The Effect of Regret*

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Abstract

The aversion to future regret has been proposed as an explanation for many puzzles in both economics and finance. Yet very few studies (particularly outside of an experimental setting) have directly analyzed the effect of realized regret on subsequent decision making. We empirically investigate the effect of regret on future decisions in the context of stock-trading strategies by individual investors. Using data for all orders submitted by individual investors on the Shanghai Stock Exchange for one year, we find that people are more likely to change their order strategy, i.e., whether to place a desperate or patient order, after experiencing regret over their most recently submitted order. Consistent with the predictions of regret theory, we find that the effect of regret on the next order placed is stronger if the prior order was executed rather than unexecuted (i.e., action leads to more regret than inaction), if the investor lost money on the prior trade (i.e., a worse mood amplifies the effect of regret), and if the prior order represented an unusual trading strategy for the individual. Moreover, the emotionally-charged decisions made because of regret lead to worse outcomes for investors, with poor returns resulting from regret-based stock orders.

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1. Introduction

"*When one door closes, another opens; but we often look so long and so regretfully upon the closed door that we do not see the one which has opened for us.*"

Alexander Graham Bell

Alexander Graham Bell is not alone in his assessment of the importance of regret, or the potential for feeling future regret, in decision making. Citing many observed violations of the von Neumann and Morgenstern (1947) decision axioms by individuals, David Bell (1982), and Loomes and Sugden (1982) developed theoretical models of decision making in which individuals desire to avoid future regret over their decisions. Consistent with the predictions of these models, Kahneman and Tversky (1982) find, using experimental surveys, that considerations of regret play a significant role in decision-making.[1] In an empirical analysis on *anticipated* regret, Odean et al (2010) find that investors are more likely to repurchase stocks that have lost value subsequent to a prior sale rather than those that have gained value. They interpret this pattern as a desire to avoid regret (i.e., investors don't want to purchase a stock that they previously sold that rose in value because the repurchase will trigger feelings of regret over having sold the stock in the first place).

Indeed, this aversion to future regret has been proposed as an explanation for many "puzzles" in both economics and finance. For example, the disposition effect, the tendency of individuals to sell winning investments and hold on to losing investments, is consistent with several determinants of decision making, including regret aversion and prospect theory (Shefrin

[1] See Zeelenberg (1999) for a survey of the subsequent research in psychology that has also shown, through various experimental studies, that people take into account anticipated regret when they make decisions.

and Statman (1985)). Avoiding the regret of having a worse outcome than others can potentially lead to herding behavior, the tendency of individuals to congregate to the same decision, as well as the large investments in own-company stock observed in pension plans (see Shiller (2000) and Benartzi et al (2007), respectively). Brown (2007), in a survey piece on annuities, mentions regret in case of dying right after the purchase of an annuity as a possible explanation for the lack of annuitization of wealth by households. All of these papers share the common theme that individuals anticipate the regret they would feel under various outcomes and thus adjust their behavior to avoid reaching these outcomes.[2]

If people are hypothesized to act so as to minimize future regret, it is natural to establish that people actually adjust their behavior after realizing regret (beyond an experimental setting). For example, if individuals do not change their behavior after realizing regret from past actions in a "real-world" setting, then regret avoidance is unlikely to be a major determinant of decision making to begin with. However, despite the important role regret aversion has been thought to play in many contexts, quantifying the actual effect regret has upon decision making is very difficult. As Shefrin and Statman (1985, p. 781) state, "Regret is an emotional feeling associated with the ex post knowledge that a different past decision would have fared better than the one chosen." Therefore, in order to measure regret, or the positive counterpart of regret that Shefrin and Statman refer to as "pride", one needs to know two things. First, one must know the alternative choice(s) the individual had at the time of the decision so as to know the benchmark for measuring subsequent regret/pride. Second, one must know whether pursuing the alternative would have indeed made the individual better or worse off.

[2] Regret theory has been applied in other contexts as well. Examples include Braun and Muermann (2004), who build a model of demand for insurance when decisions are driven by anticipated regret, Muermann, Mitchell, and Volkman (2006), who theoretically show how considerations about regret might affect portfolio choice, and Michenaud and Solnik (2008), who use regret theory to derive implications for currency hedging decisions.

Because of the lack of data on the counterfactual in many observed decisions, let alone how the counterfactual decision would have played out, there are few studies that directly measure the effect of *realized regret on subsequent decisions*.[3] In this paper, we study the effect of realized regret on subsequent decisions in the context of stock trading. Using a unique dataset from the Shanghai Stock Exchange that contains details on the type of order placed regardless of whether the order is executed or not, we can classify a stock-trade order as either being desperate (a market order) or patient (a limit order).[4] We can then measure whether realized regret over the type of order placed last time (i.e., desperate or patient) affects the type of order subsequently placed. Regret in this context is a function of the difference between the actual return earned on the last order placed and the return that would have been earned had the alternative order strategy been used instead.

Why is examining the type of order placed a natural setting in which to study regret effects on subsequent behavior? There are several advantages to testing the implications of regret theory in this context. First, we can accurately measure the performance of the alternative strategy individuals could have employed, thereby enabling us to quantify the potential regret/pride individuals feel as a result of their actual decisions. For example, if an investor placed a desperate (i.e., market) order, we can measure the return from that strategy as well as what would have happened if the investor had instead placed a patient (i.e., limit) order. We can then directly test if the difference between the actual outcome and the outcome that would have

[3] A study that does directly examine the effect of realized regret over subsequent decisions is Zeelenberg and Beattie (1997) who use an experimental setup to study regret – an ultimatum game for dividing a pot of money with feedback. After the first round, proposers in the game were informed of the minimum offer that would have still led to acceptance on the other end. The bigger the difference between the actual offer and the minimum acceptable offer in the first round led to a lower offer being made in the second round. Odean et al (2010) find that investors are significantly more likely to buy a stock that they previously sold for a gain rather than a loss. They interpret that this effect could be driven by realized regret or naïve learning. We distinguish between the absolute gain/loss earned on a prior order as well as a measure of regret over the prior order strategy in our analysis.

[4] We provide exact definitions of these decisions in Section 2.

occurred had the alternative strategy been employed affects the likelihood of individuals changing their order strategy in the future. Throughout the paper, we will use the terms "trading strategy" or "order strategy" interchangeably to refer to the choice an investor makes, conditional on placing an order to trade in stocks, between making a market/desperate order or a limit/patient order.

Second, our setting enables us to test several implications of regret theory. As we will discuss below, in this setting we are able to test whether: the effect of regret is larger following acts of commission than omission (i.e., the omission bias discussed in Kahneman and Tversky (1982)); a positive mood acts as a buffer against regret and thus dampens the regret effect upon subsequent behavior (see, for example, Aspinwall and Taylor (1997), Raghunathan and Trope (2002), and Trope and Fishbach (2005)); a deviation from usual behavior leads to greater regret (as predicted by Kahneman and Tversky (1982) and Kahneman and Riepe (1998)); and, finally, whether emotionally-charged decisions, such as those emanating from regret, lead to worse outcomes (see, for example, Lo, Repin, and Steenbarger (2005) and Shiv et al (2005)).

We find that realized regret indeed has a strong effect on subsequent behavior. A key determinant of the type of order placed in the future by investors is a comparison between how the last order placed actually performed relative to how it would have performed if a different type of order had been placed. For example, if the household placed a patient order last time, and the patient order turns out to have done better than a desperate order would have, then the household is more likely to continue with a patient order in the future. If on the other hand, the household placed a patient order last time, but a desperate order would have done better, then the household is more likely to switch to placing a desperate order for its next transaction. Thus, the realized regret over the prior type of order placed directly affects the type of order placed in the

future. This "regret effect" is very robust, as it holds true across stocks and across transactions on different sides (i.e., buy orders and sell orders). For example, we find that the regret experienced over the type of order used to sell Microsoft stock, for example, predicts the type of order that will be subsequently used to buy Pepsi stock. This result is quite striking and rules out many potential alternative explanations for our regret-based interpretation, such as a common trend in stock prices influencing the type of order placed or learning about the market for a particular stock.

We also conduct several analyses to test implications of regret theory – thus providing supporting evidence that realized regret is indeed influencing future behavior. Consistent with the predictions of regret theory laid out previously, we find that the "regret effect" on the next order placed is stronger if the prior order was executed rather than unexecuted (i.e, an act of commission leads to more regret than an act of omission). This result – the omission bias – is consistent with Carlin and Robinson (2009) who find that expected regret leads to blackjack players favoring inaction over action. We also find that the effect of regret on subsequent stock orders is stronger if the investor lost money on the prior stock trade than if she made money – consistent with a favorable mood mitigating the effect of regret.

Another implication of regret theory is that unusual behavior has the potential for greater regret than usual behavior. Consistent with this prediction, we present strong evidence that if the prior order represented a deviation from the usual trading strategy of the individual, the effect of regret is significantly amplified. For example, if an individual who has a history of placing patient orders, places a desperate order that does not perform well (i.e., a patient order would have yielded a higher return), the individual is much more likely to switch back to a patient order

strategy next time than if the individual had instead had a long history of placing desperate orders.

Finally, we also consider whether this emotional determinant of trading strategy adversely affects subsequent performance. Using our regression results on the type of order placed, to classify the extent to which trading decisions are influenced by regret, we find that regret-based decisions appear to be suboptimal since they lose money on average. The poor returns on these decisions are not temporary, with the poor performance not reversing for at least three months. Thus, consistent with Lo, Repin, and Steenbarger (2005) and Shiv et al (2005), we find that emotionally-charged decisions, in this case those attributable to regret over a prior order strategy, lead to worse returns following the next order made. The poor performance resulting from decisions attributable to regret also rules out an alternative explanation for the observed patterns in order strategy – that individuals are instead learning optimal techniques over time.

The rest of the paper is organized as follows. The next section describes our data and defines key variables. Section 3 presents the effect of realized regret on probability of changing the decision and tests the hypotheses based on regret theory. In Section 4, we examine whether regret-induced decisions are suboptimal. The last section concludes.

2. Data

Our dataset consists of all orders submitted in all stocks by individual investors on the Shanghai Stock Exchange for the period from October 2003 to September 2004. We can track each investor through the sample by a unique investor ID. For each order, we know the ID of the investor, time of order submission, the stock, whether the order is a buy or sell, the price of at

which the order is placed, quantity, bid and ask quotes at the time the order is placed, whether the order is executed or not, and time and price of execution if the order is executed. The original sample has about 8 million individual investors and 160 million orders.[5]

First we designate if an order is a market order (we also refer to this as a "desperate" order) or a limit order (a "patient" order) as follows:[6]

Buy orders:

$$\text{"Market" if Order Price} \geq \text{Ask Price}$$

$$\text{"Limit" if Order Price} \leq \text{Bid Price}$$

Sell orders:

$$\text{"Market" if Order Price} \leq \text{Bid Price}$$

$$\text{"Limit" if Order Price} \geq \text{Ask Price}$$ [7]

In our sample, 48% of all the stock orders placed by individuals are buys and 31% of all the orders are market/desperate orders (32% of buy orders are market orders and 30% of sell orders are market orders). Of all the orders placed, 65% are executed (99% of market/desperate orders are executed while 49% of limit/patient orders are).

Our main dependent variable of interest is ***Change in Order Strategy***, an indicator variable equal to one if the previous order by the investor is of a different type (market vs. limit)

[5] Orders by institutional investors are not included in our analysis. There are only 3.3 million orders placed by institutional investors, which represents about 2% of the total orders placed on the exchange during our sample period. We exclude institutional investors from our analysis because we have no way of knowing the type of institution making the order (e.g., whether it is a foreign mutual fund, a local mutual fund, a local pension fund, etc.).

[6] On the Shanghai Stock Exchange, an order is not defined as a market order or a limit order, but each order is instead submitted at a particular price.

[7] About 3% of the orders fall between the bid and ask. We designate these orders as market or limit with reference to the midpoint of the bid and ask prices.

as the current order and zero if the current and previous orders are of the same type (i.e., both market orders or both limit orders). Our main independent variable of interest is ***Regret***, calculated as the return on a hypothetical alternative order less the return on the actual order placed. Thus, to calculate *Regret*, we have to define a hypothetical alternative order for each actual order. The dimension of decision that we consider is, conditional on an order being made, whether it is a market order (desperate) or a limit order (patient). For each actual market order, the hypothetical alternative order is a limit order and vice versa. To be precise we assign a submission price for a hypothetical order as follows:

Actual Order	Hypothetical Alternative Order Strategy	Hypothetical Submission Price
Market Buy	Limit Buy	Bid Price
Limit Buy	Market Buy	Ask Price
Market Sell	Limit Sell	Ask Price
Limit Buy	Market Sell	Bid Price

The above are certainly simplifying assumptions, but we believe them to be reasonable choices for the hypothetical/alternative order strategies for individuals. Further, these assumptions are justified by the composition of orders we see in our sample. There is a large mass of orders – about 42% – exactly at the bid or ask price.[8] We treat a hypothetical buy (sell) order as executed if, after submission, the trade price for that stock reaches the submission price

[8] Further, out of the approximately 10% of buy orders placed above the ask price, more than 75% are executed at ask price. Similarly, out of the approximately 10% of sell orders placed below the bid price, 75% are executed at the bid price. Thus, effectively, an additional 7.5% of total orders can be treated as placed at the bid or ask.

or goes below (above) it before the end of the day.[9] For an executed hypothetical order, we assume the execution price to be equal to the submission price.

Next, for each order, actual or hypothetical, we calculate the return till time *t* as follows:

Buy order:

$$If\ executed: Return_t = \frac{Price_t + Dividend_t}{Execution\ Price}$$

$$If\ unexecuted: Return_t = 0$$

Sell order:

$$Return_t = -(Return\ if\ it\ were\ a\ buy\ order)$$

Time *t* could be the time after a fixed interval from the moment of the order such as one day or one week or it could be the time of some future event. For our analyses of the effect of regret on the subsequent order-type decision, we define *t* as the time of submission of the subsequent order placed by the investor.

Having defined hypothetical alternative orders and returns on each order, we are now in position to define our proxy of regret:

$$Regret_t = Return_{H,t} - Return_{A,t}$$

where subscript *H* refers to the hypothetical order and subscript *A* refers to the actual order. The above definition is quite intuitive and is motivated by Shefrin and Statman (1985). They define regret as an emotional response to what could have happened had the individual made a different decision as opposed to what actually happened. $Return_{H,t}$ captures what could have happened

[9] On Shanghai Stock Exchange, an unexecuted order at the end of the day expires.

while $Return_{A,t}$ captures what actually happened. Based on our definition, *Regret* can be positive or negative. Positive values of *Regret* indicate the potential for 'regret' over the past decision (as the alternative strategy would have yielded a higher return). Negative values of *Regret* indicate the potential for 'pride', as termed in Shefrin and Statman (1985), because the alternative strategy would have resulted in a lower return than the actual strategy adopted.

It is also important to distinguish between regret and disappointment. Disappointment is experienced when something goes wrong where regret is felt when the individual thinks that had she taken a different decision the outcome could have been better. The regret is with reference to the benchmark of an alternative action. In our setting, $Return_{A,t}$ comes close to capturing disappointment or joy over what actually happened without reference to a benchmark. In our empirical analysis of order strategy and regret, we will control for the actual *Return* earned on the prior order until the next order in an attempt to distinguish the effect of regret from the effect of disappointment.

Our primary analysis is to examine the effect of ***Regret* over order$_{t-1}$** for an investor on the probability of ***Change in Order Strategy* for order$_t$** for the same investor (we also include ***Return* from order$_{t-1}$** in some specifications). If the individual adopted the same order strategy for both the prior order and the current order (i.e., both were limit orders or both were market orders), then *Change in Order Strategy* is zero. If the order strategy for the current order is different from that of the prior order (i.e., one is a limit order and one is a market order), then *Change in Order Strategy* is one. *Regret* and *Return* from the prior order are measured from the time of the prior order to the time of the current order. For the remainder of the paper, unless stated otherwise, when we refer to *Regret* and *Return*, we are actually referring to that

experienced from the prior order that then affects the order strategy (limit vs. market) for the current order.

For our main sample, we exclude all orders where the prior order by the same investor is within five minutes of the current order (this is done so as to require a minimum amount of time for an investor so that she could realistically sense how her order strategy did relative to the alternative, and thus form regret/pride over it). We change this gap to one minute or one hour and present those results as a robustness check. We also exclude any orders where the prior order is cancelled. This is because it is unclear whether the regret over a prior cancelled order would be over the decision to place that order or to cancel that order. However, as a robustness check we also present results where the prior cancelled orders are included and treated as unexecuted orders.

Our main sample yields just over 102.3 million observations/orders from 6.8 million individual investors based on the sample conditions above.[10] The descriptive statistics for the main variables of interest are provided in Table 1. We can see that investors change their order strategy (i.e., place a market vs. a limit order) relative to their prior order 33% of the time. The average *Regret* experienced over the prior order strategy until the time of the current order is 38 basis points while the average *Return* earned on the prior order until the time of the current order is -59 basis points. As explained earlier, negative values of *Regret* indicate pride over the previous decision. Admittedly, given the typically small magnitudes of the regret over the prior

[10] Our original sample has 160 million orders placed by individual investors, thus our sample conditions reduce the number of orders in our sample by 58 million. Eight million orders are lost because they are the first order placed by an investor and thus have no prior order over which to measure regret. Another 22 million orders are lost because the prior order made by the investor was canceled. Another 9 million orders are lost because the prior order of the investor was made within 1-5 minutes of the order. For robustness, in Table 4, we relax our sample restrictions and add back orders lost because of the last two sample conditions. The remaining 19 million orders are lost because of a host of reasons such as missing details for part of the order or the prior order of the investor being made less than one minute before the order.

order when the next order is made, it is an open question whether any effect of regret can be detected in the subsequent limit/market order decision. However, if we can detect an effect of realized regret on subsequent decision making in this context, it is suggestive of an even larger role for regret in other situations where the regret may be more sizeable.

3. Effect of Regret on Subsequent Decisions

We investigate the effect of regret on a change in the decision to place a market vs. a limit order using a linear probability model (a logistic model produces very similar results). It is important to note that our analysis is conditional on the decision to place a buy or sell order in a particular stock. Regret may affect the decision to place an order itself, in which stock that order is made, and whether to buy or sell but we are not investigating those aspects of decision making.

3.1 Baseline Results on Decision to Change Order Strategy

Theoretical models of rational decision to place market vs. limit orders (for example, see Foucault, Kadan, and Kandel (2005) and Rosu (2009)) usually model the decision based on a trade-off between waiting cost and the cost of demanding immediate execution. Typically, this trade-off is a function of characteristics of the stock and of the investor. We are not testing cross-sectional predictions of these models and are instead focusing on determinants of a *change in order strategy*. We focus on the change in order strategy rather than the simple limit/market order decision itself (without regard to the prior strategy), since regret over a prior order decision (limit vs. market) should lead to a change next time around. The results presented are based on specifications with investor-day fixed effects, i.e., fixed effects for every investor-day

combination to control for investor characteristics. Thus, our results are identified not by differences in regret experienced across investors but rather differences in regret experienced within a given individual investor across various orders made on the same day.[11]

Regret theory and findings in an experimental setting by Zeelenberg and Beattie (1997) suggest that experienced regret should have a positive effect on the probability of changing the type-of-order decision. This would lead to a positive relation between *Change in Order Strategy* and *Regret*. Recall *Regret* is defined as the return from the alternative order strategy less the return from the actual order strategy from the time the prior order was placed until the time of the current order. Further, evidence in Camerer, Babcock, Loewenstein, and Thaler (1997) and Coval and Shumway (2005) suggest that people may mentally treat each calendar day separately. That is, regret over a trade placed in the morning of a given day may have a stronger effect on the type of order placed later that same day than it would on the type of order placed during the next day (in effect, feelings of regret from a prior trade may disappear when a new day begins). To allow for this possibility, we interact *Regret* with an indicator for whether the prior transaction happened on the same day. Our basic specification (which also will include investor-day fixed effects) is thus:[12]

$$Change\ in\ Order\ Strategy = \alpha_1 Regret + \alpha_2 Regret * Same\ Day \qquad (1)$$

[11] For robustness, we also estimate a specification in which we include fixed effects for each current-stock-side-day and prior-stock-side-day order combination. In this fixed-effects specification (which we discuss more below), we are identifying off of people that placed the same current order (in terms of being for the same stock, being on the same side, and being placed on the same day) as well as the same prior order, but happened to experience different levels of regret based on the order strategy they used or the timing of their order during the day. As we report below, either fixed-effects specification leads to the same significant pattern in results and conclusions regarding the effect of regret from the prior order on the current order strategy.

[12] We have also estimated a specification with only investor fixed effects (as opposed to separate fixed effects for each investor for each day). The effect of regret using this specification is also statistically significant and is slightly larger but comparable in magnitude to that with investor-day fixed effects.

Column (1) in Table 2 presents the results. Indeed, we find that a strong and positive effect of *Regret* on the probability of changing the current order type, but only if the prior order, over which the regret is formed, was placed on the same day. That is, the coefficient on *Regret*Same Day*, is statistically positive and large in magnitude. A one-standard-deviation increase in regret over the prior order (using the standard deviation of 0.0673 in Table 1), increases the probability of changing the order-type *for the current order made the same day* by 23 percentage points (i.e., 0.0673*(-0.043+3.45)=0.23). If we use the standard deviation of regret experienced for the subset of orders that were followed by another order within the same day (which is 0.0071), the effect is 2.5 percentage points. This effect is economically meaningful, as the unconditional likelihood of changing the type of order placed relative to the prior order (i.e., change from market to limit or limit to market) is 33%.[13] The coefficient on *Regret*Same Day* will be a key parameter that we will focus on in many subsequent analyses of whether individuals decide to change their order strategy (e.g., from limit to market or market to limit).

Is the strong effect of regret on the same day a result of proximity in time? To investigate this, we interact *Regret* with *24hr*, an indicator variable for when the prior order is placed within 24 hours of the current order but on an earlier calendar day, and add this interaction to our basic specification. This interaction captures, for example, how the regret of a trade placed Monday afternoon affects the type of order placed Tuesday morning. Column (2) of Table 2 shows these results. Regret has no meaningful effect on the current order-type decision if the prior order was placed yesterday, even if the order is within 24 hours of that prior order. The coefficient of

[13] If the prior order was instead placed on a day before the current order, the economic magnitude of the regret effect on the order strategy is essentially zero. In this case, a one standard-deviation increase in regret is now associated with a miniscule 0.3 percentage point decrease in the probability of changing the order strategy.

*Regret*Same Day* remains unchanged. Thus, consistent with the evidence regarding the labor supply of taxi drivers (see Camerer, Babcock, Loewenstein, and Thaler (1997)) and the risk-taking of professional futures traders (see Coval and Shumway (2005)) we referenced earlier, individual investors seem to mentally "reset" after each day, with regret over a prior trade only affecting the type of order strategy employed in trades made later that *calendar day*.

As discussed earlier, *Regret* captures performance of an action relative to an alternative. Does absolute performance of the action itself, i.e., the return of the trade from the time the prior trade was made to the time the current order is placed, have an effect on whether an investor continues with the same order strategy? Column (3) includes *Return* and *Return*Same Day* in the specification along with the regret variables. We see that coefficients on the return variables are very small in magnitude. For example, a one-standard-deviation increase in *Return* alters the probability of a change in the order-type decision by only 1.1 percentage points for an order made the same day as the individual's prior order, much smaller than the 23 percentage points for regret felt on the same day. Thus, it is really regret, the performance relative to an alternative, rather than the actual return earned, the absolute performance that might capture disappointment or joy, that seems to matter for subsequent order decisions. Given this, and that the coefficients on the regret variables are virtually identical to those from Column (1), we drop the return variables from subsequent analyses.

3.2 Is Effect of Regret Concentrated Among Most Active Investors?

Since we find an effect of regret only for orders placed within the same day, one might wonder if the effect is entirely driven by individuals who trade a lot, or is instead a broader phenomenon influencing investors. To examine this possibility, we create two variables that

capture trading activity. *Place 4+ Trades During Day* is an indicator variable for whether the investor has placed four or more orders on this particular day. *# Trades Last Month above Median* is an indicator variable for whether the investor during the previous month placed more than the median number of monthly orders in the sample (the median number of trades per month by investors in our sample is 7).

We interact both of these variables with *Regret* and *Same Day*. The results are presented in Table 3. As we can see, there is some additional effect of regret in the case of people who trade a lot, but the effect for investors who don't trade a lot remains highly significant, indicating that the influence of regret upon the type of order placed is a broader phenomenon that is not just concentrated among a small group of day traders. Further, the magnitude of the coefficient for *Regret*Same Day* in Table 3 is very similar to that in Table 2.

3.3 Robustness of Effect of Regret to Different Samples and Different Methodologies

For our main sample, we exclude an order if the prior order by the same investor is cancelled or is placed within five minutes of the current order. To check that our results are not sensitive to these restrictions, we conduct our analysis for different samples and present these results in Table 4. Column (1) shows the results for our main sample. This is the baseline regression that is also displayed in Column (1) of Table 2. Recall that the requirement of a minimum 5-minute gap between orders is done so as to require a minimum amount of time for an investor so that she could realistically sense how her order strategy did relative to the alternative, and thus form regret/pride over it. However, 5 minutes is admittedly an arbitrary cutoff point. Thus, in Columns (2) and (3), instead of requiring at least a five-minute gap between the current and prior order, we instead require a one-minute or one-hour gap,

respectively. For Column (4), we include cancelled prior orders and treat them as unexecuted. For all these different criteria, the coefficient for *Regret*Same Day* stays highly significant and its magnitude is similar to that for our main sample.

So far, all the results are based on a linear probability model (OLS). Column (5) of Table 4 shows the marginal effects based on a logistic model. Again, the effect of *Regret*Same Day* is highly significant both statistically and economically. A one-standard-deviation increase in regret over the prior order, would increase the probability of a change in the order-type decision for an order made the same day by 44 percentage points (0.0673*(-0.091+6.66)). Using the standard deviation of regret within the same day, the effect is 4.7 percentage points (a large effect given the baseline probability of changing the order-type decision by 33 percentage points). Thus, the estimated marginal effects from the logistic model are qualitatively very similar to those obtained from the linear regression, with magnitudes, based on the marginal effects, somewhat larger. For ease of interpretation, we will report results from linear models in our subsequent specifications (logistic models yield the same conclusions throughout).

While the investor-day fixed-effects specification is the default in our paper, we also consider an alternative specification where we include fixed effects for each combination of the stock-day-side of the current and prior order. For example, consider an investor whose current order is a sale of Pepsi on February 26 and the prior order was a purchase of Microsoft on January 30. We include a fixed effect for the combination current-Feb-26-Pepsi-sale-prior-Jan-30-Microsoft-buy and all other current and prior order stock-day-side combinations (there are 11.6 million such fixed effects in this regression). In this specification, we are then identifying off of people that have the same stock-day-side combination for their prior and current orders,

but happened to experience different levels of regret based on the order strategy they used or the timing of their order.

In untabulated regression results, we obtain a coefficient of -0.069 on *Regret* and 6.301 on *Regret*Same Day* from the baseline specification with these different fixed effects (both coefficients statistically significant at the 1-percent level), with an R-squared of the regression of 0.142 and an Adjusted R-squared of 0.032. These coefficient estimates are very consistent with the specification that included investor-day effects shown in Column (1) of Table 2. Both specifications show that the regret experienced over the order strategy for a prior order made the same day has a big effect on the order strategy used for the current order (i.e., *Regret*Same Day* is significant and large in magnitude), with the magnitude of the results somewhat larger in the specification with fixed effects for each current-stock-day-side and prior-stock-day-side order combination. While we continue to report specifications utilizing investor-day fixed effects, we have confirmed that either type of fixed-effects specification leads to the same significant pattern in results and conclusions regarding the effect of regret from the prior order on the current order strategy.

3.4 Results for Trades in Different Stocks and of Different Sides (Buy/Sell)

Consider that an investor places a limit order to buy a particular stock, call it Stock A. When the outcome is unsatisfactory (a market order would have been a better strategy), she proceeds to correct her strategy and places a market order to buy Stock A. Thus, the "regret effect" may just capture unsuccessful strategies for a particular stock, and it is thus not surprising that the investor changes her decision when placing a future order in that particular stock – this pattern in order strategy could simply reflect learning by the investor. Our analysis so far does

not rule out this possibility. In Column (1) of Table 5, we again report our baseline specification. In Column (2) of Table 5, we interact the regret variables with *Same Stock*, an indicator, which captures if the prior order is for the same stock as the current order. Specifically, we estimate Specification (2) that also includes investor-day fixed effects:

$$Change\ in\ Order\ Strategy = \alpha_1 Regret + \alpha_2 Regret * Same\ Day \quad (2)$$
$$+\alpha_3 Regret * Same\ Stock + \alpha_4 Regret * Same\ Day * Same\ Stock$$

The coefficient for *Regret*Same Day*, which in Specification (2) captures the effect of regret if the current order is for a different stock than the prior order, remains statistically significant and large in magnitude. For example, in this case, a one-standard-deviation increase in regret over the prior order, increases the probability of changing the order-type for the current order made the same day by 17.5 percentage points (i.e., 0.0673*(-0.030+2.63)). If we use the standard deviation of regret experienced for the subset of orders that were followed by another order within the same day, the effect is 1.8 percentage points. The coefficient on *Regret*Same Day*Same Stock* is statistically positive, indicating the effect of regret from a prior order is stronger if the next order made the same day is in the same stock than if it is for a different stock. The results as a whole rule out "learning to do the right thing for a particular stock" as an explanation for the regret effect since we observe it both when the next order is in the same stock as well as when it is in a different stock.

What if investors' order strategy is formed following a reaction to broad price trends in the market? Then, if the market is going up, and an investor placed a market order (desperate order) to sell stock A, she would feel regret because a limit order (patient order) to sell stock A would have also been executed but would have secured her a higher price. Extrapolating from

this experience of a rising stock market, she would conclude that the right thing to do if she is selling another stock is to place a limit order. Thus, her change from market order to limit order would not necessarily reflect regret – it could simply reflect her following the price trend in the market.

To examine this alternative explanation, we interact all the variables in Specification (2) with a *Same Side* indicator. This indicator is one if the previous order by the same investor was a buy (sell) and the current order is also a buy (sell). It is zero if the previous order is on a different side from the current order. In this specification, the coefficient for *Regret*Same Day* captures the effect of regret if the current order is for a different stock than the prior order and the current order is on a different side than the prior order (e.g., current order is a buy and the prior order was a sell).

Column (3) of Table 5 shows the regression results for this specification. The coefficient of *Regret*Same Day* remains statistically and economically significant. Even if the current order is in a different stock and on a different side (e.g., current order is a buy and the prior order was a sell), the effect of a one-standard-deviation increase in regret over the prior order on the likelihood of changing the order-type decision for the next order the same day is 13 percentage points. This suggests, for example, the regret formed over the order type (i.e., market or limit) employed to buy Microsoft stock influences the type of order placed when selling Pepsi. This is a quite compelling result that is very much supportive of a regret-based behavioral response as opposed to learning about how to trade a particular stock or a response to broader price trends in the market.

The regression results with both the *Same Stock* and *Same Day* interactions from Column (3) of Table 5 are also highlighted graphically in Figure 1. We display the effect of regret of 1% from the prior order (i.e., alternative order strategy would have beat the actual order strategy by 1%) on the likelihood of changing the order type for the next order placed on that same day using the regression coefficients from Table 5. To put an increase of regret of 1% in perspective, recall that the standard deviation of regret experienced for the subset of orders that were followed by another order within the same day is 0.71%. We display the effect of regret of 1% in four situations: (1) Prior order on a different side in a different stock; (2) Prior order on the same side in a different stock; (3) Prior order on a different side in the same stock; and (4) Prior order on the same side in the same stock.

As shown by the first two bars in Figure 1, an increase in regret over the prior order of 1% increases the likelihood of changing the order strategy for the next order made the same day by 2.0 percentage points when the prior order was on a different side and in a different stock than the current order (i.e., -0.029+2.01=2.0), and increases it by 3.2 percentage points when the prior order was on the same side and in a different stock than the current order (i.e., -0.029+2.01-0.002+1.19=3.2). The 2.0 percentage point "regret effect" in the first case is quite compelling; as it is unlikely to represent learning about a particular stock (because of the different stock condition) and unlikely to represent a response to broad price trends in the market (because of the different side condition). The statistically significantly larger effect when the order is on the same side as the prior order could reflect a change in order strategy in response to aggregate price trends. As shown in the far right bar in Figure 1, an increase in regret over the prior order of 1% increases the likelihood of changing the order strategy for the next order made the same day by 5.6 percentage points when the prior order was on the same side and in the same stock as

the current order (i.e., -0.029+2.01+0.026+0.264-0.002+1.19-.060+2.19=5.6). The even larger effect in this case, when the order is on the same side as the prior order and in the same stock (i.e., repeated buys of IBM), could further reflect both a change in order strategy in response to aggregate price trends as well as learning about a particular stock through repeated orders (or simply that regret effects are larger for orders made in this situation).

3.5 Further Predictions based on Regret Theory

So far we have shown that regret over a prior order during the same day strongly increases the probability of *Change in Order Strategy*. Regret theory further predicts that this effect should be stronger in certain circumstances. We now turn to these predictions. To make the results visually salient, we use graphs to show the differential effect of regret in various situations, just as we did in Figure 1. As in Figure 1, the two left-most bars represent the regret effects in situations in which the prior order was in a different stock, while the two right-most bars represent the regret effect in situations in which the prior order was in the same stock.

In Figures 2 to 5, we will utilize the specification with *Same Day* and *Same Stock* interactions in Column (2) of Table 5 as our baseline regression from which to add various further interactions, just as we did in Figure 1.[14] In other words, we will add various interactions to Specification (2) above. As with Figure 1, we will focus on the effect of regret of 1% from the prior order (i.e., the alternative order strategy would have beat the actual order strategy by 1% on the prior order) on the likelihood of changing the order type for the next order placed on that same day. We will focus our discussion on the effect of regret on the two leftmost bars in the

[14] We have also replicated Figures 2 to 5 using the specification that includes *Same Day*, *Same Stock*, and *Same Side* interactions as the baseline. The support for the three sub-hypotheses based on regret theory found in these Figures and discussed in Section 3.5 is also found in these regressions as well. We focus on the specification using *Same Day* and *Same Stock* interactions as the baseline to simplify the presentation and discussion of results.

figure, cases in which the prior order was in a different stock. As mentioned earlier, in these cases, learning about a particular stock is less likely to explain the results.

3.5.1 Action vs. Inaction

Kahneman and Tversky (1982) find that regret has a stronger effect for an action as opposed to an inaction.[15, 16] An order placed by an investor may result in an action (an executed trade) or an inaction (an order that is not executed). Then, based on the prediction above, we should expect the effect of regret to be stronger if the previous order is executed. We thus estimate an extension of Specification (2) in which all the variables in the specification are interacted with *Executed*. *Executed* is an indicator variable that is 1 if the prior order was executed, and is 0 otherwise. We also include the variable *Executed* in the regression.

The results from this regression are displayed in Figure 2. As shown by the first two bars in Figure 2, an increase in regret over the prior order of 1% increases the likelihood of changing the order strategy for the next order made the same day by 1.7 percentage points when the prior order was NOT EXECUTED and was in a different stock than the current order, and increases it by 7.6 percentage points when the prior order was EXECUTED and was in a different stock than the current order. We find that for both the "Different Stock" group (left two bars) and the "Same Stock" group (right two bars), the case in which the prior order is EXECUTED has a

[15] Omission bias, a preference for inaction as opposed to action, has been found in a variety of settings. People are reluctant to vaccinate a child if there is a small chance of death due to the vaccination, even if that chance is much smaller than chance of death due to the disease itself (see Ritov and Baron (1990)). Workers fail to participate in the employer-matched retirement savings plan (see Thaler and Benartzi (2004)). Investors fail to rebalance their portfolio (see Campbell (2006)). All of this inactivity could potentially be explained by omission bias. Anticipated regret is often invoked to explain the omission bias. Consistent with this idea, Carlin and Robinson (2009) find that expected regret leads to an omission bias among blackjack players.

[16] When asked about real-life decisions, people tend to regret inactions (missed opportunities) more than actions. Also, people tend to have stronger regret over actions in the short run than over inactions in the long run (see Gilovich and Medvec (1994, 1995)). Predictions about the short run are more relevant in our context since we find that regret has a strong effect only for orders placed on the same calendar day.

statistically greater "regret effect" than the case in which the prior order is NOT EXECUTED. This statistically significant difference confirms the prediction of regret theory regarding action vs. inaction. It is interesting to note, nonetheless, that the effect of regret following inaction (i.e., following an unexecuted order) is itself statistically significant. This indicates that individuals are influenced not only by what did happen in the past, but also by what did not happen (but could have).

3.5.2 Positive vs. Negative Mood

If a prior order is executed, it could have made money or lost money. If an investor makes money on the prior order, it is very likely that she is in a good mood. The literature in psychology finds, theoretically as well as experimentally, that a positive mood acts as a buffer against regret (for example, see Aspinwall and Taylor (1997), Raghunathan and Trope (2002), and Trope and Fishbach (2005)). Thus, we expect that the effect of regret would be stronger if the prior order had negative return rather than a positive return. We estimate an extension of Specification (2) in which all the variables in the specification are interacted with whether the prior order was executed, and if executed, whether it earned a *Positive Return* or *Negative Return*. *Positive (Negative) Return* is an indicator variable that is 1 if the prior order was executed and earned a positive (negative) return until the time of the current order, and is 0 otherwise. We also include the variable *Executed* in the regression.

The results from this regression are displayed in Figure 3. As shown by the first two bars in Figure 3, an increase in regret over the prior order of 1% increases the likelihood of changing the order strategy for the next order made the same day by 6.8 percentage points when the prior order had a POSTIVE RETURN and was in a different stock than the current order, and

increases it by 10.3 percentage points when the prior order had a NEGATIVE RETURN and was in a different stock than the current order. We find that for both the "Different Stock" group (left two bars) and the "Same Stock" group (right two bars), the case in which the prior order earned a NEGATIVE RETURN has a statistically greater "regret effect" than the case in which the prior order earned a POSITIVE RETURN. This statistically significant difference confirms the prediction of regret theory regarding the mitigating effect of a positive mood on feelings of regret. Nonetheless, even when the prior order makes money, people feel regret over the actual outcome compared to the outcome of the hypothetical order, and regret strongly affects the subsequent decision.

3.5.3 Regret over an Unusual Action

People generally feel stronger regret if they act in ways that are unusual for them (for example, see Kahneman and Tversky (1982) and Kahneman and Riepe (1998)). To test this hypothesis, we need to define an unusual action for each investor. For each investor and each order, we define the usual behavior/action leading up to $order_{t-1}$ as the average order type made by that investor for the 10 orders prior to $order_{t-1}$ (i.e., does the investor typically making a market order or typically making a limit order). We code the *Type of Order* as 1 if it is a market order and 0 if it is a limit order and then define *Deviation* as:

$$Deviation = Abs(Type\ of\ Order_{t-1} - Average\ Type\ of\ Order\ for\ Prior\ Ten\ Orders)$$

The larger is *Deviation*, the more unusual the action is for the investor. The largest value *Deviation* can take is one, when the order type for $order_{t-1}$ is completely unusual for an investor (for example, if all the prior 10 orders are limit orders but $order_{t-1}$ is a market order) and the smallest value *Deviation* can take is zero, when the order type for $order_{t-1}$ is completely usual for

an investor (for example, if all the prior 10 orders are limit orders and $order_{t-1}$ is also a limit order). We also construct a second version of *Deviation* that uses as a benchmark for $order_{t-1}$ all orders placed in the prior calendar month.

An extension of Specification (2) is estimated in which all the variables in the specification are interacted with *Deviation* of the prior order type from that typically used by the investor. We also include the variable *Deviation* in the specification. Figure 4 shows the results when *Deviation* is calculated using the order types of the 10 orders preceding the prior one. Figure 5 shows the results when *Deviation* is calculated using the order types of all the orders in the month preceding the prior one. Regardless of how we define a deviation from normal behavior, the pattern in the two figures is consistent and striking. In both Figures 4 and 5, we find that for both the "Different Stock" group (left two bars) and the "Same Stock" group (right two bars), the case in which the prior order is a TOTAL DEVIATION from past order strategies has a statistically greater and substantially larger "regret effect" than the case in which the prior order earned is NO DEVIATION from past order strategies. Thus, while an uncharacteristic prior action leads to a large effect of regret on changing subsequent behavior if the alternative would have done better, a prior action that is normal for an individual influences subsequent behavior much less (even if an alternative to that normal action would have performed much better).

3.6 Regret or Learning?

We find a strong effect of regret on subsequent decisions (in this case, the choice of a market or limit order) and confirm the patterns predicted by regret theory. Still, one may wonder if the effect is really due to regret or instead represents some form of learning. Indeed, Seru et al

(2010) find that investors learn from their trading experience. However, in our setting, given the overall pattern of results, it is unlikely that the effect we observe and describe as a reaction to regret/pride is attributable to learning. Our effect is present only for orders placed on the same calendar day. So if it is learning, it has to be very short lived. At the same time, learning has to be fairly general since subsequent orders even in a different stock and on a different side (buy/sell) are affected. Further, it is not clear why learning would have a stronger effect following executed orders, following orders that result in a negative return, and following orders that are unusual actions for the investor (all of these effects are predicted by regret theory). Finally, if the effect we observe is attributable to learning, it should improve the performance of an individual's subsequent orders. This is what we investigate in the next section.

4. Test of whether Performance of Decisions Affected by Regret

So far we have established that people change their order strategy (i.e., use of market vs. limit orders) if they experience regret. Is it good or bad to let your decisions, at least in part, be driven by regret? Shiv et al (2005) present evidence that individuals with a brain condition preventing them from processing emotions make better investment decisions than individuals without such a condition. Lo, Repin, and Steenbarger (2005), in a study involving traders in the futures market, find that an intense emotional response is negatively correlated with trading performance. We now proceed to investigate if the same is true in our setting.

To accomplish this, we first need to identify how much each of order decision is affected by regret and then see if the decisions that are affected to a larger extent by regret perform differently. Thus, our dependent variable is performance of $order_t$. We measure the performance using the return following to $order_t$ (defined as zero if the order is unexecuted) for different time

periods that range from one day to three months after the order. Our key independent variable is the Magnitude of Distortion by Regret (*MDR*) for decision for order$_t$. Regret is over order$_{t-1}$. We use a multi-stage estimation approach as follows:

$$Change\ in\ Order\ Strategy\ = \alpha_1 Regret + \alpha_2 Regret * Same\ Day$$

$$+\alpha_3 Regret * Same\ Stock + \alpha_4 Regret * Same\ Day * Same\ Stock$$

$$MDR = Abs(Change\ in\ Order\ Strategy^{\ FIT})$$

$$Return\ following\ Order\ = \beta_1 * MDR$$

The first regression is Specification (2) from Section 3.4. *Change in Order Strategy* ^{FIT} is simply the fitted value calculated from the first regression. We take the absolute value of *Change in Order Strategy* ^{FIT} to get *MDR* because regret may make you more likely while pride may make you less likely to change your decision, and we want to record the magnitude of the distortion in either direction. Thus, the higher the value of *MDR*, the more affected is the decision by regret/pride. In the second stage, we then relate the return following the order over various horizons to the *MDR* (and also the return earned on the prior order up until the time of the current order). As before, the return for an unexecuted order is defined as zero and the return following a sale is defined as the negative of the return following a buy (i.e., following a sale, the investor has done well if the stock falls in price). In both stages we control for investor-day fixed effects as before, so in this specification we control for an individual's average investment ability for each day. We are thus in effect comparing the performance of orders placed by the same investor on the same day and examining if the one that was likely influenced more by regret/pride performs worse.

The theoretically possible highest value for *MDR* is 1 and the lowest value is 0. *MDR* of 1 would indicate a decision that is completely driven by regret, while an *MDR* of 0 would indicate a decision that is not influenced by regret at all. From Table 6, which presents the descriptive statistics for the return following the order and the *MDR* for that order, we can see that after controlling for individual-day fixed effects, standard deviation of *MDR* is about 0.01, which is also the 90th percentile of this variable.

Table 7 shows the results for regression of *Return following Order* on *MDR*. Three things stand out from Table 7. First, we see that effect of *MDR* on *Return following Order* is negative. Thus, decisions affected by regret are indeed suboptimal. This provides further evidence that the "regret effect" that causes an investor to change their order strategy (i.e., whether to use a market or a limit order) from their prior order is unlikely attributable to learning. A one-standard deviation increase in *MDR* results in a reduction in the return following the regret-affected order by 10 basis points. The point estimate suggest that a change in order strategy that is 25% attributable to regret (i.e., MDR=0.25) results in an order being made that performs 2.7 percentage points worse than that with no distortion from regret. Second, this reduction in performance is not temporary. Even looking 3 months after the order, the effect of MDR remains significant and does not diminish in magnitude. Third, even when we control for the return on the prior order up until the point the current order is made, the effect of *MDR* remains negative, statistically significant, and of the same magnitude. Thus, similar to Shiv et al (2005) and Lo, Repin, and Steenbarger (2005), we also find that decisions affected by emotion – in our case by regret – perform poorly.

5. Conclusion

The aversion to future regret has been proposed as an explanation for many puzzles in both economics and finance. Indeed, many "puzzles" in financial decision making, such as the tendency to sell winning investments and hold on to losing ones, herding, lack of demand for annuities, the tendency to hold employer stock in retirement savings plan – to name a few – are thought to be at least in part a result of regret aversion. Yet very few studies (particularly outside of an experimental setting) have directly analyzed the effect of *realized* regret on subsequent decision making. This is unfortunate, because if individuals do not change their behavior after realizing regret from past actions in a "real-world" setting, then regret avoidance is unlikely to be a major determinant of decision making to begin with.

Thus, if aversion of expected regret is believed to affect decisions in real life, it is important to show that, in real life, experienced regret affects subsequent decisions. This is precisely what this paper strives to accomplish, in the process bridging the gap between regret theory, experimental evidence, and real-life decisions. To do this, we empirically investigate the effect of regret on future decisions in the context of stock-order strategies by individual investors. Using data for all orders submitted by individual investors on the Shanghai Stock Exchange for one year, we find that people are more likely to change their order strategy, i.e., whether to place a desperate or patient order, after experiencing regret over their most recently submitted order.

Despite the important role regret aversion has been thought to play in many contexts, quantifying the actual effect regret has upon decision making is difficult. Why is examining the type of order placed a natural setting in which to study regret effects on subsequent behavior?

There are several advantages to testing the implications of regret theory in this context. First, we can accurately measure the performance of the alternative strategy individuals could have employed, thereby enabling us to quantify the potential regret/pride individuals feel as a result of their actual decisions. For example, if an investor placed a desperate (market) order, we can measure the return from that strategy as well as what would have happened if the investor had instead placed a patient (limit) order. We then directly test if the difference between the actual outcome and the outcome that would have occurred had the alternative strategy been employed affects the likelihood of individuals changing their order strategy in the future. Consistent with the simplest prediction of regret theory, we find that a larger level of experienced regret is associated with a higher probability of changing the subsequent order strategy.

A second advantage of our setting is that we can test several predictions of the regret theory. Our evidence supports these predictions. We find that the effect of regret on the next order placed is stronger if the prior order was executed rather than unexecuted (i.e., action leads to more regret than inaction), if the investor lost money on the prior trade (i.e., a worse mood amplifies the effect of regret), and if the prior order represented an unusual trading strategy for the individual.

A third advantage of our setting is that we can measure the performance of an order and relate that to the extent to which that order was affected by regret. Indeed, the emotionally-charged decisions made because of regret lead to worse outcomes for investors, with poor returns resulting from regret-based stock orders. The wide array of results summarized above all follow from regret theory and, in their totality, help rule out alternative explanations for our "regret effect" such as broad learning about how to trade stocks.

We also find that the regret experienced over the type of order used to sell Microsoft stock, for example, predicts the type of order that will be subsequently used to buy Pepsi stock. That is, regret experienced over the order strategy used in the prior order, even if that was for a different stock and was on a different side (i.e., a sale rather than a buy), affects the order strategy for the next order. This result is quite striking and also helps rule out many potential alternative explanations for our regret-based interpretation, such as a common trend in stock prices influencing the type of order placed or learning about the market for a particular stock.

Admittedly, given the typically small magnitudes of the regret over the prior order strategy when the next order is made, it was *a priori* an open question whether any effect of regret can be detected in the subsequent limit/market order decision. However, given we could detect an effect of realized regret on subsequent decision making in this context, it is suggestive of an even larger role for regret in other situations where the experienced regret may be more sizeable.

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Table 1: Descriptive Statistics

This table presents descriptive statistics for orders placed by individual investors on the Shanghai Stock Exchange. The sample period is October 2003 to September 2004. *Change in Order Strategy* is an indicator variable that is 1 if the current order strategy (i.e., whether a market or limit order is placed) is different from that of the prior order, and is 0 if both the current and prior order were of the same type (i.e., both were market or both were limit orders). *Regret* is measured over the previous order and is defined as the difference between the return on a hypothetical order strategy and the return on the actual order strategy calculated till the time of the current order. A negative value of *Regret* could therefore be viewed as pride. See Section 2 for the definition of the hypothetical order strategy. *Return* is simply the return on the prior order and is calculated till the time of the current order and is zero if the prior order was not executed.

	Change in Order Strategy (0/1 decision)	***Regret***	***Return***
Mean	0.33	0.0038	-0.0059
Standard Deviation	0.47	0.0673	0.1199
10th Percentile	0.00	-0.0114	-0.0779
25th Percentile	0.00	-0.0032	-0.0156
50th Percentile	0.00	-0.0007	0.0000
75th Percentile	1.00	0.0018	0.0115
90th Percentile	1.00	0.0129	0.0605
Observations (# of orders)	102,320,043	102,320,043	102,320,043

Table 2: Effect of Regret on Subsequent Order Strategy

This table shows the results of a linear probability model (OLS) for *Change in Order Strategy*. The sample includes orders placed by individual investors on the Shanghai Stock Exchange from October 2003 to September 2004 and excludes observations if the previous order by the same investor was cancelled or was within 5 minutes of the current order. *Change in Order Strategy* is an indicator variable that is 1 if the current order strategy (i.e., whether a market or limit order is placed) is different from that of the prior order, and is 0 if both the current and prior order were of the same type (i.e., both were market or both were limit orders). *Regret* is measured over the previous order and is defined as the difference between the return on a hypothetical order strategy and the return on the actual order strategy calculated till the time of the current order. A negative value of *Regret* could therefore be viewed as pride. See Section 2 for the definition of the hypothetical order strategy. *Same Day* is an indicator variable that is 1 if the investor placed the previous order on the same calendar day as the current order, and is 0 otherwise. *24hr* is an indicator variable that is 1 if the investor placed the previous order within 24 hours of the current order but on a different calendar day, and is 0 otherwise. *Return* is simply the return on the prior order calculated till the time of the current order and is zero if the prior order was not executed. All the specifications include Investor-Day fixed effects. *t*-statistics using robust standard errors clustered by investor are in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	LHS = Change in Order Strategy from Prior Order (0/1)		
	(1)	(2)	(3)
Regret	-0.043***	-0.050***	-0.044***
	(-13.0)	(-11.3)	(-13.2)
*Regret*Same Day*	3.45***	3.45***	3.47***
	(99.2)	(98.9)	(99.0)
*Regret*24hr*		0.016**	
		(2.5)	
Return			-0.010***
			(-3.8)
*Return*Same Day*			0.104***
			(4.9)
Investor-Day Fixed Effects included?	Yes	Yes	Yes
R-squared	0.811	0.811	0.811
Adjusted R-squared	0.164	0.164	0.164
Number of Observations/Orders	102,320,043	102,320,043	102,320,043

Table 3: Effect of Regret on Subsequent Trading Strategy by Trading Frequency

This table shows the results of a linear probability model (OLS) for *Change in Order Strategy*. The sample includes orders placed by individual investors on the Shanghai Stock Exchange from October 2003 to September 2004 and excludes observations if the previous order by the same investor was cancelled or was within 5 minutes of the current order. *Change in Order Strategy* is an indicator variable that is 1 if the current order strategy (i.e., whether a market or limit order is placed) is different from that of the prior order, and is 0 if both the current and prior order were of the same type (i.e., both were market or both were limit orders). *Regret* is measured over the previous order and is defined as the difference between the return on a hypothetical order strategy and the return on the actual order strategy calculated till the time of the current order. A negative value of *Regret* could therefore be viewed as pride. See Section 2 for the definition of the hypothetical order strategy. *Same Day* is an indicator variable that is 1 if the investor placed the previous order on the same calendar day as the current order, and is 0 otherwise. *Place 4+ Trades During Day* is an indicator variable whether the investor has placed four or more orders on this particular day. *# Trades Last Month above Median* is an indicator variable for whether the investor during the previous month placed more than the median number of monthly orders in the sample (the median number of trades per month by investors in our sample is 7). All the specifications include Investor-Day fixed effects. *t*-statistics using robust standard errors clustered by investor are in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	LHS = Change Order Strategy from Prior Order (0/1)		
	(1)	(2)	(3)
Regret	-0.043***	-0.043***	-0.030***
	(-13.0)	(-13.1)	(-5.0)
*Regret*Same Day*	3.45***	3.01***	3.07***
	(99.2)	(84.6)	(52.0)
*Regret*Same Day**			
(Place 4+ Trades During Day)		1.64***	
		(19.4)	
Regret(# Trades Last Month above Median)*			-0.024***
			(-3.4)
*Regret*Same Day**			
(# Trades Last Month above Median)			0.54***
			(7.3)
Investor-Day Fixed Effects included?	Yes	Yes	Yes
R-squared	0.811	0.811	0.793
Adjusted R-squared	0.164	0.164	0.165
Number of Observations/Orders	102,320,043	102,320,043	78,441,170

Table 4: Effect of Regret on Subsequent Trading Strategy – Different Samples

This table shows the results for effect of regret on *Change in Order Strategy* for different samples or different specifications. The results presented are coefficients from a linear probability model (OLS) except for the last column which presents the marginal effects from a logistic model. The sample includes orders placed by individual investors on the Shanghai Stock Exchange from October 2003 to September 2004. The regressions in Columns (1) and (5) exclude observations if the previous order by the same investor was cancelled or was within 5 minutes of the current order, the regression in Column (2) excludes observations if the previous order by the same investor was cancelled or was within 1 minutes of the current order, the regression in Column (3) excludes observations if the previous order by the same investor was cancelled or was within 1 hour of the current order, the regression in Column (4) excludes observations if the previous order by the same investor was within 5 minutes of the current order and treats prior canceled orders as if they had not been executed. *Change in Order Strategy* is an indicator variable that is 1 if the current order strategy (i.e., whether a market or limit order is placed) is different from that of the prior order, and is 0 if both the current and prior order were of the same type (i.e., both were market or both were limit orders). *Regret* is measured over the previous order and is defined as the difference between the return on a hypothetical order strategy and the return on the actual order strategy calculated till the time of the current order. A negative value of *Regret* could therefore be viewed as pride. See Section 2 for the definition of the hypothetical order strategy. *Same Day* is an indicator variable that is 1 if the investor placed the previous order on the same calendar day as the current order, and is 0 otherwise. All the specifications include Investor-Day fixed effects. *t*-statistics using robust standard errors clustered by investor are in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	LHS = Change Order Strategy from Prior Order (0/1)				
	(1)	(2)	(3)	(4)	(5)
Regret	-0.043***	-0.036***	-0.046***	-0.036***	-0.091***
	(-13.0)	(-14.1)	(-6.3)	(-19.4)	(-27.7)
*Regret*Same Day*	3.45***	4.05***	1.99***	1.60***	6.66***
	(99.2)	(127.2)	(29.9)	(102.5)	(192.2)
Gap between previous order by the same investor and current order	5 minutes	1 minute	1 hour	5 minutes	5 minutes
Observations where previous order by the same investor was cancelled	Excluded	Excluded	Excluded	Included	Excluded
Specification	Linear Probability	Linear Probability	Linear Probability	Linear Probability	Logistic: Marginal Effects
Investor-Day Fixed Effects?	Yes	Yes	Yes	Yes	Yes
R-squared	0.811	0.762	0.920	0.754	-
Adjusted R-squared	0.164	0.168	0.175	0.222	-
Pseudo R-squared	-	-	-	-	0.0045
Number of Observations/Orders	102,320,043	111,602,307	86,151,378	124,647,059	102,320,043

Table 5: Effect of Regret on Subsequent Trading Strategy by Whether Prior Order is in the Same Stock and on the Same Side (Buy/Sell) as the Current Order

This table shows the results of a linear probability model (OLS) for *Change in Order Strategy*. The sample includes orders placed by individual investors on the Shanghai Stock Exchange from October 2003 to September 2004 and excludes observations if the previous order by the same investor was cancelled or was within 5 minutes of the current order. *Change in Order Strategy* is an indicator variable that is 1 if the current order strategy (i.e., whether a market or limit order is placed) is different from that of the prior order, and is 0 if both the current and prior order were of the same type (i.e., both were market or both were limit orders). *Regret* is measured over the previous order and is defined as the difference between the return on a hypothetical order strategy and the return on the actual order strategy calculated till the time of the current order. A negative value of *Regret* could therefore be viewed as pride. See Section 2 for the definition of the hypothetical order strategy. *Same Day* is an indicator variable that is 1 if the investor placed the previous order on the same calendar day as the current order, and is 0 otherwise. *Same Stock* is an indicator variable that is 1 if the investor placed the previous order for the same stock as the current order, and is 0 otherwise. *Same Side* is an indicator variable that is 1 if the investor placed the previous order on the same side (buy or sell) as the current order, and is 0 otherwise. All the specifications include Investor-Day fixed effects. *t*-statistics using robust standard errors clustered by investor are in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	LHS = Change Order Strategy from Prior Order (0/1)		
	(1)	(2)	(3)
Regret	-0.043***	-0.030***	-0.029***
	(-13.0)	(-6.1)	(-3.6)
Regret*Same Day	3.45***	2.63***	2.01***
	(99.2)	(57.6)	(30.9)
Regret*Same Stock		-0.024***	0.026*
		(-3.6)	(-1.9)
Regret*Same Day*Same Stock		1.60***	0.264***
		(25.7)	(2.9)
Regret*Same Side			-0.002
			(-0.2)
Regret*Same Day*Same Side			1.19***
			(14.0)
Regret*Same Stock*Same Side			-0.060***
			(-3.8)
Regret*Same Day*Same Stock			2.19***
*Same Side			(17.9)
Investor-Day Fixed Effects included?	Yes	Yes	Yes
R-squared	0.811	0.811	0.811
Adjusted R-squared	0.164	0.164	0.164
Number of Observations/Orders	102,320,043	102,320,043	102,320,043

Table 6: Descriptive Statistics - Performance Following Order and the Magnitude of Distortion in Order Strategy Induced by Regret (MDR) from Prior Order

This table presents descriptive statistics for orders placed by individual investors on the Shanghai Stock Exchange. The sample period is October 2003 to September 2004. *Return following Order* is simply the return following an order, calculated for horizons ranging from 1 day to 3 months after the date of the order, and is zero if the order was not executed. *MDR* is the magnitude of distortion in the order strategy (i.e., place a market or limit order) induced by regret over the previous order, as defined in Section 4. *MDR*, by construction, is between zero and one, with a higher value indicating a bigger share of the current order strategy explained as a reaction to regret.

	Return following Order				***Magnitude of Distortion induced by Regret (MDR)***
	1 Day	**1 Week**	**1 Month**	**3 Months**	
Mean	-0.003	-0.003	-0.004	-0.006	0.003
Standard Deviation	0.118	0.124	0.144	0.188	0.009
10th Percentile	-0.052	-0.083	-0.151	-0.234	0.000
25th Percentile	-0.013	-0.022	-0.044	-0.085	0.000
50th Percentile	0.000	0.000	0.000	0.000	0.000
75th Percentile	0.010	0.016	0.033	0.064	0.003
90th Percentile	0.045	0.075	0.139	0.218	0.009
Observations	102,320,043	102,320,043	102,320,043	102,320,043	102,320,043

Table 7: Effect of Regret on Subsequent Performance

This table presents a linear regression (OLS) of the effect of a regret-induced decision on the type of order to place (market or limit) on the subsequent performance of that order. The sample includes orders placed by individual investors on the Shanghai Stock Exchange from October 2003 to September 2004 and excludes observations if the previous order by the same investor was cancelled or was within 5 minutes of the current order. The dependent variable is *Return following Order*. It represents the return following an order, calculated for horizons ranging from 1 day to 3 months after the date of the order, and is zero if the order was not executed. *MDR* is the magnitude of distortion in the order strategy (i.e., place a market or limit order) induced by regret over the previous order, as defined in Section 4. *MDR*, by construction, is between zero and one, with a higher value indicating a bigger share of the current order strategy explained as a reaction to regret. *Return on Previous Order* is simply the return on the prior order calculated till the time of the current order and is zero if the prior order was not executed. All the specifications have Investor-Day fixed effects. *t*-statistics using robust standard errors clustered by investor are in parentheses. ***, **, and * indicate statistical significance at 1%, 5%, and 10% levels, respectively.

	LHS = Return following Order (over various periods)							
	1 Day	**1 Week**	**1 Month**	**3 Months**	**1 Day**	**1 Week**	**1 Month**	**3 Months**
MDR	-0.109***	-0.111***	-0.122***	-0.153***	-0.097***	-0.098***	-0.111***	-0.140***
	(-17.1)	(-15.6)	(-13.9)	(-13.2)	(-15.2)	(-13.9)	(-12.6)	(-12.1)
Return on Previous Order					-0.078***	-0.078***	-0.075***	-0.081***
					(-66.2)	(-65.3)	(-61.2)	(-59.8)
Investor-Day Fixed Effects?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.815	0.814	0.812	0.813	0.816	0.815	0.813	0.813
Adjusted R-squared	0.183	0.179	0.172	0.174	0.186	0.182	0.174	0.175
Number of Observations	102,320,043	102,320,043	102,320,043	102,320,043	102,320,043	102,320,043	102,320,043	102,320,043

Figure 1: Effect of Regret on Subsequent Order Strategy – Prior Order on Different or Same Side (Buy/Sell) as Current Order

This figure reports results from a linear probability model (OLS) for *Change in Order Strategy*. An extension of Specification (2) in Section 3.4 is estimated in which all the variables in the specification are interacted with *Same Side*. *Same Side* is an indicator variable that is 1 if the investor placed the previous order on the same side (buy or sell) as the current order, and is 0 otherwise. The coefficient estimates from the regression are then used to calculate the effect of regret on the likelihood of changing order strategy from the prior order (where order strategy refers to the use of a market or limit order) under various situations. The sample includes orders placed by individual investors on the Shanghai Stock Exchange from October 2003 to September 2004 and excludes observations if the previous order by the same investor was cancelled or was within 5 minutes of the current order. *Change in Order Strategy* is an indicator variable that is 1 if the current order strategy (i.e., whether a market or limit order is placed) is different from that of the prior order, and is 0 if both the current and prior order were of the same type (i.e., both were market or both were limit orders). *Regret* is measured over the previous order and is defined as the difference between the return on a hypothetical order strategy and the return on the actual order strategy calculated till the time of the current order. See Section 2 for the definition of the hypothetical order strategy. In all four cases, the effect of regret is statistically significant at the 1% level. For both the "Different Stock" group (left two bars) and the "Same Stock" group (right two bars), the case in which the prior order is of the SAME SIDE has a statistically greater "regret effect" than the case in which the prior order is on a DIFFERENT SIDE. See Section 3.4 for further details.

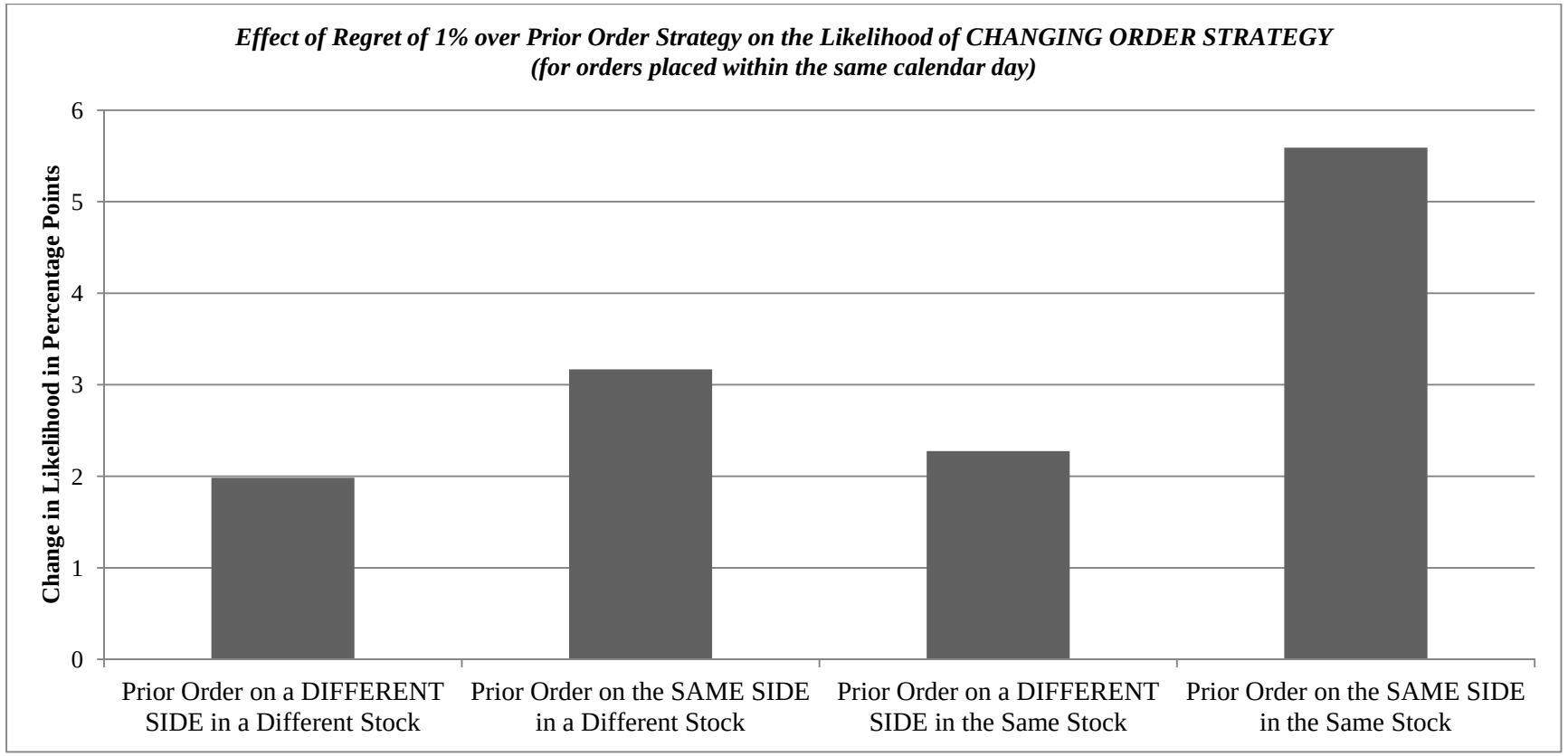

Figure 2: Effect of Regret on Subsequent Order Strategy – Prior Order Unexecuted or Executed

This figure reports results from a linear probability model (OLS) for *Change in Order Strategy*. An extension of Specification (2) in Section 3.4 is estimated in which all the variables in the specification are interacted with *Executed*. *Executed* is an indicator variable that is 1 if the prior order was executed, and is 0 otherwise. The coefficient estimates from the regression are then used to calculate the effect of regret on the likelihood of changing order strategy from the prior order (where order strategy refers to the use of a market or limit order) under various situations. The sample includes orders placed by individual investors on the Shanghai Stock Exchange from October 2003 to September 2004 and excludes observations if the previous order by the same investor was cancelled or was within 5 minutes of the current order. *Change in Order Strategy* is an indicator variable that is 1 if the current order strategy (i.e., whether a market or limit order is placed) is different from that of the prior order, and is 0 if both the current and prior order were of the same type (i.e., both were market or both were limit orders). *Regret* is measured over the previous order and is defined as the difference between the return on a hypothetical order strategy and the return on the actual order strategy calculated till the time of the current order. See Section 2 for the definition of the hypothetical order strategy. In all four cases, the effect of regret is statistically significant at the 1% level. For both the "Different Stock" group (left two bars) and the "Same Stock" group (right two bars), the case in which the prior order is of EXECUTED has a statistically greater "regret effect" than the case in which the prior order is NOT EXECUTED. See Section 3.5.1 for further details.

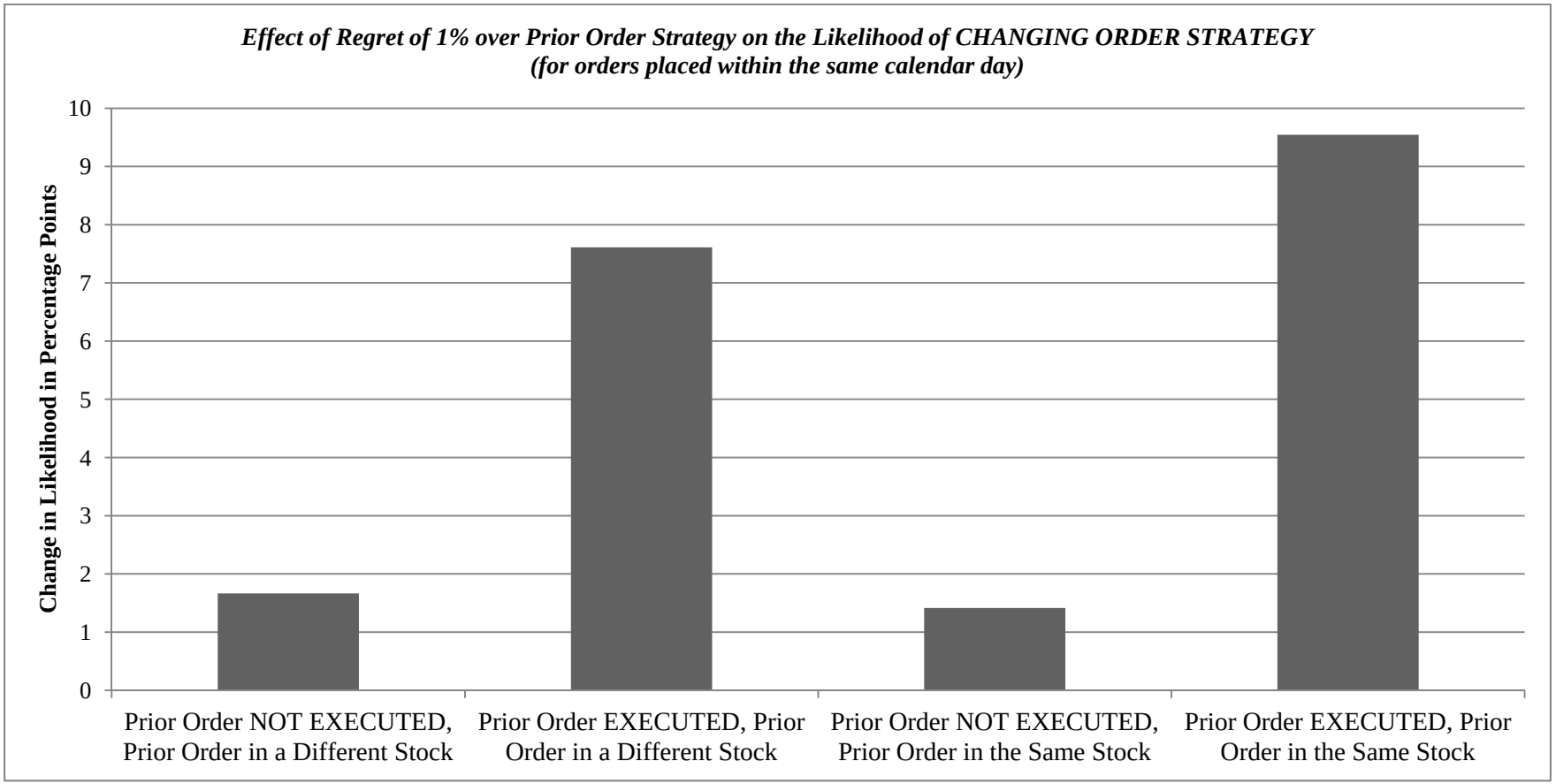

Figure 3: Effect of Regret on Subsequent Order Strategy – Prior Order had Positive or Negative Return

This figure reports results from a linear probability model (OLS) for *Change in Order Strategy*. An extension of Specification (2) in Section 3.4 is estimated in which all the variables in the specification are interacted with whether the prior order, if executed, earned a *Positive Return* or *Negative Return*. *Positive (Negative) Return* is an indicator variable that is 1 if the prior order was executed and earned a positive (negative) return until the time of the current order, and is 0 otherwise. The coefficient estimates from the regression are then used to calculate the effect of regret on the likelihood of changing order strategy from the prior order (where order strategy refers to the use of a market or limit order) under various situations. The sample includes orders placed by individual investors on the Shanghai Stock Exchange from October 2003 to September 2004 and excludes observations if the previous order by the same investor was cancelled or was within 5 minutes of the current order. *Change in Order Strategy* is an indicator variable that is 1 if the current order strategy (i.e., whether a market or limit order is placed) is different from that of the prior order, and is 0 if both the current and prior order were of the same type (i.e., both were market or both were limit orders). *Regret* is measured over the previous order and is defined as the difference between the return on a hypothetical order strategy and the return on the actual order strategy calculated till the time of the current order. See Section 2 for the definition of the hypothetical order strategy. In all four cases, the effect of regret is statistically significant at the 1% level. For both the "Different Stock" group (left two bars) and the "Same Stock" group (right two bars), the case in which the prior order earned a NEGATIVE RETURN has a statistically greater "regret effect" than the case in which the prior order earned a POSITIVE RETURN. See Section 3.5.2 for further details.

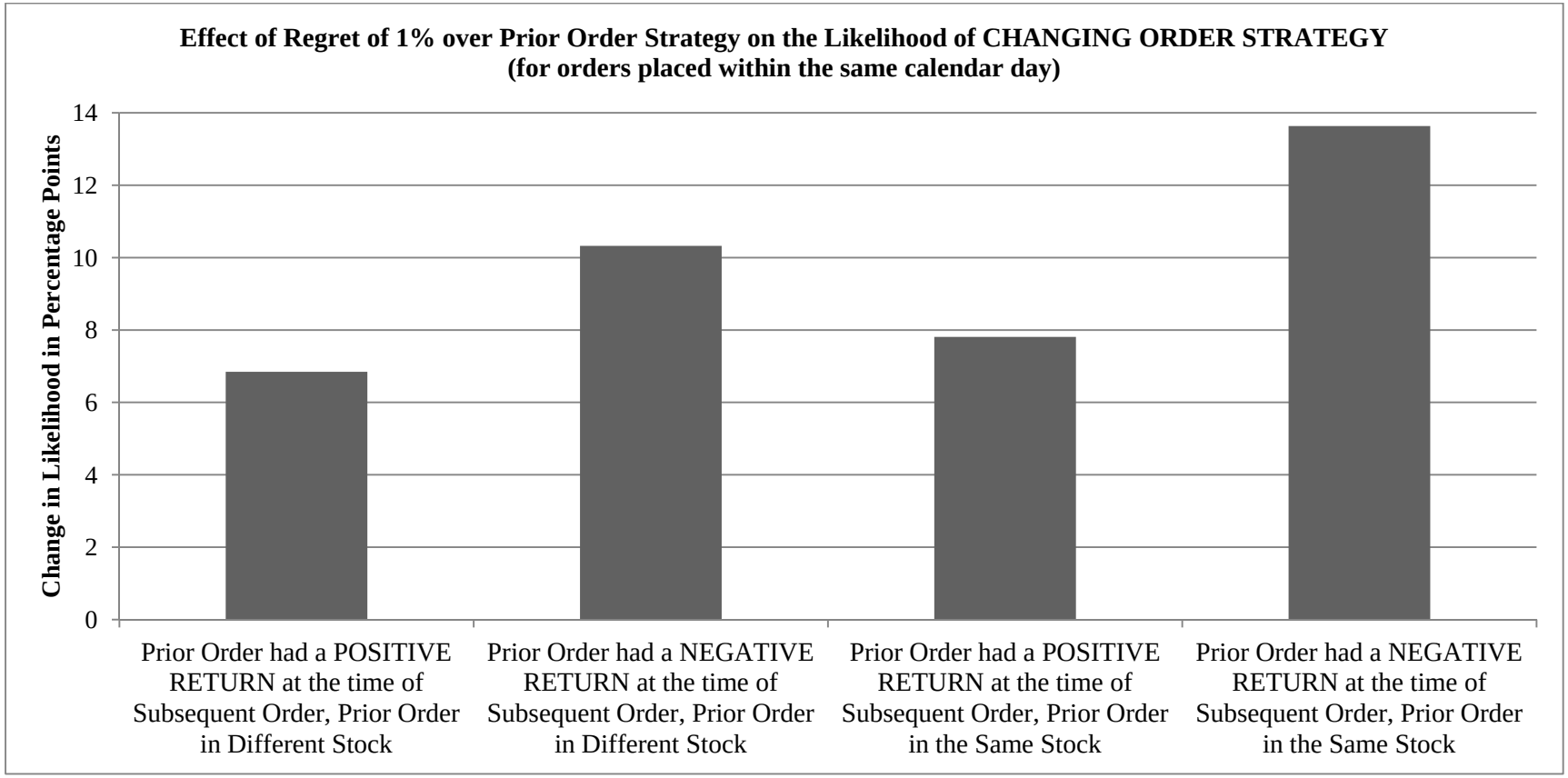

Figure 4: Effect of Regret on Subsequent Order Strategy – Deviation of Prior Order from Past 10 Orders

This figure reports results from a linear probability model (OLS) for *Change in Order Strategy*. An extension of Specification (2) in Section 3.4 is estimated in which all the variables in the specification are interacted with *Deviation*. *Deviation* is a continuous variable that takes on values between 0 and 1 and represents how different the order type of the prior order was to the average order type made in the 10 orders preceding it. Order type refers to whether the order is a market or a limit order. A value of zero indicates no deviation of the prior order type from the order types of the 10 orders preceding it (i.e., the prior order and the 10 orders preceding it were either all market orders or all limit orders). A value of one indicates a complete deviation of the prior order type from the order types of the 10 orders preceding it (e.g., the prior order was a market order and the 10 orders preceding it were all limit orders). The coefficient estimates from the regression are then used to calculate the effect of regret on the likelihood of changing order strategy from the prior order (where order strategy refers to the use of a market or limit order) under various situations. The sample includes orders placed by individual investors on the Shanghai Stock Exchange from October 2003 to September 2004 and excludes observations if the previous order by the same investor was cancelled or was within 5 minutes of the current order. *Change in Order Strategy* is an indicator variable that is 1 if the current order strategy (i.e., whether a market or limit order is placed) is different from that of the prior order, and is 0 if both the current and prior order were of the same type (i.e., both were market or both were limit orders). *Regret* is measured over the previous order and is defined as the difference between the return on a hypothetical order strategy and the return on the actual order strategy calculated till the time of the current order. See Section 2 for the definition of the hypothetical order strategy. In all four cases, the effect of regret is statistically significant at the 1% level. For both the "Different Stock" group (left two bars) and the "Same Stock" group (right two bars), the case in which the prior order type is a TOTAL DEVIATION from past order strategies has a statistically greater "regret effect" than the case in which the prior order type is NO DEVIATION from past order strategies. See Section 3.5.3 for further details.

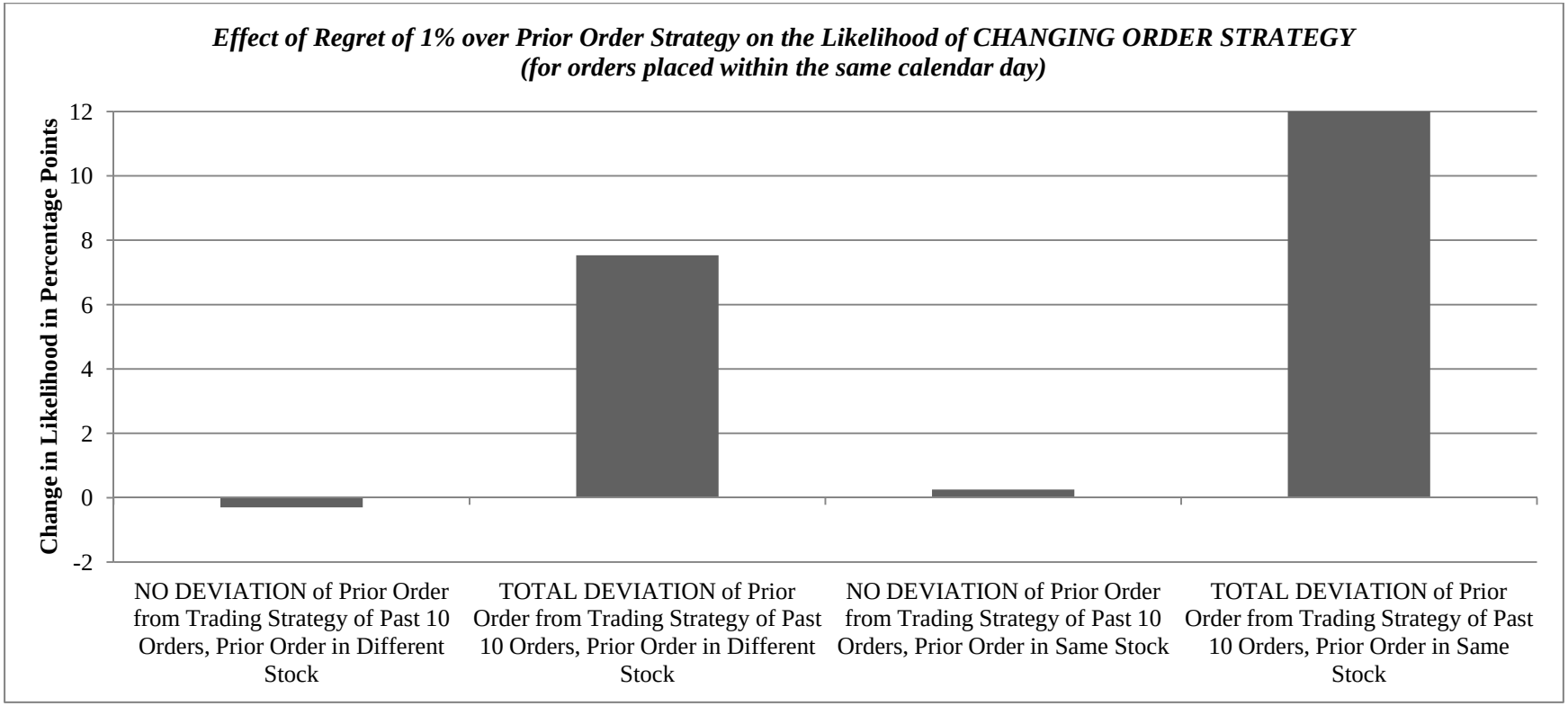

Figure 5: Effect of Regret on Subsequent Order Strategy – Deviation of Prior Order from Orders in Past Month

This figure reports results from a linear probability model (OLS) for *Change in Order Strategy*. An extension of Specification (2) in Section 3.4 is estimated in which all the variables in the specification are interacted with *Deviation*. *Deviation* is a continuous variable that takes on values between 0 and 1 and represents how different the order type of the prior order was to the average order type made during the month preceding it. Order type refers to whether the order is a market or a limit order. A value of zero indicates no deviation of the prior order type from the order types in the month preceding it (i.e., the prior order and all the orders in the month preceding it were either all market orders or all limit orders). A value of one indicates a complete deviation of the prior order type from the order types in the month preceding it (e.g., the prior order was a market order and the orders in the month preceding it were all limit orders). The coefficient estimates from the regression are then used to calculate the effect of regret on the likelihood of changing order strategy from the prior order (where order strategy refers to the use of a market or limit order) under various situations. The sample includes orders placed by individual investors on the Shanghai Stock Exchange from October 2003 to September 2004 and excludes observations if the previous order by the same investor was cancelled or was within 5 minutes of the current order. *Change in Order Strategy* is an indicator variable that is 1 if the current order strategy (i.e., whether a market or limit order is placed) is different from that of the prior order, and is 0 if both the current and prior order were of the same type (i.e., both were market or both were limit orders). *Regret* is measured over the previous order and is defined as the difference between the return on a hypothetical order strategy and the return on the actual order strategy calculated till the time of the current order. See Section 2 for the definition of the hypothetical order strategy. In all four cases, the effect of regret is statistically significant at the 1% level. For both the "Different Stock" group (left two bars) and the "Same Stock" group (right two bars), the case in which the prior order type is a TOTAL DEVIATION from past order strategies has a statistically greater "regret effect" than the case in which the prior order type is NO DEVIATION from past order strategies. See Section 3.5.3 for further details.