Market Maker Incentives and Market Efficiency: Evidence from the Australian ETF Market

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Abstract

This paper examines the impact of market maker rebates introduced by the ASX to the ETF marketplace on 1 August 2010. Looking at pre-scheme and post-scheme periods, our results show vast improvements in liquidity characteristics, namely the bid-ask spread and depth. Extending this analysis, we are able to confirm that rather than time improvements, the payment of the rebates themselves are responsible for these enhancements. Market maker trades are also assessed to determine how market makers derive their income and whether they are suppliers of liquidity. We verify that market makers do in fact supply liquidity and with no significant differences in profitability over the two periods, the improvements in the liquidity supplied are of no cost to other investors.

1. Introduction

On 1 August 2010 a market making scheme was introduced in the Australian Securities Exchange's (ASX) Exchange Traded Fund (ETF) market. The scheme provided affirmative market maker obligations and rewarded contracted market makers with rebates for meeting spread and volume requirements. The Australian ETF market is rapidly growing and is approaching $7 billion in assets under management, but the size in Australia is tiny compared to the ETF markets in the US and Europe. The scheme may be one method to try to improve trading conditions and encourage growth. This paper investigates the effect of the scheme by conducting an event study and examining the effect on market efficiency and profitability.

This paper is motivated by four factors. Firstly, compared to other, more traditional markets, academic analysis of the Australian ETF industry is limited. This study provides a valuable insight to the efficiency of the ASX's ETF market by analysing both spreads and depth. Secondly, by studying the trades of market makers, we determine whether they are fulfilling their mandated duty of supplying liquidity. Much of the literature finds that market makers use their superior order-flow information to make position-taking gains and this may be in conflict with their obligation to provide liquidity under the scheme. Thirdly, the introduction of the scheme motivates us to study the market efficiency effects and in turn offer empirical evidence that contributes to the debate. Finally, this paper is motivated by the incentives of the scheme and the effects on liquidity. We determine the effects on efficiency and study the rebates themselves to provide insight into any effects on liquidity.

Before determining effects of the scheme it is important to understand the complex role of market makers. The primary role is to provide immediacy for other investors by supplying liquidity. Market makers are often employed but at any particular moment in time, the number of market participants actively seeking to buy or sell can be quite small (Desmetz (1968), Garbade and Silber (1982)). Harris (2003) identifies two types of risk faced by market makers: inventory holding risk[1] and adverse selection risk[2]. Bagehot (1971) states that a profit must be made from liquidity traders to compensate for the losses to informed traders. These gains are achieved by setting a spread (Glosten and Milgrom, 1985)[3]. Using trade data that identifies each market maker, we find that our sample of market makers are net suppliers of liquidity and set the spread to earn profits 83% of the time after the introduction of the scheme. However, when studying the interaction between liquidity and position-taking profitability, we find that market makers make positive position-taking gains 75% of time when liquidity losses are incurred. This finding is consistent with both Manaster and Mann (1999)[4] and Copeland and Galai (1983), who identify an inverse relationship between a market makers liquidity and position-taking profitability. Therefore market makers are willing to forego their contractual duties to realise position-taking profits.

The level of skill of market makers is debatable since even though they have access to order flow, their profits may be generated by taking advantage of the bid-ask spread. Market makers may naively be considered to be uninformed traders, gaining gross trading profits composed entirely of the spread. However, the theoretical findings of Madhavan and Smidt (1993) implicitly suggest that market makers are likely to derive positive position-taking profits when they actively build positions. Hasbrouck and Sofianos (1993) apply a mark to market approach of determining total NYSE specialist profitability and they find that the

[1] Inventory holding risk arises due to events that cause unpredictable price changes (Harris, 2003). Market makers will then adjust their bid and ask quotes to attract the trades of public investors and therefore balance resulting undesired inventory positions.

[2] Like all traders, market makers lose money when they trade with those who are more informed. The risk of doing so is called adverse selection risk.

[3] Benveniste at al. (1992), Kavajecz (1998) and Dunpont (2000), argue that specialists are better able to differentiate between informed and uninformed traders compared to limit order traders, and can adjust the adverse selection component of the spread accordingly.

[4] Manaster and Mann (1999) determine that Chicago Mercantile Exchange market makers sacrifice an execution “edge”[4] to secure favourable timing.

principal source of profits is short horizon information. Therefore while a majority of net gains arise from capturing the spread, specialists are able to derive position-taking profits through the aid of superior order-flow information[5]. Consistent with the idea that market makers are using order flow information to make position profits, we find that market makers on the ASX achieve position taking gains 60% of the time after the implementation of the scheme. However, position-taking profits accrued after the introduction of the scheme are only two-thirds of the value of liquidity profits.

Our univariate analysis notes improvements in bid-ask spreads, depth and volatility following the implementation of the scheme. However, there are many arguments against the implementation of market maker obligations in the extant literature. High frequency traders act as the most active market makers in financial markets, even though they have no obligation to maintain their market presence. Many empirical papers have studied the growth in algorithmic trading and noted the benefits it has on market quality. These findings are frequently interpreted as empirical support for a market structure where designated market makers may be unnecessary (Anand and Venkataraman, 2012). Black (1971), Stoll (1998) and Bloomfield et al., (2005) all argue that markets are capable of functioning efficiently without the presence of mandated market makers.

The theoretical literature presents plenty of support for the introduction of market makers. Copeland and Galai (1983) note that since limit orders represent a free option to other market participants, traders will be reluctant to use a passive order submission strategy when order flow is strongly unidirectional or adverse selection levels are high. Therefore periods of market stress will be incredibly difficult to overcome without an exogenous

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[5] These findings are later substantiated by Harris and Panchapagesan (2005), who confirm that when transacting on the NYSE, intermediaries use information to their advantage. Similarly, Frino et al (2010) attributes position-taking net gains by locals on the Sydney Futures Exchange (SFE) to the ability to analyse conditions on the trading floor.

liquidity source. Bessembinder, Hao and Zhang (2012) believe that an obligation that requires the market maker to maintain a maximum bid-ask spread can improve allocative efficiency as it induces more uninformed investors to trade. Finally, Harris (2003) argues that the increased management and order processing costs resulting from market making obligations are compensated by the advantage derived from receiving the entire order flow.

Our empirical findings are consistent with the literature. We find consistent improvements in both bid-ask spreads and depth after the introduction of the scheme, similar to Frino et al., (2008) who find a reduction in spreads when stocks move from an auction market to a specialist market on the Italian Bourse[6]. We find no significant change in liquidity or position-taking profitability for market makers after the introduction of the scheme, suggesting that the liquidity improvements are not at the expense of other investors. Using US options and futures data respectively, Tse and Zabotina (2004) and Anand and Weaver (2006) both find empirical evidence that market maker introduction leads to improved liquidity. Christie and Huang (1994) and Barclay (1997) both find a reduction in transaction costs when firms relocate from NASDAQ (a dealer market) to a specialist market. Therefore there is also a lot of empirical support, namely the enhancements in market quality, for the introduction of schemes similar to that of the ASX ETF Market Making Scheme.

Rebate payments can also provide information about market maker activity since in the ASX scheme market makers only receive a rebate if they meet obligations 80% of the time. The rebates on trading and clearing fees are paid on a monthly basis and are conditional on market makers meeting their spread and volume requirements. Our data allows us to determine the regularity of market makers meeting their quoting requirements, and thus the payments of rebates. Therefore using only data from the period subsequent to the scheme, we

[6] Also investigating the Italian Bourse and reaffirming the conclusions of Frino et al.,, (2008), Nimalendran and Petrella (2003) find a decline in bid-ask spreads and a rise in trading volume after the introduction of obligated market making.

are able to compare the liquidity characteristics of the ETFs when rebates are paid to when they are not. This approach extends that of the traditional market maker literature and Panayides (2007) who partitions market maker profits according to discretionary and mandatory periods of participation. Our multivariate analysis confirms that while market efficiency has enhanced upon the introduction of the scheme, both bid-ask spreads and depth are most improved on the months the rebates are paid.

Section 2 provides a detailed description of the ASX ETF Market Making Scheme. Section 3 describes the data and explains the methodology employed. Section 4 presents all descriptive statistics, univariate and multivariate results. Finally, Section 5 concludes.

2. Institutional Detail

The ASX ETF Market Marking Scheme was implemented on 1 August 2010. Interested trading participants had the choice of entering the scheme as either an Advanced Market Maker or a Regular Market Maker[7]. Advanced Market Makers are contracted to make markets on a tranche of ETF products whereas Regular Market Makers have the option to pick which products they would like to be appointed to. Appendix 1 provides the list of relevant ETFs and their assigned market makers.

The ASX established a range of ETF market maker schedules that stipulate the spread and volume requirements for market making in ETFs on that schedule. The ASX, ETF issuers and market makers agreed on the ETFs that were allocated to each schedule. The decision incorporated the nature of the ETF and its liquidity characteristics. In total, ten quoting schedules were established for equity ETFs and details about quoting schedules can be found in Appendix 2.

The scheme states that market makers are required to meet the relevant schedule 80% of the time over a calendar month from 10:15am until commencement of the Pre-CSPA (Closing Single Price Auction) Session State (generally 4:00pm) on any trading day. Upon meeting the ETF requirements, the ASX will rebate all trading and clearing fees. A table of historical trading fees applicable to our sample period[8] can be found in Appendix 3. Rebated amounts are dependent on the identity of the other side of each trade. Appendix 4 provides the schedule of fee rebates.

[7] We have been advised by the ASX to consider all market makers as Advanced Market Makers.
[8] The selected sample period is 1 August 2009 to 31 July 2011. More detail is provided in Section 3.

3. Data and Methodology

The sample period is chosen to be 1 August 2009 to 31 July 2011 (504 trading days) to cover the period around the introduction of the ETF Market Maker Scheme by the ASX. The sample is divided into a pre-scheme period of 1 August 2009 to 31 July 2010 (252 trading days) and a post-scheme period of 1 August 2010 to 31 July 2011 (252 trading days). A minimum requirement of 10 trades per day over the entire sample period resulted in a final sample of 14 equity ETFs[9]. A breakdown of the ETFs and their corresponding quoting schedule is reported in Table 1.

Quote and trade data is sourced from both the Securities Industry Research Centre of Asia-Pacific (SIRCA) and the Thomson Reuters Tick History (TRTH) database. Order book data from SIRCA contains broker identifications, enabling us to track the activities of each market maker. The following fields were obtained from the order book request: instrument, date, time, record type, price, volume, value, trade direction, buyer broker ID and seller broker, bid price, ask price, bid size and ask size.

Combining the two datasets enables us to match the prevailing best bid and ask with each quote and trade. Rebate payment information is not available, however the data allows us to determine how often market makers were meeting their quoting requirements therefore the ASX rebate payment can be calculated.

To measure the efficiency of the ETF market, we focus on liquidity. Harris (2003) identifies immediacy, width, depth and resiliency as four dimensions of liquidity. In this paper, the primary focus is on width and depth. Width refers to the cost of trading at a given size, measured by the bid-ask spread, while depth refers to the size of a trade that can be

[9] The sample was selected from a total of 51 equity ETFs.

arranged at a given cost. As detailed in Section 2, market maker requirements are determined for each quoting schedule. Quoting schedules can be viewed as liquidity categories and as a result, rather than performing statistical tests across all ETFs simultaneously, liquidity analysis is conducted within each of the five quoting schedules. The time-weighted proportional bid-ask spread measures the cost of trading. First, the proportional bid-ask spread must be determined using the best bid, best ask and midpoint as follows:

$$PBAS_{i,q} = \frac{Ask_i - Bid_i}{(\frac{Ask_i + Bid_i}{2})}$$

Each spread observation *i* in option class *q* is then adjusted for the proportion of time that the quote is active during the trading day *j* (τ_i):

$$TWS_{i,q} = \frac{PBAS_{i}\,\tau_i}{\sum_{i=1}^{T} \tau_j}$$

Finally, to compute the daily time-weighted proportional bid-ask spread for option class *q*, all the $TWS_{i,q}$ for day *t* are summed:

$$TWS_{t,q} = \sum_{i=1}^{T} TWS_i$$

To measure depth, the quantities at the best bid and ask are summed. Depth is time-weighted using the same technique as above:

$$TWD_{i,q} = \frac{D_{i}\,\tau_i}{\sum_{i=1}^{T} \tau_j}$$

$$TWD_{t,q} = \sum_{i=1}^{T} TWD_i$$

where D_i is the depth amount, and τ_i again refers to the time that the depth quote was active during the trading day.

Other supplementary metrics, including volume, turnover, spread volatility and price volatility, are measured for each trading day. Volume is the number of shares traded, while turnover is the dollar amount of trading. Spread volatility is the variance of $TWS_{t,q}$. Price volatility is computed by the ratio of the day's highest price divided by the lowest price.

For each of the liquidity measures, the mean, median, standard deviation, skewness and kurtosis are estimated. The non-parametric Wilcoxon rank-sum test is used to compare the two periods. The Wilcoxon rank-sum technique tests for differences in the underlying distribution between the two periods. This non-parametric test has been chosen as it is impossible for any of our liquidity measures to be negative and therefore a normal distribution cannot be assumed as positive skewness is likely to be exhibited. Furthermore, Campbell et al., (1997) state that microstructure data is likely to show strong kurtosis due to the regularity of outliers.

Multivariate analysis is undertaken over the entire period and also for the post-scheme period only. The purpose of this is to first determine the effects of the ETF Market Maker rebate scheme on ETF liquidity and then the influence of the rebate payments themselves. Given that the rebate payments only occur in the post-scheme period, data from the pre-scheme period is not examined except when comparing the two periods. Using data for the entire sample period, the following regression models are estimated:

$$\ln(TWS_{t,q}) = \beta_0 + \beta_1 D_t + \beta_2 \ln(Volume_{t,q}) + \beta_3 \ln(Volatility_{t,q}) + \varepsilon_t \quad (1)$$

$$\ln(TWD_{t,q}) = \beta_0 + \beta_1 D_t + \beta_2 \ln(Volume_{t,q}) + \beta_{3\,\ln}(Volatility_{t,q}) + \beta_4 \ln(TWS_{t,q}) + \varepsilon_t \quad (2)$$

Log-log regressions are used to obtain residuals that are approximately symmetrically distributed around zero. The regressions are estimated using the Generalized Method of Moments (GMM) technique. To adjust for serial correlation, the Parzen Kernel suggested by Gallant (1987) is used.

The primary variable of interest D_t is a dummy variable that assumes the value of 0 if day *t* is during the pre-scheme period and 1 for the post-scheme period. $Volume_{t,q}$ refers to the total volume traded on day *t* in the ETFs grouped in quoting schedule q. This variable has been included due to the empirical findings by Hausman (1978) and others that volume is related to the bid-ask spread. Bargerstock et al., (2010) note that there is a positive relationship between volatility and the bid-ask spread in the ETF market on NASDAQ. Thus $Volatility_{t,q}$ represents the volatility of the ETFs in quoting schedule q on day t.

Since both the bid-ask spread and depth are used to measure liquidity, the variables explained in the paragraph above are also used as control variables when examining the depth measure. The variable $TWS_{t,q}$ refers to the time-weighted proportional bid-ask spread for the ETFs in quoting schedule q on day t.

As mentioned previously, multivariate analysis is also undertaken for the post-scheme period only. Using data for the post-scheme sample period, the following regression models are estimated:

$$\ln(TWS_{t,q}) = \beta_0 + \beta_1 R_{t,q} + \beta_2 \ln(Volume_{t,q}) + \beta_3 \ln(Volatility_{t,q}) + \varepsilon_t \qquad (3)$$

$$\ln(TWD_{t,q}) = \beta_0 + \beta_1 R_{t,q} + \beta_2 \ln(Volume_{t,q}) + \beta_3 \ln(Volatility_{t,q}) + \beta_4 \ln(TWS_{t,q}) + \varepsilon_t \qquad (4)$$

R_t is a dummy variable that assumes the value of 1 if a rebate was paid to the market makers for more than two-thirds of the ETFs in quoting schedule *q* on the month including day *t* and 0 otherwise. This analysis allows us to estimate the direct effect of the rebate payments themselves on both the time-weighted proportional bid-ask spread and the time-weighted depth. The control variables are the same as those explained above.

Market maker profitability is examined during the rebate period following Frino et al., (2010). Market maker profits are split into two components: a static liquidity component and a dynamic position-taking component. For a consistent unit of observation, income is measured and analysed for each trading day.

Market makers earn liquidity profits by setting a spread. Investors often pay a premium for immediacy: the difference between the trade price and the fundamental value of the underlying asset. Whilst the trade price is observed in our data, a proxy for the fundamental value must be determined. The most consistent approach in the prior literature[10] is to use the midpoint of the prevailing bid-ask spread. This proxy is intuitively appealing[11] and presents an unbiased reflection of trader valuations. Glosten and Milgrom (1985) also present a model where the price that would prevail if all investors had the same information as market makers is straddled within the bid-ask spread. As a result, this paper adopts the same approach. Following this, when supplying liquidity, the market makers revenue is determined by the difference between the trade price[12] and the midpoint. Investors therefore cross the bid-ask spread and incur a cost equal to half the bid-ask spread when demanding liquidity. Incorporating the quantity of the underlying asset traded, the daily liquidity profits realised by the market maker *M* in ETF *e* across *N* trades on day *t* is:

[10] Glosten (1987), Stoll (1989) and Frino et al.,, (2010) are examples of papers that have used the midpoint of the prevailing bid-ask spread as a proxy for the fundamental value of the underlying asset.
[11] Given that the average cost of a round-trip transaction is the bid-ask spread, it follows that the cost of liquidity for any initiated trade is half the spread.
[12] The direction of the difference depends on whether the market maker is making a purchase or sale.

$$LP_{M,t,e} = \sum_{i=1}^{N}(Q_i \times D_i \times (X_i - P_i))$$

where Q_i represents the number of ETFs bought or sold by M in trade i. D_i equals 1 if M purchased e and – 1 if M sold e. Finally, X_i is the midpoint of the prevailing best bid and ask P_i is the trade price.

Total liquidity profits are:

$$TLP_t = \sum LP_{M,t,e}$$

To make position-taking gains, traders must first be demanders of liquidity. Position-taking profits are earned when there is a change in the fundamental value of the asset. The "true" price of the underlying asset is again proxied by the mid-point of the prevailing bid-ask spread. This approach is consistent with the methodology employed in Hasbrouck and Sofianos (1993) where long (short) inventory positions yield positive position-taking profits whenever the midpoint increases (decreases). Again, in determining position-taking profits, the quantity of the underlying asset traded must be considered. Position-taking profits are determined for each transaction in a round trip as follows:

$$PP_{M,t,e} = \sum_{i=1}^{N}(Q_i \times D_i \times (X_c - P_s))$$

where X_c is the prevailing mid-point at the end of the inventory cycle while P_s is the prevailing mid-point at the start of the inventory cycle.

Total position-taking profits are:

$$TPP_t = \sum PP_{M,t,e}$$

Position-taking profits can only be realised when inventory positions are closed out. If an inventory cycle is incomplete at the end of a trading day, the remaining open positions are marked to market using the midpoint (X_e) of the bid and ask quotes prevailing at the end of the day. This approach is unlikely to have a major impact on our analysis as Kuserk and Locke (1993, 1994) document that both scalpers and day traders are unlikely to hold positions overnight. If positions are held overnight, they are typically small.

We refer to the entire net gains made by market makers as total profit. Total profitability per market maker (TP_M) is therefore a summation of liquidity and position-taking profits:

$$TP_M = LP_{M,t,e} = \sum_{i=1}^{N}(Q_i \times D_i \times (X_i - P_i)) + PP_{M,t,e} = \sum_{i=1}^{N}(Q_i \times D_i \times (X_c - P_s))$$

Total profitability is calculated as:

$$TP = \sum TP_M$$

This expression of total market maker profitability simplifies to the expression derived by Fishman and Longstaff (1992). The measure of total market maker profitability in this study is also consistent with the approach outlined in Hasbrouck and Sofianos (1993).

To measure profitability, both components of profitability and interactions between liquidity and position-taking profits are measured in the pre-scheme and post-scheme periods. The earlier univariate tests used for liquidity are also conducted. Univariate analysis is carried out for total liquidity and position-taking profits across our sample of ETFs to explicitly capture overall profits.

Multivariate analysis is undertaken for profitability over the entire period. The following regression models are estimated:

$$TLP_t = \beta_0 + \beta_1 D_t + \beta_2 \ln(Volume_{t,q}) + \beta_3 \ln(Volatility_{t,q}) + \beta_4 \ln(TWS_{t,q}) + \beta_5 (TPP_t) + \varepsilon_t \quad (5)$$

$$TPP_t = \beta_0 + \beta_1 D_t + \beta_2 \ln(Volume_{t,q}) + \beta_3 \ln(Volatility_{t,q}) + \beta_4 (TLP_t) + \varepsilon_t \quad (6)$$

We apply the same GMM methodology used in the liquidity analysis. Again, D_t is our primary variable of interest.

The width of the bid-ask spread is likely to influence the liquidity behaviour of market makers. Therefore the control variable $TWS_{t,q}$ has been included for liquidity profits and not position-taking profits.

4. Results

4.1. Liquidity

The liquidity descriptive statistics for pre-scheme and post-scheme periods are reported in Table 2. As mentioned in Section 3, liquidity results are presented for each quoting schedule subsample. A reduction in $TWS_{t,q}$ occurs for quoting schedules one, two, three and five. By far, the greatest improvement in spreads is the 37% drop in quoting schedule one. Like $TWS_{t,q}$, improvements in $TWD_{t,q}$ are shown in all quoting schedules barring quoting schedule four. A rise of 69% in quoting schedule three presents the greatest improvement in depth. An increase in turnover occurs across all five quoting schedules, however the mean daily volume has decreased for quoting schedule one. Spread volatility is very small for all quoting schedules and changes do not exhibit any clear patterns. Price volatility has decreased for all five quoting schedules. Looking at distributional properties, all sub-samples show positive skewness and are leptokurtic, a typical characteristic of microstructure data (Campbell et al., 1997).

Table 3 presents the Wilcoxon rank-sum test results for our five liquidity subsamples. The most consistent statistical change is the decreased volatility in share price. A reduction in price volatility occurs in all five of the quoting schedules and is consistent with the summary statistics presented in Table 2. Other compelling evidence of improvements in liquidity are the reduction in spreads and increased depth, our primary liquidity metrics, in all but one of the quoting schedules. Like Table 2 shows, improvements in spreads and depth do not occur for the ETFs in quoting schedule four in our post-scheme period. Consistent with Table 2, the greatest bid-ask spread and depth improvements occur in quoting schedules one and three respectively. There appears to be no adverse effects for turnover and volume, with improvements occurring in quoting schedules two, three and four.

These findings demonstrate significant liquidity enhancements in the year subsequent to the introduction of the ETF Market Making Scheme. The liquidity improvements are accompanied by consistent changes in actual trading outcomes, indicating that the scheme has been successful in improving quoting behaviour as well as affecting trading activity.

The GMM regression results associated with model (1) for each of the five quoting schedules are reported in Table 4. The period dummy variable D_t reveals that $TWS_{t,q}$ significantly decreases from the pre-scheme period to the post-scheme period in four of the five quoting schedules at the 1% level. Consistent with both Table 2 and Table 3, the improvement is greatest in quoting schedule one, with a reduction of 46% as a result of the scheme. $\ln(Volume_{t,q})$ is a statistically-significant negative determinant of $TWS_{t,q}$ in quoting schedule one only. $\ln(Volatility_{t,q})$ is a positive determinant of $TWS_{t,q}$ across our sample at the 1% significance level. This result is consistent with Copeland and Galai's (1983) information asymmetry models that predict wider spreads for volatility and less frequently traded assets[13] as a result of higher adverse selection risk.

Table 5 presents the GMM regression results associated with model (2) for each of the five quoting schedules. Similar to the results for $TWS_{t,q}$ in Table 4, the coefficient on D_t indicates improvements in $TWD_{t,q}$ from the pre-scheme period to the post-scheme period in four of the five quoting schedules at the 1% level. Consistent with both Table 2 and Table 3, the improvement is greatest in quoting schedule three, with an increase of 57% as a result of the scheme. The coefficient for $\ln(TWS_{t,q})$ is negative for quoting schedules one and three

[13] Even with a minimum requirement of 10 trades per day over the entire sample period, many of the ETFs are thinly traded.

but positive for quoting schedule five. $\ln(Volatility_{t,q})$ has a negative impact $TWD_{t,q}$ in quoting schedule one only, at the 10% significance level and may be expected given the negative and significant coefficient for $\ln(TWS_{t,q})$ in quoting schedule one. $\ln(Volume_{t,q})$ has a positive and significant impact on $TWD_{t,q}$ for quoting schedules two, three and four, but a negative impact for quoting schedule five.

The results for quoting schedule five in both Table 5 and Table 6 are generally inconsistent with the rest of our sample. A possible explanation could be that only one of our sample ETFs belong to quoting schedule five. Schedule five notwithstanding, overall, the regression results for model (1) and model (2) show efficiency improvements as a result of the ETF Market Making Scheme.

Rebates are only paid when market makers meet their quoting requirements at least 80% of the time over the calendar month. We calculate the rebate payments to determine whether these payments are associated with market efficiency improvements. Table 6 presents the results for model (3). The coefficient on $R_{t,q}$ reports improvements in $TWS_{t,q}$ when rebates are paid in quoting schedules three and four, at a level of significance of 1% and 5%, respectively. Consistent with the results in Table 4, $\ln(Volatility_{t,q})$ positively determines $TWS_{t,q}$ across the five quoting schedules at the 1% level.

Table 7 presents the results for model (4). The coefficient on $R_{t,q}$ indicates an enhancement in $TWD_{t,q}$ in four of the five quoting schedules at the 1% level. The payment of rebates by the ASX, and consequently the increased participation of market makers, has a greater and more consistent influence on depth than it does spreads.

Overall, the ETF Market Making Scheme demonstrates an improvement in the efficiency of the ETF market, notably through decreases in spreads and increases in depth.

These changes are one aspect of the market makers' activities on the ASX with the other side being trading for their own accounts that may also have been affected by the scheme. Changes in this area would be observable in profitability calculations.

4.2. Profitability

Table 8 presents descriptive statistics relating to the profitability of all market makers trading in our sample of ETFs in the year subsequent to the ETF Market Making Scheme. A similar table has been constructed for both the entire period and pre-scheme period can be found in Appendix 5. Panel A reports that market makers are often achieving profits, with close to three quarters of trading days resulting in positive total profit.

There are two measures of liquidity that we examine in this paper. Table 9 reports market makers liquidity profits in the year subsequent to the scheme. The same table for both the entire period and pre-scheme period can be found in Appendix 6. Panel A of Table 9(a) reports that market makers are net suppliers of liquidity. Panel B also illustrates that that total liquidity profits are positive for the sample period. Therefore market makers obtain income from supplying liquidity. Negative liquidity profits occur 17% of the time, indicating that market makers are passive in their trading activity. These findings are similar to Silber (1984) who found that his representative scalper supplied liquidity in 77% of all transactions.

Table 9(b) provides descriptive statistics for market maker position-taking profitability across all days in the sample period. Similar to liquidity profits, market makers experience more days with positive position-taking profits than days with negative position-taking profits. Only accounting for 39% of total profitability, position-taking profits are not as large as liquidity profits. Therefore, liquidity profits make up a greater proportion of total profits in the period subsequent to the scheme.

Panel C of Table 9(a) and Table 9(b) indicate that the mean profit is significantly greater than zero at the 1% level. Similarly, the median profits for each day are significantly greater than zero at the 5% level. These results confirm that the distribution of daily profits is not significantly different.

The relationship between the market makers liquidity and position-taking profits is reported in Table 10. Similar tables for both the entire period and pre-scheme period can be found in Appendix 7. Panel A of Table 10 provides an insight into the relative distribution of position-taking profits when market makers realise liquidity losses (relatively active traders). Market makers obtain position-taking profits far more often than losses when they are net demanders of liquidity. Specifically, market makers make position-taking profits 74.42% of the days when they demand liquidity and 59.64% of the time when they supply liquidity. Therefore, consistent with Manaster and Mann (1999), market makers are willing to forego their contractual duties to realise position-taking profits when they have information regarding the direction of a price movement. Table 10, Panel B, reports that when market makers are net suppliers of liquidity, they are less successful in predicting future price movements.

Table 11 presents Wilcoxon signed rank-sum tests for both liquidity profits and position-taking profits. The results confirm that both daily liquidity and position-taking profits do not significantly change after the implementation of the scheme.

The GMM regression results associated with model (5) and model (6) are reported in Table 12. As univariate results in Table 10 suggest, the coefficient on D_t indicates there is no change in TLP_t or TPP_t from the pre-scheme period to the post-scheme period. We also find that $\ln(Volatility_{t,q})$ has a positive effect on TLP_t at the 10% level. In addition, TPP_t and TLP_t have an inverse relationship, with liquidity profits influencing position-taking profits at a greater magnitude. This result is consistent with the relationship noted by Copeland and Galai (1983) and reaffirms the conclusions drawn from the descriptive statistics.

Our results indicate that market makers are net suppliers of liquidity and are therefore fulfilling their mandated duties. In the year following the scheme, liquidity profits are greater than position-taking profits. However, the position-taking gains made on days where liquidity losses are realised and the significant inverse relationship noted between liquidity and position-taking gains strongly imply that market makers would rather make further gains at the sacrifice of their obligated duties. With no change in profitability after the introduction of the scheme, we can also confirm that the efficiency enhancements found in Section 4.1 are not at the expense of other investors.

5. Conclusion

This paper examines the market quality and profitability effects of the introduction of the Market Making Scheme on the ETF market on the ASX. Our study examines how the market liquidity and efficiency are affected as well as how market maker profitability is impacted and how the incentives of the scheme are related to the market effects.

Market makers are found to be net suppliers of liquidity however we discover that large position-taking gains are often realised on days with liquidity losses. The inverse relationship between liquidity and position-taking profits is confirmed in our regression analysis and is consistent with the empirical findings in other markets, such by Copeland and Galai (1983) and Manaster Mann (1999) who study the US equity market. We report significant improvements in both spreads and depth after the introduction of the scheme that are accompanied by consistent changes in actual trading outcomes. Further multivariate analysis confirms that profitability does not change after the introduction after the scheme. Finally, we find that rebates vary that and on days with rebates earned, measures of market efficiency improve.

Our findings have a number of implications. Market makers are often satisfying their contractual duties by supplying liquidity. However, market makers are willing to use their superior order-flow information to make position-taking gains and this behaviour may be in conflict with their obligation to provide liquidity under the scheme. The aforementioned improvements signify that the rebates have been successful in enhancing the efficiency of the ETF market and that this has not occurred at the expense of other investors as profitability remains unchanged.

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Tables

Table 1
Sample ETF Split by Quoting Schedule

This table presents the 14 sample ETFs and their corresponding Quoting Schedule.

Quoting Schedule 1	Quoting Schedule 2	Quoting Schedule 3	Quoting Schedule 4	Quoting Schedule 5
IVV	SLF	IAA	IVE	IBK
SFY	VEU	IEM		
VAS	VTS	IEU		
		IJP		
		IOO		
		IZZ		

Table 2

Liquidity: Descriptive Statistics

This table provides summary statistics of liquidity measures during the pre-scheme and post-scheme periods for ETFs in each of the quoting schedules. TWS refers to the daily time-weighted proportional spread. TWD refers to the daily time-weighted depth at the best bid and ask. Turnover refers to total daily turnover. Volume refers to the daily total number of ETFs traded. Spread volatility refers to the daily volatility of the bid-ask spread. Price volatility denotes the daily volatility of ETF prices.

	Mean		Median		Standard Deviation		Skewness		Kurtosis	
Quoting Schedule 1	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
TWS	0.19%	0.12%	0.18%	0.10%	0.06%	0.08%	1.47	10.77	3.68	144.41
TWD	579736	843507	595876	852378	160620	202822	0.03	0.17	0.01	0.18
Turnover	$ 491,343	$ 553,237	$ 269,544	$ 366,995	$ 599,752	$ 621,544	2.96	2.01	11.49	4.64
Volume	7269	6673	3919	4043	9190	8291	3.07	2.44	12.63	7.30
Spread Volatility	0.000	0.000	0.000	0.000	0.000	0.000	8.84	11.36	83.40	142.04
Price Volatility	1.011	1.008	1.009	1.007	0.007	0.004	2.19	2.66	7.14	13.08
Quoting Schedule 2										
TWS	0.46%	0.39%	0.43%	0.30%	0.16%	0.35%	1.94	4.92	5.08	27.25
TWD	166070	246745	157221	224894	45019	87724	0.48	1.10	-0.13	0.46
Turnover	$ 76,988	$ 140,788	$ 58,310	$ 86,623	$ 69,057	$ 184,289	1.71	3.78	3.04	17.17
Volume	1477	2526	1101	1595	1404	2958	1.92	3.21	3.99	12.76
Spread Volatility	0.001	0.001	0.000	0.000	0.013	0.004	15.54	8.17	244.49	78.86
Price Volatility	1.010	1.008	1.009	1.007	0.006	0.003	5.13	1.53	49.00	4.27
Quoting Schedule 3										
TWS	0.64%	0.58%	0.60%	0.53%	0.18%	0.20%	3.27	2.73	21.65	10.29
TWD	180217	333743	171670.9	327708.9	42469	94614	0.70	0.69	0.34	0.93
Turnover	$ 147,129	$ 254,393	$ 129,724	$ 158,213	$ 91,273	$ 282,588	1.53	2.73	3.20	8.23
Volume	3546	7082	3018	3949	2505	12147	2.53	7.85	10.69	84.78
Spread Volatility	0.000	0.001	0.000	0.000	0.001	0.003	3.59	6.61	13.24	51.35

Price Volatility	1.012	1.010	1.010	1.009	0.006	0.005	1.91	2.29	6.53	8.07
Quoting Schedule 4										
TWS	0.74%	0.81%	0.75%	0.79%	0.23%	0.36%	-0.04	2.74	-0.41	13.53
TWD	202370	175542	198488	177110	67794	77741	0.41	1.45	0.05	5.95
Turnover	$ 370,913	$ 527,959	$ 145,664	$ 278,972	$ 779,012	$ 729,291	6.48	2.95	53.82	12.50
Volume	2959	4209	1158	2243	6206	5765	6.45	2.86	53.15	11.61
Spread Volatility	0.000	0.000	0.000	0.000	0.000	0.003	8.46	13.63	83.23	198.58
Price Volatility	1.009	1.008	1.007	1.007	0.008	0.007	4.89	2.32	42.67	8.94
Quoting Schedule 5										
TWS	0.94%	0.74%	0.78%	0.59%	0.63%	0.66%	2.73	5.36	10.08	36.80
TWD	89917	217011	75767	96755	57401	202568	2.79	1.08	9.71	-0.09
Turnover	$ 81,843	$ 101,090	$ 55,396	$ 59,110	$ 92,386	$ 144,278	3.94	4.03	28.42	23.14
Volume	1693	2146	1101	1226	1954	3171	4.13	4.21	30.95	25.04
Spread Volatility	0.007	0.004	0.001	0.001	0.040	0.015	12.77	8.29	181.92	78.90
Price Volatility	1.014	1.008	1.011	1.006	0.014	0.009	3.05	3.01	13.25	13.30

Table 3

Non-Parametric Univariate Analysis of Liquidity

This table presents the results of the non-parametric univariate analysis of liquidity. Statistics refer to the Z score for the Wilcoxon rank-sum *U* Statistic testing for different underlying distributions between the pre-scheme and post-scheme periods for the ETFs in each of the five quoting schedules. The ASX divides all ETFs into five quoting schedules determined by their liquidity characteristics. ***, ** and * represent significance at the 1%, 5% and 10% level respectively. TWS refers to the daily time-weighted proportional spread. TWD refers to the daily time-weighted depth at the best bid and ask. Turnover refers to total daily turnover. Volume refers to the daily total number of ETFs traded. Spread volatility refers to the daily volatility of the bid-ask spread. Price volatility denotes the daily volatility of ETF prices.

Daily	Quoting Schedule 1	Quoting Schedule 2	Quoting Schedule 3	Quoting Schedule 4	Quoting Schedule 5
	Statistic	Statistic	Statistic	Statistic	Statistic
TWS	-14.823***	-11.863***	-5.826***	1.648*	-6.049***
TWD	13.422***	11.798***	17.251***	-4.217***	7.067***
Turnover	-0.619	5.324***	4.235***	2.272**	0.359
Volume	1.335	5.268***	5.094***	2.297**	0.495
Spread Volatility	-9.283***	2.145**	8.810***	6.758***	-0.57
Price Volatility	-4.898***	-5.669***	-3.231***	-1.878*	-7.850***

Table 4
Regression Analysis for Time-Weighted Proportional Bid-Ask Spread Across Quoting Schedules

This table reports GMM regression (1) results for quoting schedules one, two, three, four and five ETFs for the period 1 August 2009 to 31 July 2011. The ASX divides all ETFs into five quoting schedules determined by their liquidity characteristics. The dependent variable is the time-weighted proportional bid-ask spread, ln(TWS). Period dummy takes on a value of zero for the pre-scheme period and one for the post-scheme period. Ln(Volume) is the natural logarithm of daily volume. Ln(Volatility) is the natural logarithm of daily price volatility. Test statistics are reported in brackets under the coefficients for each independent variable. ***, ** and * represent significance at the 1%, 5% and 10% level respectively.

	Quoting Schedule				
Variable	One	Two	Three	Four	Five
Intercept	-6.248***	-5.534***	-5.131***	-5.125***	-5.097***
	(-74.13)	(-39.55)	(-45.81)	(-42.78)	(-61.95)
Period Dummy	-0.459***	-0.231***	-0.076***	-0.174***	0.114***
	(-15.20)	(-6.39)	(-3.32)	(-3.51)	(-2.91)
Ln(Volume)	-0.026***	-0.008	-0.016	0.019	-0.009
	(-2.71)	(-0.42)	(-1.18)	(-1.1)	(-0.98)
Ln(Volatility)	11.026***	17.272***	14.687***	10.828***	19.87***
	(-3.74)	(-4.19)	(-6.30)	(-5.15)	(-5.92)
Adjusted R-Squared	0.389	0.154	0.122	0.099	0.13

Table 5

Regression Analysis for Time-Weighted Depth Across Quoting Schedules

This table reports GMM regression (2) results for quoting schedules one, two, three, four and five ETFs for the period 1 August 2009 to 31 July 2011. The ASX divide all ETFs into five quoting schedules determined by their liquidity characteristics. The dependent variable is the time-weighted depth, ln(TWD). Period dummy takes on a value of zero for the pre-scheme period and one for the post-scheme period. Ln(Volume) is the natural logarithm of daily volume. Ln(Volatility) is the natural logarithm of daily price volatility. Ln(TWS) is the natural logarithm of the daily time-weighted bid-ask spread. Test statistics are reported in brackets under the coefficients for each independent variable. ***, ** and * represent significance at the 1%, 5% and 10% level respectively.

	Quoting Schedule				
Variable	One	Two	Three	Four	Five
Intercept	12.622***	11.575***	10.819***	10.511***	14.666***
	(46.12)	(53.93)	(39.38)	(25.78)	(44.64)
Period Dummy	0.328***	0.344***	0.565***	0.523***	-0.211***
	(9.87)	(11.26)	(23.14)	(7.57)	(-5.28)
Ln(Volume)	-0.001	0.062***	0.044**	0.068**	-0.034***
	(-0.13)	(4.7)	(2.37)	(2.16)	(-4.07)
Ln(Volatility)	-4.333*	-0.473	-3.179	-1.600	-3.274
	(-1.76)	(-0.2)	(-1.54)	(-0.56)	(-1.12)
Ln(TWS)	-0.104**	0.002	-0.185***	-0.076	0.457***
	(-2.52)	(0.05)	(-4.08)	(-1.15)	(7.02)
Adjusted R-Squared	0.330	0.304	0.594	0.137	0.212

Table 6

Regression Analysis for Time-Weighted Proportional Bid-Ask Spread Across Quoting Schedules

This table reports GMM regression (3) results for Quoting Schedules one, two, three, four and five ETFs for the period 1 August 20010 to 31 July 2011. The ASX divides all ETFs into fives quoting schedules determined by their liquidity characteristics. The dependent variable is the time-weighted proportional bid-ask spread, ln(TWS). Rebate dummy takes on a value of zero if rebates are not paid during the respective calendar month and one if rebates are paid during the respective calendar month. Ln(Volume) is the natural logarithm of daily volume. Ln(Volatility) is the natural logarithm of daily price volatility. Test statistics are reported in brackets under the coefficients for each independent variable. ***, ** and * represent significance at the 1%, 5% and 10% level respectively.

	Quoting Schedule				
Variable	One	Two	Three	Four	Five
Intercept	-6.950***	-5.816***	-5.030***	-5.188***	-4.978***
	(-65.52)	(-23.54)	(-30.56)	(-25.43)	(-36.09)
Rebate Dummy	-0.058	0.027	-0.154***	-0.280**	-0.018
	(-1.53)	(0.61)	(-3.43)	(-2.38)	(-0.21)
Ln(Volume)	0.006	-0.008	-0.021	0.033	-0.012
	(0.54)	(-0.24)	(-1.31)	(1.57)	(-1.01)
Ln(Volatility)	13.263**	20.561***	12.838***	12.624***	23.641***
	(2.10)	(3.08)	(3.05)	(2.90)	(4.90)
Adjusted R-Squared	0.033	0.014	0.127	0.094	0.152

Table 7

Regression Analysis for Time-Weighted Depth Across Quoting Schedules

This table reports GMM regression (4) results for quoting schedules one, two, three, four and five ETFs for the period 1 August 2009 to 31 July 2011. The ASX divides all ETFs into five quoting schedules determined by their liquidity characteristics. The dependent variable is the time-weighted depth, ln(TWD). Rebate dummy takes on a value of zero if rebates are not paid during the respective calendar month and one if rebates are paid during the respective calendar month. Ln(Volume) is the natural logarithm of daily volume. Ln(Volatility) is the natural logarithm of daily price volatility. Ln(TWS) is the natural logarithm of the daily time-weighted bid-ask spread. Test statistics are reported in brackets under the coefficients for each independent variable. ***, ** and * represent significance at the 1%, 5% and 10% level respectively.

	Quoting Schedule				
Variable	One	Two	Three	Four	Five
Intercept	12.933***	12.072***	11.527***	11.481***	13.780***
	(36.92)	(39.21)	(31.45)	(16.41)	(34.72)
Rebate Dummy	-0.138***	0.263***	0.122***	1.120***	0.588***
	(-4.19)	(6.45)	(3.36)	(12.5)	(7.33)
Ln(Volume)	0.009	0.061***	0.066***	0.004	-0.020**
	(1.01)	(3.00)	(2.88)	(0.90)	(-2.06)
Ln(Volatility)	-0.349	12.245**	-2.923	-3.925	-1.417
	(-0.12)	(2.49)	(-0.88)	(-0.55)	(-0.36)
Ln(TWS)	-0.098**	0.088**	-0.103	0.139	0.439***
	(-2.01)	(1.98)	(-1.54)	(1.12)	(5.83)
Adjusted R-Squared	0.060	0.138	0.077	0.210	0.398

Table 8

Total Market Maker Profitability: Descriptive Statistics (Post-Scheme)

This table reports descriptive statistics relating to the total profitability of all market makers for our sample of ETFs. They are reported for trading that takes place for the period 1 August 2010 to 30 July 2011. The ratio of positive to negative days in Panel A is computed by dividing the number of days with positive total profits, by the number of days with negative total profits. Total market maker profit in Panel B is attained by summing the total profit derived across all days for the sample period. Panel C outlines the distribution of total market maker profitability each day. Panel C also reports a sign and Wilcoxon rank that examines whether the distribution is centered around zero. The respective *p*-values for these tests are the probabilities of a greater absolute value for the centered statistic. The t-statistics test examines whether the mean is significantly different to zero.

Panel A: Distribution of total market maker profitability across all days	
Days with positive total profit	73.81%
Days with negative total profit	26.19%
Days with zero total profit	0.00%
Ratio: Positive: Negative days	2.818
Panel B: Total market maker profitability across all days (sum of all days)	
Total market maker profit	$547370.18
Panel C: Total market maker profitability per day	
Median	1857.238
Mean	2172.104
25th percentile	-113.543
75th percentile	3565.875
Std Dev.	10401
p-value (sign test)	<0.0001
p-value (sign rank test)	<0.0001
t-stat (mean = 0)	3.315
Number of days	252

Table 9

(a) Market Maker Liquidity Profits: Descriptive Statistics and (b) Market Maker Position-Taking Profits: Descriptive Statistics (Post-Scheme)

(a) This table reports descriptive statistics for market maker liquidity profits over the period 1 August 2010 to 31 July 2011, for the ETFs in our sample. Panel A outlines the frequency of days with positive and negative liquidity profits, as well as the ratio of profitable to unprofitable liquidity profit days. Panel B computes the total liquidity profitability across all days over the period. It is also expressed as a % of total summed market maker profitability. Panel C outlines the per day ETF liquidity profits for all market maker days. Panel C reports a sign and Wilcoxon sign rank that examines whether the distribution is centered around zero. The respective *p*-values for these tests are the probabilities of a greater absolute value for the centered statistic. The t-statistic test examines whether the mean is significantly different to zero.

(b) This table reports descriptive statistics for market maker position-taking profitability over 1 August 2010 to 31 July 2011. Panel A outlines the frequency of cycles with positive and negative position-taking profitability, as well as the ratio of profitable to unprofitable days. Panel B computes the total position-taking profitability across all days over the period. It is also expressed as a percentage of total summed market maker profitability. Panel C outlines the per day ETF position-taking profits for all days. Panel C reports a sign and Wilcoxon sign rank that examines whether the distribution is centered around zero. The respective *p*-values for these tests are the probabilities of a greater absolute value for the centered statistic. The t-statistic test examines whether the mean is significantly different to zero.

(a)	
Panel A: Distribution of market maker liquidity profits across all days	
Days with positive liquidity profits	82.94%
Days with negative liquidity profits	17.06%
Days with zero liquidity profits	0.00%
Ratio: Positive: Negative days	4.862
Panel B: Total market maker liquidity profitability across all days (sum of all days)	
Total liquidity profit	$331345.31
Percentage of total profit	61%
Panel C: Market maker liquidity profitability per day	
Median	1130.236
Mean	1314.862
25th percentile	459.298
75th percentile	2231.415
Std Dev.	4799
p-value (sign test)	<0.0001
p-value (sign rank test)	<0.0001
t-stat (mean = 0)	4.349
Number of days	252
(b)	
Panel A: Distribution of market maker position-taking profits across all days	
Days with positive position-taking profits	59.92%
Days with negative position-taking profits	40.08%
Days with zero position-taking profits	0.00%

Ratio: Positive: Negative days	1.495
Panel B: Total market maker position-taking profitability across all days (sum of all days)	
Total position-taking profit	$216024.87
Percentage of total profit	39%
Panel C: Market maker position-taking profitability per day	
Median	680.958
Mean	857.2416
25th percentile	-1526.945
75th percentile	2627.783
Std Dev.	10650
p-value (sign test)	0.002
p-value (sign rank test)	0.0164
t-stat (mean = 0)	1.278
Number of days	252

Table 10
Interaction Between Market Maker Liquidity and Position-Taking Profitability (Post-Scheme)

This table partitions market maker daily liquidity profits into two states: negative and positive liquidity profitability. For both of these states of liquidity profits, this table reports descriptive statistics for daily "round-trip" position-taking profitability. This analysis is conducted for all ETFs in our sample from 1 August 2010 to 31 July 2011. Position-taking profits for each day are calculated as the movement in the mid-point of the bid-ask quotes between when an inventory position is opened and closed. Liquidity profits in each inventory cycle are calculated as the difference between the transaction price and the quote midpoints. The ratio of positive to negative days is computed by dividing the number of days with positive position-taking income by the number of days with negative position-taking profitability.

Panel A: Days with negative liquidity profits	
Days with	
Positive position-taking profits	74.42%
Negative position-taking profits	25.58%
Zero position-taking profits	0.00%
Ratio: Positive: Negative days	2.909
Number of days	43
Panel B: Days with positive liquidity profits	
Days with	
Positive position-taking profits	59.64%
Negative position-taking profits	43.06%
Zero position-taking profits	0.00%
Ratio: Positive: Negative days	1.385
Number of days	209

Table 11

Non-Parametric Univariate Tests of Market Maker Profits

This table presents the non-parametric univariate tests of market maker profits. Statistic refers to the Z score for the Wilcoxon signed rank-sum *U* Statistic testing for different underlying distributions between the pre-change and post-change periods for total daily profits, daily liquidity profits and daily position-taking profits. The *p*-value is the corresponding two-tail *p*-value for the given Z score. ***, ** and * represent significance at the 1%, 5% and 10% level, respectively.

Total Daily Profits		Daily Liquidity Profits		Daily Position-Taking Profits	
Statistic	*p*-value	Statistic	*p*-value	Statistic	*p*-value
902	0.437	520	0.655	1002	0.388

Table 12

Regression Analysis for Liquidity and Position-Taking Profits

This table reports GMM regression () results for the dependent variables daily liquidity and profits and daily position-taking profits for the period 1 August 2009 to 31 July 2011. Period dummy refers takes on a value of zero for the pre-rebate period and one for the post-rebate period. Ln(Volume) is the natural logarithm of daily volume. Ln(Volatility) is the natural logarithm of daily price volatility. Ln(TWS) is the natural logarithm of the mean daily bid-ask spread. Position-Taking Profit and Liquidity Profit are the sum earned daily by the market makers for all ETFs in our sample. Test statistics are reported in brackets under the coefficients for each independent variable. ***, ** and * represent significance at the 1%, 5% and 10% level respectively.

	Dependent Variable	
Variable	Liquidity Profits	Position-Taking Profits
Intercept	-12630.600	-5689.340
	(-1.4)	(-0.66)
Period Dummy	90.986	525.576
	-0.22	-0.53
Ln(Volume)	-61.552	578.748
	(-0.21)	-0.65
Ln(Volatility)	142162.300*	250059.700
	-1.89	-1.09
Ln(TWS)	-2503.26	
	(-1.48)	
Position-Taking Profit	-0.108*	
	(-1.76)	
Liquidity Profit		-0.628***
		(-3.37)
Adjusted R-Squared	0.0915	0.0714

Appendices

APPENDIX 1

Exchange Traded Funds - Equity						
	Market Maker					
ASX ETF Code	Susquehanna Pacific	Citigroup Global Markets Australia	IMC Pacific	Deutsche Securities Australia	Optiver Australia	UBS Securities Australia
DGA	x					
EEU	x					
ENY	x	x				
FIN	x	x				
FIX	x	x				
IAA	x	x				
IBK	x	x				
IDD	x	x				
IEM	x	x				
IEU	x	x				
IHD	x	x		x	x	x
IHK	x	x				
IJP	x	x				
IJR	x	x				
IKO	x	x				
ILC	x	x		x	x	x
IOO	x	x				
IOZ	x	x		x	x	x
IRU	x	x				
ISG	x	x				
ISO	x	x		x	x	x
ITW	x	x				
IVE	x	x				
IVV	x	x				
IXI	x	x				
IXJ	x	x				
IZZ	x	x				
MAM	x	x				
OZF	x	x		x		
OZR	x	x		x		
POU	x					
QRE	x		x		x	
QFN	x		x		x	

RDV	x			x		
RVL				x		
RSR	x	x				
SFY	x	x		x		
SLF	x	x	x	x		
SSO	x	x		x		
STW						
SYI	x	x		x		
USD	x	x	x		x	
VAP	x	x		x		
VAS	x	x		x		
VEU	x	x		x		
VHY	x	x		x		
VLC	x	x		x		
VSO	x	x		x		
VTS	x	x		x		

APPENDIX 2

Quoting Schedules for Equity ETFs		
Schedule 1		
Bid Price in $AUD for Shares	Maximum Spread	Minimum Quantity
$5<	2c	$50,000 worth of stock
>$5	40 bps of best bid	$50,000 worth of stock
Schedule 2		
Bid Price in $AUD for Shares	Maximum Spread	Minimum Quantity
$5<	3c	$30,000 worth of stock
>$5	60 bps of best bid	$30,000 worth of stock
Schedule 3		
Bid Price in $AUD for Shares	Maximum Spread	Minimum Quantity
$5<	5c	$25,000 worth of stock
>$5	1% of best bid	$25,000 worth of stock
Schedule 4		
Bid Price in $AUD for Shares	Maximum Spread	Minimum Quantity
$5<	7c	$20,000 worth of stock
>$5	1.5% of best bid	$20,000 worth of stock
Schedule 5		
Bid Price in $AUD for Shares	Maximum Spread	Minimum Quantity
$5<	10c	$17,500 worth of stock
>$5	2% of best bid	$17,500 worth of stock
Schedule 6		
Bid Price in $AUD for Shares	Maximum Spread	Minimum Quantity
$5<	12c	$15,000 worth of stock
>$5	2.5% of best bid	$15,000 worth of stock
Schedule 7		
Bid Price in $AUD for Shares	Maximum Spread	Minimum Quantity
$5<	17c	$12,500 worth of stock
>$5	3.5% of best bid	$12,500 worth of stock
Schedule 8		
Bid Price in $AUD for Shares	Maximum Spread	Minimum Quantity
$5<	25c	$10,000 worth of stock
>$5	5% of best bid	$10,000 worth of stock
Schedule 9		
Bid Price in $AUD for Shares	Maximum Spread	Minimum Quantity
$5<	37c	$7,500 worth of stock
>$5	7.5% of best bid	$7,500 worth of stock
Schedule 10		
Bid Price in $AUD for Shares	Maximum Spread	Minimum Quantity
$5<	50c	$5,000 worth of stock
>$5	10% of best bid	$5,000 worth of stock

APPENDIX 3

Trading Fees	
Type of Trade	Trade Fee (bps, paid monthly)
1 July 2010 - 1 July 2011	
ETF Trade	0.15 (capped at $75 per trade, per side)
ETF (auction)	0.28 (capped at $75 per trade, per side)
1 July 2011 - 1 July 2012	
ETF Trade	0.15 (capped at $75 per trade, per side)
ETF (auction)	0.28 (capped at $75 per trade, per side)
1 July 2012 - 1 July 2013	
ETF Trade	0.15 (capped at $75 per trade, per side)
ETF (auction)	0.28 (capped at $75 per trade, per side)

Clearing Fees	
Type of Trade	Trade Fee (bps)
ETF	0.25

APPENDIX 4

Trading and Clearing Fee Rebates			
Rebate Side 1	Side 1	Side 2	Rebate Side 2
50%	Reg MM	Reg MM	50%
50%	Reg MM	Adv MM	100%
zero	Customer	Customer	zero
zero	Customer	Adv MM	200%
zero	Customer	Reg MM	120%
100%	Adv MM	Adv MM	100%

APPENDIX 5

Total Market Maker Profitability: Descriptive Statistics (Total Period)

This table reports descriptive statistics relating to the total profitability of all market makers for our sample of ETFs. They are reported for trading that takes place for the period 1 August 2009 to 31 July 2011. The ratio of positive to negative days in Panel A is computed by dividing the number of days with positive total profits, by the number of days with negative total profits. Total market maker profit in Panel B is attained by summing the total profit derived across all days for the sample period. Panel C outlines the distribution of total market maker profitability each day. Panel C reports a sign and Wilcoxon rank that examines whether the distribution is centered around zero. The respective *p*-values for these tests are the probabilities of a greater absolute value for the centered statistic. The t-statistics test examines whether the mean is significantly different to zero.

Panel A: Distribution of total market maker profitability across all days	
Days with positive total profit	74%
Days with negative total profit	26%
Days with zero total profit	0%
Ratio: Positive: Negative days	2.818
Panel B: Total market maker profitability across all days (sum of all days)	
Total market maker profit	$1087670.99
Panel C: Total market maker profitability per day	
Median	1922.918
Mean	2158.077
25th percentile	-183.738
75th percentile	4197.108
Std Dev.	9060
p-value (sign test)	<0.0001
p-value (sign rank test)	<0.0001
t-stat (mean = 0)	5.347
Number of days	504

Total Market Maker Profitability: Descriptive Statistics (Pre-Period)

This table reports descriptive statistics relating to the total profitability of all market makers for our sample of ETFs. They are reported for trading that takes place for the period 1 August 2009 to 31 July 2010. The ratio of positive to negative days in Panel A is computed by dividing the number of days with positive total profits, by the number of days with negative total profits. Total market maker profit in Panel B is attained by summing the total profit derived across all days for the period. Panel C outlines the distribution of total market maker profitability each day. Panel C reports a sign and Wilcoxon rank that examines whether the distribution is centered around zero. The respective *p*-values for these tests are the probabilities of a greater absolute value for the centered statistic. The t-statistics test examines whether the mean is significantly different to zero.

Panel A: Distribution of total market maker profitability across all days	
Days with positive total profit	73.81%
Days with negative total profit	26.19%
Days with zero total profit	0.00%
Ratio: Positive: Negative days	2.818
Panel B: Total market maker profitability across all days (sum of all days)	
Total market maker profit	$540300.81
Panel C: Total market maker profitability per day	
Median	1987.684
Mean	2144.051
25th percentile	-247.125
75th percentile	5034.590
Std Dev.	7504
p-value (sign test)	<0.0001
p-value (sign rank test)	<0.0001
t-stat (mean = 0)	4.536
Number of days	252

APPENDIX 6

(a) Market Maker Liquidity Profits: Descriptive Statistics and (b) Market Maker Position-Taking Profits: Descriptive Statistics (Total Period)

(a) This table reports descriptive statistics for market maker liquidity profits over the period 1 August 2009 to 31 July 2011, for the ETFs in our sample. Panel A outlines the frequency of days with positive and negative liquidity profits, as well as the ratio of profitable to unprofitable liquidity profit days. Panel B computes the total liquidity profitability across all days over the period. It is also expressed as a % of total summed market maker profitability. Panel C outlines the per day ETF liquidity profits for all market maker days. Panel C reports a sign and Wilcoxon sign rank that examines whether the distribution is centered around zero. The respective *p*-values for these tests are the probabilities of a greater absolute value for the centered statistic. The t-statistic test examines whether the mean is significantly different to zero.

(b) This table reports descriptive statistics for market maker position-taking profitability over 1 August 2009 to 31 July 2011. Panel A outlines the frequency of cycles with positive and negative position-taking profitability, as well as the ratio of profitable to unprofitable days. Panel B computes the total position-taking profitability across all days over the period. It is also expressed as a percentage of total summed market maker profitability. Panel C outlines the per day ETF position-taking profits for all days. Panel C reports a sign and Wilcoxon sign rank that examines whether the distribution is centered around zero. The respective *p*-values for these tests are the probabilities of a greater absolute value for the centered statistic. The t-statistic test examines whether the mean is significantly different to zero.

(a)	
Panel A: Distribution of market maker liquidity profits across all days	
Days with positive liquidity profits	82%
Days with negative liquidity profits	18%
Days with zero liquidity profits	0%
Ratio: Positive: Negative days	4.599
Panel B: Total market maker liquidity profitability across all days (sum of all days)	
Total liquidity profit	$652520.78
Percentage of total profit	60%
Panel C: Market maker liquidity profitability per day	
Median	48.035
Mean	88.670
25th percentile	6.930
75th percentile	157.360
Std Dev.	992.568
p-value (sign test)	<0.0001
p-value (sign rank test)	<0.0001
t-stat (mean = 0)	7.663
Number of days	504
(b)	
Panel A: Distribution of market maker position-taking profits across all days	
Days with positive position-taking profits	61%
Days with negative position-taking profits	39%

Days with zero position-taking profits	0%
Ratio: Positive: Negative days	1.564
Panel B: Total market maker position-taking profitability across all days (sum of all days)	
Total position-taking profit	$435150.21
Percentage of total profit	40%
Panel C: Market maker position-taking profitability per day	
Median	6.900
Mean	59.130
25th percentile	-52.450
75th percentile	137.226
Std Dev.	2304
p-value (sign test)	<0.0001
p-value (sign rank test)	<0.0001
t-stat (mean = 0)	2.201
Number of days	504

(a) Market Maker Liquidity Profits: Descriptive Statistics and (b) Market Maker Position-Taking Profits: Descriptive Statistics (Pre-Period)

(a) This table reports descriptive statistics for market maker liquidity profits over the period 1 August 2009 to 31 July 2010, for the ETFs in our sample. Panel A outlines the frequency of days with positive and negative liquidity profits, as well as the ratio of profitable to unprofitable liquidity profit days. Panel B computes the total liquidity profitability across all days over the period. It is also expressed as a % of total summed market maker profitability. Panel C outlines the per day ETF liquidity profits for all market maker days. Panel C reports a sign and Wilcoxon sign rank that examines whether the distribution is centered around zero. The respective *p*-values for these tests are the probabilities of a greater absolute value for the centered statistic. The t-statistic test examines whether the mean is significantly different to zero.

(b) This table reports descriptive statistics for market maker position-taking profitability over 1 August 2009 to 31 July 2010. Panel A outlines the frequency of cycles with positive and negative position-taking profitability, as well as the ratio of profitable to unprofitable days. Panel B computes the total position-taking profitability across all days over the period. It is also expressed as a percentage of total summed market maker profitability. Panel C outlines the per day ETF position-taking profits for all days. Panel C reports a sign and Wilcoxon sign rank that examines whether the distribution is centered around zero. The respective *p*-values for these tests are the probabilities of a greater absolute value for the centered statistic. The t-statistic test examines whether the mean is significantly different to zero.

(a)	
Panel A: Distribution of market maker liquidity profits across all days	
Days with positive liquidity profits	81.35%
Days with negative liquidity profits	18.65%
Days with zero liquidity profits	0.00%
Ratio: Positive: Negative days	4.362
Panel B: Total market maker liquidity profitability across all days (sum of all days)	
Total liquidity profit	$321175.47
Percentage of total profit	59%
Panel C: Market maker liquidity profitability per day	
Median	1307.467
Mean	1274.506
25th percentile	388.622
75th percentile	2315.562
Std Dev.	2436
p-value (sign test)	<0.0001
p-value (sign rank test)	<0.0001
t-stat (mean = 0)	8.305
Number of days	252
(b)	
Panel A: Distribution of market maker position-taking profits across all days	
Days with positive position-taking profits	61.51%
Days with negative position-taking profits	38.49%
Days with zero position-taking profits	0.00%
Ratio: Positive: Negative days	1.598
Panel B: Total market maker position-taking profitability across all days (sum of all days)	
Total position-taking profit	$219125.34
Percentage of total profit	41%

Panel C: Market maker position-taking profitability per day	
Median	1084.459
Mean	869.545
25th percentile	-1744.720
75th percentile	3899.700
Std Dev.	7574
p-value (sign test)	0.0003
p-value (sign rank test)	0.0011
t-stat (mean = 0)	1.822
Number of days	252

APPENDIX 7

Interaction Between Market Maker Liquidity and Position-Taking Profitability (Total Period)

This table partitions market maker daily liquidity profits into two states: negative and positive liquidity profitability. For both of these states of liquidity profits, this table reports descriptive statistics for daily "round-trip" position-taking profitability. This analysis is conducted for all ETFs in our sample from 1 August 2009 to 31 July 2011. Position-taking profits for each day are calculated as the movement in the mid-point of the bid-ask quotes between when an inventory position is opened and closed. Liquidity profits in each inventory cycle are calculated as the difference between the transaction price and the quote midpoints. The ratio of positive to negative days is computed by dividing the number of days with positive position-taking income by the number of days with negative position-taking profitability.

Panel A: Days with negative liquidity profits	
Days with	
Positive position-taking profits	73%
Negative position-taking profits	27%
Zero position-taking profits	0%
Ratio: Positive: Negative days	2.750
Number of days	90
Panel B: Days with positive liquidity profits	
Days with	
Positive position-taking profits	59%
Negative position-taking profits	42%
Zero position-taking profits	0
Ratio: Positive: Negative days	1.379
Number of days	414

Interaction Between Market Maker Liquidity and Position-Taking Profitability (Pre-Period)

This table partitions market maker daily liquidity profits into two states: negative and positive liquidity profitability. For both of these states of liquidity profits, this table reports descriptive statistics for daily "round-trip" position-taking profitability. This analysis is conducted for all ETFs in our sample from 1 August 2009 to 31 July 2010. Position-taking profits for each day are calculated as the movement in the mid-point of the bid-ask quotes between when an inventory position is opened and closed. Liquidity profits in each inventory cycle are calculated as the difference between the transaction price and the quote midpoints. The ratio of positive to negative days is computed by dividing the number of days with positive position-taking income by the number of days with negative position-taking profitability.

Panel A: Days with negative liquidity profits	
Days with	
Positive position-taking profits	72%
Negative position-taking profits	28%
Zero position-taking profits	0%
Ratio: Positive: Negative days	2.615
Number of days	47
Panel B: Days with positive liquidity profits	
Days with	
Positive position-taking profits	59.02
Negative position-taking profits	40.98
Zero position-taking profits	0
Ratio: Positive: Negative days	1.440
Number of days	205