

Evidence of the Endowment Effect in Stock Market Order Placement

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The psychological endowment effect is apparent when investors place greater value on something when they mentally “own” it than when someone else owns it. Although this effect is well established in laboratory studies, there is relatively little documented evidence of an endowment bias in actual trading. This study examines order placements of stock traders on the Australian Stock Exchange. Consistent with the endowment effect, sellers appear to value their own shares higher than buyers independent of current market price, by consistently placing sell orders on average “further from the market” (i.e., from the best quote) than buy orders. This asymmetry is more pronounced in private client trading than in orders made through institutional brokers, suggesting that more sophisticated investors are less affected by asset ownership than the private clients of retail brokers. Since private “day traders” have been able to trade online themselves rather than through a broker, the quote asymmetry relative to the best-standing quotes between asks and bids has become more pronounced. Over the same period, the relatively small asymmetry apparent in institutional quotes has remained unchanged.

Introduction

This paper provides evidence that order placement by stock market traders is consistent with the endowment effect (see Thaler [1980]). The endowment effect prompts an implicitly irrational decision maker to ask a higher price when selling an asset than he would be willing to pay when buying it. Kahneman et al. [1991] give a resonant example of a wine-drinking economist who would not accept \$200 for a long-held bottle of vintage French wine, but also refused to pay that much today to acquire another bottle. The endowment effect is a contradiction of the neoclassical conclusion that there should be little difference between an individual decision maker's willingness to pay (WTP) and willingness to accept (WTA), provided Hicksian income effects are negligible (Willig [1976]).

Beginning with Knetsch and Sinden [1984], Knetsch [1989], and Kahneman, Knetsch, and Thaler [1990], a series of laboratory experiments in diverse contexts has provided empirical evidence of the endowment effect.¹ Knetsch et al. [1998] and List [2003b] present the endowment effect as one of the most empirically robust of all established behavioral

biases.² There is, however, little documented evidence of it in naturally occurring markets.

List [2003a] provides the only published study to date involving trader behavior in a real-world asset exchange. By observing market participants trading sports memorabilia, List found that seasoned traders traded at frequencies consistent with rational economic theory. More naïve traders, however, apparently affected by the asymmetry between losses and gains explicit in prospect theory, made an inefficient number of trades. Such behavior is consistent with the endowment effect.

Kahneman, Knetsch, and Thaler [1990] posit that the endowment effect is a manifestation of “loss aversion,” a deeper behavioral bias. Loss aversion, implicit in the asymmetric prospect theory value function (Kahneman and Tversky [1979]), means that the psychological hurt from a loss is not matched by the pleasure from an equal gain. A transaction is perceived as a loss when an asset is given up, and as a gain when it is acquired. It follows that individuals tend to want greater monetary compensation to give up an asset than they would be willing to pay to acquire it ($WTA > WTP$).

The endowment effect is sometimes interpreted as symptomatic of a more pervasive *status quo* bias (Samuelson and Zeckhauser [1988]), whereby the preservation of what is already owned is preferred to either buying or selling, notwithstanding contrary economic considerations. From a rationalist standpoint, such economic inertia is of itself a market imperfection.

For example, traders subject to any form of *status quo* bias are prevented from realizing the marginal eco-

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nommic value that would come from selling one asset to invest in a higher NPV alternative. In effect, such investors prefer “irrational” psychological gratification to “rational” economic gain. At an aggregate level, the liquidity and efficiency of markets can be affected detrimentally if traders with long positions have a systematically distorted notion of an asset’s true value merely because they, not someone else, are the owners.

Several studies suggest that the endowment bias is not expected to affect professional dealers to the same extent as more naïve or inexperienced traders (see, e.g., Knez, Smith, and Williams [1985], Coursey, Hovis, and Schulze [1987], Shogren et al. [1994], and List [2003a, 2003b]).³ List [2003b] found that traders learn to overcome the endowment effect. With sufficient trading experience, they tend to behave according to the neoclassical model, without apparent *status quo* bias.

Consistent with this observation, we illustrate that order placements made through institutional stock brokers show relatively little evidence of the endowment effect when compared to contemporaneous orders placed by presumably less sophisticated clients of retail brokers. We also find time series evidence of a gradual reduction in the endowment effect among retail traders since low-cost online trading became widely available.

Hypotheses

Hypothesis 1

The literature to date suggests that the endowment effect exists on average, but does not affect all traders equally. It may be virtually non-existent among the most seasoned traders. We hypothesize that at any given moment of trading, the average ask quote will be further from the best quote (further off the market), the more pronounced the endowment effect. Furthermore, the endowment effect applies to traders with a long position in an asset, but does not bias bidder perceptions (potential buyers) carrying zero or negative inventory. Thus the existence of the endowment effect among some but not all traders will cause the average ask to exceed the best (lowest) ask by more than the best (highest) bid exceeds the average bid. Hence we test:

H₁: On average, buy orders will be “closer to the market” than sell orders.

Hypothesis 2

If experienced or otherwise sophisticated traders are least subject to the endowment effect, we expect

their ask quotes to cluster more closely to the market and not to differ on average by significantly more than their bids. Assuming that quotes placed through institutional brokers are generally more sophisticated than those placed through retail brokers, we test as follows:

H₂: The asymmetry between buy orders and sell orders relative to “the market” is more pronounced in private client trading than in institutional trading.

Hypothesis 3

In a rising market, the endowment effect might be seen as part of rational rather than irrational trading. That is, a trader asking a significantly higher price than the lowest current ask may be merely waiting for an anticipated price increase and using a high ask quote as a means to time (postpone) the moment of sale. To control for market trends, we test:

H₃: On average, buy orders will be closer to the market than sell orders in both rising and falling markets.

Data

We use order placement data from the Australian Stock Exchange (ASX), which is especially suitable for several reasons. First, the ASX is an order-driven market, so we can truly observe participant behavior without being impacted by a market maker. Second, the full order book is transparent; each buy and sell order is visible to the market.

Third, counterparties of ASX transactions are identified by a unique broker ID, which allows us to categorize market participants into retail and institutional trading. Each unique broker ID is confidential, but the ASX provided us with sufficient detail for our study (see below).

The data contain all orders placed on the Australian stock exchange during the five-year period between July 1, 1998 and June 30, 2003. For each order placed, we know the stock code, time, price, volume, and the important counterparty ID for the broker placing the order. We used the IDs to partition the order placement data into two groups: “retail” broker orders, conducting primarily private client trading, and “institutional” broker orders, trading primarily for institutions and themselves (principal trading). As a result, while we cannot observe order placement on the level of individual brokerage firms, we can compare order placement behavior of a specific class of traders. See appendix B for the detailed classification list of brokerage houses.

To begin, we restrict our data to the three-year period from July 1, 2000, to June 30, 2003. The period of 1998 to 2000 was characterized by a dramatic structural change in the market with the rise of Internet-based brokers targeting private clients. We consider this period in the section (below) on historical developments. During our primary study period of 2000–2003, however, market membership was very stable. This data subset includes a period of rise and fall in market prices, allowing us to test for the endowment effect under both trends.

Metrics

To measure the “willingness to buy or sell,” we measured the average distance that buy/sell orders are placed from the current best bid (ask). We chose to use “distance to current best bid (ask),” rather than “distance to last trade” (i.e., to the last traded price) because it relates to the exact time the order is placed rather than to the time of the last trade. It also prevents the bid-ask spread from influencing our results.⁴

We based our measures on the ratio of the price of each bid (ask) to the current best bid (ask). For each order o , we hold the following information: time of order $t(o)$, quoted price $p(o)$, volume $v(o)$, security identifier $code(o)$, and broker group $b(o)$. We also calculate for each order the current best price, $best(o)$, which is the highest bid at time $t(o)$ when o is a bid, or the lowest ask at $t(o)$ when o is an ask.

We are interested in the ratio between order price $p(o)$, and current best price $best(o)$. For each order o , we calculate the ratio.

$$r(o) = \frac{p(o)}{best(o)}$$

By implication, $0 < r(o) \leq 1$ for each bid, and $r(o) \geq 1$ for each ask. The percentage distance from current best bid or ask is given by

$$\frac{100}{r(o)} - 100$$

for bids, and $100r(o) - 100$ for asks.

Value-Weighted Ratios

The value-weighted average distance $VWAD$ of quoted bids (asks) from the best bid (ask) over the set Ω of bids (asks) is calculated by weighting all orders by their total dollar value, $v(o) \times p(o)$, giving

$$VWAD = \frac{\sum_{\Omega} p(o) \times v(o) \times r(o)}{\sum_{\Omega} p(o) \times v(o)}$$

To simplify comparison and presentation, we also present this ratio as a percentage distance, $\%VWAD$, where $\%VWAD = 1 - VWAD$ for asks, and $\%VWAD = 1 - 1/VWAD$ for bids.

Unweighted Ratios

The unweighted average distance AD of quoted bids (asks) from the best bid (ask) is calculated by the simple average of $r(o)$ over the set Ω . Similarly, we define a summary measure $\%AD$ relative to AD for bids and asks in the same way as $\%VWAD$.

Results

We found that the data contained a relatively small set of extreme outliers in the quoted order prices. These prices occasionally reached as much as 10 or 100 times the current best ask, or as little as 1/10 or 1/100 of the current best bid. These appeared to be errors in order placement. In order to avoid having our results influenced by unintended or frivolous quotes, we disregarded any bids with a price smaller than half the current best bid, and any asks with a price more than twice the current best ask. This reduced our sample size by 59,145 bids and by 59,337 asks, or less than 0.002%. We varied the filter parameters to different levels to test the robustness of the results (see below).

Hypothesis 1: Table 1 shows the results obtained over the entire sample period. A total of about 61 million orders were placed during trading hours on the ASX during that time, consisting of approximately 36.2 million bids and 34.2 million asks. We find a strong asymmetry between the placement of buy orders and sell orders by market participants.

Using our value-weighted ratio, bids were placed an average of 0.291% away from the current best bid (value-weighted), while asks were placed an average of 0.359% away from the current best ask. Asks were placed on average 23.4% further away from the market than bids.

Using the simple average across all orders without value-weighting, the results are somewhat more pronounced. Asks were placed on average 57.1% further away from the market than bids (1.035% versus 0.659%). This is consistent with H_1 : On average, buy

Table 1. *Sample Period Results*

	Sample Size	VWAD	%VWAD	AD	%AD
Bids	36,194,481	0.9971	0.291	0.99345	0.659
Asks	34,208,400	1.00359	0.359	1.01035	1.035

orders were placed significantly closer to the market than sell orders.

Hypothesis 2: In Table 2, the aggregated results from Table 1 are partitioned between institutional and retail brokers. These results support H₂: The observed asymmetry in order placement is significantly more pronounced in private client trading than in institutional trading.

The difference between retail and institutional order placement with regard to the observed asymmetry between buy and sell orders is remarkable. When value-weighted, retail traders placed their sell orders 77.3% further away from the market than their buy orders. The result using an unweighted average is virtually identical, at 77.7%. In contrast, the asymmetry is much less pronounced in institutional trading. Sell orders were placed on average 6.7% further away from the market when value-weighted, or 41.4% further away when unweighted.

The difference in results indicates that, for institutional trading, order size affects the extent, but not the existence, of the endowment effect asymmetry. This may be partially due to brokers classified as institutional by the ASX acting on behalf of some retail clients making relatively small orders.

Hypothesis 3: We investigate whether the asymmetry observed in the placement of bids and asks is related to overall price trends in the market.

Figure 1 shows the behavior of VWAD (monthly average values) over time (July 1999–June 2003) relative to the path of the market index. Comparable plots are provided for buy and sell orders placed through institutional and retail brokers (as per the ASX classification). Figure 2 shows the same results presented as an average distance from best bid/ask in percent. Tables with detailed results are provided in the appendix.

Both figures show graphically the asymmetry of sell order placement compared to buy order placement,

as well as the persistence of the phenomenon over time. The significant difference between order placement by retail clients and institutional traders is also apparent. Note that the observed asymmetry between buy and sell orders is most obvious in private client trading, and much less apparent in institutional trading.

We also observe a substantial variation in the results over time, and find some correlation to market movements. Specifically, in months with extreme falls in the market index, observed asymmetry narrows. For retail trading, the asymmetry is always present, however, even in months with extreme downward movements such as October 2000 or September 2001. In institutional trading, the situation reverses occasionally during heavy market downturns, and bids are on average placed further away from the market than asks.

Figure 3 demonstrates these results vividly. The values are obtained by calculating the ratio of VWAD (sell) to VWAD (buy) for each month (shown as a percentage). Thus, any value above zero indicates asymmetry consistent with the endowment effect.

The results confirm H₃: The asymmetry between bid and ask placement is generally highly persistent through both market upturns and downturns, and in the case of retail trading holds even through market “crashes” such as October 2000 and September 2001.

Historical Developments

The time series results in Figures 1–3 suggest that this phenomenon may be driven significantly by the advent of private investors trading in real time. Over the financial year July 1998 to June 1999, the discrepancy between bids and asks placed by private and institutional investors was significantly less pronounced than in following years. As Figures 4 and 5 clearly show, in the following years, the endowment effect asymmetry grew markedly, concurrent with the growth of Internet trading. This appears to confirm our hypothesis that the endowment effect manifests itself more strongly in the trading behavior of less sophisticated “day traders.”

Table 2. *Sample Period Results, Divided into Institutional and Retail Brokers*

	Sample Size	VWAD	%VWAD	AD	%AD
Institutional Bids	25,918,907	0.99748	0.253	0.99562	0.44
Institutional Asks	25,359,557	1.0027	0.27	1.00622	0.622
Retail Bids	10,275,574	0.99431	0.572	0.98765	1.25
Retail Asks	8,848,843	1.01014	1.014	1.02221	2.221

FIGURE 1
Value-Weighted Average Distance (VWAD) of Quoted Bids and Asks
from Contemporaneous Best Quoted Price

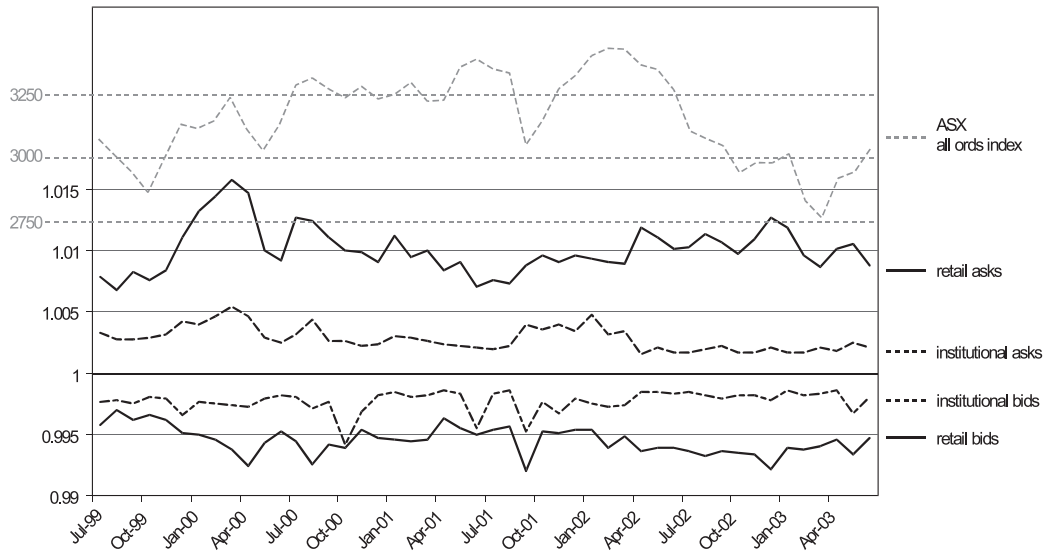
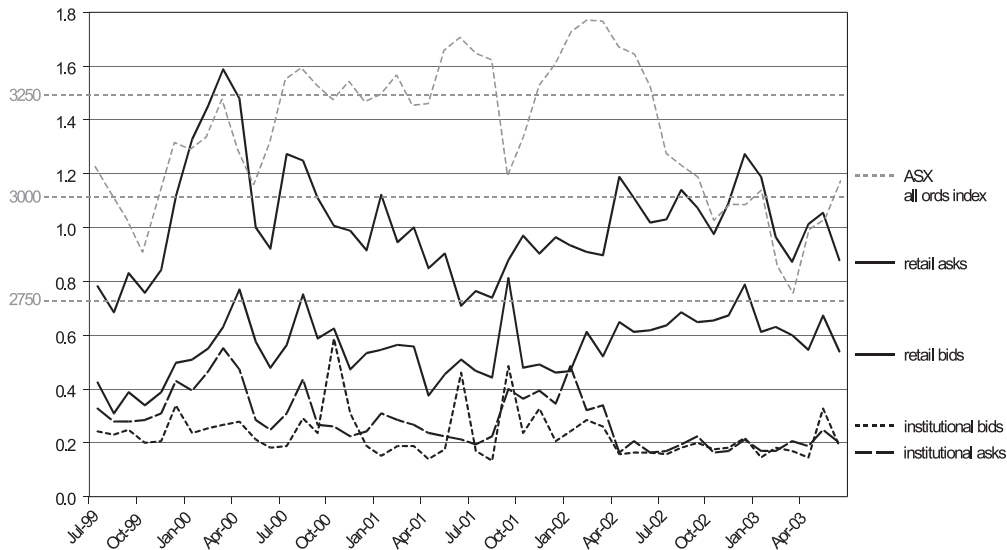


FIGURE 2
Proportionate Value-Weighted Average Distance (% VWAD) of Quoted Bids and Asks
from Contemporaneous Best Quoted Price



Robustness of Results and Alternative Explanations

It is debatable whether individual orders should be equally weighted or weighted according to dollar value (as in Figures 1 and 2). As a robustness check, we repeated our analysis with equally weighted orders. We calculated the ratio $r(o)$ for each order separately, and then averaged across all orders equally.

The results are shown in Figure 6, which is the equivalent of Figure 1 in terms of general findings. The

only noteworthy difference is that, for retail orders, the average distances of bids (asks) from the best quoted price is clearly greater when bids (asks) are equally weighted. This indicates that large orders are generally placed closer to the market than small retail orders. This seems true in general for both retail and institutional brokers, but more obviously for the private clients of retail brokers.

We conducted further tests to ensure that our results were not influenced by extreme values, which

FIGURE 3
Ratio of Monthly Value-Weighted Average Distance (VWAD) of Ask Quotes from Best Ask Quote to Value-Weighted Average Distance of Bid Quotes from Best Bid Quote

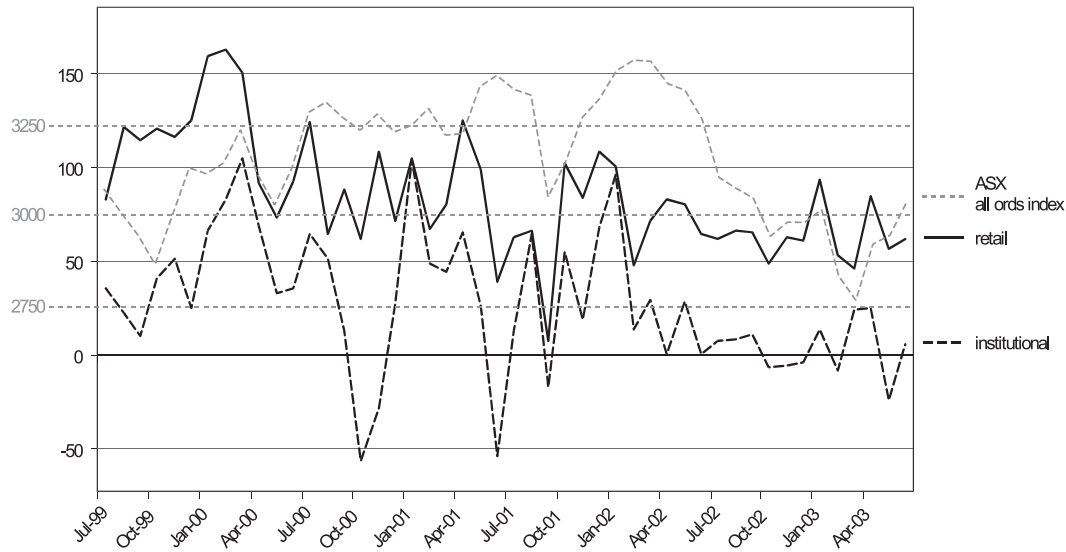
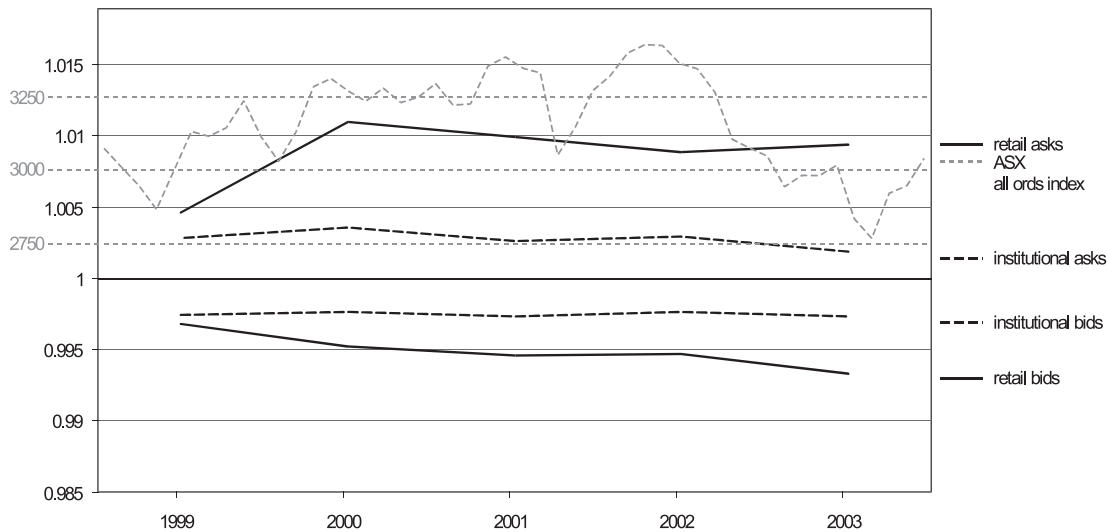


FIGURE 4
Time Series of Value-Weighted Average Distance (VWAD) of Quoted Bids and Asks from Contemporaneous Best Quoted Price



are relatively common in our large dataset. We filtered all of our data to ignore orders priced more than twice the current best ask or less than half the current best bid. Several test runs were conducted with different filter settings, down to a filter setting of $\pm 10\%$ of current best bid/ask. The key phenomenon, whereby the asymmetry of relative ask placement exceeded relative bid placement by roughly a factor of 2, persisted.

The question remains of whether our observations are truly a manifestation of the endowment effect, or

whether the order placement asymmetry is caused by other factors. One alternative explanation presented itself from the discussion of the “day trader” phenomenon. We noticed that many day traders appeared to use a simplistic trading strategy of purchasing shares and then immediately offering them for sale again at a “satisfactory” profit margin. They did not appear to monitor the market regularly. If their sell order got executed, they were satisfied; if it did not, it expired and the trader entered a new sell order. However, we do not believe this strategy was used on a large enough scale to

FIGURE 5
Time Series of Proportionate Value-Weighted Average Distance (% VWAD) of Quoted Bids and Asks from Contemporaneous Best Quoted Price

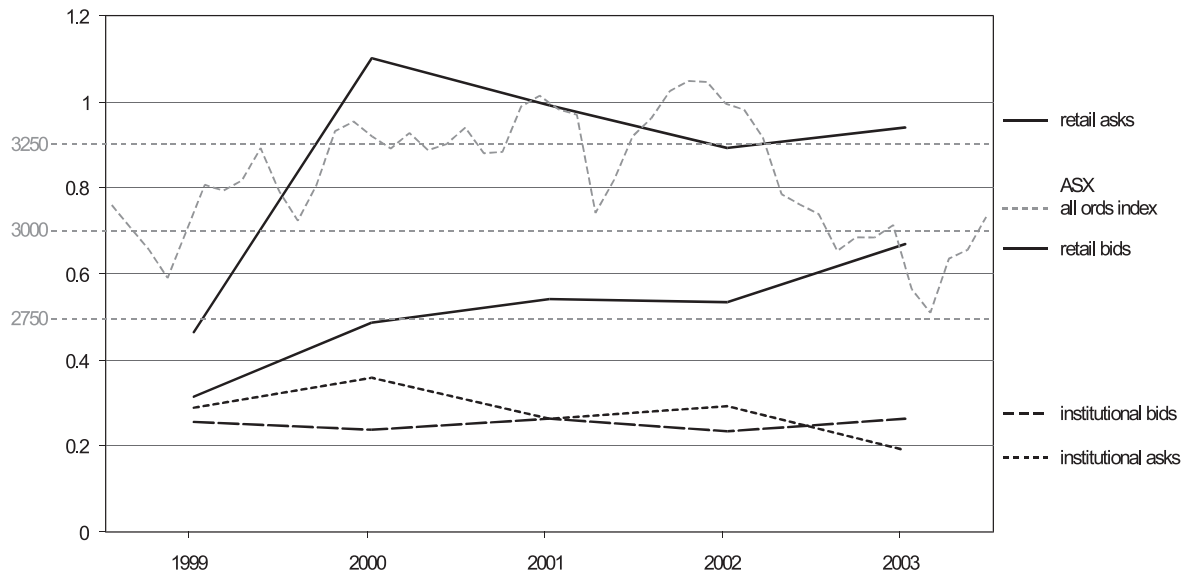
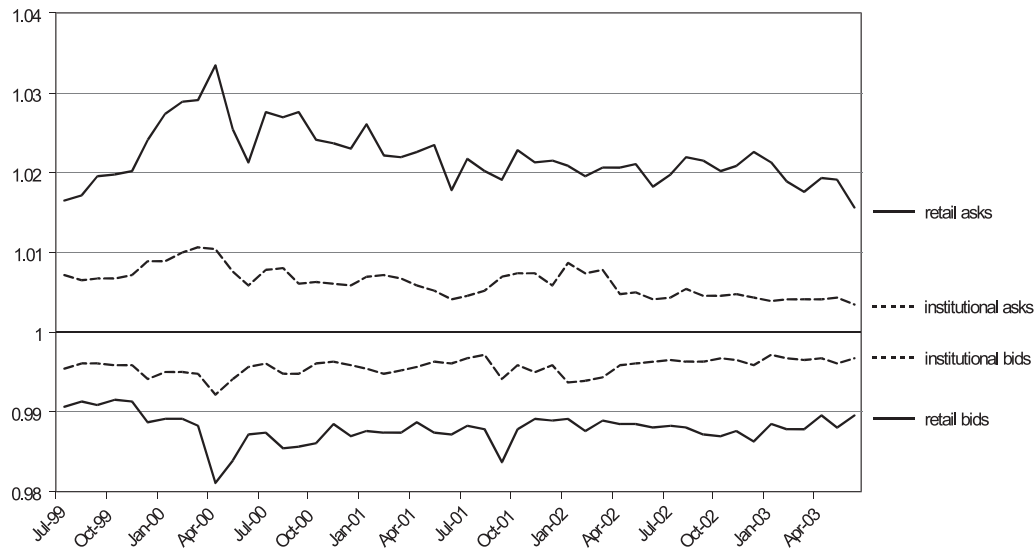


FIGURE 6
Unweighted Average Distance of Quoted Bids and Asks from Contemporaneous Best Quoted Price



influence our results, as we would then have observed a much larger number of sell orders than buy orders. Our sample actually provided just the opposite—it contained more buy than sell orders.

Conclusion

We found evidence consistent with the endowment effect in the bid and ask quotes made by traders on the Australian Stock Exchange (ASX). Asks are sys-

tematically further from the market than bids, and more pronounced for small-value orders than for large-value orders. The effect is much more obvious in retail trading than in institutional trading, consistent with the argument that the endowment effect has more influence over less sophisticated investors. There is no evidence that the endowment effect has become less influential as markets have evolved. Rather than disappearing over time, it has become more evident on the ASX in the years since the emergence of online “day traders.”

Because the endowment effect does not influence all traders or investors equally, its consequences for stock market efficiency are stronger for liquidity than for price discovery. Accurate price discovery requires that at least some traders (perhaps just one) on the sell side are not affected by the endowment effect.

There are economic arguments, however, that price discovery occurs most efficiently in highly liquid markets (O'Hara [2003, p. 1339]). The endowment effect clearly reduces market depth and therefore liquidity. If many sellers have an upwardly biased expectation of the price they should achieve for their stock, some informed buyers, who know the "true value" of the stock, will not all be able to buy at that value. Alternatively, they will incur high transaction costs, perhaps discouraging them from trading. Market efficiency is therefore reduced, not necessarily in the average time or number of trades required for accurate price discovery, but in the time required for traders to buy sufficiently large quantities of stock at the current "true" stock price.

Acknowledgments

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Notes

1. Kahneman, Knetsch, and Thaler [1990] and Horowitz and McConnell [2000] survey the empirical literature.
2. Plott and Zeiler [2002] contest this conclusion, arguing that the gap between "willingness to accept" and "willingness to pay," while observable, can be attributed more to the experimental device used than to an intrinsic difference in values under different endowments.
3. List [2003b] cites Camerer and Hogarth's [1999] finding that "cognitive capital" accrues over months or years rather than during the period of a laboratory experiment.
4. Test runs using distance to last or next trade instead show virtually no change in results.

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APPENDIX A
Tables with Detailed Results

Time	Retail Bids			Institutional Bids			Retail Asks			Institutional Asks			All Bids			All Asks		
	<i>n</i>	VWAD	%	<i>N</i>	VWAD	%	<i>n</i>	VWAD	%	<i>n</i>	VWAD	%	<i>n</i>	VWAD	%	<i>n</i>	VWAD	%
10:10-10:30	734093	0.9943	0.57	1655523	0.9975	0.26	658075	1.0102	1.02	1632273	1.0037	0.37	2389616	0.9970	0.30	2290348	1.0046	0.46
10:30-11:00	874133	0.9941	0.60	1730013	0.9978	0.22	785094	1.0106	1.06	1720592	1.0028	0.28	2604146	0.9973	0.28	2505686	1.0039	0.39
11:00-11:30	725537	0.9944	0.56	1470208	0.9970	0.31	654359	1.0103	1.03	1470902	1.0026	0.26	2195745	0.9966	0.34	2125261	1.0037	0.37
11:30-12:00	641897	0.9945	0.56	1334993	0.9982	0.18	579061	1.0099	0.99	1330422	1.0024	0.24	1976890	0.9977	0.23	1909483	1.0034	0.34
12:00-12:30	558226	0.9938	0.62	1154243	0.9965	0.35	498574	1.0108	1.08	1142525	1.0030	0.30	1712469	0.9961	0.39	1641099	1.0041	0.41
12:30-13:00	462724	0.9927	0.74	665737	0.9975	0.25	403744	1.0136	1.36	659655	1.0033	0.33	1128461	0.9966	0.34	1063399	1.0052	0.52
13:00-13:30	411195	0.9919	0.82	517074	0.9973	0.27	354031	1.0155	1.55	505675	1.0037	0.37	928269	0.9961	0.39	859706	1.0062	0.62
13:30-14:00	417954	0.9924	0.77	626530	0.9975	0.25	356323	1.0135	1.35	614983	1.0032	0.32	1044484	0.9966	0.34	971306	1.0050	0.50
14:00-14:30	485593	0.9947	0.53	1205665	0.9980	0.20	428919	1.0086	0.86	1193696	1.0022	0.22	1691258	0.9976	0.24	1622615	1.0029	0.29
14:30-15:00	543825	0.9953	0.47	1457203	0.9982	0.18	476786	1.0074	0.74	1445018	1.0020	0.20	2001028	0.9978	0.22	1921804	1.0026	0.26
15:00-15:30	601565	0.9956	0.44	1604266	0.9981	0.19	518415	1.0071	0.71	1566450	1.0021	0.21	2205831	0.9979	0.22	2084865	1.0026	0.26
15:30-16:00	822168	0.9957	0.43	2076217	0.9978	0.22	673477	1.0061	0.61	2026251	1.0022	0.22	2898385	0.9976	0.24	2699728	1.0026	0.26
10:10-16:00	7278910	0.9945	0.55	15497672	0.9977	0.23	6386858	1.0095	0.95	15308442	1.0026	0.26	22776582	0.9973	0.27	21695300	1.0035	0.35

	07/98-06/99			07/99-06/00			07/00-06/01			07/01-06/02			07/02-06/03		
	<i>n</i>	VWAD	%	<i>n</i>	VWAD	%	<i>n</i>	VWAD	%	<i>n</i>	VWAD	%	<i>n</i>	VWAD	%
Retail Bids	1055408	0.9969	0.31	2552737	0.9952	0.48	2659134	0.9946	0.54	3246678	0.9947	0.54	2718098	0.9934	0.67
Retail Asks	921045	1.0047	0.47	2191647	1.0110	1.10	2428446	1.0099	0.99	2845620	1.0089	0.89	2269378	1.0094	0.94
Institutional Bids	4306125	0.9974	0.26	5981186	0.9976	0.24	5440184	0.9974	0.26	6647785	0.9977	0.23	6875070	0.9974	0.26
Institutional Asks	4214563	1.0029	0.29	5773120	1.0036	0.36	5487000	1.0026	0.26	6612992	1.0029	0.29	6535469	1.0019	0.19

	07/98-06/99		07/99-06/00		07/00-06/01		07/01-06/02		07/02-06/03	
	VWAD	Unweighted Average	VWAD	Unweighted Average	VWAD	Unweighted Average	VWAD	Unweighted Average	VWAD	Unweighted Average
Retail Bids	0.9969	0.9925	0.9952	0.9887	0.9946	0.9876	0.9947	0.9886	0.9934	0.9880
Retail Asks	1.0047	1.0122	1.0110	1.0234	1.0099	1.0225	1.0089	1.0195	1.0094	1.0183
Institutional Bids	0.9974	0.9943	0.9976	0.9950	0.9974	0.9957	0.9977	0.9955	0.9974	0.9964
Institutional Asks	1.0029	1.0065	1.0036	1.0082	1.0026	1.0063	1.0029	1.0062	1.0019	1.0043

Appendix B
Broker Classification

The following brokers are classified as “primarily private investor trading.” The remainder of brokerage firms trading on the ASX has been classified as “institutional.” This classification is based on criteria published on the ASX web site, www.asx.com.au.

- Commonwealth Securities Ltd
- JDV Ltd
- ITG Australia Ltd
- ETRADE Australia Securities Ltd
- Smith Barney Citigroup Australia Pty Ltd
- National Online Trading Ltd
- Andrew West & Co
- Sanford Securities Ltd
- Barton Capital Securities Ltd
- UBS Private Clients Australia Ltd
- Susquehanna Pacific Pty Ltd

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