The Impact of an Increase in Pre-Trade Transparency on Market Quality: Evidence from the Sydney Futures Exchange

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Abstract

This paper examines the impact of an increase in pre-trade transparency on market quality in a futures market setting. Results indicate that both quoted depth and trading volume increase, while both bid-ask spreads and price volatility are not significantly affected. While this suggests that the increase in transparency leads to an increase in market quality, analysis of a control contract indicates similar improvements in market quality. Regression results, which control for both contract-specific and market-wide levels in trading activity and price volatility, confirm that the improvements in market quality are common to both the experimental and control contracts. These results are robust to the seasonality in futures trading. We conclude that an increase in transparency does not lead to an improvement in market quality.

1. Introduction

Liquidity in financial markets is an important issue for market participants, regulators and academics. An important aspect of the provision of liquidity is the level of pre-trade transparency. Several markets worldwide have increased the amount of the limit order book that is visible to participants prior to the execution of a trade. The primary motivation for these changes is to disclose greater levels of information to all participants in the market. This has led to research examining the impact of a change in transparency on market quality. This paper extends the literature by providing a thorough examination of market quality surrounding an increase in transparency away from the best quotes in a futures market setting.

Early research into the affects of pre-trade transparency on market participants are generally theoretical or experimental. Pagano and Roell (1996) argue that optimal levels of pre-trade transparency are dependant on investor type, with greater pre-trade transparency reducing transaction costs of uninformed investors, while informed traders are adversely affected. Bloomfield and O'Hara (1999) find that in an experimental market setting, prices become more efficient, but trading costs are also higher. Flood, Huisman, Koedijk, and Mahieu (1999), using a similar experimental setting in a foreign exchange market, find that a more transparent market leads to less efficient prices and lower trading costs.

Empirical studies into the impact of altering pre-trade transparency provide mixed evidence. Lin (2006) examines the impact of a move from only showing the best bid and ask quotes to showing the best five price levels on the Taiwan Stock Exchange (TSEC), a call auction market. Using measures such as the quoted half-spread, effective bid-ask spread and realised bid-ask spread as proxies for market quality, Lin finds that effective spreads decrease, indicating an improvement in liquidity. Interestingly, realised spreads do not exhibit a systematic decrease. The authors do not discuss changes in depth, and as realised spreads

are unchanged, this could indicate that increasing transparency does not significantly improve liquidity.

Madhavan, Porter and Weaver (2005) examine the 1990 change by the Toronto Stock Exchange to increase transparency from one to four price steps on either side of the limit order book. Their primary finding is that greater transparency does not improve market quality. Limiting the study to the stocks trading on CATS (an automated limit order book system), the authors find that after the move to increased transparency, bid-ask spreads widen. They find that transaction costs increase, possibly due to traders' reluctance to expose free options to other market participants, resulting in lower levels of depth in the limit order book. They also find an increase in price volatility.

Bortoli, Frino, Jarnecic and Johnstone (2006) examine the January 2001 increase in transparency, from one to three price levels, on the Sydney Futures Exchange. This study is unique in that it is the first time a change in transparency affects all market participants equally (prior to the change, brokers, investors and market-makers were all restricted to viewing only the best bid and ask). Results indicate that depth at the best bid and ask decrease by approximately 35 percent. Bid ask spreads increase slightly, with the 90 Day BAB futures and 3 Year bond futures experiencing an increase of 1.14 percent, and a 1.82 percent increase for the 10 Year bond futures contract. Both daily volume and volatility increase after the change in transparency. After controlling for volume and volatility, the authors conclude that increased limit order book transparency results in a significant decrease in depth, although the increase in bid-ask spreads is not different from zero. The authors also find an increased proportion of market orders which are executed beyond the best prices on each side of the book, supporting their hypothesis that traders are less likely to display orders.

This paper extends the literature by examining market quality in the 10 Year Commonwealth Treasury Bond Futures (10 Year bond futures), trading on the Sydney

Futures Exchange (SFE), around the increase in transparency on 15 April, 2003. Traditional proxies of market quality, including bid-ask spreads, quoted depth, trading volume and price volatility are compared around the increase in transparency from the best three to the best five price levels. As the 3 Year Commonwealth Treasury Bond Futures contract (3 Year bond futures) is a potential substitute for hedging purposes, it is used as a control contract to separate market-wide movements from the impact of the change in transparency.

Results indicate that bid-ask spreads are not significantly affected, while quoted depth is significantly higher, after the increase in transparency. Trading volume is higher, while price volatility is not significantly affected. While these results suggest an improvement in market quality, analysis of the 3 Year bond futures reveals similar improvements in bid-ask spreads, quoted depth and trading volume, indicating that the improvement in market quality is *not* driven by the increase in transparency. These results are robust to the seasonality in futures trading.

The remainder of this paper is structured as follows. Section 2 describes the data and method, Section 3 presents the empirical results, Section 4 presents results of a robustness test, and Section 5 concludes. A brief overview of the institutional details of the Sydney Futures Exchange are provided in the Appendix.

2. Data and Method

2.1 Data

To examine market quality surrounding the increase in transparency, a trade-by-trade data set for the 10 Year and 3 Year bond futures contracts, provided by SIRCA, is used. The data range from 15 April, 2002 to 15 July, 2003. The data contain fields describing the contract code, the date and exact time of each trade, along with the price and volume transacted. It also provides order book data, with information on the prices and volumes of

prevailing bid and ask quotes for the entire visible limit order book. From this data set, one-minute, five-minute and fifteen-minute interval aggregate data sets are generated. For each interval, the transaction price at the end of the interval, the maximum and minimum traded price in the interval, the total on-market volume traded in the interval and the time-weighted bid-ask spread (explained below) are calculated. All quotes and associated volumes at the end of each interval are also included.

2.2 Univariate Testing

On 15 April, 2003, the 10 Year bond futures, which trade at a minimum price increment of 0.5 basis points, had an increase in transparency from three to five price levels. As the structural change occurs in the middle of the June 2003 contract, the pre-period consists of the three months before the increase in visibility (15 January, 2003 to 14 April, 2003) and the post-period consists of the three months after the increase (16 April, 2003 to 15 July, 2003). The day of the change (15 April, 2003) is excluded. Consistent with Frino and McKenzie (2002), the last five days prior to contract expiry, which is dominated by liquidity motivated trading for roll-over purposes, are excluded from the analysis. Consistent with Bortoli, Frino, Jarnecic and Johnstone (2006), analysis is restricted to daytime trading in the near-to-expiry contract. As the 3 Year bond futures is a substitutable contract, it is also examined to control for potential market-wide events. The level of transparency in the 3 Year bond futures remained constant at the best three price levels on each side of the limit order book.

Two different bid-ask spread measures are examined. The first is the time-weighted bid-ask spread measure from McInish and Wood (1992), where the quoted bid-ask spread is calculated for every single quote revision and then weighted for how long the quotes prevailing are “alive” in one-, five-, and fifteen-minute intervals. These time-weighted bid-

ask spreads are averaged over the day and are then averaged across the pre- and post-event periods to determine the change in bid-ask spreads around the change in transparency. As the minimum tick in futures markets are considerably tighter than in traditional equities markets, another measure, used in Frino, Lepone and Wearin (2007), adjusts the quoted bid-ask spread for the minimum tick of the contract.[1]

Another integral component of liquidity is quoted depth. To examine quoted depth, this study focuses on (i) the change in depth at the best quotes, and (ii) the change in depth at the best three price levels before and after the change. Best depth is measured as the combined quoted depth at the best prevailing bid and ask quotes at the end of each interval, while total depth is calculated as the sum of the combined quoted depth at the best three bid and ask quotes at the end of each interval. Both of these measures are averaged over the day and then averaged across the pre- and post-event periods.

To examine changes in trading activity around the reduction in minimum tick, average daily traded volume is compared before and after the increase in transparency. To examine if the increase in transparency affects price volatility and, consistent with Bessembinder and Seguin (1992), volatility is calculated as the logarithmic difference between daily high and low prices.

2.3 Regression Testing

Harris (1994) argues that there are several factors that impact bid-ask spreads, including volume and volatility. Chordia, Roll and Subrahmanyam (2000) find that market-wide factors affect bid-ask spreads. Both the Harris (1994) and Chordia, Roll and Subrahmanyam (2000) specifications are merged, with the resulting regressions (below) accounting for both market-wide and contract-specific factors that affect market quality.

[1] Effective bid-ask spreads are commonly compared, but as the SFE operates a fully automated electronic limit order book, all transactions occur at the quoted prices, so the effective spread is equal to the quoted spread.

$$BAS = \alpha_0 + \alpha_1 Change + \alpha_2 Ln(Volume_{10}) + \alpha_3 Volatility_{10} + \alpha_4 Ln(Volume_3) + \alpha_5 Volatility_3 + \varepsilon \quad (1)$$

$$Ln(BestDepth) = \alpha_0 + \alpha_1 Change + \alpha_2 Ln(Volume_{10}) + \alpha_3 Volatility_{10} + \alpha_4 Ln(Volume_3) + \alpha_5 Volatility_3 + \varepsilon \quad (2)$$

$$Ln(TotalDepth) = \alpha_0 + \alpha_1 Change + \alpha_2 Ln(Volume_{10}) + \alpha_3 Volatility_{10} + \alpha_4 Ln(Volume_3) + \alpha_5 Volatility_3 + \varepsilon \quad (3)$$

The dependent variable is the time-weighted average bid-ask spread in Equation 1, the average depth at the prevailing quotes in Equation 2 and the average depth at the best three price levels in Equation 3, all for the 10 Year bond futures contract. *Change* is a dummy variable equal to one for the post-period, zero otherwise. $Ln(DailyVolume_{10})$ is the natural logarithm of the average daily volume in the 10 Year bond futures, and $Volatility_{10}$ is the daily volatility, calculated as the log difference between daily high and low prices, in the 10 Year bond futures. The variables $Ln(DailyVolume_3)$ and $Volatility_3$ represent the natural logarithm of the average daily volume and daily price volatility, respectively, for the 3 Year bond futures. These three regressions are re-estimated using the 3 Year bond futures bid-ask spread / quoted depth as dependent variables.

3. Empirical Results

3.1 Descriptive Statistics

Results in Table 1 indicate that the increase in transparency in the 10 Year bond futures contract does not have a significant impact on bid-ask spreads, with reductions in both bid-ask spread measures not significantly different from zero. Quoted depth at the best prevailing quotes increases by 35 contracts after the change, significant at the one percent level. Further, the level of depth at the best three price steps is significantly higher, increasing

by 110 contracts. Traded volume is significantly greater after the increase in transparency, with an increase of 1,637 contracts per day, significant at the five percent level. Price volatility is not significantly different after the increase in transparency.

<INSERT TABLE 1>

While this indicates that an increase in visibility has a positive impact on quoted depth and trading volume in the 10 Year bond futures, analysis of the 3 Year bond futures contract indicates similar increases in quoted depth and traded volume after the increase in transparency, significant at the one and five percent levels, respectively. These findings suggest that the increase in depth and volume could be driven by market-wide factors, not by the increase in transparency.

3.2 Regression Results

To control for broader market movements, regression equations (1), (2) and (3) are estimated, with the *Change* dummy variable equal to one after the increase in transparency, and zero otherwise. Results of these regressions are presented in Table 2. Results for the 10 Year bond futures indicate that bid-ask spreads are not significantly different before and after the change in transparency. Depth at both the best quotes, and at the best three price levels, is significantly greater after the change. These results suggest that the increase in transparency has improved market quality. However, results for the 3 Year bond futures, also shown in Table 2, indicate that around the change in 10 Year bond futures, bid-ask spreads are not affected, while quoted depth (both at the best prices and visible in the limit order book) is significantly greater. Market-wide effects, and *not* the change in transparency, are leading to improvements in liquidity in *both* the 10 Year and 3 Year bond futures contract.

<INSERT TABLE 2>

4. Robustness Test

Trading in interest rate futures contracts is seasonal, with distinct patterns emerging in each quarterly contract. Market activity and volatility follow seasonal patterns, and as such, the impact of an increase in transparency may not be distinguishable from seasonality's in trading. To address this, a year-on-year analysis is conducted to test the robustness of the traditional pre-post analysis. The post-period remains between 16 April, 2003 and 15 July, 2003, while the pre-period consists of the three months between 16 April, 2002 and 15 July, 2002.

Descriptive statistics are presented in Table 3. There is a significant decrease of 0.0005 basis points for spreads in the 10 Year bond futures contract, which is matched by a reduction of 0.0006 basis points in the 3 Year bond futures. Quoted depth, both at the best quotes, and throughout the limit order book, increases market-wide. Trading volume is significantly higher for both the 10 Year and 3 Year bond futures, while volatility across both contracts is reduced in the post-period, significant at the one percent level. These results suggest that the improvement in market quality cannot be isolated to the 10 Year bond futures, and as a result, the increased level of transparency appears to have no effect on liquidity in this contract.

<INSERT TABLE 3>

Results of the seasonal controlled regressions are presented in Table 4, and support the results of the previous regression estimated around the increase in transparency. While bid-ask spreads decrease year-on-year, this decrease occurs in both contracts, indicating that improvements are market-wide. Quoted depth levels for both contracts also increase when controlling for seasonality in trading, in line with initial results regarding quoted depth levels.

These results confirm that the improvement in market quality in the 10 Year bond futures is not attributable to the increase in transparency.

<INSERT TABLE 4>

5. Conclusions

The provision of liquidity in financial markets is an important issue, with a primary aspect relating to the level of pre-trade transparency. On 15 April, 2003, the Sydney Futures Exchange increased the level of pre-trade transparency in the 10 Year bond futures contract from three to five price levels. This paper examines the impact of this change on market quality. Results indicate that both quoted depth and trading volume increase after the change in transparency, while both bid-ask spreads and price volatility are not significantly affected. While this may suggest that the increase in transparency led to an increase in market quality, analysis of the 3 Year bond futures contract, which did not experience any change in transparency, indicates similar improvements in market quality. Regression results, which control for both contract-specific and market-wide levels in trading activity and price volatility, confirm that the improvements in market quality are common to both the 10 Year and 3 Year bond futures. These results are robust to the seasonality in futures trading. We conclude that an increase in transparency does *no*t lead to an improvement in market quality.

Appendix

The Sydney Futures Exchange (SFE) is one of the top ranked futures and options exchanges globally based on turnover. The 3 Year Commonwealth Treasury Bond Futures and 10 Year Commonwealth Treasury Bond Futures trade on a quarterly cycle starting on the 15th of December, March, June or September. Settlement occurs within three days of the quarterly expiration date. Daytime trading commences at 8:30am and ends at 4:30pm for interest rate futures.

The electronic trading platform, SYCOM, is an electronic limit order book where both Local SFE Participants and Full SFE Participants enter orders directly into the order book. A pre-opening phase precedes open trading where individual orders can be submitted into the limit order book and executed at the commencement of open trading based on an algorithm which determines a 'common price' that maximises the number of executable trades. Limit orders placed on SYCOM that do not immediately execute are queued and executed on a price and time priority basis. When a trade is executed, all traders are able to view, in real-time, the traded volume and price of the trade but not the identity of the brokers that executed the trade.

Prior to the increase in transparency, the 10 Year bond futures displayed the best three price levels on both sides of the order book. The minimum price increment was 0.5 basis points. After the change, the best five price levels on both sides of the order book were visible, with no change in the minimum price increment. The 3 Year bond futures displayed the best three price levels on both sides of the order book, and the minimum price increment was one basis point.

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Table 1
Descriptive Statistics

This table presents results for various market quality indicators around the increase in transparency in the 10 Year bond futures contract. *Bid-Ask Spread* is the time-weighted bid-ask spread in each contract; *BAS* adjusts the quoted bid-ask spread for the minimum tick in each contract; *Best Depth* is the quoted depth at the prevailing quotes; *Total Depth* is the quoted depth at the best three price levels in the limit order book; *Volatility* is calculated as the natural logarithm of the difference between daily high and low prices; *Volume* is the daily traded volume in each contract. The pre-period is 15 January, 2003 to 14 April, 2003, while the post-period is 16 April, 2003 to 15 July, 2003. Results are presented separately for the 10 Year and 3 Year bond futures contracts.

	Bid- Ask Spread	*BAS*	*Best Depth*	*Total Depth*	*Volatility*	*Volume*
Panel A – Pre-period						
10 Year	0.0057	1.179	149	506	0.0701	10,803
3 Year	0.0108	1.103	1,743	6,081	0.0688	35,877
Panel B – Post- period						
10 Year	0.0056	1.135	184	666	0.0615	12,440
3 Year	0.0106	1.100	2,224	7,632	0.0649	40,798
Panel C – Change from pre-period to post-period						
10 Year	-0.0001	-0.0438	35**	110**	-0.0086	1,637*
3 Year	-0.0002	-0.0032	481**	1,551**	-0.0039	4,921*

* Significantly different from zero at the 5 percent level.
** Significantly different from zero at the 1 percent level.

Table 2
Regression Results

This table presents results from the following regression models:

$BAS_i = \alpha_0 + \alpha_1 Change + \alpha_2 Ln(TenVolume) + \alpha_3 TenVolatility + \alpha_4 Ln(ThreeVolume) + \alpha_5 ThreeVolatility$

$Ln(BestDepth_i) = \alpha_0 + \alpha_1 Change + \alpha_2 Ln(TenVolume) + \alpha_3 TenVolatility + \alpha_4 Ln(ThreeVolume) + \alpha_5 ThreeVolatility$

$Ln(TotalDepth_i) = \alpha_0 + \alpha_1 Change + \alpha_2 Ln(TenVolume) + \alpha_3 TenVolatility + \alpha_4 Ln(ThreeVolume) + \alpha_5 ThreeVolatility$

Where BAS_i represents the bid-ask spread in each futures contract, $Ln(BestDepth_i)$ represents the depth at the best prevailing quotes and $Ln(TotalDepth_i)$ represents the depth at the best three price levels. *Change* takes the value of one after the increase in transparency, zero otherwise; $Ln(TenVolume_i)$ is daily traded volume in the 10 Year bond futures; *TenVolatility* is daily volatility in the 10 Year bond futures, calculated as the natural logarithm of the daily high and low difference; *Ln(ThreeVolume)* and *ThreeVolatility* represent daily traded volume and volatility in the 3 Year bond futures contract, respectively. The pre-period is 15 January, 2003 to 14 April, 2003, while the post-period is 16 April, 2003 to 15 July, 2003. Regressions are estimated separately for the 10 Year and 3 Year bond futures contracts.

	Intercept	*Change*	*Ln(TenVolume)*	*TenVolatility*	*Ln(ThreeVolume)*	*ThreeVolatility*	R^2
Panel A: Bid-Ask Spreads							
BAS_{10}	0.0054*	0.0000	-0.0002	0.0475	0.0002	-0.0406	0.0134
BAS_3	0.0117	0.0010	-0.0002	0.0748	0.0019	0.1692	0.0451
Panel B: Best Depth							
$Ln(BestDepth_{10})$	2.942**	0.1510**	0.6014**	-49.14**	-0.1231	-15.97	0.3590
$Ln(BestDepth_3)$	5.199**	0.1432**	0.0732	-46.70**	0.3481**	-19.20	0.2941
Panel C: Total Depth							
$Ln(TotalDepth_{10})$	3.966**	0.1994**	0.6467**	-56.30**	-0.1226	-15.19	0.3924
$Ln(TotalDepth_3)$	6.349**	0.1300**	0.1640	-45.14**	0.2765*	-10.39	0.2417

*Significantly different from zero at the 5 percent level.
** Significantly different from zero at the 1 percent level.

Table 3
Descriptive Statistics – Seasonal Control

This table presents results for various market quality indicators around the increase in transparency in the 10 Year bond futures contract. *Bid-Ask Spread* is the time-weighted bid-ask spread in each contract; *BAS* adjusts the quoted bid-ask spread for the minimum tick in each contract; *Best Depth* is the quoted depth at the prevailing quotes; *Total Depth* is the quoted depth at the best three price levels in the limit order book; *Volatility* is calculated as the natural logarithm of the difference between daily high and low prices; *Volume* is the daily traded volume in each contract. The pre-period is 16 April, 2002 to 15 July, 2002, while the post-period is 16 April, 2003 to 15 July, 2003. Results are presented separately for the 10 Year and 3 Year bond futures contracts.

	Bid- Ask Spread	*BAS*	*Best Depth*	*Total Depth*	*Volatility*	*Volume*
Panel A – Pre-period						
10 Year	0.0061	1.458	126	420	0.0799	10,267
3 Year	0.0112	1.335	1,257	4,370	0.0985	35,111
Panel B – Post- period						
10 Year	0.0056	1.135	184	666	0.0615	12,440
3 Year	0.0106	1.100	2,224	7,632	0.0649	40,798
Panel C – Change from pre-period to post-period						
10 Year	-0.0005**	-0.3231**	58**	246**	-0.0185**	2,173*
3 Year	-0.0006**	-0.2348**	967**	3,626**	-0.0336**	5,687*

* Significantly different from zero at the 5 percent level.
** Significantly different from zero at the 1 percent level.

Table 4
Regression Results – Seasonal Control

This table presents results from the following regression models:

$BAS_i = \alpha_0 + \alpha_1 Change + \alpha_2 Ln(TenVolume) + \alpha_3 TenVolatility + \alpha_4 Ln(ThreeVolume) + \alpha_5 ThreeVolatility$

$Ln(BestDepth_i) = \alpha_0 + \alpha_1 Change + \alpha_2 Ln(TenVolume) + \alpha_3 TenVolatility + \alpha_4 Ln(ThreeVolume) + \alpha_5 ThreeVolatility$

$Ln(TotalDepth_i) = \alpha_0 + \alpha_1 Change + \alpha_2 Ln(TenVolume) + \alpha_3 TenVolatility + \alpha_4 Ln(ThreeVolume) + \alpha_5 ThreeVolatility$

Where BAS_i represents the bid-ask spread in each futures contract, $Ln(BestDepth_i)$ represents the depth at the best prevailing quotes and $Ln(TotalDepth_i)$ represents the depth at the best three price levels. *Change* takes the value of one after the increase in transparency, zero otherwise; $Ln(TenVolume_i)$ is daily traded volume in the 10 Year bond futures; *TenVolatility* is daily volatility in the 10 Year bond futures, calculated as the natural logarithm of the daily high and low difference; *Ln(ThreeVolume)* and *ThreeVolatility* represent daily traded volume and volatility in the 3 Year bond futures contract, respectively. The pre-period is 16 April, 2002 to 15 July, 2002, while the post-period is 16 April, 2003 to 15 July, 2003. Regressions are estimated separately for the 10 Year and 3 Year bond futures contracts.

	Intercept	*Change*	*Ln(TenVolume)*	*TenVolatility*	*Ln(ThreeVolume)*	*ThreeVolatility*	R^2
Panel A: Bid-Ask Spreads							
BAS_{10}	0.0045*	-0.0004*	0.0001	0.0019	0.0001	0.0006	0.0456
BAS_3	0.0117	-0.0021*	-0.0006	0.0521	-0.0005	0.0452	0.0796
Panel B: Best Depth							
$Ln(BestDepth_{10})$	2.766**	0.2555**	0.4951**	-53.47**	-0.0360	-4.955	0.5070
$Ln(BestDepth_3)$	4.811**	0.5156**	-0.0447	-61.38**	0.4525**	-10.00	0.6554
Panel C: Total Depth							
$Ln(TotalDepth_{10})$	3.408**	0.7545**	0.5367**	-72.30**	-0.0207	-6.080	0.7542
$Ln(TotalDepth_3)$	6.010**	0.4949**	-0.0083	-49.52**	0.4237**	-12.01	0.6397

*Significantly different from zero at the 5 percent level.
** Significantly different from zero at the 1 percent level.