday Distribution of Spreads and Turnover**

For each stock and day, we calculate the fraction of the time the intraday quoted bid-ask spread lies within each of the following intervals: 0-20, 20-40, 40-100, 100-200, 200-300, 300-400, 400-499, and 500+ basis points. Across stocks and days, we show means and standard deviations of these fractions and also report the daily turnover (in 1,000s USD) in each category.

| | Fraction of time | | Turnover (1,000s usd) | |
|---|---|---|---|---|
| Spread-interval (bps) | Mean | SD | Mean | SD |
| 0-20 | 0.13 | 0.21 | 688 | 1836 |
| 20-40 | 0.12 | 0.17 | 399 | 935 |
| 40-100 | 0.21 | 0.24 | 343 | 734 |
| 100-200 | 0.18 | 0.24 | 98 | 259 |
| 200-300 | 0.10 | 0.20 | 19 | 72 |
| 300-400 | 0.05 | 0.14 | 5 | 21 |
| 400-499 | 0.03 | 0.12 | 2 | 8 |
| +500 | 0.18 | 0.33 | 12 | 51 |

**Table 3:**
**Summary Statistics for Lost-status Firms, before and after the Regulation**

This table is similar to Table 1, but reports means and standard deviation for four subsets of the data: the sample of stocks with lost-status versus all others (non-lost status); both in the period before the SVS regulation on Feb 1, 2012 (PRE) and the period afterwards (POST).

| | Lost status-PRE | | Lost status-POST | |
|---|---|---|---|---|
| | Mean | SD | Mean | SD |
| Market cap (millions usd) | 297 | 380 | 268 | 357 |
| Turnover (1000s usd) | 169 | 2,427 | 122 | 1,247 |
| Bid ask spread (bps) | 313 | 134 | 214 | 129 |
| Effective spread (bps) | 119 | 84 | 83 | 69 |
| Price impact (bps) | 12 | 31 | 26 | 42 |
| Realized spread (bps) | 106 | 90 | 57 | 78 |
| Quoted depth (millions CLP) | 14.48 | 16.03 | 27.81 | 24.71 |
| Order Imb Ratio | 0.75 | 0.32 | 0.79 | 0.31 |
| Realized volatility (bps) | 6.09 | 14.60 | 3.46 | 10.40 |
| Var Ratio 30 min | 1.41 | 1.64 | 1.37 | 1.64 |
| Abs Var Ratio 30 min | 0.47 | 1.62 | 0.47 | 1.62 |
| Count | 1,806 | | 3,029 | |
| | non Lost status PRE | | non Lost status POST | |
| Market cap (millions usd) | 3,282 | 4,887 | 3,271 | 4,772 |
| Turnover (1000s usd) | 2,318 | 12,700 | 2,201 | 7,839 |
| Bid ask spread (bps) | 197 | 165 | 171 | 151 |
| Effective spread (bps) | 71 | 86 | 59 | 75 |
| Price impact (bps) | 12 | 21 | 18 | 30 |
| Realized spread (bps) | 59 | 89 | 41 | 77 |
| Quoted depth (millions CLP) | 27.31 | 21.66 | 39.01 | 30.65 |
| Order Imb Ratio | 0.55 | 0.35 | 0.57 | 0.35 |
| Realized volatility (bps) | 6.64 | 13.15 | 4.74 | 10.81 |
| Var Ratio 30 min | 1.64 | 1.59 | 1.78 | 1.86 |
| Abs Var Ratio 30 min | 0.72 | 1.56 | 0.86 | 1.82 |
| Count | 20,305 | | 35,743 | |

**Table 4: Impact of a Designated Market Maker on Stock Market Liquidity**

This table reports the IV regression results from Equations 6 and 7, where the endogenous variable $DMM_{it}$ is a dummy equal to one if firm $i$ engages a designated market maker on day $t$. Column (1) presents the first-stage results, using as instrument Lost $\text{Status}_i \times \text{Post}_t$: a dummy equal to one for firms that lost exchange-presence status when Rule 327 tightened the trading-volume requirement, interacted with an indicator equal to one after February 1, 2012. The dependent variables are various liquidity measures defined in Appendix Section A. Volatility is the realized intraday volatility and is standardized to have unit variance. The regressions contain firm and year-month fixed effects, and standard errors are clustered by firm and date.

| | First stage | Second stage | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) DMM | (2) Eff spread | (3) Price Impact | (4) Realized Spread | (5) Quoted Spread | (6) Quoted Depth | (7) Var Ratio | (8) Abs Var Ratio |
| Lost Status×Post | 0.49*** | | | | | | | |
| | (3.91) | | | | | | | |
| $\widehat{\text{DMM}}$ | | -55.3*** | 15.2*** | -70.5*** | -179*** | 5.41 | -0.28** | -0.21* |
| | | (-3.35) | (2.80) | (-3.57) | (-3.39) | (1.00) | (-2.30) | (-1.76) |
| Ln Turnover | 0.0045*** | -4.75*** | 1.71*** | -6.46*** | -11.8*** | 3.13*** | 0.041*** | 0.045*** |
| | (2.85) | (-9.41) | (10.0) | (-11.1) | (-11.7) | (15.9) | (9.18) | (10.5) |
| Ln Market cap | -0.057 | -24.6*** | -8.13*** | -16.5*** | -50.4*** | 10.3*** | 0.15*** | 0.15*** |
| | (-1.61) | (-4.32) | (-5.95) | (-2.77) | (-4.34) | (5.08) | (3.09) | (3.02) |
| Volatility | -0.0065*** | 12.7*** | 3.08*** | 9.67*** | 10.9*** | -0.83*** | -0.0099 | -0.0036 |
| | (-2.77) | (14.1) | (11.2) | (9.85) | (10.9) | (-5.83) | (-1.13) | (-0.41) |
| Price inverse | -0.000073 | 0.0030 | 0.011*** | -0.0082 | -0.023 | 0.00057 | -0.000086 | -0.000053 |
| | (-0.76) | (0.18) | (2.97) | (-0.48) | (-0.87) | (0.13) | (-0.53) | (-0.32) |
| Observations | 60,883 | 58,906 | 58,906 | 58,906 | 60,791 | 60,791 | 60,817 | 60,817 |
| R-squared | 0.15 | 0.069 | 0.033 | 0.061 | 0.123 | 0.079 | 0.001 | 0.002 |
| Number of firm | 160 | 160 | 160 | 160 | 160 | 160 | 160 | 160 |

## Table 5: Impact of a Designated Market Maker on the Distribution of Intraday Bid-ask Spreads

This table presents the IV regression results from Equations 6 and 7, analogous to Table 4, but using as dependent variables the fraction of intraday trading time that the quoted bid–ask spread falls within each of the following intervals: 0–20, 20–40, 40–100, 100–200, 200–300, 300–400, 400–499, and 500+ basis points. The endogenous variable is $DMM_{it}$, instrumented with Lost-status$_i$ $\times$ Post$_t$. We report the second-stage results, as the first-stage is identical to that of column (1) in Table 4. The regressions contain firm and year-month fixed effects, and standard errors are clustered by firm and date.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| | Spread interval (in basis points) | | | | | | | |
| | 0-20 | 20-40 | 40-100 | 100-200 | 200-300 | 300-400 | 400-499 | 500+ |
| $\widehat{\text{DMM}}$ | -0.020 | 0.048*** | 0.22*** | 0.20*** | 0.092 | -0.097*** | -0.075** | -0.36** |
| | (-1.14) | (2.83) | (4.23) | (2.72) | (1.50) | (-3.47) | (-2.55) | (-2.57) |
| Ln Turnover | 0.0092*** | 0.0089*** | 0.011*** | -0.00014 | -0.0052*** | -0.0036*** | -0.0031*** | -0.017*** |
| | (7.33) | (7.93) | (7.84) | (-0.079) | (-5.07) | (-5.43) | (-5.65) | (-7.69) |
| Ln Market cap | 0.071*** | 0.057*** | 0.023 | -0.026 | -0.038*** | -0.019*** | -0.018*** | -0.051* |
| | (5.09) | (5.28) | (0.87) | (-1.17) | (-2.92) | (-3.07) | (-2.89) | (-1.92) |
| Volatility | -0.012*** | -0.011*** | -0.0084*** | 0.0027 | 0.0071*** | 0.0062*** | 0.0049*** | 0.010*** |
| | (-7.71) | (-8.15) | (-4.40) | (1.02) | (6.47) | (8.82) | (7.39) | (4.17) |
| Price inverse | 0.00014** | 0.00011** | -0.000055 | -0.00010 | -0.00010* | -0.000067 | -0.000040 | 0.00011 |
| | (2.36) | (2.22) | (-0.66) | (-1.27) | (-1.81) | (-1.60) | (-0.89) | (0.82) |
| Observations | 60,883 | 60,883 | 60,883 | 60,883 | 60,883 | 60,883 | 60,883 | 60,883 |
| R-squared | 0.028 | 0.028 | 0.011 | 0.020 | 0.020 | 0.019 | 0.017 | 0.061 |
| Number of firms | 160 | 160 | 160 | 160 | 160 | 160 | 160 | 160 |

**Table 6: A Designated Market Maker and Inventory Management**

Column (1) shows the second stage IV results including Order Imbalance Ratio (OIR) as a control to proxy for inventory management difficulty, where $OIR = \frac{|B-S|}{B+S}$, for buyer (B) and seller (S) initiated market order flow. Columns (2)-(4) present the second stage IV results from a specification in which both $DMM_{it}$ and the interaction $DMM_{it} \times D_{OIR,i}$ are treated as endogenous. The dummy $D_{OIR} = 1$ identifies the lost-status firms with above-median levels of pre-event OIR. The two endogenous variables are instrumented by Lost Status$_i$ × Post$_t$ and Lost Status$_i$ × Post$_t$ $\times D_{OIR}$. A caveat is that in the first-stage, the Sanderson-Windmeijer multivariate F test of excluded instruments are 23.94 ($DMM_{it}$) and 5.42 ($DMM_{it} \times D_{OIR,i}$), respectively, implying the interaction term is weakly identified. The dependent variables are the fraction of the time the spread falls within the indicated spread interval. The regressions contain firm and year-month fixed effects, and standard errors are clustered by firm and date.

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | | Spread interval (bps) | | |
| | Quoted Spread | 0-200 | 200-300 | 300+ |
| $\widehat{\text{DMM}}$ | -180*** | 0.26*** | -0.069*** | -0.19* |
| | (-3.42) | (2.84) | (-2.80) | (-1.89) |
| $\widehat{\text{DMM} \times D_{OIR}}$ | | 0.28 | 0.25*** | -0.53*** |
| | | (1.64) | (5.51) | (-2.64) |
| OIR$_t$ | 46.6*** | | | |
| | (15.5) | | | |
| Ln Turnover | -10.9*** | 0.030*** | -0.0048*** | -0.025*** |
| | (-11.1) | (12.1) | (-4.68) | (-9.63) |
| Ln Market cap | -47.5*** | 0.12*** | -0.043*** | -0.081** |
| | (-4.21) | (3.74) | (-3.31) | (-2.48) |
| Volatility | 12.5*** | -0.029*** | 0.0065*** | 0.023*** |
| | (12.6) | (-12.0) | (5.76) | (8.14) |
| Price inverse | -0.0061 | 0.00025 | -0.00011 | -0.00014 |
| | (-0.11) | (1.57) | (-1.23) | (-0.81) |
| Observations | 58,437 | 58,577 | 58,577 | 58,577 |
| R-Squared | 0.144 | 0.093 | 0.022 | 0.124 |
| Number of firms | 149 | 149 | 149 | 149 |

**Table 7: Impact of a Designated Market Maker on Turnover and Gross Trading Revenue**

This table presents the IV regression results from Equations 6 and 7, analogous to Table 4, but using as dependent variables daily log dollar turnover and Gross Trading Revenue (GTR). GTR is proxied by the product of dollar turnover and the average daily realized spread, and is standardized and winsorized at the 1st and 99th percentiles. The regressions include firm and year–month fixed effects, and standard errors are clustered by firm and date.

| | First stage | Second stage | | | |
|---|---|---|---|---|---|
| | (1)<br>DMM | (2)<br>Ln turnover | (3)<br>Ln turnover | (4)<br>GTR | (5)<br>GTR |
| Lost Status×Post | 0.50***<br>(3.93) | | | | |
| $\widehat{\text{DMM}}$ | | 0.74*<br>(1.75) | 0.056<br>(0.19) | 0.33***<br>(2.58) | 0.41***<br>(2.59) |
| Ln Market cap | -0.049<br>(-1.43) | 1.75***<br>(11.5) | 1.49***<br>(13.1) | 0.27***<br>(3.41) | 0.34***<br>(4.63) |
| Volatility | -0.0053**<br>(-2.45) | 0.28***<br>(15.9) | 0.31***<br>(19.6) | 0.14***<br>(9.26) | 0.15***<br>(10.1) |
| Price inverse | -0.000070<br>(-0.72) | 0.00080**<br>(2.39) | 0.00068**<br>(2.38) | 0.00039<br>(1.45) | 0.00044<br>(1.64) |
| Quoted Spread | | | -0.0037***<br>(-11.1) | | 0.00045***<br>(4.33) |
| OIR | | | | | 0.42***<br>(10.7) |
| Observations | 60,883 | 60,883 | 60,791 | 58,906 | 58,840 |
| R-Squared | 0.145 | 0.075 | 0.117 | 0.021 | 0.038 |
| Number of firms | 160 | 160 | 160 | 160 | 160 |

# Appendix A Definitions Liquidity Measures

The effective half spread is a trade-based measure calculated as the equal-weighted average across all $T$ trades for a given stock on a specific day, expressed in basis points:

$$\text{Ef\_spread} = \frac{1}{T}\sum_{t=1}^{T}\frac{p_t - m_t}{m_t}D_t \times 10,000,$$

where $p_t, m_t$ and $D_t$ are the price, midpoint and trade direction, respectively. The effective spread is further decomposed into the five-minute price impact:

$$\text{Price\_Impact} = \frac{1}{T}\sum_{t=1}^{T}\frac{m_{t+5min} - m_t}{m_t}D_t \times 10,000,$$

and the realized spread:

$$\text{Realized\_Spread} = \frac{1}{T}\sum_{t=1}^{T}\frac{p_t - m_{t+5min}}{m_t}D_t \times 10,000.$$

Similar to the bid-ask spread, when the effective spread exceeds 5%, it is capped at 5%, with the realized spread adjusted accordingly.

Realized volatility is calculated as the sum of squared one-minute transaction price returns, expressed in basis points. To focus on intraday volatility, we exclude overnight returns and standardize the measure across stocks and days to have a mean of zero and unit variance for ease of interpretation.

The Variance Ratio 30 is defined as the daily variance of equally spaced five-minute midpoint returns divided by the variance of 30-minute returns, multiplied by six. If prices follow a random walk, the variance ratio equals one. A ratio greater (lower) than one indicates momentum (reversals) at the five-minute frequency. For this reason, we also consider the absolute value of the Variance Ratio 30 minus one, as both positive and negative deviations from one signal violations of market efficiency.

# Appendix B Additional Figures and Tables

This appendix contains the following additional results.

Figure B.1 shows the liquidity trends between lost-status and non-lost status firms, after applying controls. It confirms that the parallel trends assumption holds visually.

Table A.1 estimates the impact of a DMM on the fraction of trading days with zero-trades, using a cross-sectional variation of the main IV model.

Table A.2 repeats the main IV model, but uses spread measures where the imposed maximum is 10% intraday (as compared to the 5% upper limit used in the main specification).

Table A.3 shows IV regressions of the impact of the instrument (lost status) on market quality, but uses as additional control variable "old DMM" indicator.

Table A.4 shows the IV regression using data collapsed to a single observation in the pre and post period.

Table A.5 shows IV regressions of the impact of a variation of our instrument (lost status firms including other small firms) on market quality.

Table A.6 shows IV regressions of the impact of the instrument (lost status) on market quality, but using large firms only as a control group.

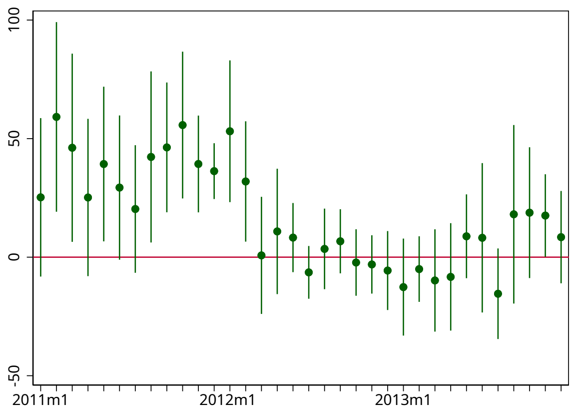
**Figure B.1:**
**Liquidity Trends after control variables: Lost-status versus non-lost-status**

This figure plots the monthly difference in effective and quoted spread between lost-status and non-lost status firms. The differences are represented by the coefficients $\delta_\tau$ on the interaction dummies between year-month fixed effects ($T_\tau$) and the lost-status dummy ($LS_i$) from the following daily panel regression:

$$Y_{it} = \sum_{\tau=1}^{36} \gamma_\tau T_\tau + \sum_{\tau=1}^{36} \delta_\tau T_\tau \times LS_i + \beta Controls_{it} + \varepsilon_{it}$$

Control variables are Ln Turnover, Ln Market cap, Volatility, and the inverse price (as in Table 4). The omitted case is the final month in the sample, December 2013, for the lost-status stocks, so all coefficients (and their 95% confidence intervals) are relative to this month. The SVS regulation was implemented on Feb 1, 2012. For brevity, we report results of two spread measures—other liquidity measures are available upon request.

Effective spread (bps)




Quoted spread (bps)

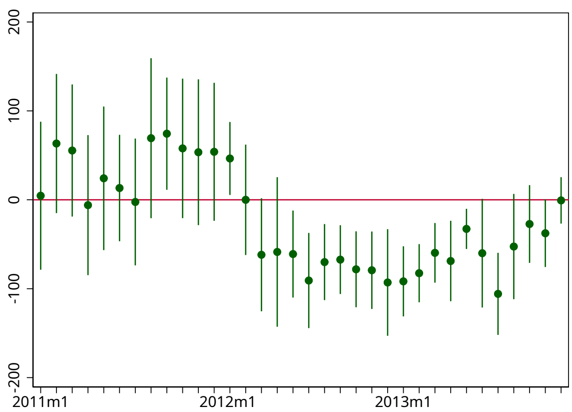


**Table A.1: The impact of a Designated Market Maker on Zero-trading days: Cross-sectional Evidence**

We estimate the main IV model in Equation (7) using cross-sectional data to analyze the impact of a DMM on the number of zero-trade days. Specifically, starting from the daily panel, for all regression variables we create the difference between the average in the PRE and POST period. The variable DMM takes a value of 1 if, in the post-period, the firm ever engaged a DMM. Column (1) shows the first-stage regression, while column (2) uses dependent variable ΔZero Days, which is the difference in the number of zero-trade days in the POST minus PRE period. In column (3), ΔZero Days% represents the difference in the fraction of zero-trade days POST minus PRE.

| | (1) | (2) | (3) |
|---|---|---|---|
| | DMM | ΔZero days | ΔZeroDays% |
| Lost-status × Post | 0.65*** | | |
| | (4.59) | | |
| $\widehat{\text{DMM}}$ | | 16.7 | -0.0037 |
| | | (1.05) | (-0.17) |
| ΔLn market cap | -0.20** | -6.71 | 0.052* |
| | (-2.05) | (-0.40) | (1.83) |
| ΔVolatility | -0.12 | 24.1 | 0.028 |
| | (-1.11) | (1.29) | (1.27) |
| ΔPrice inverse | -0.00031 | -0.048 | 0.00037*** |
| | (-1.39) | (-0.48) | (6.63) |
| ΔLn Turnover | 0.019 | -17.5*** | -0.069*** |
| | (0.99) | (-5.53) | (-13.3) |
| Constant | 0.085*** | 43.6*** | 0.021*** |
| | (3.36) | (8.44) | (3.04) |
| Observations | 143 | 143 | 143 |
| R-squared | 0.279 | 0.237 | 0.622 |

**Table A.2: Impact of a Designated Market Maker on Stock Market Liquidity: Maximum Possible Spread of 10%**

In the main panel data, we impose a maximum quoted and effective spread of 5% at any point in time. This limits the direct impact of a DMM on spreads in times of extreme illiquidity. In this table, we repeat the main IV analysis from Table 4 but construct spread measures assuming a maximum level of 10% of the midpoint. Column (1) repeats the first stage, and columns (2-5) the second stage regressions with the altered spread measures.

| | (1) DMM | (2) Eff spread | (3) Price Impact | (4) Realized Spread | (5) Quoted Spread |
|---|---|---|---|---|---|
| Lost Status × Post | 0.47*** | | | | |
| | (3.51) | | | | |
| $\widehat{\text{DMM}}$ | | -72.3*** | 3.46 | -75.8*** | -257** |
| | | (-2.62) | (0.61) | (-2.87) | (-2.43) |
| Ln Market cap | -0.062* | -27.8*** | -11.4*** | -16.4** | -69.9*** |
| | (-1.70) | (-3.99) | (-6.16) | (-2.50) | (-3.26) |
| Ln Turnover | 0.0047*** | -6.54*** | 1.97*** | -8.51*** | -18.2*** |
| | (2.92) | (-11.2) | (9.18) | (-13.5) | (-10.0) |
| Volatility | -0.0066*** | 12.2*** | 3.95*** | 8.27*** | 12.3*** |
| | (-2.78) | (14.2) | (11.0) | (8.90) | (6.70) |
| Price inverse | -0.000075 | -0.026 | -0.0024 | -0.023 | 0.065 |
| | (-0.72) | (-0.94) | (-0.34) | (-0.92) | (0.86) |
| Observations | 60,883 | 59,361 | 59,361 | 59,361 | 60,791 |
| R-squared | 0.13 | 0.077 | 0.026 | 0.068 | 0.089 |
| Number of firms | 162 | 160 | 160 | 160 | 160 |

**Table A.3: Impact of a Designated Market Maker on Stock Market Liquidity: Controlling for old-style Market Maker Contracts**

This table shows the main IV model from Table 4, using as additional control variable "old DMM", a dummy indicating whether a firm on a given date had a DMM arrangement based on a contract that does not comply with the conditions of Rule 312. Some firms maintained such contracts after Feb 1, 2012, without upgrading the conditions to comply with the regulatory requirements of Rule 312 (hence the negative coefficient on Old DMM in column (1)). Column (1) shows the first-stage regression, and the remaining columns the second stage results with different liquidity measures.

| | (1) DMM | (2) Eff spread | (3) Price Impact | (4) Realized Spread | (5) Quoted Spread | (6) Quoted Depth |
|---|---|---|---|---|---|---|
| Lost Status×Post | 0.47*** | | | | | |
| | (3.74) | | | | | |
| $\widehat{\text{DMM}}$ | | -57.8*** | 13.9** | -71.7*** | -187*** | 5.34 |
| | | (-3.31) | (2.43) | (-3.49) | (-3.48) | (0.94) |
| Old DMM | -0.50*** | -19.0 | -2.50 | -16.5 | -74.8* | -0.51 |
| | (-3.40) | (-1.43) | (-0.42) | (-0.92) | (-1.92) | (-0.16) |
| Ln Turnover | -0.50*** | 0.0039 | 0.011*** | -0.0068 | -0.020 | 0.00060 |
| | (-3.40) | (0.23) | (2.61) | (-0.39) | (-0.71) | (0.13) |
| Ln Market cap | 0.0041*** | -4.75*** | 1.68*** | -6.43*** | -11.8*** | 3.13*** |
| | (2.64) | (-9.39) | (9.91) | (-11.1) | (-11.7) | (15.9) |
| Volatility | -0.051 | -24.6*** | -8.38*** | -16.2*** | -50.0*** | 10.3*** |
| | (-1.49) | (-4.31) | (-5.96) | (-2.72) | (-4.29) | (5.08) |
| Price inverse | -0.0064*** | 12.8*** | 3.01*** | 9.81*** | 10.8*** | -0.83*** |
| | (-2.76) | (14.2) | (10.5) | (9.85) | (10.7) | (-5.83) |
| Observations | 60,883 | 58,908 | 58,908 | 58,908 | 60,791 | 60,791 |
| R-squared | 0.18 | 0.069 | 0.032 | 0.061 | 0.123 | 0.079 |

## Table A.4: Impact of a Designated Market Maker on Liquidity: Collapsed Data

This table presents results of the IV model using collapsed data, where all variables are averaged to produce a single observation in the pre-event period and in the post-event period. This approach ensures that each lost-status firm engaging with a designated market maker (DMM) is represented only once—in contrast with the main daily panel, where a single event generates many consecutive days of treated observations.

| | (1) Eff spread | (2) Price Impact | (3) Realized Spread | (4) Quoted Spread | (5) Quoted Depth | (6) Var Ratio | (7) Abs Var Ratio |
|---|---|---|---|---|---|---|---|
| $\widehat{\text{DMM}}$ | -62.1** | 24.0*** | -86.1*** | -182*** | 25.0*** | -0.096 | -0.050 |
| | (-2.54) | (3.14) | (-2.99) | (-4.51) | (4.52) | (-1.20) | (-0.63) |
| Ln market cap | 28.4 | -0.50 | 28.9 | 26.3** | -1.18 | -0.18** | -0.17** |
| | (0.72) | (-0.15) | (0.70) | (2.11) | (-0.14) | (-2.46) | (-2.42) |
| Volatility | -0.16 | 0.0064 | -0.16 | -0.0088 | 0.017 | 0.000011 | 0.000042 |
| | (-0.89) | (1.03) | (-0.93) | (-0.32) | (1.59) | (0.071) | (0.31) |
| Price inverse | -62.1** | 24.0*** | -86.1*** | -182*** | 25.0*** | -0.096 | -0.050 |
| | (-2.54) | (3.14) | (-2.99) | (-4.51) | (4.52) | (-1.20) | (-0.63) |
| Ln Turnover | -1.29 | 0.46 | -1.75 | -26.6*** | 1.67** | 0.070*** | 0.078*** |
| | (-0.25) | (0.74) | (-0.33) | (-10.8) | (2.49) | (5.73) | (6.37) |
| Observations | 286 | 286 | 286 | 286 | 286 | 286 | 286 |
| R-squared | 0.091 | 0.430 | 0.126 | 0.798 | 0.234 | 0.259 | 0.312 |
| Number of firms | 143 | 143 | 143 | 143 | 143 | 143 | 143 |

## Table A.5:
## Impact of a Designated Market Maker on Stock Market Liquidity: Lost status and Small as Treatment

This table represents the IV regression results analogous to those of Table 4, but using a different instrumental variable: (Lost-status+small)×Post. Lost-status+small is a dummy equal to 1 for all firms who did not meet the updated trading volume requirements for exchange presence on Feb 1, 2012, which includes the firms who lost status, but also smaller firms who never had exchange presence. The regression contains firm and year-month fixed effects, and standard errors are clustered on the firm and date level. The number of observations is lower in this sample, because 15 firms entered after Feb 1, 2012, setting $\text{small}_i$ to missing.

| | First stage | Second stage | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) DMM | (2) Eff spread | (3) Price Impact | (4) Realized Spread | (5) Quoted Spread | (6) Quoted Depth | (7) Var Ratio | (8) Abs Var Ratio |
| (Lost Status+Small)×Post | 0.27*** | | | | | | | |
| | (3.65) | | | | | | | |
| $\widehat{\text{DMM}}_{LS+S}$ | | -108*** | 24.9*** | -133*** | -249*** | -14.0 | -0.41** | -0.32* |
| | | (-3.69) | (3.54) | (-3.93) | (-4.45) | (-1.31) | (-2.08) | (-1.70) |
| Ln Turnover | 0.0042*** | -4.47*** | 1.65*** | -6.12*** | -11.5*** | 3.23*** | 0.043*** | 0.047*** |
| | (2.77) | (-8.13) | (9.74) | (-9.78) | (-11.0) | (15.6) | (9.12) | (10.4) |
| Ln Market cap | -0.057 | -27.5*** | -7.57*** | -20.0** | -54.2*** | 9.09*** | 0.13*** | 0.13*** |
| | (-1.49) | (-3.81) | (-4.96) | (-2.56) | (-4.07) | (4.01) | (2.76) | (2.74) |
| Volatility | -0.0073*** | 12.4*** | 3.15*** | 9.23*** | 10.4*** | -0.96*** | -0.011 | -0.0045 |
| | (-2.89) | (13.3) | (11.4) | (9.05) | (9.84) | (-5.83) | (-1.24) | (-0.51) |
| Price inverse | 0.000097 | 0.034 | 0.0027 | 0.031 | 0.019 | 0.0013 | -0.00028 | -0.00027 |
| | (0.25) | (0.67) | (0.32) | (0.61) | (0.26) | (0.090) | (-0.68) | (-0.69) |
| Observations | 57,283 | 57,283 | 57,283 | 57,283 | 59,103 | 59,103 | 59,129 | 59,129 |
| R-squared | 0.607 | 0.041 | 0.027 | 0.025 | 0.094 | 0.051 | 0.001 | 0.001 |
| Number of firm | 148 | 148 | 148 | 148 | 148 | 148 | 148 | 148 |

**Table A.6: Impact of a Designated Market Maker on Stock Market Liquidity: Only Large firms as Control**

This table represents the IV regression results analogous to those of Table 4, but uses as control group only the subset of 'Large' firms, which had Exchange Presence before and after the regulation. Thus, the small firms, which never had exchange presence, are excluded from the sample. The regression contains firm and year-month fixed effects, and standard errors are clustered on the firm and date level.

| | (1) DMM | (2) Eff spr | (3) Pr Imp | (4) Realized Spr | (5) Quoted Spread | (6) Quoted depth | (7) Var Ratio | (8) Abs Var Ratio |
|---|---|---|---|---|---|---|---|---|
| Lost-status$_{\mathrm{L}}$ $\times$Post | 0.51*** | | | | | | | |
| | (3.82) | | | | | | | |
| $\widehat{\mathrm{DMM}}$ | | -60.5*** | 15.9*** | -76.4*** | -187*** | 3.69 | -0.27** | -0.20 |
| | | (-3.61) | (2.82) | (-3.75) | (-3.44) | (0.64) | (-2.10) | (-1.59) |
| Ln Market cap | -0.051 | -20.5*** | -8.19*** | -12.3** | -49.4*** | 10.7*** | 0.16*** | 0.16*** |
| | (-1.25) | (-3.59) | (-5.22) | (-2.03) | (-3.59) | (4.52) | (2.91) | (2.80) |
| Volatility | -0.0067** | 11.4*** | 3.28*** | 8.11*** | 12.0*** | -1.01*** | -0.013 | -0.0061 |
| | (-2.39) | (12.3) | (10.5) | (8.21) | (10.7) | (-6.39) | (-1.23) | (-0.60) |
| Price inverse | -0.000023 | 0.016 | 0.018* | -0.0016 | 0.034 | -0.011 | -0.00052 | -0.00051 |
| | (-0.064) | (0.53) | (1.78) | (-0.047) | (0.39) | (-0.70) | (-0.72) | (-0.71) |
| Ln Turnover | 0.0049** | -5.81*** | 1.67*** | -7.48*** | -15.0*** | 3.57*** | 0.049*** | 0.053*** |
| | (2.36) | (-11.8) | (8.54) | (-12.5) | (-13.1) | (14.9) | (8.47) | (9.69) |
| Observations | 49,822 | 49,279 | 49,279 | 49,279 | 49,802 | 49,802 | 49,774 | 49,774 |
| R-squared | 0.20 | 0.119 | 0.030 | 0.095 | 0.158 | 0.092 | 0.002 | 0.003 |
| Number of firms | | 74 | 74 | 74 | 74 | 74 | 74 | 74 |

**Table A.7: Reduced-Form Impact on Stock Market Liquidity**

This table presents the reduced-form estimates of the impact of the Lost-status × Post instrument on various liquidity measures. The model includes firm and year-month fixed effects, and standard errors are clustered at the firm and date level.

| | (1) Eff spr | (2) Pr Imp | (3) Realized Spr | (4) Quoted Spread | (5) Quoted depth | (6) Var Ratio | (7) Abs Var Ratio |
|---|---|---|---|---|---|---|---|
| Lost-status× Post | -27.7*** | 7.59*** | -35.3*** | -88.6*** | 2.67 | -0.14*** | -0.10* |
| | (-3.14) | (3.26) | (-3.52) | (-3.46) | (0.88) | (-2.63) | (-1.88) |
| Ln Turnover | -4.98*** | 1.77*** | -6.75*** | -12.6*** | 3.15*** | 0.040*** | 0.045*** |
| | (-9.75) | (10.2) | (-11.3) | (-12.5) | (16.5) | (8.85) | (10.2) |
| Ln Market cap | -21.4*** | -9.01*** | -12.4** | -40.3*** | 9.99*** | 0.16*** | 0.16*** |
| | (-3.94) | (-6.07) | (-2.14) | (-3.55) | (4.90) | (3.42) | (3.28) |
| Volatility | 13.1*** | 2.97*** | 10.2*** | 12.0*** | -0.86*** | -0.0081 | -0.0022 |
| | (14.1) | (10.6) | (9.93) | (12.1) | (-6.18) | (-0.94) | (-0.26) |
| Price inverse | 0.0071 | 0.010** | -0.0030 | -0.010 | 0.00017 | -0.000066 | -0.000038 |
| | (0.40) | (2.33) | (-0.16) | (-0.34) | (0.036) | (-0.42) | (-0.24) |
| Observations | 58,906 | 58,906 | 58,906 | 60,791 | 60,791 | 60,817 | 60,817 |
| R-Squared | 0.410 | 0.127 | 0.378 | 0.660 | 0.434 | 0.056 | 0.063 |

## Table A.8: Income Statement Virtu Financial Inc. 2013–2015

In 2013, total operational expenses are USD 477,000, of which the variable component is USD 195,000 (Brokerarge, exchange and clearance fees) or 40%. The other components are mainly fixed in nature. Source: Virtu Financial Inc 10-K Form, p.70.

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**Virtu Financial, Inc. and Subsidiaries**
**Consolidated Statements of Comprehensive Incom e**

| | December 31, 2015 | 2014 | 2013 |
|---|---|---|---|
| **(in thousands, except share and per share data)** | | | |
| **Revenues:** | | | |
| Trading income, net | $ 757,455 | $ 685,150 | $ 623,733 |
| Interest and dividends income | 28,136 | 27,923 | 31,090 |
| Technology services | 10,622 | 9,980 | 9,682 |
| Total revenue | 796,213 | 723,053 | 664,505 |
| | | | |
| **Operating Expenses:** | | | |
| Brokerage, exchange and clearance fees, net | 232,469 | 230,965 | 195,146 |
| Communication and data processing | 68,647 | 68,847 | 64,689 |
| Employee compensation and payroll taxes | 88,026 | 84,531 | 78,353 |
| Interest and dividends expense | 52,423 | 47,083 | 45,196 |
| Operations and administrative | 25,991 | 21,923 | 27,215 |
| Depreciation and amortization | 33,629 | 30,441 | 23,922 |
| Amortization of purchased intangibles and acquired capitalized software | 211 | 211 | 1,011 |
| Acquisition related retention bonus | — | 2,639 | 6,705 |
| Debt issue cost related to debt refinancing | — | — | 10,022 |
| Initial public offering fees and expenses | — | 8,961 | — |
| Transaction advisory fees and expenses | — | 3,000 | — |
| Reserve for legal matter | 5,440 | — | — |
| Charges related to share based compensation at IPO | 44,194 | — | — |
| Financing interest expense on senior secured credit facility | 29,254 | 30,894 | 24,646 |
| Total operating expenses | 580,284 | 529,495 | 476,905 |
| Income before income taxes and noncontrolling interest | 215,929 | 193,558 | 187,600 |
| Provision for income taxes | 18,439 | 3,501 | 5,397 |
| Net income | 197,490 | $ 190,057 | $ 182,203 |
| Noncontrolling interest | (176,603) | | |
| Net income available for common stockholders | $ 20,887 | | |
| | | | |
| Earnings per share | | | |
| Basic | $ 0.60 | | |
| Diluted | $ 0.59 | | |
| | | | |
| Weighted average common shares outstanding | | | |
| Basic | 34,964,312 | | |
| Diluted | 35,339,585 | | |
| | | | |
| Net income | $ 197,490 | $ 190,057 | $ 182,203 |
| Other comprehensive income (loss) | | | |
| Foreign exchange translation adjustment, net of taxes | (4,255) | (5,032) | 1,382 |
| Comprehensive income | 193,235 | $ 185,025 | $ 183,585 |
| Less: Comprehensive income attributable to noncontrolling interest | (172,249) | | |
| Comprehensive income attributable to common stockholders | $ 20,986 | | |

See accompanying notes to the consolidated financial statements.

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