Limit Order Book, Anonymity and Market Liquidity:

Evidence from the Sydney Futures Exchange

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Abstract

This study examines the impact of the removal of broker mnemonics on the Sydney Futures Exchange. Early research finds that a decrease in transparency reduces liquidity in the market, while more recent research finds reduced transparency improves market quality. Results of this study indicate an improvement in liquidity after the removal of broker mnemonics. There is a significant increase in quoted depth and trading volume, and a significant decrease in quoted spreads in the 90 Day BAB, 3 Year Treasury Bond and 10 Year Treasury Bond Futures. This improvement in liquidity is robust to the length of the event window around the structural change and trading in a control market.

1. Introduction

This paper examines the impact on market liquidity of the removal of broker mnemonics in an electronic limit order market. The majority of previous research examines the change in bid-ask spreads associated with changes in both pre- and post-trade anonymity. Simaan, Weaver and Whitcomb (2003) argue that anonymity reduces collusion among quote providers. A transparent market allows dealers to collude and post wider spreads, with participants providing tighter spreads easily identified and subsequently reprimanded by other dealers. They document that Nasdaq dealer quotes on anonymous electronic communication networks (ECN's) are tighter than quotes posted on Nasdaq (a transparent dealer quotation system).

Foucault, Moinas and Theissen (2003) develop a theoretical model which predicts that anonymity leads to a change in bid-ask spreads. By separating traders who supply liquidity into two classes, informed and uninformed, they argue that in a market setting that provides broker identification, informed traders supplying liquidity provide information regarding future price movements. In this environment, uninformed quote providers learn from the quotes provided by informed traders, and can thus quote more aggressively in front of the informed traders. To protect themselves from this behaviour, Foucault, Moinas and Theissen argue that informed traders will occasionally set wider spreads than required to deceive uninformed quote setters.

Foucault, Moinas and Theissen (2003) also argue that in a market that does not provide broker identification, uninformed traders determine the proportion of informed traders in the market before submitting orders. If the fraction of informed traders is low, then a wide spread is a weak signal of private information, and uninformed traders are

more likely to offer price improvement. If the fraction of informed traders is high, then a wide spread is a strong signal of private information, and uninformed traders are less likely to improve on the best quotes. In an anonymous market setting, informed traders are less likely to engage in "bluffing" activities, and are more likely to post competitive quotes. Foucault, Moinas and Theissen document a decline in bid-ask spreads (after controlling for trading activity, volatility and price) on Euronext Paris subsequent to the removal of pre-trade broker identification. They conclude that the removal of broker identifiers has a positive effect on market liquidity.

Comerton-Forde, Frino and Mollica (2005) extend the analysis of Foucault, Moinas and Theissen (2003). In addition to examining Euronext Paris, they also examine the removal of broker identification on the Tokyo Stock Exchange, and the introduction of broker identification for limit orders on the Korea Stock Exchange, thus increasing the already high levels of pre-trade transparency. Their results indicate that a reduction in transparency leads to a decrease in both relative and effective bid-ask spreads, while both relative and effective bid-ask spreads increase for the Korea Stock Exchange, supporting the notion that an increase in limit order anonymity improves liquidity.

On 20 February, 2004, the Sydney Futures Exchange (herein SFE) removed the display of broker mnemonics on the limit order book for the three primary interest rate futures contracts. The decision to remove mnemonics was the outcome of an extensive consultation program undertaken with SFE Participants. The primary motivation of this study is to examine the impact of the removal of broker identifiers on market liquidity. In particular, this study concentrates on changes in *both* quoted bid-ask spreads and *quoted depth* associated with the structural change. In addition, this is the first study (to

our knowledge) that examines the impact of the removal of broker identifiers in a futures market. Given the lower probability of private information in futures markets (Frino and Oetomo, 2005; Gorton and Pennacchi, 1993; Subrahmanyam, 1991), we examine how liquidity changes in a market with (possibly) fewer informed traders.

Results of our analysis suggest that removal of broker mnemonics leads to an increase in market liquidity. There is a significant reduction in quoted bid-ask spreads, and significant increases in both quoted depth and trading activity. These results are confirmed after controlling for changes in volume and volatility, are robust to the time period examined around the structural change, and are robust to trading in a control market.

The reminder of this paper is organised as follows. Section 2 discusses the institutional detail of the SFE, while Section 3 describes the data and method. Section 4 presents univariate and regression results, while the final section summarises the paper.

2. Institutional Details

The SFE is the largest futures exchange in the Asia-Pacific region, and is ranked among the top ten futures and options exchanges worldwide by value of turnover.[1] The 90-Day BAB futures were launched in 1979, and represent the first interest rate futures contract to be listed outside the United States. Day trading on the SFE commences at 8:30 a.m. and ends at 4:30 p.m. for interest-rate future contracts. Trading on the SFE is conducted via a fully automated trading system, the Sydney Computerised Market (SYCOM). SYCOM was originally launched on November 30, 1989, as an overnight

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[1] Aitken, Frino, Hill and Jarnecic (2004) and Frino, Harris, McInish and Tomas III (2004).

trading system. On October 4, 1999, SFE abandoned floor trading in favour of electronic screen trading, and SYCOM was upgraded to an open-architecture design (SYCOM IV) in order to serve as the primary trading platform.

The three contracts examined in this study follow a quarterly expiration cycle (March, June, September and December). Trading in the nearest-to-delivery contract on the 90-Day BAB futures ceases at 12:00 Noon on the second Friday of the delivery month. Settlement for the 3-Year and 10-Year Bond futures occurs one business day following the last permitted day of trading, which is the fifteenth day of the contract month. All interest rates futures contracts are quoted as 100 minus the yield to maturity of the contracts, expressed in percent per annum.

On 16 March, 2001, the SFE reduced the coupon rate of both the 3-Year and 10-Year Bond futures contracts from 12 percent per annum to 6 percent per annum. The face value of the 90-Day BAB, 3-Year and 10-Year Bonds underlying the futures contracts are AUD 1 million for the BAB's and AUD 100,000 for the 3-Year and 10-Year Bonds. The decision to remove mnemonics (broker identifiers) for Australian Interest Rate Products is the outcome of an extensive consultation program undertaken with SFE Participants during 2003. The decision was made based on recommendations received from SFE Participants as well as feedback provided by various end-users.[2]

3. Data and Research Design

The data used in this study are obtained from a Reuter's database. The dataset includes all trades executed in the 90 Day BAB, 3-Year Bond and 10-Year Bond futures

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[2] For complete information on the removal of broker identifiers, see the "Removal of Mnemonics" document published by the SFE (2004).

contracts traded on the SFE. Details of the trade price, trade volume, prevailing bid and ask quotes and prevailing depth at the best quotes are included. Also included are daily open, high, low and close prices for all three contracts. The data extends from 1 August, 2003 to 31 August, 2004 (six months before and after the structural change). Consistent with prior event studies in futures markets, analysis is restricted to daytime trading in the near term contract (see Aitken et al., 2004).[3] The final sample includes 39,126 transactions in the 90-Day BAB futures, 219,433 transactions in the 3-Year Bond futures and 193,519 transactions in the 10-Year Bond futures.

To examine the impact on liquidity of the change to an anonymous market structure, the prevailing quoted depth at the best bid and ask quotes is calculated as follows -

$$\text{Depth} = \text{Volume at the Best Ask} + \text{Volume at the Best Bid} \qquad (1)$$

Consistent with Frino, Lepone and Wearin (2008), we also examine relative quoted bid-ask spreads and volatility, defined as follows -

$$\text{Relative Spread} = [\text{Best Ask} - \text{Best Bid}] / \text{MinTick} \qquad (2)$$

$$\text{Volatility} = \text{Log} [\text{Daily High} / \text{Daily Low}] \qquad (3)$$

where 0.01 is the minimum tick for 90-Day BAB and 3-Year Bond futures, and 0.005 is the minimum tick for the 10-Year Bond futures. The volume variable is calculated as the total number of contracts traded each day.

The change in liquidity due to the removal of broker mnemonics' is tested by examining the change in bid-ask spreads, quoted depth at the best quotes and trading volume in the pre- and post-event samples. These variables are sampled for each trade,

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[3] To test the robustness of these restrictions, we also examine overnight trading and trading in deferred contracts. Results from this are qualitatively similar to the results presented in this paper, and are available upon request.

and then averaged across each day. Averaging bid-ask spreads and depth to produce one observation for each day removes intraday variation across these variables. A *t*-test is used to examine whether the means of the variables in the pre- and post-event periods are significantly different.

Harris (1994) develops a model which identifies a number of variables that explain changes in bid-ask spreads and depth, namely trading volume and price volatility.[4] Controlling for changes in these variables ensures that any changes in bid-ask spreads and quoted depth observed in this study are attributable to the change in anonymity, and not changes in market conditions which influence these variables. The models below are estimated using OLS –

$$PBAS_t = a + \beta_1 D_t + \beta_2 VOLUME_t + \beta_3 VOLATILITY_t + \varepsilon \qquad (4)$$

$$DEPTH_t = a + \beta_1 D_t + \beta_2 VOLUME_t + \beta_3 VOLATILITY_t + \varepsilon \qquad (5)$$

where the dependent variable $PBAS_t$ in Equation 4 is the quoted spread divided by the minimum tick, and the dependent variable $DEPTH_t$ in Equation 5 is the daily average limit order volume at the best buy and sell prices. $VOLUME_t$ is the log transformation of trading volume, consistent with Harris (1994). $VOLATILITY_t$ is the log difference of daily high and low prices. The variable D_t is a dummy variable that takes the value of one after the structural change, zero otherwise. All *t*-statistics are adjusted for heteroskedasticity and autocorrelation using the procedure developed by Newey and West (1987).[5]

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[4] See also Tinic (1972), Tinic and West (1972), Stoll (1978), Amihud and Mendelson (1980) and Copeland and Galai (1983) for the use of volume and volatility as determinants of bid-ask spreads.
[5] We also perform the Hausman Endogeneity Test to formally determine if volume is an endogenous variable. Results confirm that volume is not endogenous. These results are available upon request.

4. Results

4.1 Univariate Results

Table 1 provides summary statistics for various measures of liquidity, both six months before and after the structural change. The proportional bid-ask spread is significantly tighter for all three contracts. The reduction in bid-ask spreads ranges from 0.010 percent for 10-Year Bond futures to 0.003 percent for 90-Day BAB futures. Quoted depth for all three contracts is also significantly higher in the post period, with the increase ranging from 83 contracts for 10-Year Bond futures to 943 contracts for 3-Year Bond futures.

Other liquidity measures also exhibit variation over the sample period. Average daily volume is higher after the structural change for all there contracts, with an increase of approximately 2,000 contracts per day for 3-Year Bond futures. Daily volatility is significantly lower in the post-period for 90-Day BAB futures and 3-Year Bonds futures (reductions of approximately 0.01 percent), but there is no discernable change in volatility for 10-Year Bond futures.

<center>**<INSERT TABLE 1>**</center>

4.2 Regression Analysis

Univariate results indicate a significant reduction in bid-ask spreads and a significant increase in quoted depth after the change to anonymity. Also, other factors, including volume and volatility, vary with the change. Changes in these other factors could be driving the reduction in bid-ask spreads and increase in quoted depth. To control for the impact that these additional factors have on bid-ask spreads and quoted

depth, several regressions are estimated. Table 2 presents results of regression analysis for both bid-ask spreads and quoted depth.

Results indicates that after controlling for variation in volume and volatility, bid-ask spreads are significantly tighter after broker identification is removed. The coefficient of the change dummy variable is significantly negative for all three contracts. Coefficient variables for the other explanatory variables are as expected. Similar results are found for the quoted depth regressions. The volume variable has a significantly positive coefficient, while the volatility variable has a significantly negative coefficient. The change dummy variable has a positive coefficient (which is significant at all conventional levels), indicating an increase in quoted depth with the reduction in transparency.[6] Overall, after controlling for factors that affect both bid-ask spreads and quoted depth, there is a significant increase in market liquidity under an anonymous market structure.

<center>**\<INSERT TABLE 2\>**</center>

5. Additional Tests

This section provides several additional tests to examine the robustness of the reduction in bid-ask spreads and increase in quoted depth after the change to an anonymous market structure.

5.1 Length of Event Window

To examine the sensitivity of results to the length of the event window, we re-estimate all statistics using data from three months before and after the structural change.

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[6] Results from the Dickey-Fuller test indicate that regression residuals are not correlated.

Univariate results are presented in Table 3. Results are similar to those based on six months data before and after the structural change. Although changes in the bid-ask spread, quoted depth, daily volume and volatility for the 90-Day BAB futures are insignificantly different from zero, there is a significant increase in quoted depth of 859 contracts for 3-Year Bond futures and 70.55 contracts for 10-Year Bond futures. Volume is also significantly higher, with an increase of 5,130 contracts for 3-Year Bond futures and an increase of 1,229 contracts for 10-Year Bond futures. Quoted bid-ask spreads are significantly tighter for both 3-Year and 10-Year Bond futures.

<center>**<INSERT TABLE 3>**</center>

We also re-estimate all regressions separately for the three-month event window. Results are reported in Table 4. Results indicate that all coefficient estimates are consistent with the original results. All change dummy variables are significantly negative for bid-ask spread regressions, and significantly positive for depth regressions, indicating a significant increase in market liquidity. Volume and volatility coefficients are as expected. The improvement in market liquidity is thus robust to the length of the event window around the structural change.

<center>**<INSERT TABLE 4>**</center>

5.2 Control Market

It is possible that market-wide events are leading to the reduction in bid-ask spreads and increase in quoted depth. The New Zealand Bank-Bill futures contract trades on the same platform as the 90-Day BAB futures, with equivalent contract specifications. Over the transition period, trading in the New Zealand contract continued normally.   If

liquidity and other contract characteristics exhibit systematic changes over the same event window, overall market forces could be driving the reduction in bid-ask spreads and increase in quoted depth for the 90-Day BAB futures. To examine this possibility, we examine the New Zealand Bank-Bill futures over the same time period. The results are presented in Table 5.

Descriptive statistics are presented in Panel A of Table 5. Bid-ask spreads, quoted depth, daily volume and daily volatility do not exhibit any significant variation for the New Zealand contract around the structural change. To control for variation in volume and volatility in both the Australian and New Zealand markets, the following regressions are estimated –

$$AU\_DV_t = \beta_0 + \beta_1 \, Change_t + \beta_2 \, \ln(AU\_Volume_t) + \beta_3 \, AU\_Volatility_t$$

$$+ \beta_4 \, \ln(NZ\_Volume_t) + \beta_5 \, NZ\_Volatility_t + \varepsilon_t \qquad (6)$$

where AU_DV_t is either the proportional bid-ask spread or quoted depth of the 90-Day BAB futures; AU_Volume_t is the log transformation of total daily volume of the 90-Day BAB futures (similarly for the NZ Bank-Bill futures); $AU\_Volatility_t$ is the daily volatility (measured as the log difference of daily high and low prices) of the 90-Day BAB futures (similarly for the NZ Bank-Bill futures); $Change_t$ is a dummy variable that takes the value of one after the structural change, zero otherwise.

Results in Panel B of Table 5 indicate that, after controlling for variation in volume and volatility in both the Australian and New Zealand markets, there is a significant reduction in bid-ask spreads and a significant increase in quoted depth for the 90-Day BAB futures after the structural change (both dummy variable coefficients are

significantly different from zero). The improvements in market liquidity are thus robust to market-wide trading activity.

<center>**<INSERT TABLE 5>**</center>

5. Conclusion

This paper examines the impact of removing broker identifiers on market liquidity. Several studies show that a reduction in transparency leads to a reduction in bid-ask spreads and an overall improvement in market quality. On 20 February, 2004, the SFE ceased displaying broker mnemonics on the limit order book. Results indicate a significant reduction in quoted bid-ask spreads, and a significant increase in both quoted depth and trading activity. These results are robust to changes in factors that affect spreads and depth, specifically volume and volatility. The results are also robust to the length of the event window around the structural change. Using the New Zealand Bank Bill futures as a control, we confirm the increase in quoted depth and reduction in quoted bid-ask spreads. The removal of broker identifiers has improved market liquidity.

References

Aitken, M., Frino, A., Hill, A. and Jarnecic, E., 2004, The impact of electronic trading on bid-ask spreads: Evidence from futures markets in Hong Kong, London, and Sydney, *Journal of Futures Markets* 24, 675-696.

Amihud, Y. and Mendelson, H., 1980, Dealership market: Market-making with inventory, *Journal of Financial Economics* 8, 31-53.

Comerton-Forde, C., Frino, A. and Mollica, V., 2005, The impact of limit order anonymity on liquidity: Evidence from Paris, Tokyo and Korea, *Journal of Economics and Business* 57, 528-540.

Copeland, T.E. and Galai, D., 1983, Information Effects on the bid-ask spread, Journal of Finance 38, 1457-1469.

Foucault, T., Moinas, S. and Theissen, E., 2004, Does anonymity matter in electronic limit order markets?", Working Paper, HEC.

Frino, A., Lepone A. and Wearin, G., 2008, Intraday paterrns in quoted depth in a competitive dealer market, Journal of Futures Markets XX, 1-XX.

Frino, A. and Oetomo, T., 2005, Slippage in futures markets: Evidence from the Sydney Futures Exchange, *Journal of Futures Markets* 25, 1129-1146.

Frino, A., Harris, F., McInish, T. and Tomas, M., 2001, Price discovery in the pits: The role of market makers on the CBOT and the Sydney Futures Exchange, *Journal of Futures Markets* 24, 785-804.

Harris, L., 1994, Minimum price variations, discrete bid-ask spreads, and quotations sizes, *Review of Financial Studies* 7, 149–178.

Gorton, G.B. and Pennacchi, G.G., 1993, Security baskets and index-linked securities, *Journal of Business* 66, 1-27.

Newey, W.K. and West, K.D., 1987, A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix, *Econometrica* 55, 703-708.

SFE, 2004, Removal of Mnemonics, SFE Publication.

Simaan, Y., Weaver, D. and Whitcomb, D., 2003, Market maker quotation behavior and pre-trade transparency, *Journal of Finance* 58, 1247-1267.

Stoll, H., 1978, The pricing of security dealer services: An empirical study of NASDAQ stocks, *Journal of Finance* 33, 1153-1172.

Subrahmanyam, A., 1991, A theory of trading in stock index futures, *Review of Financial Studies* 4, 17-51.

Tinic, S.M., 1972, The economics of liquidity services, *Quarterly Journal of Economics* 86, 79-93.

Tinic, S.M. and West, R.R., 1972, Competition and the pricing of dealer services in the over-the-counter market, *Journal of Financial and Quantitative Analysis* 8, 1707-1727.

TABLE 1
Descriptive Statistics

This table reports descriptive statistics including daily number of trades, proportional spread, quoted depth, daily volume and daily volatility for 90-Day BAB futures, 3-Year Bond futures and 10-Year Bond futures traded on the Sydney Futures Exchange. The proportional spread is calculated as the bid-ask spread divided by the minimum tick (0.01 for 90-Day BAB and 3-Year Bond futures, and 0.005 for 10-Year Bond futures). Daily volatility is calculated as the natural logarithm of the ratio of daily high and low prices. Daily volume is the average number of contracts traded per day. For each variable, the table reports the mean and change in mean for six months before and after the structural change.

	90-Day BAB		3-Year Bond		10-Year Bond	
	Pre	Post	Pre	Post	Pre	Post
No. of Observations	21,716	17,410	108,543	110,890	98,612	94,907
Daily Trades						
Mean	154.3	137.9	706.8	687.4	798.2	824.2
Mean change	-16.35		-19.40		26.00	
Proportional spread (%)						
Mean	1.004	1.001	1.009	1.001	1.011	1.001
Mean change	-0.0030*		-0.0080**		-0.0100**	
Quoted Depth						
Mean	2,881	3,386	2,623.4	3,566.4	226.5	309.3
Mean change	505.0**		943.0**		82.80**	
Daily Volume						
Mean	11,198	11,594	30,508	32,584	9,678	11,019
Mean change	396.0		2,076**		1,341**	
Daily Volatility (%)						
Mean	0.0412	0.0326	0.0631	0.0548	0.0612	0.0632
Mean change	-0.0086**		-0.0083**		0.0020	

** Indicates statistical significance at the 0.01 level
 * Indicates statistical significance at the 0.05 level

TABLE 2
Regressions Results

This table reports regression results for 90-Day BAB futures, 3-Year Bond futures and 10-Year Bond futures traded on the Sydney Futures Exchange. In the first regression, the dependent variable is the proportional spread (calculated as the bid-ask spread divided by the minimum tick of 0.01 for 90-Day BAB and 3-Year Bond futures, and 0.005 for 10-Year Bond futures). In the second regression, the dependent variable is the quoted depth at the best quotes. The change dummy variable takes the value of one after the 20 February, 2004 structural change, zero otherwise. The regressions include the natural logarithm of daily volume and daily volatility, measured as the natural logarithm of the ratio of daily high and low prices. All variables are calculated using data from six months before and after the structural change. For each regression, coefficient estimates, statistical significance, the rho statistic from the Dickey-Fuller test and adjusted R-squared values are reported.

Dependent Variable	Intercept	Volume	Volatility	Change	Dickey-Fuller (ρ)	R-Square
Proportional Spread						
90-Day BAB	0.2400*	0.0074	-12.93*	-1.046*	95.22**	0.0463
3-Year Bond	0.8210**	0.0085*	-36.45	-0.0581**	91.18**	0.0268
10-Year Bond	0.3522*	0.0064	18.72	-0.0560*	97.68**	0.0392
Quoted Depth						
90-Day BAB	-291.0**	0.0121	-58.46***	399.3**	91.31**	0.2046
3-Year Bond	484.9	0.0031	-126.6*	1,001**	89.49**	0.2541
10-Year Bond	36.63**	0.0038**	-16.43**	74.09**	93.49**	0.2584

** Indicates statistical significance at the 0.01 level
 * Indicates statistical significance at the 0.05 level

TABLE 3
Sensitivity to Event Window – Descriptive Statistics

This table reports descriptive statistics including daily number of trades, proportional spread, quoted depth, daily volume and daily volatility for 90-Day BAB futures, 3-Year Bond futures and 10-Year Bond futures traded on the Sydney Futures Exchange. The proportional spread is calculated as the bid-ask spread divided by the minimum tick (0.01 for 90-Day BAB and 3-Year Bond futures, and 0.005 for 10-Year Bond futures). Daily volatility is calculated as the natural logarithm of the ratio of daily high and low prices. Daily volume is the average number of contracts traded per day. For each variable, the table reports the mean and change in mean for three months before and after the structural change.

	90-Day BAB		3-Year Bond		10-Year Bond	
	Pre	Post	Pre	Post	Pre	Post
Daily Trades						
Mean	140.1	138.2	590.2	639.5	698.6	777.7
Mean change	-1.840		49.39		79.12	
Proportional spread (%)						
Mean	1.003	1.001	1.003	1.002	1.003	1.002
Mean change	-0.0020		-0.0010		-0.0010	
Quoted Depth						
Mean	2,783	2,807	2,666	3,525	233.0	303.5
Mean change	24.00		859.0**		70.50**	
Daily Volume						
Mean	10,416	10,735	25,598	30,728	8,796	10,025
Mean change	319.0		5,130*		1,229*	
Daily Volatility (%)						
Mean	0.0312	0.0283	0.0501	0.0471	0.0612	0.0632
Mean change	-0.0171		-0.0170		0.0020	

** Indicates statistical significance at the 0.01 level
 * Indicates statistical significance at the 0.05 level

TABLE 4
Sensitivity to Event Window – Regression Results

This table reports regression results for 90-Day BAB futures, 3-Year Bond futures and 10-Year Bond futures traded on the Sydney Futures Exchange. In the first regression, the dependent variable is the proportional spread (calculated as the bid-ask spread divided by the minimum tick of 0.01 for 90-Day BAB and 3-Year Bond futures, and 0.005 for 10-Year Bond futures). In the second regression, the dependent variable is the quoted depth at the best quotes. The change dummy variable takes the value of one after the 20 February, 2004 structural change, zero otherwise. The regressions include the natural logarithm of daily volume and daily volatility, measured as the natural logarithm of the ratio of daily high and low prices. All variables are calculated using data from three months before and after the structural change. For each regression, coefficient estimates, statistical significance, the rho statistic from the Dickey-Fuller test and adjusted R-squared values are reported.

Dependent Variable	Intercept	Volume	Volatility	Change	Dickey-Fuller (ρ)	R-Square
Proportional Spread						
90-Day BAB	0.8411**	0.0002	-13.63*	-1.042**	78.52**	0.1602
3-Year Bond	0.4532**	0.0001**	-66.07*	-1.024**	74.51**	0.0046
10-Year Bond	0.3030**	0.0006	24.75	-1.035**	77.93**	0.0263
Quoted Depth						
90-Day BAB	22.07	-0.0001	-28.69*	17.97	69.24**	0.1306
3-Year Bond	133.7	0.0089**	-15.32*	745.7**	68.27**	0.2334
10-Year Bond	94.37	0.0045**	-16.01**	62.83***	71.75**	0.5398

** Indicates statistical significance at the 0.01 level
 * Indicates statistical significance at the 0.05 level

TABLE 5
Control with New Zealand Bank-Bill Futures

This table reports descriptive statistics and regression results for New Zealand Bank-Bill futures. Panel A presents descriptive statistics including daily number of trades, proportional spread, quoted depth, daily volume and daily volatility. The proportional spread is calculated as the bid-ask spread divided by the minimum tick of 0.01. Daily volatility is calculated as the natural logarithm of the ratio of daily high and low prices. Daily volume is the average number of contracts traded per day. Panel B presents regression results. In the first regression, the dependent variable is the proportional spread, and in the second regression, the dependent variable is the quoted depth at the best quotes. The change dummy variable takes the value of one after the 20 February, 2004 structural change, zero otherwise. The regressions include the natural logarithm of daily volume and daily volatility, for both the Australian and New Zealand markets. All variables are calculated using data from six months before and after the structural change.

Panel A – Descriptive Statistics		Pre	Post
Daily Trades			
Mean		9.142	9.021
Mean change		-0.121	
Proportional Spread (%)			
Mean		1.690	1.720
Mean change		-0.030	
Quoted Depth			
Mean		265.2	302.6
Mean change		37.40	
Daily Volume			
Mean		471.5	465.3
Mean change		-6.200	
Daily volatility (%)			
Mean		0.0067	0.0040
Mean change		-0.0027	

Panel B – Regression Results			
Quoted Depth		**Proportional Spread**	
Intercept	10.02**	Intercept	0.8020**
AU_Volume	15.73**	AU_Volume	0.0005
AU_Volatility	0.0001	AU_Volatility	-0.0056
NZ_Volume	0.0010	NZ_Volume	0.0001
NZ_Volatility	0.0001	NZ_Volatility	-0.3945
Change	8.030*	Change	-0.0475*
R-Square	0.5780	R-Square	0.1561

** Indicates statistical significance at the 0.01 level
 * Indicates statistical significance at the 0.05 level