The Reach of the Disposition Effect: Large Sample Evidence Across Investor Classes

by

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Abstract

We examine detailed daily Australian Stock Exchange share registry data for investors in IPO and index stocks between 1995 and 2000 and find that the "disposition effect", investors' reluctance to crystallise losses and relative eagerness to realise gains, is pervasive across investor classes. However, traders instigating larger investments tend to be affected less by the disposition bias. Our novel findings include that (a) the disposition effect ameliorates over time, being undetectable from around 200 trading days after purchase, (b) the "house money" effect tempers the disposition effect, (c) shareholder loyalty schemes also partially offset investors' relative preference for selling winning stocks and (d) the reversal of the disposition effect in June (the last month of the Australian tax year) does not occur among investors unable to take advantage of tax shields. In line with earlier research, our results support a tax-related explanation for the June effect rather than window dressing or momentum explanations. Finally, we confirm Odean's (1998) finding that the disposition effect is not driven by diversification motives, or by higher transaction costs associated with lower priced stocks.

Keywords:
Disposition effect, behavioural finance, tax-loss selling, house-money effect, prospect theory.

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1. INTRODUCTION

The still dominant hypothesis in finance, that markets are efficient, is based on the premise that investors are rigorously rational. Rationality works well as a first order approximation of investor behaviour although we now recognise that behavioural biases can induce trading patterns at odds with the implications of economic rationality. This paper focuses on one such bias, investors' reluctance to crystallise investment losses relative to gains, i.e., the "disposition effect" (Shefrin and Statman 1985).

We contribute to the literature on the disposition effect by using large scale detailed shareholding data to document (a) its pervasiveness across institutional, retail and foreign investors, (b) the weakening of the disposition effect over time and when gains and losses are weighted by dollar value, (c) the countervailing influence of the "house money" effect and (d) that shareholder loyalty schemes substantially reduce, while tax-loss selling can reverse, the disposition effect. Much of our research design is modelled on Odean's (1998) study. We extend his work by analysing the relative influence of the disposition effect among different categories of investor, including foreign and government investors.[1] Our analysis of the "house money" effect, shareholder loyalty schemes, the time-related amelioration of the disposition effect, and the impact of dollar value weighting of gains are novel extensions. We contend they are important because our findings allow more detailed mapping of the impact of the disposition effect on investor behaviour.

The data we use comprise end-of-day shareholdings for all CHESS[2] registered investors in 450 IPO stocks and 380 Australian Stock Exchange (ASX) index stocks between 1995 and 2000. At the start of our sample period, firms comprising about 97% of the total market capitalisation of Australian stocks were on the CHESS register. Use of CHESS eliminates

* We gratefully acknowledge support for the research from Australian Stock Exchange. The provision of CHESS data by ASX required that we maintain the confidentiality of these data and required that the data not be made available to other researchers without ASX permission. We have complied with both conditions. We thank Joe Tang for programming assistance and Peter Swan for useful comments. We claim all errors as our own.

[1] Odean (1998) reviewed the trading records of 10,000 accounts at a discount broking house. He observed that "it would be illuminating to repeat this study with data on institutional trading and with data from a retail brokerage house" (p. 1796).

[2] CHESS is short for the Clearing House Electronic Subregister System. It is a system for the electronic transfer and delivery of equities in the Australian market.

representativeness problems inherent in survey data or data from a single brokerage firm. Since the electronic records are equivalent to official certificates of ownership, the data are highly accurate (see also Grinblatt and Keloheraju 2001). Another advantage of CHESS data is that investors are categorised according to their type. For this reason, we can analyse investors' behaviour according to their level of sophistication. Our SEATS price data cover all ASX listed stocks, price and volume being available on an individual order or trade and measured with a time precision of one hundredth of a second.

We study the disposition effect among investors in IPOs because we can determine with complete accuracy the price at which subscribers make their initial purchase, a pertinent issue given the purchase price is a key reference point for investors. We start in 1995 because CHESS records are available only from September 1995. To mitigate any concern that investor behaviour in IPOs is not representative, we repeat our analysis on investors who purchased on-market either an IPO stock or a stock that was included in the ASX All-Ordinaries Index and who had not held that index stock for at least the most recent 200 trading days before their purchase. Importantly, in all tests, results from the three samples are consistent.

Our principal findings are as follows. Investors are inclined to realise winners rather than losers in all months of the year except June, the last month of the Australian fiscal year. In June, we find the disposition effect is tempered by tax-loss selling for all investors except tax-exempt government organisations and foreign traders. This result lowers the likelihood that "window-dressing" or momentum effects are better explanations for the tempering of the disposition effect at the end of the first tax year since acquisition, a conclusion reinforced when we review investors' propensity to repurchase stocks they sold in June. Moreover, we find the strength of the disposition effect in July to May and tax-loss selling in June is weaker for larger investors. The disposition effect however diminishes over time, with investors becoming relatively indifferent between the realisation of their gains and losses when their holding period reaches about 200 trading days.[3]

Behavioural biases, explicated in prospect theory (Kahneman and Tversky 1979), provide one explanation for the disposition effect. Competing explanations include investors' belief

[3] As we discuss below, we use the IPO issue price as the benchmark for our calculations. Perhaps investors revise the benchmark after listing, thus causing our realised losses to be overstated. Alternatively, it may be that investors simply "come to peace with their losses".

(rational or not) that today's losers will be tomorrow's winners, investors selling winning stocks to restore diversification, or investors' reluctance to sell losers due to the higher transaction costs associated with lower priced stocks. We find that after controlling for portfolio rebalancing and the level of the share price, the disposition effect is still observed for all categories of investor. However, traders instigating larger investments tend to be less affected by this particular bias.

We also test Johnson and Thaler's (1990) "house money effect", which predicts that investors are more risk seeking following previous gains and have a stronger bias towards "breaking even" after prior losses. We find strong evidence that prior gains tend to cushion subsequent losses and that investors who realise initial losses have a greater propensity to "break even" when given appropriate opportunities. Our results confirm that investors engage in "narrow framing". That is, they account for gains and losses at an individual stock level rather than, say, at their total wealth portfolio level when thinking about and evaluating their investments (Thaler 1980, Barbaris and Huang 2001).

The rest of the paper is structured as follows. Section two provides an overview of related research that places our findings in context. Section three describes the data and research design. Section four presents our detailed findings and discussion. Section five comprises a summary, conclusions and suggestions for future research.

2. THE DISPOSITION EFFECT

Investors' reluctance to realise losses has long been noted. Shefrin and Statman (1985) drew attention to the potentially substantial impact of this bias on investor behaviour in capital markets and, importantly, showed the scope of Kahneman and Tversky's (1979) seminal work on prospect theory in generating predictions about the effect of this bias. Prospect theory is founded on two propositions. First, investor utility is a function of gains and losses relative to a benchmark, rather than a function of absolute wealth. Second, investors' utility functions are concave for gains and convex for losses (i.e., the regret from a loss is greater than the pleasure from a gain of equivalent magnitude). More specifically, prospect theory implies investors employ a valuation function that reflects risk aversion in the domain of gains and risk seeking in the domain of losses.

Investigations in experimental settings (Weber and Camerer 1998) and market settings (Ferris, Haugen and Makhija 1998, Odean 1998, Kaustia 2000, Brown, Smith and Wilkie 2001, Grinblatt and Keloharju 2001) have yielded findings consistent with the implications of prospect theory. Moreover, the market-based results indicate the impact is substantial, vindicating Shefrin and Statman's early contention that the assumption of complete rationality is predictively inaccurate in important respects. Given these findings, two questions become interesting. One is whether the disposition effect is truly attributable to behavioural bias rather than other explanations, some of which might be reconcilable with rational behaviour. The other is the extent to which the disposition effect is manifest in capital markets.[4] For instance, it is reasonable to suppose that more sophisticated investors might be less susceptible to the bias given that it can lead to sub-optimal investing, as Odean (1998) documents.[5] Further, in cases where the wealth loss from exhibiting the disposition effect would be salient and substantial, such as failure to capture the tax shields from unrealised capital losses, we might expect virtually all investors to overcome their usual reluctance to sell losing stocks.

Explanations that compete with prospect theory to explain the disposition effect include contrarian investment strategies, diversification motives and transaction cost minimisation. Odean (1998) provides persuasive evidence against each of these explanations, showing that "investors who sell winners and hold losers because they expect the losers to outperform the winners are, on average, mistaken" (p.1790) and that investors who sell all their holdings – and who are thus unlikely to be motivated by diversification motives – remain reluctant to include losing stocks in their sales. He also finds "investors appear to prefer to sell winners and hold losers even when trading costs for both are about the same" (p. 1792).

There is strong evidence that "professionalism" or investor sophistication does not bring total immunity. For instance, Coval and Shumway (2001) analyse the trades of Chicago Board of Trade professional market makers. Traders who lose money in the morning will, in the afternoon, (a) place more trades, (b) place trades with larger average size and (c) assume greater total dollar risk than those with profitable mornings. However, Shapira and Venezia

[4] Brennan (2001) points out "there is a danger that the relaxation of the rationality criterion will lead to the adoption of radically different behavioural postulates to explain different phenomenon. This would be indicative of a degenerative scientific research program (Lakatos 1979), in which representative agent models become little more than the fables used to justify particular pricing kernels that are found to be empirically successful in explaining asset prices. While this might be the route to explaining asset prices in a statistical sense, it is clearly not the route to understanding them" (p. 1293).

[5] Shefrin and Statman (1985) cite several anecdotal examples to show professional traders are aware of the pitfalls of succumbing to the disposition effect.

(2000) find that while the disposition effect is pervasive it is significantly weaker among professional investors than among amateurs in Israel, where stock market gains are tax free. The conclusion that greater investment expertise is associated with less susceptibility to the disposition effect is supported by Locke and Mann (2000). They study the trading behaviour of professional futures traders and find that while all traders hold losers longer than winners, the least successful traders hold losses the longest, while the most successful traders hold losses for the shortest time. One contribution of our paper is to document the extent institutional investors are susceptible to the disposition effect, an issue of interest in light of the agency complications attendant on institutional investment (Odean, 1998, p. 1797).

Notwithstanding that both ostensibly sophisticated and unsophisticated investors display varying susceptibility to the disposition effect in general, there is evidence that investors are more inclined to override their biases in cases where the benefits of doing so are salient, such as when income tax can be reduced. Tax-paying investors can reduce the present value of their future payments by postponing some share sales into future tax periods and crystallising capital losses by selling shares (Bremer and Kato 1996).[6] In line with this proposition, Odean (1998) finds that although investors realise a greater proportion of gains than losses for every month of the year, the highest proportion of losses realised is observed in December (the US fiscal year-end).[7] This feature remains true over different time periods and across different groups of traders based on trade frequency. Assuming trade frequency is correlated with investor sophistication, Odean's findings indicate the benefits of tax minimisation are salient to all tax paying investors.

We provide a more conclusive test that tax loss selling prompts investors to overcome their usual aversion to selling losers by identifying investors for whom Australian tax is less relevant (government bodies and foreign investors) and comparing their propensity to sell losing stocks at fiscal year end against other investors. Our research design thus also allows a test of Grinblatt and Keloharju's (2000) contention that tempering of the disposition effect at the end of the financial year may arise from the momentum effect. Evidence that lends *prima facie* plausibility to this hypothesis includes Grinblatt and Moskowitz's (2000) finding that for stocks that have declined in value over the year, the momentum effect is about 2.5 times

[6] Australian individual taxpayers can only offset capital losses to the extent that they have realised capital gains in the same year of income. Excess capital losses can be carried forward to subsequent income years.

[7] Other studies that find evidence consistent with tax-loss selling by investors include Grinblatt and Keloharju (2001). Odean's results come closest to being conclusive.

larger in December than for the rest of the year and about an order of magnitude larger than the overall winner momentum effect.

Tax loss selling is the most widely investigated countervailing factor to the disposition effect. We extend this literature by reviewing the impact of another potentially salient rational prompt against the disposition effect: shareholder loyalty schemes. We identify winning firms with shareholder loyalty schemes and investigate whether their investors retain their holdings more steadfastly than investors in other winning firms.

Investor sophistication per se and salient prompts about the economic cost of the disposition effect are two factors that mitigate its influence. A third factor is the passage of time and, intriguingly, a fourth factor is investors' experience of prior gains and losses (Johnson and Thaler 1990). We investigate directly how the passage of time ameliorates the disposition effect but the explanation why it is mitigated is *ad hoc*, resting on the premise that after a period of time investors "make peace with their losses" (Kahneman and Tversky 1979).

The notion that investors' prior gains and losses influence the operation of the disposition effect is more developed. Johnson and Thaler (1990) contend, and document evidence, that the degree of investors' loss aversion depends upon their *prior* gains and losses: a loss that comes after a prior gain is less painful than otherwise because it is cushioned by the earlier gain. Conversely, a loss that comes after an earlier loss is more painful: after suffering from their first loss, people are even more sensitive to an additional setback. In short, people are less risk averse following an earlier gain and more risk averse after a loss, a phenomenon Johnson and Thaler term the "house-money effect".

A complication with the house money effect is that it conflicts, *prima facie,* with prospect theory's implication that investors are risk-seeking after losses to make up their shortfall. However, Barberis, Huang and Santos (2001) contend there is no real inconsistency. Prospect theory predicts behaviour over the course of a series of associated investments or gambles, e.g., a day at the races or consecutive investments in a single stock. The house money effect makes predictions about behaviour *after* the gain or loss at the end of the series is experienced, not before. One implication is that after *selling out* of an investment at a loss, an investor will be more risk averse when making subsequent investment decisions. We test this implication directly for subsequent investments in the same stock.

In summary, the research evidence to date shows the disposition effect is substantial yet subject to variation in influence and likely caused by behavioural bias. We extend the literature by employing a data set that provides us with opportunities to study variation in the disposition effect over time and across investor category and trade size, and also to assess the impact of countervailing factors such as the "house money" effect, tax-motivated trading, a shareholder loyalty scheme and investor sophistication.

3. DATA AND METHOD

3.1 Data Sources

Calculation of individual investors' paper gains and losses and realised gains and losses requires information on the prices at which shares have traded and how many, and when, shares were bought or sold. We source this information from CHESS settlement data and SEATS share price data.[8]

CHESS reports opening and closing daily balances and thus intraday multiple purchases or sales of the same stock are netted. For example, a sale of 300 shares of stock X at 10.00 a.m. and the sale of 500 shares of stock X at 3.00 p.m. is treated as a single disposal of 800 shares. Similarly, the purchase of 300 shares of stock X and the subsequent same-day sale of 100 shares of X is reported as an increase of 200 shares in the investors' account. This netting of all same day trades reduces the impact of high frequency trading on our tests.

Because CHESS provides no record of the price at which an investor acquired or sold their shares (i.e., the broker-broker cash settlement system is separate), our transaction prices are estimated using share price data from SEATS (described earlier), taking into account the three to five day lag in CHESS records.[9] The price associated with net purchases or sales identified in CHESS is estimated from SEATS trade records by computing each stock's volume weighted average trade price (VWAP) on each trading day in our sample period.

[8] Information on SEATS and CHESS can be obtained from http://www.asx.com.au

[9] Settlement three business days after the trade (T+3) was introduced on 1 February 1999. Prior to this date, CHESS allowed settlement five days after the trade (T+5). Over 99% of trades are settled within the maximum time allowed.

3.2 Samples

Tests are carried out separately for three samples.

Subscribers to IPOs, December 1995-December 2000

The first sample comprises all initial subscribers to 480 IPOs that were first listed on the ASX between December 1995 and December 2000. We focus on IPOs for two reasons. As noted earlier, an advantage of using IPOs is that we can determine with complete accuracy the issue price at which subscribers make their initial purchase. The other reason is that since CHESS records are available only from September 1995, it is impossible to reconstruct shareholding balances in stocks listed before then other than for a very limited number of shareholders. To reduce our estimation error of investors' cost base, we thus utilise IPOs for which we have a complete record of investors' buying and selling activity. We cannot escape all error because we do not incorporate information about stock acquired within the sample period by means other than a purchase on the ASX or an IPO.

Non-subscribers to IPOs, December 1995-December 2000

Our second sample includes all investors who purchased shares in the above sample of IPO stocks from a previous zero holding balance, on a date subsequent to the list date. There are two sub-samples. The first comprises investors who repurchased shares of an IPO stock after previously closing out their position and the second comprises non-subscribers who first purchased an IPO stock some time after the issue date. The first sub-sample is used for tests of the house money effect, where we need to identify investors who subsequently repurchased a stock after liquidating their previous holding.

Investors in Index Stocks

The third sample, chosen to mitigate concern about the IPO investors being a potentially biased sample, comprises investors who purchased a stock that is included in the ASX's All-Ordinaries Index, not having held the stock for some days before. As CHESS records exist only from September 1995, we confine this sample to investors who did not hold a particular index stock for at least 200 trading days prior to their purchase.

3.3 Research Design

We broadly follow the approach of Odean (1998). A key observation he makes is that to see whether investors sell their winners too quickly and hold their losers for too long, we cannot simply compare the number of realised gains with the number of realised losses over a

defined period of time. In a bull market, for example, the number of opportunities to realise a gain will far exceed the number of opportunities to realise a loss. In this case, an observation of more realised gains than losses is not necessarily because investors prefer to realise their winning investments. To test whether investors have a stronger propensity to realise their winners, we must examine the frequency with which investors sell their winning and losing investments *relative to their opportunities to sell each type*.

Our research method can be described by reference to the primary IPO sample. For the entire sample of 480 IPOs there is an average of 624 subscribers per IPO. An average of 406 trading days is examined for each IPO.[10] As noted earlier, we assume each trade occurs at the volume weighted average price for the day.[11] If the shareholder increased their shareholding of stock *i* during day *t*, we re-calculate the investor's weighted average purchase price (WAPP) and make no further use of this case.[12] If the shareholder sold down their shareholding of stock *i* during day *t*, we record either a realised gain or realised loss by comparing the investor's WAPP with the VWAP for that day. For days when the investor did not change their level of shareholding of stock *i*, we record either a paper gain or paper loss, again by comparing the investor's WAPP with the VWAP for that day. This process is followed for all days, all shareholders and for each of the 450 IPO stocks.[13]

Realised gains, paper gains, realised losses and paper losses are summed for each category.[14] To make inferences about relative disposition of investors within a given category to sell

[10] Stocks may have less than 500 trading days in the sample for two reasons. First, some stocks were first listed on the ASX in 1999 and 2000. Second, some stocks were delisted during the test period.

[11] Volume weighted average prices were adjusted for bonus issues, rights issues, and share splits or consolidations. Daily price relatives were calculated and all daily returns greater than 1.5 or less than 0.5 were independently examined to ensure dilutions were accounted for on the correct trading day. Appropriate adjustments for missing dilutions were made. For the sample of index stocks, we corrected 21 missing or wrong dilutions from a total number of 192 daily price relatives that we examined. For the sample of IPO stocks, we corrected 17 missing or wrong dilutions from a total of 141.

[12] We assume that the average purchase price is the reference point against which investors frame their decisions. Alternative reference points include the highest purchase price, the stock's monthly or yearly high, the most recent purchase price, or alternatively, the first-in first-out (FIFO) purchase price. Da Silva Rosa and Walter (2000) examine capital gains tax in Australia and find similar results using both WAPP and FIFO inventory costing methods. Our utilisation of WAPP assumes investors consider their shareholding in one particular stock as an aggregated bundle rather than separate investments. Commissions and dividends may or may not be included when framing investment decisions.

[13] While the approach of Odean is loosely adhered to, our method is a significant improvement. Odean identifies days when a sale of a stock takes place and then records paper gains and losses for all stocks in the investor's portfolio that are not sold on this day. Our method, on the other hand, focuses on investment decisions for individual stocks, ignoring possible interaction with other investments. Examining portfolios has two weaknesses over individual stock accounting. First, the approach of Odean ignores mental accounting theory, which holds that investors view each investment as a separate account and thus ignore possible interaction. Second, for portfolios that hold only winners or losers, investors can choose only which stock to sell. For these reasons, we examine investors' decisions on a stock-by-stock basis.

[14] All gains and losses calculated are adjusted for share splits and stock dividends. We do not examine specifically whether cash dividends are incorporated into the framing decision and make no adjustment for them.

winners and hold losers, we compute the proportion of gains realised (PGR) and likewise the proportion of losses realised (PLR):

$$\frac{\text{Realised Gains}}{\text{Realised Gains + Paper Gains}} = \text{Proportion of Gains Realised (PGR)}$$

$$\frac{\text{Realised Losses}}{\text{Realised Losses + Paper Losses}} = \text{Proportion of Losses Realised (PLR)}$$

For example, assume that on March 20, 1997, the set of all insurance companies had 1,000 stock positions.[15] Assume the companies made no further purchases that day but 300 stock positions were reduced (sold down), 200 realising gains and 100 realising losses. Of the remaining 700 'held' positions, assume 250 had accumulated paper gains and 450 had paper losses. In this example, the PGR ratio (for the category of insurance companies with stock positions brought forward on March 20, 1997) is 200/(200 + 250) = 0.44 and the PLR ratio is 100/(100 + 450) = 0.18. For much of our analysis we compute the ratio of PGR/PLR, which in this example is 0.44/0.18 = 2.44. If we observe over a number of days that the proportion of gains realised significantly exceeded the proportion of losses (equivalently, that the PGR/PLR ratio was significantly >1), we conclude that insurance companies are more disposed to hold on to their losers than their winners. The difference between the average PGR and PLR for each category is tested for statistical significance using a one tailed *t*-test.[16] In the following commentary the results are at times partitioned into alternative intervals, such as categories by months or by day, and *t*-statistics are computed using the same approach. This primary test assumes that each case within a pre-defined category is, in statistical terms, an independent drawing; i.e., that within that category any one investor's decision to hold or sell down a given stock on day *t* (i.e., one particular case) is observed independently of every other case. Further, the main test weights all positions equally, so that each unique triplet (i.e., a registered CHESS holding of ordinary shares in an ASX listed company on a given trading day) counts as one observation.[17]

[15] A "position" is defined as a holding of ordinary shares issued by one company listed on the ASX and held in the name of one CHESS-registered holder.

[16] To calculate the *t*-statistics in Table 1, the standard error for the differences in the proportions PGR and PLR is

$$\sqrt{\frac{PGR(1-PGR)}{Nrg+Npg}+\frac{PLR(1-PLR)}{Nrl+Npl}}$$

where Nrg, Npg, Nrl and Npl are the number of realised gains, paper gains, realised losses and paper losses respectively.

[17] In subsequent tests we weight traders by the size of their holding.

We also identified three IPO companies - Telstra, NRMA and TAB - that had loyalty benefit schemes for their shareholders during the test period. They were excluded from the main sample and examined separately.

We compute PGR and PLR for several investor types, classified on two definitions of investor sophistication: (a) CHESS category and (b) investor size. For the first definition, all investors are categorised by CHESS and identified according to their personal holder identification number (HIN). We aggregate all investors into nine categories: 1) Banks and Other Deposit Taking Lenders, 2) Nominee Companies, 3) Insurance Companies, 4) Superannuation Funds, 5) Trusts, 6) Government Holdings, 7) Other Incorporated Companies, 8) Individuals and 9) Foreign Investors. For the second definition, investors are grouped, somewhat arbitrarily, into six categories according to the size of their initial investment. The six categories are: 1) more than $1 million, 2) $250,001 - $1,000,000, 3) $50,001 - $250,000, 4) $25,001 - $50,000, 5) $10,001 - $25,000, and 6) less than $10,000. For IPO stocks, we rank subscribing investors according to the dollar value of their subscription. Similarly, we classify investors in the index sample and subsequent purchasers of the IPO stocks by the size of their first purchase (following a previous zero shareholding).

4. RESULTS

Our findings are set out as follows. We first show the varying impact of the disposition effect across calendar period, investor category, time from initial investment, and investor experience of past gains and losses. Results from alternative specifications of our tests are described to indicate the robustness of our results. Our aim is to demonstrate that while the disposition effect is substantial, its impact is not immutable, being subject to (hitherto undocumented) variation attributable to several factors including the "house-money" effect. We then focus on explaining calendar variation in the disposition effect, showing that it principally reflects tax-related trading rather than momentum effects, window dressing or information-based trading. We close our results section by reviewing evidence on how shareholder loyalty schemes mitigate the disposition effect.

4.1 Preliminary observations, including amelioration of the disposition effect over time

Table 1 highlights the large size of our samples, by documenting the number of realised and paper gains and losses examined. Our smallest sample, subscribers to IPOs, includes over

36.6 million observations of gains and losses on investor accounts, which is over 15 times the number of observations analysed by Odean in the US market, for example. The disposition effect is evident even in the coarse descriptive data. IPO subscribers realised 1.05% of their gains but just 0.66% of their losses, a ratio of percentage gains realised (PGR) to percentage losses realised (PLR) of 1.59. Subsequent investors in IPOs (ie, non-subscribers) realised 0.62% of their gains and just 0.36% of their losses, a PGR/PLR ratio of 1.72. The corresponding percentages for index stock investors are 0.42% and 0.18%, respectively, giving a PGR/PLR ratio of 2.33.

Table 1
Total Number of Observations Utilised in Tests of Disposition Effects

ALL MONTHS	Realised Gains	Paper Gains	Realised Losses	Paper Losses
Subscribers to IPOs	193,885	18,542,279	119,867	18,135,782
Non-Subscribers to IPOs	1,284,096	208,408,194	933,202	258,014,938
Investors - Index Stocks	633,424	149,098,091	224,017	124,170,401
% realised – IPO subscribers	1.05%		0.66%	
% realised – non-IPO subscribers	0.62%		0.36%	
% realised – Index stocks	0.42%		0.18%	
Ratio of Proportion Gains Realised (PGR) to Proportion Losses Realised (PLR)				
IPO subscriber ratio		1.59		
Non-IPO subscriber ratio		1.72		
Index stocks investor ratio		2.33		

It might be that the higher proportion of gains and losses realised by IPO subscribers reflects the trading behaviour of the subset of investors who subscribed with the intention to "flip" (i.e., resell for a quick profit) their shares.[18] We leave testing of this hypothesis to further research, but point out that the lower PGR/PLR ratio documented for IPO subscribers compared to index stock investors suggests that the results from our main sample are conservative estimates of the influence of the disposition effect on the typical (i.e., non-IPO) investment.

Figure 1 shows the change in investors' propensity to realise gains and losses as they hold their stocks for longer periods of time. Over the entire 500 trading day period examined for IPO stocks, the average ratio of PGR/PLR is 1.15, indicating investors' disposition towards realising their gains more readily than their losses. However, the disposition effect ameliorates over time. Specifically, the PGR/PLR is highest over the first two weeks

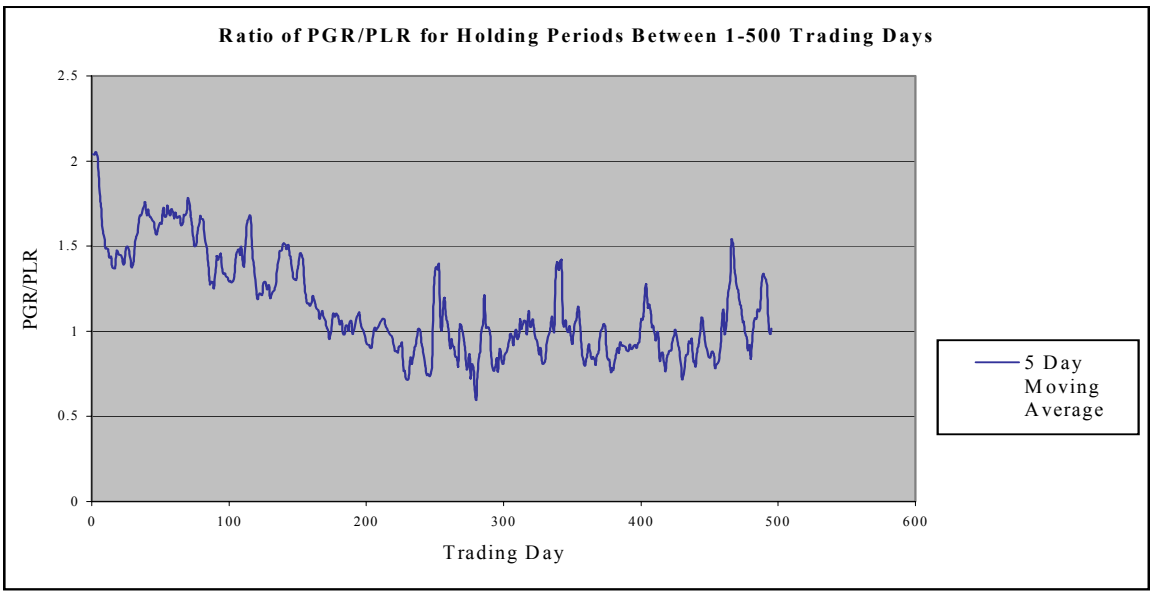
[18] Some IPOs trade immediately at a discount to their subscription so flipping is not always profitable. The "flipping" subscribers might nevertheless have to sell if they cannot remain invested in the long-term, hence their higher realisation of losses relative to non-subscribers and investors in index stocks.

following listing, with the propensity to realise winners being approximately twice that of losers in the first nine trading days. After trading day nine, the ratio of PGR/PLR drops substantially.[19] It gradually declines over the next 200 trading days, to a level where investors are relatively consistent in their realisation of gains and losses. There is strong statistical support for the proposition that investors prefer to sell winning rather than losing stocks over the first 90 days. However, we cannot reject the hypothesis that PGR-PLR = 0 for 264 of the remaining 410 trading days.[20] In the long term, investors appear indifferent between realising gains or losses. The finding that the disposition effect ameliorates over time has important implications, given Odean's finding (consistent with our results) that the effect imposes costs on investors. For investors prone to the disposition effect bias, a simple remedy to avoid incurring the associated costs might be the imposition of a minimum time horizon before investment decisions are reconsidered (absent, of course, other considerations such as tax-loss trading).

[19] This sudden drop might be due to the cessation of underwriter support for the IPO.
[20] The daily values of PGR and PLR with associated t-statistics are available on request from the authors.

Figure 1
PGR/PLR for Days 1-500 Following the List Date (Subscribers to IPOs)

This graph displays the ratio of the Proportion of Gains Realised (PGR) to the Proportion of Losses Realised (PLR), where PGR is calculated on a daily basis as the number of realised gains (on all positions) divided by the number of realised gains plus the number of paper (unrealised) gains, and PLR is the number of realised losses divided by the number of realised losses plus the number of paper (unrealised) losses. For the 500 trading days, there are 193,885 realised gains, 18,542,279 paper gains, 119,867 realised losses and 18,135,782 paper losses.



4.2 The disposition effect across investor categories and calendar periods.

Table 2 (and its associated graph) report the ratio of PGR to PLR in each month for all investors. Investors' relative aversion to realising losses shows up in 11 of the 12 months of the year, when PGR/PLR exceeds unity. The notable exception is June, when PGR/PLR is 0.84 (*t*-statistic = –14.38). The likely tax-related reasons for June being different are discussed and tested later. However, we note that the gradual decline in the ratio PGR/PLR, from 2.23 in December to 0.84 in June, supports Constantinides' (1984) tax-loss selling model, in which investors realise losses for tax purposes throughout the financial year but more so towards the end of the fiscal year. Odean (1998) also finds the disposition effect is strongest in the first half of the fiscal year.

Table 2
PGR and PLR for All Subscribers to IPOs (Partitioned by Months)

This table compares the ratio of the aggregate Proportion of Gains Realised (PGR) to the aggregate Proportion of Losses Realised (PLR), where PGR is the number of realised gains divided by the number of realised gains plus the number of paper (unrealised) gains, and PLR is the number of realised losses divided by the number of realised losses plus the number of paper (unrealised) losses. Realised gains, paper gains, realised losses and paper losses are aggregated for all subscribers to IPOs between 1995 and 2000 and the ratio of PGR/PLR is reported for each month of the year. For the entire year, there are 193,885 realised gains, 18,542,279 paper gains, 119,867 realised losses and 18,135,782 paper losses. The *t*-statistics test the null hypothesis that the differences in PGR and PLR are equal to zero, assuming that all realised gains, paper gains, realised losses and paper losses result from independent decisions.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PGR %	1.02	1.15	1.04	0.85	0.78	0.86	1.07	1.17	0.78	1.10	1.10	1.39
PLR %	0.63	0.65	0.63	0.66	0.74	1.03	0.64	0.56	0.51	0.54	0.65	0.62
PGR-PLR	0.39	0.50	0.41	0.20	0.03	-0.16	0.42	0.60	0.27	0.56	0.45	0.77
PGR/PLR	1.62	1.77	1.65	1.30	1.05	0.84	1.65	2.07	1.52	2.05	1.70	2.23
t-statistic	38.13	47.00	40.09	18.18	3.50	-14.38	40.38	58.82	29.70	55.37	43.10	68.43

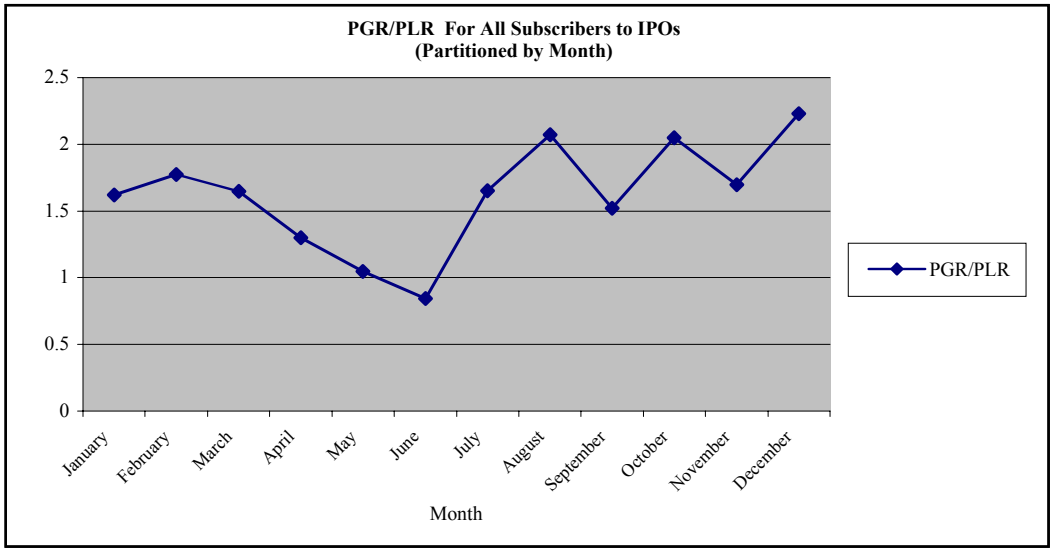


Table 3 shows in greater detail the varying impact of the disposition effect by reporting PGR and PLR for different categories of IPO investor across three periods: the entire year; the 11 July-May; and June.[21] Across the entire year, eight of the nine investor categories months exhibit a statistically significant disposition effect, the ratio PGR/PLR exceeding 1.5 for six of them. Nominee companies, trusts and insurance companies exhibit the weakest disposition effect, although PGR is still significantly higher than PLR for nominees and trusts. Thus

[21] We exclude the "Banks and Other Deposit Takers" category in our figures due to the small number of observations for them.

there is weak evidence that more sophisticated investors resist the disposition effect to a degree. We return to this point later. Table 4 shows our results are robust when the tests are repeated for investors in index stocks.

Table 3
PGR and PLR for Subscribers of IPOs (Partitioned by Investor Category)

This table compares the ratio of the aggregate Proportion of Gains Realised (PGR) to the aggregate Proportion of Losses Realised (PLR), where PGR is the number of realised gains divided by the number of realised gains plus the number of paper (unrealised) gains, and PLR is the number of realised losses divided by the number of realised losses plus the number of paper (unrealised) losses. Realised gains, paper gains, realised losses and paper losses are aggregated for all subscribers to IPOs between 1995-2000 and the ratio of PGR/PLR is reported for each category of investor for three periods: the entire year, June only and July-May. For the entire year, there are 193,885 realised gains, 18,542,279 paper gains, 119,867 realised losses and 18,135,782 paper losses. For the month of June there are 10,955 realised gains, 1,257,599 paper gains, 17,335 realised losses and 1,672,265 paper losses. The *t*-statistics test the null hypothesis that the differences in proportions are equal to zero, assuming that all realised gains, paper gains, realised losses and paper losses result from independent decisions.

Category	Banks	Nominee Coys	Insur-ance	Super-annuation	Trusts	Govern-ment	Incorp. Coys	Indivi-duals	Foreign	All Investors
All Months										
PGR	1.50%	5.80%	2.90%	0.60%	2.50%	3.00%	1.10%	0.70%	1.10%	1.00%
PLR	0.40%	4.30%	2.70%	0.40%	2.20%	1.90%	0.60%	0.40%	0.60%	0.70%
PGR – PLR	1.10%	1.50%	0.20%	0.30%	0.30%	1.10%	0.40%	0.30%	0.50%	0.40%
PGR/PLR	3.720	1.339	1.077	1.706	1.152	1.579	1.692	1.606	1.913	1.576
t-statistic	2.27	41.41	1.13	34.02	6.89	3.79	70.87	84.45	12.87	125.80
June										
PGR	0.00%	5.50%	2.80%	0.50%	3.00%	2.00%	0.90%	0.50%	0.70%	0.90%
PLR	0.70%	5.10%	4.00%	0.70%	3.30%	1.50%	1.10%	0.80%	0.70%	1.00%
PGR – PLR	-0.70%	0.40%	-1.20%	-0.20%	-0.30%	0.50%	-0.10%	-0.20%	0.00%	-0.20%
PGR/PLR	0	1.073	0.704	0.694	0.897	1.362	0.860	0.696	1.068	0.842
t-statistic	-1.00	2.89	-1.60	-6.99	-1.74	0.60	-6.17	-19.79	0.35	-14.38
July-May										
PGR	1.50%	5.80%	2.90%	0.60%	2.50%	3.10%	1.10%	0.70%	1.10%	1.00%
PLR	0.40%	4.20%	2.60%	0.30%	2.10%	2.00%	0.60%	0.40%	0.60%	0.60%
PGR – PLR	1.20%	1.60%	0.30%	0.30%	0.40%	1.10%	0.50%	0.30%	0.60%	0.40%
PGR/PLR	4.250	1.369	1.133	1.889	1.201	1.580	1.830	1.772	1.998	1.692
t-statistic	2.38	42.65	1.81	38.26	8.41	3.68	77.09	96.25	13.19	137.91

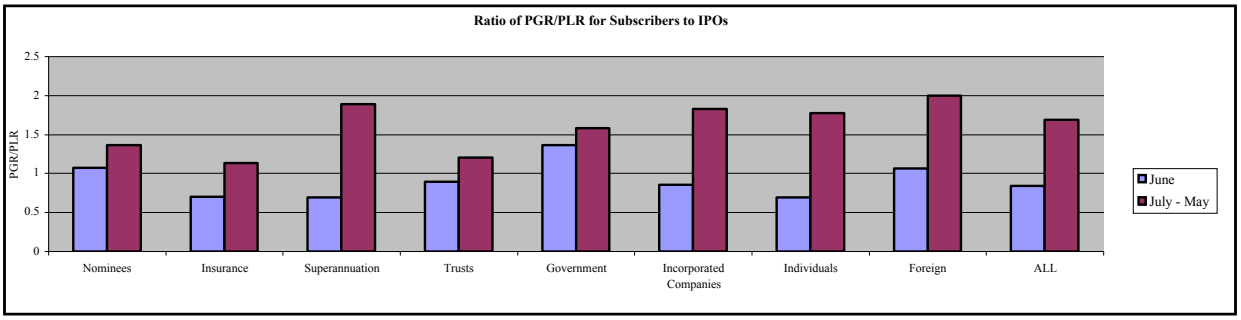
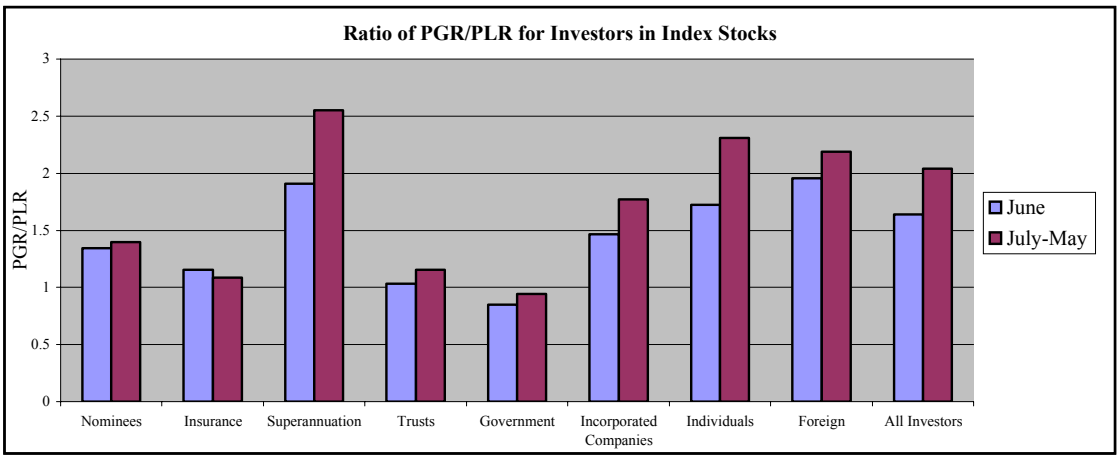


Table 4
PGR and PLR for Investors in Index Stocks (Partitioned by Investor Category)

This table compares the ratio of the aggregate Proportion of Gains Realised (PGR) to the aggregate Proportion of Losses Realised (PLR), where PGR is the number of realised gains divided by the number of realised gains plus the number of paper (unrealised) gains, and PLR is the number of realised losses divided by the number of realised losses plus the number of paper (unrealised) losses. Realised gains, paper gains, realised losses and paper losses are aggregated for each category of investors who purchased index stocks between 1995 and 2000 from a previous zero shareholding. The value of PGR and PLR is reported for three periods: the entire year, the month of June and July-May. For the entire year there are 988,944 realised gains, 149,098,090 paper gains, 413,217 realised losses and 124,170,401 paper losses. For the month of June there are 35,308 realised gains, 7,128,248 paper gains, 39,216 realised losses and 9,722,799 paper losses. The *t*-statistics test the null hypothesis that the differences in PGR and PLR are equal to zero, assuming that all realised gains, paper gains, realised losses and paper losses result from independent decisions.

Period	Banks	Nominee Coys	Insur-ance	Super-annuation	Trusts	Govern-ment	Incorp. Coys	Indivi-duals	Foreign	All Investors
All Months										
PGR	0.55%	3.68%	2.70%	0.47%	2.34%	4.49%	0.83%	0.51%	0.65%	0.66%
PLR	0.28%	2.61%	2.47%	0.19%	2.05%	4.83%	0.48%	0.23%	0.30%	0.33%
PGR-PLR	0.28%	1.07%	0.23%	0.28%	0.29%	-0.34%	0.35%	0.28%	0.35%	0.33%
PGR/PLR	1.99	1.41	1.09	2.47	1.14	0.93	1.73	2.22	2.17	1.99
t-stat.	0.48	29.96	1.20	18.98	5.56	-0.88	31.37	58.03	8.30	75.53
June										
PGR	0.58%	3.49%	3.00%	0.50%	2.61%	4.31%	0.93%	0.60%	0.63%	0.73%
PLR	0.13%	2.56%	2.58%	0.26%	2.52%	5.10%	0.63%	0.35%	0.32%	0.45%
PGR-PLR	0.45%	0.92%	0.42%	0.24%	0.09%	-0.80%	0.30%	0.25%	0.31%	0.29%
PGR/PLR	4.31	1.36	1.16	1.91	1.04	0.84	1.47	1.73	1.96	1.65
t-stat.	0.26	7.46	0.60	4.69	0.49	-0.60	7.35	13.84	2.13	18.13
*July-M*ay										
PGR	0.55%	3.70%	2.67%	0.47%	2.32%	4.51%	0.82%	0.50%	0.65%	0.65%
PLR	0.29%	2.61%	2.46%	0.18%	2.00%	4.80%	0.46%	0.22%	0.30%	0.32%
PGR-PLR	0.26%	1.08%	0.21%	0.29%	0.31%	-0.29%	0.36%	0.28%	0.35%	0.33%
PGR/PLR	1.87	1.41	1.09	2.56	1.16	0.94	1.78	2.32	2.19	2.05
t-stat.	0.41	29.03	1.08	18.51	5.75	-0.73	30.82	57.01	8.04	74.00



4.3 Robustness tests: Realisations by trade volume and by dollar value of trades.

The results above are obtained after counting each combination of investor, stock and day as a sale for a gain, sale for a loss, paper gain or paper loss. In computing PGR and PLR, shareholders in each stock on each day are weighted equally, regardless of the number of shares they bought, sold or held on the day. Dependence in buying behaviour will inflate the test statistics, although it will not bias the observed proportions (Odean 1998). Given the extremely large *t*-statistics, this lack of independence is not likely to pose serious problems. However, to test robustness, we calculate PGR and PLR using two alternative specifications.[22]

We have assumed that gains and losses are of equal size. If investors happened to be selling equal dollar amounts of stock for gains or losses, they might appear to be realising a smaller proportion of losses when we simply count the number of trades. By using the volume traded rather than the number of trades to measure PGR and PLR, we also give greater weighting to shareholders who trade larger volumes of stock. We recalculate PGR and PLR as before, but based on share volumes. Table 5 shows the results.

For the entire sample of IPO subscribers, the ratio of PGR/PLR for months July-May is 1.19 while for June the ratio is 0.49. The disposition effect is more evident under this alternative specification, with all investors except Government bodies realising a larger proportion of gains in all months except June. Evidence for loss taking in June is strengthened too, with six of the eight categories of investor realising twice as many losses as gains in this month. Interestingly, the ratio PGR/PLR is below 1 from as early as April, again supporting Constantinides' (1984) tax-loss selling model.[23] When performed on investors in index stocks the same test yields consistent results.[24]

[22] For the remainder of the paper we will focus primarily on the results for investors in IPO stocks. For the majority of tests performed, we find the index sample largely confirms the results we observe for IPO investors. Further, for the remainder of the paper we calculate PGR and PLR in terms of trades and potential trades.

[23] This evidence of PGR/PLR for each month of the year, under this alternative test's specifications, is available on request to the corresponding author.

[24] This evidence of PGR/PLR for index stocks, calculated using volumes, is available on request to the corresponding author.

Table 5

PGR and PLR for Subscribers to IPOs (Calculated Using *Volumes*)

This table compares the ratio of the aggregate Proportion of Gains Realised (PGR) to the aggregate Proportion of Losses Realised, where PGR is the number of realised gains divided by the number of realised gains plus the number of paper (unrealised) gains, and PLR is the number of realised losses divided by the number of realised losses plus the number of paper (unrealised) losses. The values of PGR and PLR in this table are computed using share volumes and thus large trades are weighted more heavily than small trades. Realised gains, paper gains, realised losses and paper losses are aggregated for each category of investors in IPOs between 1995 and 2000 and the ratio of PGR/PLR is reported for each category for three periods: the entire year, June only and July-May. For the entire year, there are 193,885 realised gains, 18,542,279 paper gains, 119,867 realised losses and 18,135,782 paper losses. For the month of June there are 10,955 realised gains, 1,257,599 paper gains, 17,335 realised losses and 1,672,265 paper losses. The *t*-statistics test the null hypothesis that the differences in proportions are equal to zero, assuming all realised gains, paper gains, realised losses and paper losses result from independent decisions.

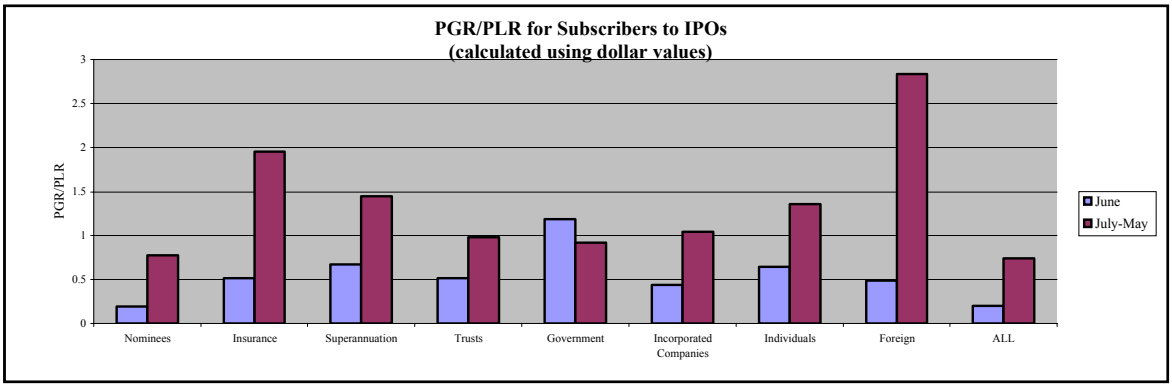
Category	Banks	Nominees	Insurance	Super'tn	Trusts	Govt.	Incorp. Cos.	Indivs.	Foreign	ALL
All Months										
PGR	0.50%	1.00%	0.80%	0.40%	0.30%	0.30%	0.30%	0.50%	0.60%	0.50%
PLR	0.00%	0.70%	0.60%	0.30%	0.30%	0.40%	0.40%	0.40%	0.20%	0.50%
Difference	0.50%	0.30%	0.20%	0.10%	0.00%	-0.10%	-0.10%	0.10%	0.40%	0.00%
PGR/PLR	96.771	1.433	1.360	1.269	0.881	0.737	0.820	1.312	2.890	1.043
t-stat	1.89	19.96	2.28	13.55	-2.05	-0.87	-17.63	43.84	13.76	9.13
June										
PGR	0.00%	1.12%	0.75%	0.29%	0.31%	0.10%	0.39%	0.40%	0.14%	0.58%
PLR	0.01%	1.08%	1.57%	0.59%	0.77%	0.08%	1.55%	0.71%	0.27%	1.17%
Difference	-0.01%	0.04%	-0.82%	-0.30%	-0.45%	0.02%	-1.15%	-0.31%	-0.13%	-0.59%
PGR/PLR	0.0000	1.0356	0.4758	0.4890	0.4086	1.2329	0.2551	0.5636	0.5111	0.4933
t-stat	-0.12	0.63	-1.90	-11.93	-5.44	0.09	-50.16	-28.65	-1.94	-55.63
July-May										
PGR	0.50%	0.94%	0.78%	0.44%	0.25%	0.30%	0.33%	0.53%	0.65%	0.51%
PLR	0.00%	0.63%	0.49%	0.31%	0.24%	0.43%	0.29%	0.37%	0.21%	0.42%
Difference	0.50%	0.32%	0.30%	0.13%	0.01%	-0.13%	0.04%	0.17%	0.45%	0.08%
PGR/PLR	108.083	1.505	1.610	1.403	1.041	0.707	1.138	1.450	3.173	1.199
t-stat	1.88	21.39	3.27	18.24	0.60	-0.98	10.12	56.60	14.46	36.15

If investors tend to realise their smaller gains frequently and realise large losses less frequently, then the results may falsely indicate the disposition effect. If this were the case, investors may be selling the same proportion of gains and losses but at a disproportionate daily rate. For this reason, we recalculate PGR and PLR, measuring losses, gains, potential gains and potential losses using dollar values rather than volume or potential trades. Table 6 (and associated graph) displays the results.

Table 6
PGR and PLR for Subscribers to IPOs (Calculated Using *Dollar Values*)

This table compares the ratio of the aggregate Proportion of Gains Realised (PGR) to the aggregate Proportion of Losses Realised (PLR), where PGR is the number of realised gains divided by the number of realised gains plus the number of paper (unrealised) gains, and PLR is the number of realised losses divided by the number of realised losses plus the number of paper (unrealised) losses. The values of PGR and PLR in this table are computed using dollar values. Realised gains, paper gains, realised losses and paper losses are aggregated for each category of investors in IPOs between 1995 and 2000 and the ratio of PGR/PLR is reported for each category for three periods: the entire year, June only and July-May. For the entire year, there are 193,885 realised gains, 18,542,279 paper gains, 119,867 realised losses and 18,135,782 paper losses. For the month of June there are 10,955 realised gains, 1,257,599 paper gains, 17,335 realised losses and 1,672,265 paper losses. The *t*-statistics test the null hypothesis that the differences in proportions are equal to zero, assuming that all realised gains, paper gains, realised losses and paper losses result from independent decisions.

Category	Banks	Nominee Cos.	Insurance	Super'tn.	Trusts	Gov'nt	Incorp. Cos.	Indivs	Foreign	All Investors
All Months										
PGR	0.55%	1.19%	0.82%	0.45%	0.27%	0.34%	0.31%	0.48%	0.79%	0.56%
PLR	0.00%	2.13%	0.54%	0.33%	0.31%	0.36%	0.35%	0.37%	0.30%	1.01%
PGR-PLR	0.55%	-0.94%	0.28%	0.12%	-0.04%	-0.02%	-0.04%	0.10%	0.49%	-0.45%
PGR/PLR	n/a	0.56	1.53	1.37	0.87	0.96	0.89	1.27	2.63	0.56
t-statistic		-45.21	3.13	18.08	-2.28	-0.13	-9.58	37.50	14.75	-154.52
June										
PGR	0.00%	1.80%	0.95%	0.28%	0.38%	0.12%	0.45%	0.34%	0.17%	0.82%
PLR	0.00%	9.24%	1.85%	0.41%	0.74%	0.10%	1.03%	0.53%	0.35%	4.07%
PGR-PLR	0.00%	-7.44%	-0.90%	-0.13%	-0.36%	0.02%	-0.58%	-0.19%	-0.18%	-3.25%
PGR/PLR	0.00	0.19	0.51	0.67	0.52	1.18	0.43	0.64	0.49	0.20
t-statistic	-0.06	-58.95	-1.90	-5.96	-4.25	0.08	-28.61	-19.73	-2.37	-189.45
July-May										
PGR	0.56%	1.14%	0.81%	0.47%	0.26%	0.36%	0.30%	0.49%	0.84%	0.54%
PLR	0.00%	1.48%	0.41%	0.32%	0.27%	0.39%	0.29%	0.36%	0.30%	0.74%
PGR-PLR	0.56%	-0.33%	0.40%	0.14%	-0.01%	-0.03%	0.01%	0.13%	0.55%	-0.19%
PGR/PLR	n/a	0.77	1.95	1.44	0.98	0.92	1.04	1.36	2.83	0.74
t-statistic		-17.30	4.49	20.15	-0.31	-0.25	2.70	45.05	15.38	-70.62



Interestingly, when we calculate PGR and PLR using dollar values, the disposition effect largely disappears. We find that for all investors aggregated, the ratio of PGR/PLR is 0.74 and highly significant, indicating that the disposition effect is driven primarily by smaller investors. Significantly, traders with larger investments tend to be less, if not entirely unaffected by the disposition bias. This important finding indicates that investors' reluctance towards realising losses can be reduced or eliminated through training and experience.

4.4 The influence of investor sophistication

We noted earlier that we find only weak evidence that more sophisticated investors are less susceptible to the disposition effect. A possible reason is that the CHESS categories are poor proxies of investor sophistication. A superior proxy may be the dollar value of investors' trades, on the premise that investors who instigate higher value trades are likely to be more sophisticated. We therefore partition all investors into six categories based on the dollar value of their initial investment in each IPO.

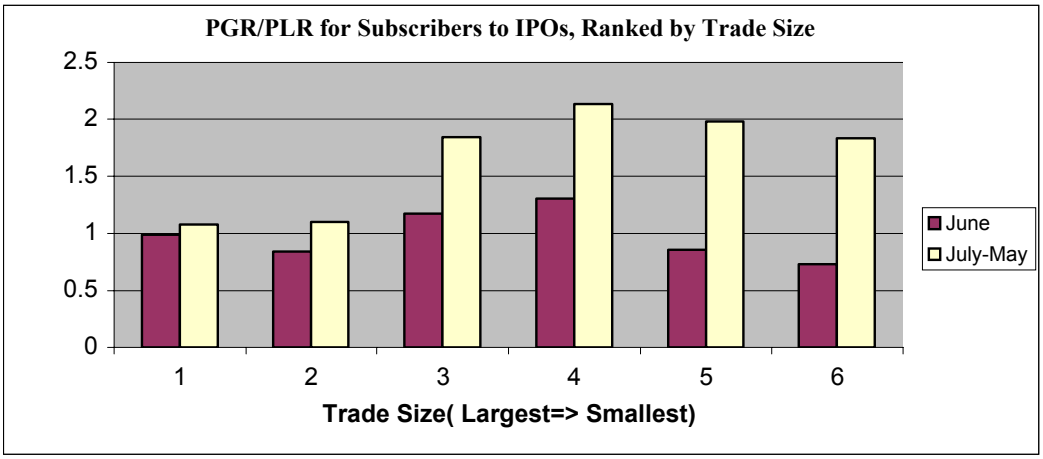
The results in Table 7 clearly show that more sophisticated investors are less asymmetric in their realisation of gains and losses. For all months, the ratio PGR/PLR increases from 1.06 for investors who make the largest trades (worth over $1 million), to 1.66 for the smallest investors (those who trade less than $10,000) in an IPO stock. This inverse relationship, between investor sophistication and loss aversion, increases monotonically for the first four investor categories.[25] However, the proposition that PGR<PLR is rejected for all categories, indicating that even large traders hold on to their losers longer than their winning investments. Interestingly, we find that in June all categories other than the largest group of traders realise a higher proportion of losses than gains. The largest traders do not appear to engage in significant tax-loss selling in June, perhaps because they are largely blockholders with control rights that are more valuable than the benefits from tax-loss selling.

[25] This finding is consistent with Grinblatt and Keloharju (2000), who report that investors executing the smallest trades tend to follow contrarian strategies.

Table 7
PGR and PLR for Subscribers to IPOs – Investors Categorised by Subscription Size

This table compares the ratio of the aggregate Proportion of Gains Realised (PGR) to the aggregate Proportion of Losses Realised, where PGR is the number of realised gains divided by the number of realised gains plus the number of paper (unrealised) gains, and PLR is the number of realised losses divided by the number of realised losses plus the number of paper (unrealised) losses. Realised gains, paper gains, realised losses and paper losses are aggregated over time (1995-2000) for six investor categories, determined according to the dollar value of their IPO holding. (Category 1 refers to largest subscribers while category 6 refers to the smallest.) The value of PGR and PLR for each investor category is reported for three periods: the entire year; June only; and July to May. For the entire year, for all investors aggregated there are 193,885 realised gains, 18,542,279 paper gains, 119,867 realised losses and 18,135,782 paper losses. For the month of June there are 10,955 realised gains, 1,257,599 paper gains, 17,335 realised losses and 1,672,265 paper losses. The *t*-statistics test the null hypothesis that the differences in proportions are equal to zero, assuming that all realised gains, paper gains, realised losses and paper losses result from independent decisions.

Trade Size	>$1m	$250,001 - $1m	$50,001- $250,000	$25,001 - $50,000	$10,001 - $25,000	<$10,000
All Months						
PGR	10.21%	5.05%	3.52%	1.83%	1.10%	0.74%
PLR	9.64%	4.74%	1.99%	0.90%	0.60%	0.45%
PGR-PLR	0.58%	0.31%	1.53%	0.93%	0.50%	0.30%
PGR/PLR	1.06	1.07	1.77	2.04	1.84	1.66
t-stat	5.78	4.90	44.21	41.69	56.01	105.54
June						
PGR	11.78%	5.18%	3.14%	1.56%	0.79%	0.57%
PLR	11.91%	6.16%	2.69%	1.20%	0.93%	0.79%
PGR-PLR	-0.13%	-0.99%	0.45%	0.36%	-0.13%	-0.21%
PGR/PLR	0.99	0.84	1.17	1.30	0.86	0.73
t-stat	-0.34	-4.07	3.49	4.46	-4.14	-20.04
July-May						
PGR	10.10%	5.04%	3.55%	1.85%	1.13%	0.76%
PLR	9.41%	4.60%	1.92%	0.87%	0.57%	0.41%
PGR-PLR	0.69%	0.44%	1.63%	0.98%	0.56%	0.34%
PGR/PLR	1.07	1.10	1.84	2.13	1.98	1.83
t-stat	6.68	6.74	45.35	42.28	59.80	118.76



Our findings for investors in IPOs are largely confirmed by our results for traders in index stocks. Smaller traders exhibit the largest disposition effects in the months of July to May, and engage more in tax-loss selling in June.

4.5. Test of the portfolio diversification explanation

Lakonishok and Smidt (1986) argue that investors may sell winners in order to restore diversification to their portfolios. Given that these diversification motivated trades are not an "emotional" decision, we repeat our analysis after excluding all sales where only a proportion of an investor's entire shareholding of a particular stock was sold.[26] If the propensity to sell winners over losses is induced by a desire to diversify, the removal of partial sales should reduce the extent of any apparent disposition effects. Results reported in Table 8 (and associated graph) show our findings are not substantially changed, indicating that the disposition effect is not attributable to portfolio rebalancing.[27] Similarly, when partial sales are removed for investors in index stocks, the results are consistent with the results of the main test.

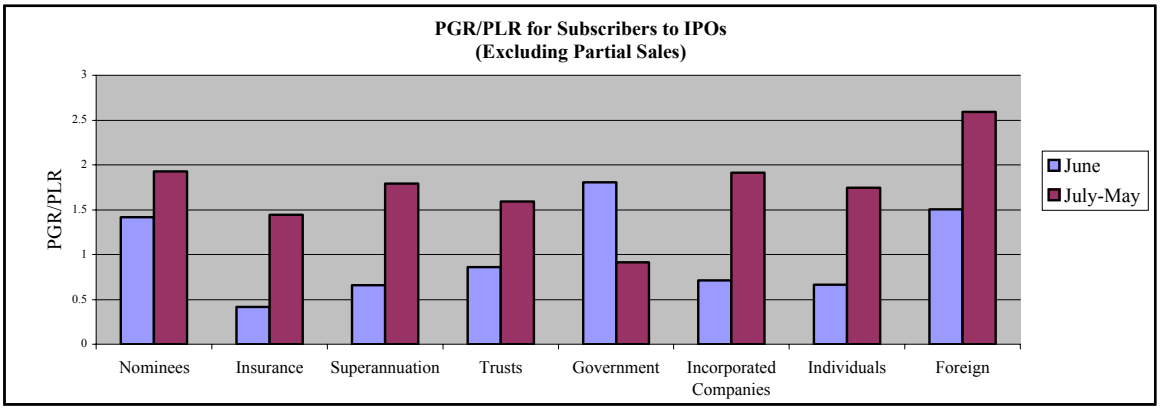
[26] The removal of partial sales could be potentially erroneous due to there being cases where investors held stock prior to the period for which CHESS records exist. By examining only IPOs that listed within the period for which CHESS registry data is available, we can eliminate such difficulties encountered by Odean. However, in our second sample of index stocks, the removal of sales that could be motivated by diversification may not be entirely accurate.

[27] We employ a second test to determine whether the disposition effect is generated to any extent by diversification motives. Recognising that investors who sell stocks for diversification purposes may well make a subsequent purchase in the period following the sale, we repeat the main test including only sales for which there is no subsequent repurchase within the following three weeks. Our results for this alternative test are available on request. Again, they are not substantially different, indicating that diversification trades are not a significant determinant of observed disposition effects.

Table 8
PGR and PLR for Subscribers to IPOs When the Entire Position in a Stock is Sold

This table compares the ratio of the aggregate Proportion of Gains Realised (PGR) to the aggregate Proportion of Losses Realised, where PGR is the number of realised gains divided by the number of realised gains plus the number of paper (unrealised) gains, and PLR is the number of realised losses divided by the number of realised losses plus the number of paper (unrealised) losses. In this table, losses and gains are counted only if an investor's entire position in a stock was sold on that day. Realised gains, paper gains, realised losses and paper losses are aggregated for all investors and the value of PGR and PLR for each category of investor is reported for three periods: the entire year; June only; and July to May. For all investors combined, for the entire year, there are 113,370 realised gains, 18,542,279 paper gains, 67,818 realised losses and 18,135,782 paper losses. For the month of June there are 6,182 realised gains, 1,257,599 paper gains, 11,424 realised losses and 1,619,017 paper losses. The *t*-statistics test the null hypothesis that the differences in proportions are equal to zero, assuming that all realised gains, paper gains, realised losses and paper losses result from independent decisions.

Category	Banks	Nominee Cos.	Insurance	Super'tn.	Trusts	Gov'nt	Incorp. Cos.	Indivs	Foreign	All Investors
All Months										
PGR	1.21%	1.26%	0.59%	0.47%	0.42%	0.41%	0.64%	0.57%	0.74%	0.61%
PLR	0.32%	0.67%	0.49%	0.29%	0.30%	0.43%	0.37%	0.36%	0.30%	0.37%
PGR-PLR	0.90%	0.60%	0.10%	0.20%	0.10%	0.00%	0.30%	0.20%	0.40%	0.23%
PGR/PLR	3.80	1.87	1.22	1.61	1.42	0.97	1.71	1.57	2.48	1.63
t–statistic	2.07	37.30	1.30	26.67	6.58	-0.11	55.08	72.18	13.59	102.07
June										
PGR	0.00%	1.20%	0.51%	0.37%	0.58%	0.18%	0.51%	0.45%	0.59%	0.49%
PLR	0.65%	0.85%	1.21%	0.56%	0.67%	0.00%	0.71%	0.67%	0.39%	0.68%
PGR-PLR	-0.65%	0.35%	-0.71%	-0.19%	-0.10%	0.18%	-0.21%	-0.22%	0.20%	-0.19%
PGR/PLR	0.00	1.41	0.42	0.66	0.86	n/a	0.71	0.67	1.51	0.72
t–statistic	-1.00	5.95	-1.89	-7.31	-1.08	1.00	-11.06	-20.37	1.76	-21.38
July-May										
PGR	1.26%	1.26%	0.60%	0.48%	0.41%	0.43%	0.65%	0.58%	0.75%	0.61%
PLR	0.27%	0.66%	0.41%	0.27%	0.26%	0.47%	0.34%	0.33%	0.29%	0.34%
PGR-PLR	0.99%	0.61%	0.18%	0.21%	0.15%	-0.04%	0.31%	0.25%	0.46%	0.27%
PGR/PLR	4.64	1.93	1.45	1.79	1.59	0.91	1.91	1.74	2.59	1.80
t–statistic	2.22	37.31	2.26	30.90	8.06	-0.29	62.48	84.01	13.64	116.09



4.6. Tests of the trading cost explanation

Odean (1998) suggests that investors may tend to realise smaller rather than larger gains and losses due to loss averse investors being "most loathe to realising their greatest losses and due to tax consequences, they postpone realising their greatest gains." If this were the case, stocks trading in lower price ranges are likely to have a greater proportion of large losers and a smaller proportion of small losers than those in larger price ranges. Further, Harris (1988) suggests that the disposition effect may be driven by investors' reluctance to sell losing investments due to the higher transaction costs associated with lower priced stocks. As lower price ranges are likely to have a greater proportion of large losers and a smaller proportion of large winners than upper price ranges, we calculate PGR and PLR for different price and return ranges.

More specifically, we partition stocks equally into three categories according to price limits, chosen to ensure about a third of the stocks in the sample are represented in each category. We further partition the sample on magnitude of return over the sample period, in order to control for the disproportionate level of large losers being realised by investors. We partition the sample into three ranges, depending on the absolute value of the return ranges: < 0.3; $0.3 - 0.5$; and > 0.5. PGR and PLR are then calculated for each partition and for the entire sample of investors.

Table 9 reports the ratio of PGR/PLR for the entire sample of investors in IPOs, partitioned by price and return. In eight of the nine partitions, winners are realised at a greater rate than losers. This difference in proportions is statistically significant at the five percent level for seven partitions. Thus when realising winners and losers of similar magnitude, investors appear to be biased towards selling their winners and holding on to their losers, even when there are negligible differences in transaction costs.

Table 9

PGR and PLR for Subscribers to IPOs, Partitioned by Price and Return

This table compares the ratio of the aggregate Proportion of Gains Realised (PGR) to the aggregate Proportion of Losses Realised (PLR), where PGR is the number of realised gains divided by the number of realised gains plus the number of paper (unrealised) gains, and PLR is the number of realised losses divided by the number of realised losses plus the number of paper (unrealised) losses. The data are partitioned on stock price and on absolute value of the return to date (|R|) for all subscribers to IPOs (1995-2000), January to November only. The *t*-statistics test the null hypothesis that the differences in proportions are equal to zero, assuming that all realised gains, paper gains, realised losses and paper losses from independent decisions.

Absolute Return	$\|R\| < 0.3$	$0.3 < \|R\| < 0.5$	$0.5 < \|R\|$
Low Priced Stock			
PGR	2.89%	1.17%	2.40%
PLR	0.66%	0.68%	0.83%
Difference	2.23%	0.49%	1.58%
PGR/PLR	435.00%	172.00%	290.00%
t-statistic	1.75	5.92	79.12
Medium Priced Stock			
PGR	0.74%	0.98%	1.59%
PLR	0.90%	0.78%	0.61%
Difference	-0.16%	0.19%	0.98%
PGR/PLR	82.00%	125.00%	260.00%
t-statistic	-1.92	4.67	112.08
High Priced Stock			
PGR	1.65%	1.01%	0.98%
PLR	0.86%	0.89%	0.70%
Difference	0.79%	0.12%	0.28%
PGR/PLR	192.00%	114.00%	140.00%
t-statistic	5.74	3.23	62.41

4.7 Test of the information trading explanation

Lakonishok and Smidt (1986) posit that the disposition effect may be explained by investors buying stocks based on information and selling them once they have appreciated, to incorporate the new information. Alternatively, if the stock were to depreciate, the investor may continue to hold onto the stock, believing that the market still had failed to incorporate the information. Contrarian behavioural theory proposes that investors perceive today's winners as tomorrow's losers and are thus expected to sell stocks that have appreciated, and to buy stocks that have depreciated.

We test these explanations for the observation of a disposition effect for investors ex post by calculating their buy and hold returns in excess of the All Ordinaries Accumulation Index

return up to the last day of the test period,[28] for each of the first 250 trading days. An average is then calculated, which weights each observation equally. These computations allow us to determine the success rate of each category's observed trading behaviour. They also shed additional evidence on tax motivated selling in July. In particular, we examine the difference in subsequent returns for sales of stock at a gain or the observation of a paper loss. Such a comparison enables us to test whether investors who sell winners and hold losers, because they expect the losers to outperform the winners in the future, are on average correct or mistaken. Examining subsequent returns across a range of investor categories further enables comparisons of investors with different levels of sophistication.

Table 10 reports average returns in excess of the All Ordinaries Accumulation Index to IPO stocks for every observation of a realised or paper, gain or loss. We observe that for all investors combined, the average market-adjusted return for winners sold is 20 percent greater than it is for losers that are not sold. In other words, contrarian investors who believe today's winners are tomorrow's losers, and vice versa, are on average mistaken. Interestingly, we find that the return on realised gains exceeds that of paper losses for every category of investor. For investors in index stocks, we find similar results—for all investors aggregated, the average market-adjusted return for winners sold is 15 percent greater than it is for losers that are not sold. Again, we find this result to be strong for all categories of investor, despite differences in their presumed level of expertise. Overall, these observations are consistent with the results documented by Odean, who notes that the superior return to former winners is consistent with Jegadeesh and Titman's (1993) finding of price momentum for up to 18 months.

[28] For the IPO sample, the average number of days of trading analysed per stock was 406 days. Of the 450 stocks in the sample, exactly half had 500 days of trading data.

Table 10
Ex Post Returns – Investors in IPOs and Index Stocks

This table compares the average return in excess of the All Ordinaries Accumulation Index to stocks that are sold for a profit or loss, in addition to stocks that incur paper gains and losses. For each realised/paper gain or loss that occurs within the first 250 trading days, we calculate the average buy and hold return to day 500 in excess of the market index. All buy and hold returns are then averaged for each category of investor as well as for the entire sample.

IPO Stocks	Banks	Nominee Cos.	Insurance	Super'tn.	Trusts	Gov'nt	Incorp. Cos.	Indivs	Foreign	All Investors
Realised gains	10.40%	21.90%	17.50%	15.40%	11.70%	21.90%	19.90%	19.80%	25.90%	19.90%
Paper gains	36.70%	14.20%	11.00%	15.40%	6.70%	11.70%	16.60%	15.30%	11.60%	15.40%
Realised losses	9.00%	29.40%	32.50%	16.30%	13.40%	5.30%	21.00%	16.40%	23.60%	21.10%
Paper losses	-12.00%	8.40%	25.00%	4.00%	3.10%	7.20%	4.70%	-2.50%	-18.90%	0.03%
Index Stocks										
Realised Gains	-1.40%	-5.50%	2.10%	-5.20%	2.40%	-12.80%	-6.30%	-6.00%	-13.10%	-5.80%
Paper Gains	-7.60%	0.40%	4.00%	0.20%	2.10%	8.10%	-1.90%	-1.40%	-7.70%	-1.40%
Realised Losses	-9.00%	-21.00%	-30.80%	-22.60%	-23.50%	-22.70%	-23.20%	-25.90%	-25.40%	-24.20%
Paper losses	-21.20%	-17.60%	-24.20%	-19.30%	-18.40%	-27.30%	-21.40%	-20.80%	-21.90%	-20.80%

4.8. Impact of the "house money" effect on the disposition effect

Johnson and Thaler (1990) contend that prior losses or gains influence subsequent risk aversion by investors when they make similar decisions. If investors track their individual stock investments in separate mental accounts, we expect individuals who sold out of a stock at a gain to be less risk averse in their subsequent investment decisions concerning the same stock. This implies that investors are more willing to realise a subsequent loss because the pain from crystallising the loss is cushioned by their feeling good about previous gains. By the same logic, we expect investors who sold out previously at a gain to be more willing to hold on to a winner (as represented by a paper gain). That is, prior gains induce investors to let subsequent winners run because they are "playing with the house money." The essence behind this idea is that until winnings are fully depleted, losses are mentally coded as reductions of a gain, as if losing some of "their money" does not hurt as much as losing one's own cash. After a gain, subsequent losses that are smaller than the original gain can be integrated with the prior gain, mitigating the influence of loss aversion and facilitating risk seeking. In sum, if investors are risk loving after prior gains, we expect the ratio of PGR/PLR

for these investors to be lower for subsequent behaviour. In the case of prior losses, Johnson and Thaler (1990) argue that a prior loss may induce risk aversion for subsequent investments. However, importantly, individuals will be more likely to take opportunities that offer the chance to break even. Hence we expect investors who sell losses will realise subsequent gains at a higher rate than otherwise. This will be evidenced by a relatively high PGR/PLR ratio.

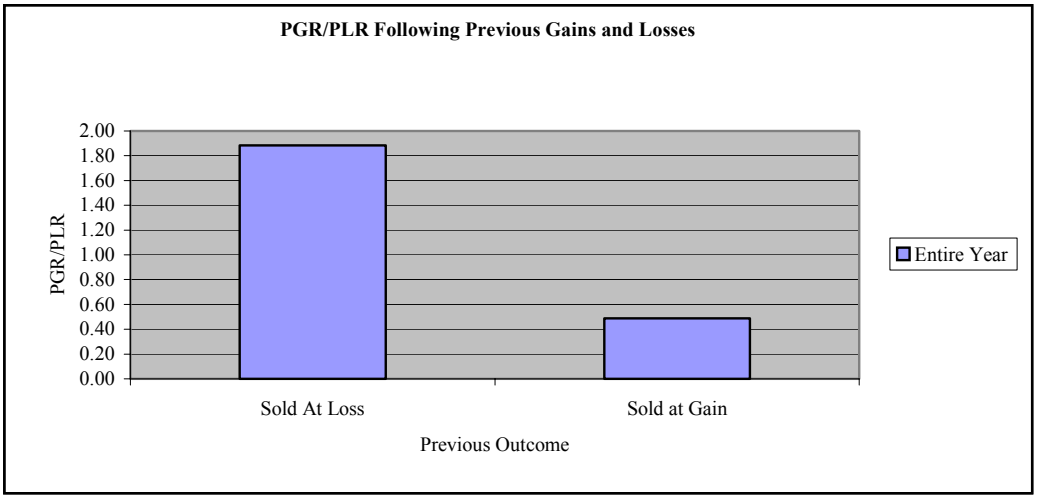
To test for the house money effect, we first identify all subscribers to an IPO who subsequently liquidated their entire investment in the IPO stock. We then identify the sub-sample of these "liquidating" subscribers who repurchased the same stock at a later date. For this sub-sample, we calculate PGR and PLR over their second holding period, after partitioning the sub- according to whether they sold out their final IPO holding for a gain or loss. In this way, we analyse investors' propensity to sell winners and losers, conditional on their prior gains or losses. Our research design is influenced by extensions to multi-attribute choices that show a prior outcome that is coded in a different mental account is less likely to influence a choice (Barberis and Huang, 2001). For this reason, we examine the level of loss aversion for investors repurchasing the same stock that they sold previously.

Table 11 (and associated graph) documents PGR and PLR for the sub-sets of investors who previously realised a gain or loss from the sale of an IPO stock. We find very strong support for the house money effect, indicated by the extremely large difference in the ratio of PGR/PLR for investors who previously had realised a gain or a loss. For investors who sold previously at a loss, the ratio of PGR/PLR for all months is 1.88 and the hypothesis that PGR is not different from PLR is rejected at a very high level ($t = 30$). It appears that, when a stock increases in price, enabling an investor to possibly "break even" (or at least recoup some proportion of their previous loss) in one mental account, investors are 88% more likely to realise the gain. Conversely, investors who sell initially at a gain will later realise a significantly smaller proportion of gains and a higher level of losses, indicated by a ratio of PGR/PLR of 0.49 for all months. This indicates that after previous gains, investors are more risk seeking. They tend to let winners ride and are less averse to realising losses.

Table 11
PGR and PLR Following Prior Gains and Prior Losses on an IPO Stock (test of the house money effect)

This table and graph compare the ratio of the aggregate Proportion of Gains Realised (PGR) to the aggregate Proportion of Losses Realised (PLR) *after* investors have previously realised a gain or a loss. PGR refers to the number of realised gains divided by the number of realised gains plus the number of paper (unrealised) gains, and PLR is the number of realised losses divided by the number of realised losses plus the number of paper (unrealised) losses. In this table, realised gains, paper gains, realised losses and paper losses are counted only for investors who previously sold their entire shareholding of an IPO stock at a gain or loss. PGR and PLR are reported for these investors who realise previous gains and losses for three periods: all months aggregated, June only, and July to May. For investors who sold out previously at a loss, there are 1,536 realised gains, 570 paper gains, 1,855 realised losses and 2,864 paper losses. For investors who sold out previously at a gain, there are 2,271 realised gains, 5,654 paper gains, 2,357 realised losses and 1,667 paper losses. The *t*-statistics test the null hypothesis that the differences in proportions for investors who sell at a gain and loss are equal to zero.

SOLD AT LOSS	PGR	PLR	PGR-PLR	PGR/PLR	*t*-statistic
All Months	73.39%	38.97%	34.42%	188.00%	30.00
June	79.49%	35.92%	43.57%	221.00%	11.32
July-May	72.93%	39.31%	33.63%	186.00%	27.99
SOLD AT GAIN	PGR	PLR	PGR-PLR	PGR/PLR	*t*-statistic
All Months	28.73%	58.85%	-30.12%	49.00%	-33.36
June	30.15%	63.64%	-33.49%	47.00%	-8.56
July-May	28.66%	58.57%	-29.92%	49.00%	-32.24



4.9 Tax-motivated trading and the disposition effect

Our discussion so far has described the reach of the disposition effect. We now focus on the striking differences in the month of June relative to other months, showing that the differences are principally a function of tax-related trading rather than momentum effects,

window dressing or information trading. We demonstrate (a) that investors' propensity to engage in tax-loss selling varies in line with their tax-paying status, (b) that the proportion of losses realised is highest in the last six trading days of June, (c) that "wash sale" repurchases are more common in June, (d) that investors' repurchase activity is strongly linked to the size of the capital loss incurred on stocks sold in June, and (e) that realised losses in June are of a much larger magnitude than those realised in other months of the year. .

4.9.1 Tax-loss trading by investor category

The results in Table 2 (reviewed earlier) confirm that investor behaviour in June, the month in which the Australian fiscal year ends, is different. Across all IPO investors the hypothesis that PGR-PLR in June > PGR-PLR in July through May is rejected with a *t*-statistic of 50.4. However, foreign and government investors continue to realise a higher proportion of gains relative to losses in June. The probable reason for foreign investors behaving in this manner is that their tax years close in months other than June,[29] while government investors are generally tax exempt and therefore have negligible tax selling motives at the end of the financial year. We find the strong association between tax-paying status and higher propensity to realise losses at fiscal year to be persuasive evidence that tax motives override disposition effects in June. If window dressing or momentum effects were the cause of loss selling at the end of the financial year, we should observe high loss realisations for all investors, regardless of their tax-status.

Given tax concerns mitigate the disposition effect at year end, an interesting issue is whether this occurs by investors reducing the proportion of gains or realising a higher level of losses. Table 12 reports the ratios of PGR_{June} / $PGR_{July\text{-}May}$ and PLR_{June} / $PLR_{June\text{-}May}$ for subscribers to IPOs. The results show that tax motives both reduce investors' propensity to realise winners and increase their propensity to realise losses in June. However, loss selling by investors clearly drives the results. Superannuation companies, incorporated companies and individuals have the strongest propensity to realise losses in June, as evidenced by the large difference between their $PLR_{July\text{-}May}$ and PLR_{June}. For these categories, the PLR in June is about double that of all other months. Results for investors in index stocks are consistent with those in Table 12, indicating that our findings among IPO firms are representative.

[29] December in the US and March in Japan and the UK.

Table 12
Examination of the Difference in PGR and PLR in June and July-May (Subscribers to IPOs)

This table compares the ratio of the aggregate Proportion of Gains Realised in June (PGR_{June}) to the aggregate Proportion of Gains Realised over the period July-May ($PGR_{July\text{-}May}$). Further, the table compares the ratio of the aggregate proportion of losses realised in June (PLR_{June}) to the proportion of losses realised in the months July to May ($PLR_{July\text{-}May}$), where PGR is the number of realised gains divided by the number of realised gains plus the number of paper (unrealised) gains, and PLR is the number of realised losses divided by the number of realised losses plus the number of paper losses. For the entire year, there are 193,885 realised gains, 18,542,279 paper gains, 119,867 realised losses and 18,135,782 paper losses. For the month of June there are 10,955 realised gains, 1,257,599 paper gains, 17,335 realised losses and 1,672265 paper losses. The *t*-statistics test the null hypotheses that the differences in PGR_{June} and $PGR_{July\text{-}May}$ are equal to zero, and further that the differences in PLR_{June} and $PLR_{July\text{-}May}$ are equal to zero.

Category	Nominee Co.s	Insurance	Super-annuation	Trusts	Gov't	Incorp. Cos	Indiv.s	Foreign	All Investors
$PGR_{June}/PGR_{July\text{-}May}$	95%	95%	72%	119%	64%	82%	75%	64%	82%
$PLR_{June}/PLR_{July\text{-}May}$	122%	153%	196%	159%	74%	175%	191%	120%	166%
t-statistic (diff in PGR)	0.76	0.89	5.78	-3.45	24.67	16.79	25.8	34.56	14.78
t-Statistic (diff in PLR)	2.45	26.89	40.3	3.56	-5.3	27.44	53.36	45.6	43.67

4.9.2 Variation in PGR and PLR over June

Given that tax-motivated trades exert their strongest influence in June, we examine gain and loss realisations each trading day in June, in aggregate as well as for each category of investor. The results in Table 13 show that, in aggregate, the proportion of losses realised exceeds that of gains for 19 of the 21 days. However, investors realise the highest proportion of their losses in the last six trading days of the fiscal year. Interestingly, the highest level of loss realisations does not occur on the last trading day.[30] Analysis of loss realisation by category of investor shows that the strong loss realisation levels in the six days prior to the end of the financial year appears driven by individuals, incorporated companies, and superannuation and insurance investors. Trusts tend to realise a higher proportion of their losses earlier. As expected, government and foreign investors do not appear significantly affected by tax motives at any stage during the entire month.

[30] Alternatively, this finding may be due to specification error in estimating prices taking account of the 3- to 5-day lag in registry data reporting.

Table 13
PGR and PLR Daily in June for All Investors Aggregated (Subscribers to IPOs)

This table compares the ratio of the aggregate Proportion of Gains Realised (PGR) to the aggregate Proportion of Losses Realised (PLR), where PGR is the number of realised gains divided by the number of realised gains plus the number of paper (unrealised) gains, and PLR is the number of realised losses divided by the number of realised losses plus the number of paper (unrealised) losses. In this table, PGR and PLR for all investors aggregated are reported for each trading day in June leading up to the end of the financial year and the ratio PGR/PLR is displayed graphically. For the 21 trading days in June, there are 10,955 realised gains, 1,257,628 paper gains, 17,336 realised losses and 1,672,417 paper losses. The *t*-statistics test the null hypothesis that there is no difference in the proportions, assuming that all realised gains, paper gains, realised losses and paper losses result from independent decisions.

Day	PGR	PLR	PGR-PLR	PGR/PLR	*t*-statistic
1	0.50%	0.90%	-0.40%	60.20%	-6.626
2	0.70%	0.80%	-0.10%	92.10%	-1.315
3	0.70%	0.80%	-0.10%	81.90%	-3.182
4	0.70%	0.80%	-0.20%	81.20%	-3.432
5	0.90%	0.80%	0.10%	116.00%	2.563
6	0.80%	0.90%	-0.10%	89.40%	-1.945
7	0.70%	0.80%	-0.10%	88.10%	-2.122
8	0.70%	1.00%	-0.20%	76.80%	-4.658
9	0.80%	0.90%	-0.10%	90.30%	-1.793
10	0.80%	0.90%	-0.10%	94.10%	-1.064
11	1.10%	1.00%	0.10%	105.80%	1.122
12	0.80%	1.10%	-0.30%	74.70%	-5.359
13	1.10%	1.00%	0.00%	104.50%	0.854
14	0.90%	1.00%	-0.10%	87.00%	-2.530
15	0.90%	1.10%	-0.20%	82.00%	-3.835
16	0.80%	1.30%	-0.60%	57.70%	-10.380
17	0.90%	1.30%	-0.50%	65.20%	-8.281
18	1.10%	1.50%	-0.40%	70.60%	-7.387
19	1.10%	1.60%	-0.50%	66.90%	-8.551
20	1.10%	1.10%	0.00%	95.80%	-0.842
21	1.00%	1.00%	0.00%	105.10%	0.919

4.9.3 Wash sales related to tax-motivated trading

We have interpreted our results in terms of tax-motivated trading. "Window dressing" and "momentum effects" are other reasons why we might observe relatively stronger June sales of stocks with capital losses. Grinblatt and Keloharju (2000) argue that to demonstrate that taxes are the key motivation for a sale of stock that has declined in value, it is necessary to show that investors are willing to repurchase the stock sold in June. To see if "wash sale" repurchases are more common for sales in June, we follow their approach.

We identify all sales that take place in the 21 trading days in June. For all investors identified, we then compute the cumulative percentage of shares in the same stock that are repurchased (by the same investor) from 1 to 25 trading days after the sale date. Share repurchases are capped at 100% of the stock and we employ an algorithm that assigns each sale to the next nearest purchase, then the next nearest purchase after that, and so on until there is no further purchase or the sale amount is fully depleted. We further partition repurchase activity into four categories according to the size of each investor's capital gain or loss when a stock was sold in June. In this way, we calculate average repurchase ratios for all categories of investor for gains greater than 30 percent, between zero and 30 percent, and losses greater than 30 percent, and between zero and 30 percent.[31] A significant difference in repurchase ratios for stocks sold for capital gains and stocks sold for losses indicates clear support for tax motivated, wash sale activity. As a test of robustness, we compute the cumulative percentage of shares repurchased for stocks sold in July. A significant difference in repurchase ratios for stocks sold in June compared with stocks sold in July adds weight the tax-loss selling hypothesis.

Table 14 documents the propensity to repurchase by event period, relative to the turn of the year, for investors in IPO stocks. Investors are partitioned into five categories and further by the size of the return realised from their sale of stock. For the five turn-of-years examined between 1995 and 2000, there were 93,399 sales in June (event days -21 to -1) and 87,565 sales in July (event days -24 to -1) inclusive.

Firstly, we examine the repurchase rates for investors who sell stocks in June. We find that for the entire group of investors, 12.7 percent of large losing stocks sold in June are repurchased, compared with only 2.2% of large winners sold. Our results clearly suggest that capital losses in excess of 30% have a substantially stronger association with repurchase activity than similar-sized capital gains. This difference in repurchase rates is highly significant. We find higher repurchasing activity for large capital losses suffered by all categories of investor.

[31] The choice of 30 percent to describe a large gain or loss is arbitrary, though it does result in a sufficiently large number of observations in each of the partitions.

Table 14
Propensity to Repurchase Stocks Sold in June (evidence for wash sales by IPO subscribers)

This table describes the extent to which investors repurchase a stock within 25 trading days from the sale conditional on the prior holding yielding a capital gain or loss. The table analyses a 50 trading-day interval around the turn of the financial year for the period between 1995 and 2000. Each sell transaction has the same weight, irrespective of the size of the sale. In the analysis of repurchases, all intraday purchases and sales of a given stock by a given investor are netted separately. If a sale takes place on the same day as a purchase, the purchase is assumed to occur after the sale. The cumulative proportion repurchased is capped at 100% of the size of the prior sale. In the 21 trading days of June, there were 11,917 'large' realised gains, 27,070 'small' realised gains, 21,431 'large' realised losses and 32,981 'small' realised losses. In the 21 trading days in July, there were 17,158 'large' realised gains, 38,372 'small' realised gains, 6,189 'large' realised losses and 25,846 'small' realised losses. In the computation of realised holding period return, all same day trades in the same stock by the same investor are netted.

June Sales Repurchased	R > 0.3	0.3 > R > 0	0 > R > -0.3	R < -0.3
Other Investors	6.40%	51.90%	54.90%	13.30%
Incorporated Companies	1.40%	6.60%	9.90%	14.20%
Individuals	1.40%	6.20%	9.50%	12.20%
Foreign	2.20%	5.30%	6.50%	7.10%
All Investors	2.20%	24.80%	26.50%	12.70%
July Sales Repurchased	R > 0.3	0.3 > R > 0	0 > R > -0.3	R < -0.3
Other Investors	8.50%	49.70%	52.90%	2.60%
Incorporated Companies	3.10%	6.80%	5.10%	3.60%
Individuals	4.00%	7.10%	5.00%	2.90%
Foreign	4.10%	8.50%	3.30%	2.60%
All Investors	4.50%	21.20%	24.50%	3.00%

A comparison of repurchase rates for capital losses in June and capital losses in July also reveals strong support for tax motivated wash sales at the end of the financial year. We find higher repurchase activity in June for all categories of investor, for both small and large capital losses. Again, the difference between the (largely June) 12.7 percent repurchase rate and the (largely July) 3 percent repurchase rate is highly significant. Overall, our results provide strong support for the proposition that investors realise losses towards the end of the financial year for taxation reasons. In particular, investors' repurchase activity is strongly linked to the size of the capital losses incurred on stocks sold in June.

4.9.4 Returns to realised winners and losers

Table 15 reports the average returns since the day of purchase for realised and paper gains and losses. We aggregate the six smallest categories for clarity. For the entire sample of investors, realised losses in June are of a much larger magnitude than losses realised in other months of the year. On an individual category level, larger losses are realised in June for three of the four categories reported (incorporated companies are the exception). Further, we observe for all categories of investor, the gains realised in June are significantly smaller than those realised in other months. This evidence provides even starker support for the tax-loss selling motive.

Table 15
Average Returns: Subscribers to IPOs

This table reports the mean return realised on stocks sold for a gain and on stocks sold for a loss, for all investors in IPO stocks between 1995 and 2000. We include only sales which reduced the investor's holding of a stock to zero. For all accounts over the entire year there are 248,675 realised gains and 154,625 realised losses. In June there are 12,033 realised gains and 17,560 realised losses for all investors aggregated. This table aggregates the banks, trusts and insurance, superannuation and government investors under the one category "other investors", for simplification.

Investor Category	Other Investors	Incorporated Companies	Foreign	Individuals	All Investors
Entire Year					
Return on Realised Gains	49.10%	42.10%	63.80%	67.10%	60.20%
Return on Realised Losses	-18.80%	-17.40%	-24.30%	-25.40%	-22.80%
June					
Return on Realised Gains	28.00%	10.00%	33.70%	44.80%	35.40%
Return on Realised Losses	-20.70%	-4.10%	-31.50%	-33.30%	-29.10%
July-May					
Return on Realised Gains	50.30%	42.20%	65.20%	68.00%	61.40%
Return on Realised Losses	-18.60%	-18.40%	-23.30%	-24.20%	-22.00%

4.10. Shareholder Loyalty Benefits and the Disposition Effect

For all tests reported so far in this study, we exclude three stocks (Telstra, NRMA and TAB) that we identified as having shareholder benefit schemes,[32] which might induce alternative shareholder behaviour and affect our results. Although we separately examine only three

[32] These schemes vary in detail, though they generally involve loyal shareholders receiving a special dividend, or a discount on subsequent subscription price.

stocks from the IPO sample with such schemes, these stocks have the largest number of subscribers and are thus likely to have enough observations to make comparisons definitive.

Table 16 documents PGR and PLR for investors in the three IPO loyalty stocks. It is clear that loyalty schemes do have their intended effect on shareholder behaviour, with the proportion of losses exceeding that of gains for 10 of the 12 months of the year. To determine whether loyalty benefit schemes have a proportionate affect on the realisation of gains and losses, we examine the PGR and PLR ratios of stocks in the main sample (no loyalty benefits) relative to the corresponding PGR and PLR ratios of loyalty stocks.

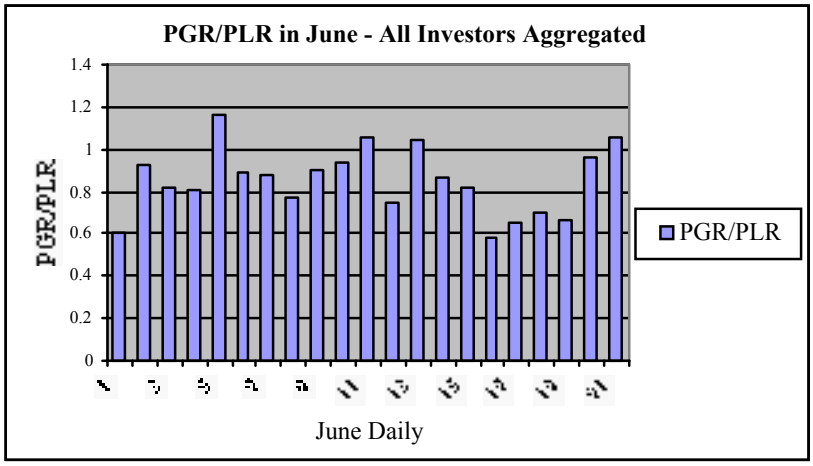
A significant difference in these ratios would indicate that loyalty benefit schemes have a disproportionate effect on the selling behaviour of investors. Table 16 shows that for all months of the year except June, the ratio of the respective PGRs significantly exceeds that of the PLRs. This finding implies that the reduction in the realisation of gains drives the differing behaviour of investors who trade stocks with loyalty benefits.

Overall, it seems that loyalty benefit schemes do have their desired effect on all categories of investor, with traders holding on to winning stocks more readily than they would in the absence of the schemes. Investors' loss realisations (given their opportunities) are similarly reduced, although to a smaller extent.

Table 16
PGR and PLR for Loyalty stocks and non-loyalty stocks (Subscribers to IPOs)

This table reports the ratio of the proportion of gains realised by traders who invest in stocks with no loyalty benefits to the proportion of gains realised by traders who do invest in stocks with loyalty benefit schemes. It also reports the ratio of the proportion of losses realised by traders who invest in stocks with no loyalty benefits (No LB) to the proportion of losses realised by traders who do invest in shares with loyalty benefits (LB). PGR is the number of realised gains divided by the number of realised gains plus the number of paper (unrealised) gains, and PLR is the number of realised losses divided by the number of realised losses plus the number of paper (unrealised) losses. For the entire year, investors in the three loyalty stocks (NRMA, Telstra and TAB) had 32,473 realised gains, 15,651,759 paper gains, 1,602 realised losses and 663,689 paper losses while investors without loyalty benefits had 193,885 realised gains, 18,542,279 paper gains, 119,867 realised losses and 18,135,782 paper losses.

Category	Others	Incorporated Companies	Individuals	Foreign	All Investors
All Months					
$PGR_{No\ LB}/PGR_{LB}$	10.57	5.62	4.91	6.64	6.69
$PLR_{No\ LB}/PLR_{LB}$	2.80	1.34	1.37	0.81	1.80
June					
$PGR_{No\ LB}/PGR_{LB}$	6.22	2.32	2.43	3.70	3.43
$PLR_{No\ LB}/PLR_{LB}$	4.39	6.42	4.50	0.58	5.03
July-May					
$PGR_{No\ LB}/PGR_{LB}$	11.22	6.26	5.25	6.93	7.16
$PLR_{No\ LB}/PLR_{LB}$	2.71	1.24	1.25	0.81	1.69



5. SUMMARY AND CONCLUSIONS

We present a comprehensive analysis of investor's asymmetric behaviour towards the realisation of their gains and losses. Our main findings are as follows.

First, we find strong evidence that the disposition effect exists for all categories of investor in both IPO and index stocks and for all months of the year except June, the last month of the Australian tax year. In June, the disposition effect is tempered by tax-loss selling by all investors except government and foreign investors, which are the two investor groups least likely to trade for tax reasons at the end of the fiscal year. Our tests do not support several non-tax related explanations for the end-of-year tempering of the disposition effect, such as portfolio rebalancing, momentum effects and higher trading costs associated with lower priced stocks. Contrarian investing explanations for the disposition effect are not supported either. Investors in IPO and index stocks who sell winners and hold on to losers, perhaps because they expect the losers to subsequently outperform the winners, are on average mistaken.

The strength of the disposition effect gradually diminishes as the investor's holding period increases. After about 200 trading days, investors appear impartial between the realisation of their gains and losses. Traders instigating larger investments tend to be less affected, if not entirely unaffected, by the disposition bias. The strength of the disposition effect clearly depends on investors' experience of past gains and losses, at least for the same stock. We find a strong "house money" effect, in that investors are more willing to realise losses following prior gains, and conversely they are more predisposed to realising gains following prior losses.

Consistent with past research, we find more sophisticated investors are less reluctant to realise a loss. Trusts, insurance companies and nominee companies appear least susceptible to the disposition effect. Further, the largest traders tend to exhibit it least, consistent with the idea that professional training and expertise can reduce judgmental bias.

An important issue for the future is to explain how people update their benchmark dynamically through time, i.e., from one evaluation date to another. Kahneman and Tversky's (1979) prospect theory applies only to one-shot gambles. Finally, we chose to examine the weighted average purchase price as a reference point for framing investment decisions. Alternative reference points that might have a role are the highest purchase price, the first purchase price, the most recent purchase price and the stock's monthly or 52-week high or low.

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