Naive Diversification and Narrow Framing Among Individual Investors

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Abstract

We show that individual investors buying multiple stocks on the same day often employ the naive diversification $1/N$ rule for dividing money amounts equally across buy-day purchases. The use of this rule-of-thumb is common across investors by age, gender and timing of the purchase, and only decreases modestly as the financial stakes increase. However, investors appear not be using a $1/N$ portfolio allocation rule. Focusing on individuals who "top-up" positions in their portfolios by adding to existing stocks, we show that these investors appear to narrowly frame the buy-day allocation decision independently of their existing portfolio. They use a $1/N$ rule for dividing monies across new purchases on the buy-day, not as a rule for obtaining equal portfolio shares. Hence very few investors maintain a $1/N$ portfolio allocation. In addition, many investors appear to jointly determine their total buy-day investment and number of stocks so that the $1/N$ calculation is made simpler, for example buying 2 stocks with spends of £2000 or £4000, but 3 stocks with a spend of £3000.

Keywords: investor behavior; portfolio allocation; naive diversification; narrow bracketing

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1 Introduction

When faced with complicated financial tasks, individuals can turn to simple heuristics for making decisions. Instead of attempting complex calculations, they might adopt rules-of-thumb, such as setting their level of saving to be constant fraction of their income, or choosing a mortgage contract that keeps their monthly repayments at a target value. The types of rules-of-thumb that individuals use in practice are important for developing realistic models of individual behavior and informing policy design.

In this paper we investigate how individuals go about approaching a common, yet complex, financial choice: splitting investments across multiple stocks. Portfolio theory guides investors towards holding optimally diversified portfolios comprising multiple stocks (Markowitz, 1952). But prior studies of investor behavior find that individual investors appear not to hold the optimally diversified portfolios implied by theory and tend to exhibit biases such as over-trading, sensitivity to gains compared with losses and rank effects.[1]

We explore how individual investors go about building their stock portfolios in practice. The innovation in our paper is that we study "buy-days" on which investors purchase multiple stocks. Portfolio theory implies that investors should consider the balance of their whole portfolio, and purchase new stocks so that their portfolio is optimally balanced. That is, investors should be taking a portfolio-level decision, integrating information about their existing portfolio position with the new purchases. In contrast, we find that a very large fraction of investors reduce the complexity of this problem by adopting a $1/N$ rule-of-thumb, approximately equalizing the money amount invested across the stocks bought on the buy-day without regard to the composition of their portfolio. In our data sample, half of individual investors adopt this *naive diversification* rule-of-thumb

[1] Individual investors appear not to hold the optimally diversified portfolios implied by modern portfolio theory (Markowitz, 1952). Instead, individual investors typically hold only a few stocks (Barber and Odean, 2000), in under-diversified portfolios (Goetzmann and Kumar, 2008). Individual investors also tend to adjust their portfolios by selling gains more than losses (Odean, 1998) and by tending to sell the extreme winning or losing positions within their portfolio (Hartzmark, 2015). In addition, investors appear susceptible to overconfidence, evidenced in trading too often (Barber and Odean, 2000). These findings from the prior literature suggest that investors do not approach the problem of building and adjusting their portfolios using sophisticated diversification strategies.

at least once.

We go on to show that, on subsequent multiple stock buy-days, investors continue to use a $1/N$ rule-of-thumb to split the monies invested on each buy-day. The net result is that they accrue portfolios that are some distance away from a $1/N$ allocation. That is, investors appear to be using the $1/N$ rule only to split monies over new purchases and not as a rule for determining portfolio shares. Hence the net effect of many buy-days is to create portfolios away from the $1/N$ allocation, in many cases appearing quite complex.

Our results strongly suggest that investors exhibit *narrow framing*, approaching the allocation of buy-day decisions with reference only the stocks they are buying, acting as if without reference to their existing portfolio. Investors appear to fail to integrate information about their existing portfolio when making this allocation. Unless one looks at individual buy-days, the use of the $1/N$ heuristic for buying is hidden in the resulting portfolio positions, in part due to the aggregation over many trades and in part due to movements in the prices of the stocks within the investor's portfolio.

The data we use is provided by a mainstream brokerage platform in the United Kingdom (UK) and covers a large sample of UK individual investors building portfolios containing common stocks through the brokerage business. We examine the allocation decisions of over 40,000 investors on 190,000 "buy-days" involving new purchases of multiple stocks. Our first contribution is to show that $1/N$ behaviour is a common rule-of-thumb used by investors to split their monies invested on the days across stocks. We show this for values of N ranging from 2 to 5 (there are very few observations of buy-days involving more than 5 stocks).

We find that the proportion of investors adopting $1/N$ splitting is remarkably similar across investors by their age and gender. This result is in contrast to previous studies which find gender differences in trading behaviour among individual investors (Barber and Odean, 2001). Additionally, the proportion of investors adopting the $1/N$ strategy remains similar across day of the week on which the investment is made and month of the year in which the investment occurs, suggesting that this behaviour does not only occur when investors face high opportunity costs of time in making portfolio decisions such as on Fridays, a day on which investors are less responsive to earnings announcements (Dellavigna and Pollet, 2009).[2]

In further analysis we show that the propensity to use the $1/N$ rule–of–thumb decreases, if only modestly, with investor experience and as the financial stakes of the buy-day investment increase. The proportion of investments made $1/N$ falls with the length of time the investor has held the trading account and with the frequency with which the investor trades. Nevertheless, among top quartile of buy-days by these characteristics the proportion of investments made $1/N$ is typically in excess of 25%. The proportion of investments split $1/N$ also decreases as the difference in recent and future stock performance between stocks widens. However, among the top quartile of stock-pairs chosen by investors by difference in recent and future returns the proportion of investments made $1/N$ again remains above 20%. Hence $1/N$ investing is only modestly sensitive to the economic stakes of investing.

One obvious explanation for our main result could be that the trading platform provided by the broker creates a default $1/N$ allocation for investors buying multiple stock and many investors choose to stick with this default. However, this is not the case as the trading interface requires investors to key in the amount they wish to invest in each stock separately and does not generate a default $1/N$ allocation, or present the suggestion that $1/N$ is a recommended allocation.

In further analysis, we show that investors appear to use the $1/N$ rule-of-thumb as a rule of allocating monies across new purchases of stock and not as a portfolio asset allocation rule. The cleanest setting in which we can distinguish between $1/N$ as a buy-day rule vs. an asset allocation rule is when an investor "tops up" existing positions in N stocks. For example, an investor holding positions in stocks A and B who, on a buy-day, buys additional units of stock A and B could decide split the new monies invested 50:50 across A and B, or split the new monies such that at the end-of-day the ratio of the total positions in A and B is 50:50 (or make some other allocation). We find that the former case—splitting new monies invested 50:50—is overwhelmingly more likely. Hence

[2] Prior studies have also uncovered a "January effect" whereby there is a seasonal increase in stock prices during the month of January. See Bhardwaj and Brooks (1992)

our evidence suggests that $1/N$ splitting is a “buy-day rule”. This finding in consistent with previous studies which show that consumers tend to separate the choice problem of a buying new stocks in isolation from the position of their existing portfolio.

We interpret investors’ use of the $1/N$ rule as a buy-day rule as an example of choice bracketing (Read et al., 1999) in which investors construe their task narrowly. Instead of addressing the normative question of how their whole portfolio might be rebalanced, they are addressing the cognitively easier (but more narrow) question about only the additional stocks that they purchase. As in many applications of individual reasoning, people are replacing a cognitively hard task with a cognitively easier one (cf. Kahneman and Tversky, 1982).

This result highlights an important distinction between $1/N$ asset allocation within a portfolio and $1/N$ as a buy-day rule for splitting new monies across purchases. DeMiguel et al. (2009) show that, if expected returns of stocks are independently proportional to their variance (i.e., risk), a $1/N$ portfolio allocation is an optimal choice. It is well known that Markowitz relied on a simple $1/N$ portfolio allocation rule in his own asset allocation decisions.[3] A line of research in psychology suggests that people tend to think that a reward is proportional to a corresponding risk (Pleskac and Hertwig, 2014). Thus, if investors have certain beliefs about the proportionality between risk and reward, a $1/N$ portfolio position may be optimal given beliefs. However, because our investors are buying with $1/N$ and the aggregate effects of many such buys is portfolios away from $1/N$, our investors’ depart from optimal behavior under this risk-reward heuristic.

We also examine the joint decision which investors make in determining the number of stocks to be purchased on the day and the total buy–day investment. Strikingly, investors appear to adjust both margins in order to make the $1/N$ task mathematically simple. When N=3, the distribution of total investment amounts is dominated by round number multiples of 3, with heaping at £3,000, £6,000, £9,000, £15,000 and £30,000. When N=4, the distribution shows heaping at £4,000, £8,000, £20,000 and £40,000. This leads to

[3] Gerd Gigerenzer writes: *“Markowitz proved that there is an optimal portfolio that maximizes the return and minimizes the risk. One might assume that when he made his own retirement investments he relied on his award-winning optimization strategy. But he did not. Instead he relied on a simple heuristic, the* $1/N$ *rule: Allocate your money equally to each of* N *funds”* p. 9 of (Gigerenzer, 2008)

odd and discontinuous behaviour, with investors likely to buy exactly two stocks with total investments of £20,000 and £40,000, but 3 stocks with a total investment of £30,000. We cannot reject the notion that investors make a joint decision to highly simplify their investment tasks, even when this results in large monetary value shifts in the monies invested on the day.

Finally, we broaden our analysis to all buy-days (single-stock or multiple-stock) to explore whether any investors buy stocks as if they are targeting $1/N$ portfolio allocations. We find only a small subset of investors appear to use this rule, investing an amount in a new position that equals the value of their existing positions in other stocks such that they end the day with $1/N$ portfolio allocation.

While our results show that naïve diversification strategies are common, they should be taken with the caveat that at least the investors in our sample are purchasing multiple stocks and de facto achieving some degree of diversification their portfolios, albeit in a crude manner. Investors typically hold too few stocks and investors choosing to hold portfolios of single stocks is not uncommon (Barber and Odean, 2013). Naïve diversification is an improvement on no diversification at all. Nevertheless, our results show investor behaviour is far from the sophisticated strategies suggested by theory.

Our paper is closest to the well-known study by Benartzi and Thaler (2001) who examine how employees newly enrolled in defined contribution retirement savings plans divide their contributions between options offered in the plan. They find that a large share of employees use a simple $1/N$ asset allocation rule, where N is the number of options in the plan.[4] The end result is that, unlike our investors who make multiple decisions, these single-decision investors have retirement savings portfolios with $1/N$ in each option—they have 1/N portfolios.

It is perhaps surprising that a large share of our sample of individual investors, who are typically higher net worth compared with the population of company employees, employ what appears to be an even more naïve diversification strategy of splitting their buy–day

[4] Huberman and Jiang (2006) also find that employees tend to allocate contributions equally across funds, though this effect weakens as the number of funds used increases. They also find that employees tend to use only a small number of the investment funds made available to them within the plan.

equally across stocks. The fact that many individual investors exhibit the same naïve diversification suggests that the observed behavior in Benartzi and Thaler (2001) is not an artefact of recommendation bias (where investors take a cue that naïve diversification is the implied behaviour arising from the number of options offered in the plan) and does not arise endogenously with the options offered (due to, for example, firms offering plan options which match the preferences of their employees).

Our result also relates to a broader psychological literature which demonstrates that individual engage in naïve diversification strategies in a range of domains. Rubinstein (2002) shows that investors diversify their gambles across lottery choices in line with the probability of each outcome, even when one option stochastically dominates others. Gathergood et al. (2017) show that when individuals allocate repayments across multiple credit cards they tend to split repayments in proportion to the balances on each card, instead of prioritising repayments to the card with the highest interest rate. An explanation for this behaviour offered in the psychology literature in the classic work of Herrnstein (1961) is that in choice problems individuals tend to 'match' their allocations to an observable margin (probabilities in a lottery, balances on a credit card, or number of stocks on a buy-day) even when the observable margin is not the margin on which the individual should optimise.

2 Data

2.1 Brokerage Account Data

We use data from a large mainstream UK based discount brokerage platform. The data consist of transaction history of 182,569 accounts held with the broker between April 2014 and February 2017. Among these, 135,153 accounts have at least one buy or sell transaction within the data period. The data include stock identification numbers (Stock Exchange Daily Official List (SEDOL) numbers, a list of security identifiers used in the United Kingdom and Ireland for clearing purposes), transaction dates, transaction types (e.g., buy, sell), transaction quantities, and transaction prices. The data include accounts that open and close within the time period. We use SEDOL numbers to match in additional data on individual stock performance via Datastream.

2.2 Sample Selection

Our interest is in how individuals choose to allocate monies invested on buy-days involving purchases of multiple stocks. A “buy-day” is a day in which the investor makes a purchase of common stock, either opening a position in a new stock, or adding additional stock to an existing position. We focus our analysis upon buy-days involving new positions, or additional investments in existing positions, in two or more stocks. We call these days “multiple stock buy-days”. In our data we rarely see investors open positions or add to positions in more than five stocks on a buy-day.

Our analysis focuses on two samples. First, we draw a sample of all accounts in which we see at least one multiple-stock buy-day. The sample includes accounts already open at the beginning of our data period and also new accounts which open within the data period. This sample restriction provides 42,478 accounts (36% of all accounts which make at least one buy trade in the sample period) and 188,359 multiple-stock buy-days.

Second, from the first sample we draw a sub-sample of new accounts which are opened within the data period. For this sub–sample of new accounts we have richer data in that we observe the complete portfolio position of the account from opening date onwards, including cases where existing positions are transferred into the account from another broker service. This sample restriction provides 8,194 accounts (33% of accounts in this sample which make at least one buy trade in the sample period) and 20,685 multiple-stock buy-days. In a later version of this paper we hope to extend out analysis by matching daily portfolio positions for the sample of existing accounts as well as this sample of new accounts.

Summary statistics for the sample of all accounts and new accounts are shown in Table A1 and Table A2. Among the all accounts sample approximately 71% of account holders are male. The average age of the account is six and a half years. Account holders make on average 1.6 trades per month, with an average investment amount of over £13,500 on a multiple-stock buy-day (median value is close to £6,000). Among the sample of new accounts, for which we have additional information, we see that investor portfolios are worth on average £45,000 with an average investment amount on a multiple stock buy-day of £9.000. Portfolios contain on average 8 individual stocks and investors engage in on average of 1.4 trades per month.

3 1/N Buying on Multiple Stock Buy–Days

We begin by showing allocations across purchased stocks on two-stock buy-days. We use the sample of all two-stock buy-days, including those on which investors make additional purchases of stocks they already hold in their portfolio. We calculate the percentage of the total buy-day investment (in pounds sterling and net of fees) that is allocated to each stock. Choosing one of the two stocks at random to be "Stock A", Figure 1 plots the proportion of the buy-day investment allocated to Stock A among all buy-days in the sample. The width of each bin is 1%.

Strikingly, Figure 1 shows large heaping in the bars at 49%–51%. In total 28.9% of two-stock buy-days involve allocations in the 49%–51% interval. This suggests that many investors choose allocations that are close to a 50%:50%, i.e., $1/N$ allocation, and may be using that rule as a heuristic to guide their allocation choices.

Of course, the non-divisibility of individual stocks means that investors could not in all cases make precise $1/N$ allocations (even if they wanted to). Hence the relevant interval in which we could detect *approximate* $1/N$ allocations is not self-evident.[5] For example, consider the case that an investor intends to invest £1,000 to buy two stocks, called Stocks A and B, and that a price of Stock A is £4.50 per unit and a price of Stock B is £100.50 per unit. Were the investor to aim for a 1 / N allocation the precise stock split generating an equal money cost split would be: Stock A = £500/£4.50 = 111.11 units, Stock B £500/£100.50 = 4.96 units. Unlike mutual funds, which allow purchases in fractional units, purchases of common stock must be made in non-divisible single units. Due to this non-divisibility in common stock investing, the investor cannot invest £500 for each stock and so might instead decide to buy 111 shares of Stock A with a cost of 111

[5] Figure A1 illustrates a version of Figure 1 with a bin width of 2%.

× £4.50 = £499.50 and to buy shares of Stock B with a cost of 5 x £100.50 = £502.50. Thus, the allocation of the investment to Stock A is £499.50 / (£499.50 + £502.50) = .498 and that to Stock B is .502.

This simple example serves to make the point that investors employing a $1/N$ heuristic would most likely achieve an allocation close to $1/N$. Moreover, we do not imagine that investors of a type who tend to adopt a heuristic approach to decision making would employ the form of precise calculation above. Instead we envisage that, in the mode of "fuzzy math" in heuristic decision making, they would seek instead to achieve a close to $1/N$ allocation if not the exact closest possible allocation.

Therefore, as our choice of the 49%–51% interval in Figure 1 is somewhat arbitrary, as a sensitivity check Table 1 reports the proportion of multiple-stock buy-days in which a buy-day investment of £P is split such that the money value of stock purchases are divided in the intervals $£P/N \times (1 \pm X)$ where X takes values of 0.02, 0.05 and 0.1. in Panels A–C. In the two-stock case these intervals translate to a proportion of the total buy-day investment invested in Stock A of 49%–51% (Panel A), 47.5%-52.5% (Panel B) and 45%-55% (Panel C). 95% bootstrapped confidence intervals are also reported in the table. Of the close to 190,000 multiple stock buy-days in the data, approximately 71% involve two stocks.

The estimates in Table 1 show that, for two stock buy-days, allocations across stocks fall in the $1/N$ interval in between one quarter and one third of cases depending on the width of the defined interval. As the number of stocks purchased on the multiple stock buy-day increases, the proportion of allocations falling within the range decreases, illustrated in Figure 2. This will be in part due to the non-divisibility of individual stocks yielding $1/N$ allocations less likely as the number of stocks purchased rises. Across all buy-days involving multiple stock purchases, 47.6% CI[47.1%, 48.1%] of investors exhibit at least one buy-day on which they make an allocation in the interval $£P/N \times (1 \pm X)$ with $X = 0.02$.

It is clear that a large share of multiple-stock buy-days are resulting in $1/N$ allocations. A natural question to ask is whether there is some mechanical means by which investors would end up with $1/N$ allocations. For example, if the investment platform uses an interface in which a $1/N$ allocation is presented as an on-screen default, inertia in individual behaviour might lead investors to accept this default. However, the platform used by the brokerage did not automatically default, or suggest, equal money investments across multiple stocks. Investors were required to key in their investment amount for each stock separately, with no default allocation or recommended allocation shown on screen.

4 1/N Buying and Investor Characteristics

In the following sections we explore how $1/N$ buy-day allocations vary with investor characteristics, characteristics of the stocks purchased on the buy-day, and characteristics of the portfolio held by the investor. First, we explore how the tendency of individual investors to make in $1/N$ buy-day allocations on two-stock buy-days varies with investor characteristics.

4.1 Age and Gender

We first explore the propensity to make $1/N$ buy-day allocations across investors by gender. Prior studies have found that men tend to trade more actively and aggressively than women (Dorn and Huberman, 2005; Agnew et al., 2003; Choi et al., 2002; Mitchell et al., 2006). As more active traders, we might also expect that men tend to be more confident in making allocation decisions of their own volition and might not therefore adopt a $1/N$ heuristic. Figure 3 Panel A shows a box plot of the bootstrapped estimate of the percentage of two-stock buy-days in which the investment is split within the 49%–51% interval by gender.[6] The plot shows that the proportions of $1/N$ buy-day allocations are very similar across men and women. Figure A2 shows the similarity in histogram plots for men and women separately. The figure shows that there are no notable differences in the distributional characteristics of the buy-day allocation by gender.

Prior research has also found a relationship between age and investor behavior. Investment performance typically declines with age, possibly due to age related declines in

[6] We use this interval to identify allocations $1/N$ buy-day allocations throughout this section of the paper.

cognitive abilities (Korniotis and Kumar, 2013). It might be possible that older investors are more likely to adopt a $1/N$ heuristic if declining cognitive ability reduces their capacity to choose a stock allocation. Figure 3 Panel B shows the same plot by decade of birth. Very few investors in the sample were born in the 1930s or the 1990s, the age distribution is shown in Figure A3. The plot illustrates a similar propensity to engage in $1/N$ stock buying across investors by age. Figure A4 shows the similarity in histogram plots for investors by each decade of birth. This pattern in investor behavior suggests that the tendency to engage in $1/N$ buy-day allocation does not decline with age.

4.2 Day of the Week and Month of the Year

Next we consider whether the propensity to engage in $1/N$ buy-day allocation exhibits day of the week or month of the year effects. Prior studies have found day of the week effects, including the so-called "Friday effect" whereby the market reaction to earnings announcements is less pronounced on Fridays (Dellavigna and Pollet, 2009), though this has not yet been detected in individual investor trading behavior (Hirshleifer et al., 2008). Potentially, a $1/N$ heuristic might be more commonly adopted as a "Friday rule" if investors devote less cognitive resource or attention to their investment allocation on days when they have depleted cognitive resource to due tiredness or face increased distractions.

Figure 4 Panel A reproduces the box plot figure by day of the week on which the trade is booked. This is reflected in the increased sample size of Monday trades compared with the average number of trades on Tuesday to Friday, shown in Figure A5. The box plot indicates a slightly downward trend in the proportion of $1/N$ buy-day allocations through the week, though the differences are small. Figure A6 confirms that the histogram plots are very similar for each day of the week.

Month of the year box plots are shown in Figure 4 Panel B. The distribution of buy-days is even across months of the year. Figure A7 shows no marked seasonality in the proportion of $1/N$ buy-day allocations, but there is some evidence of a small "December effect" uptick in the proportion of $1/N$ buy-day allocations, consistent with individuals being slightly more likely to adopt this rule in December when the opportunity cost of investing time, or potential distractions, are perhaps higher. Figure A8 again shows very similar histogram plots across months of the year.

4.3 Experience and Trading Frequency

Next we explore account tenure as a measure of investor experience. There is evidence from the prior literature that investor behavior tends to evolve over time. For example, studies have found that investors tend to learn to avoid the disposition effect as they gain more trading experience (Seru et al., 2010; Feng and Seasholes, 2005). While a $1/N$ buy-day allocation might be a naïve action of a new investor, with experience investors may become more informed or confident to choose alternative allocations. Figure 5 Panel A shows the box plot illustration across quartiles of the distribution of account tenure. This is an imperfect measure of investor experience as it measures only tenure on the account with this stock broker and also excludes from measurement any experience in other asset classes. Measured in months from account opening, the quartile cut values are 25% : 24 months; 50% : 60 months and 75% : 110 months. Figure 5 Panel A shows that the propensity to engage in $1/N$ buy-day allocations falls with tenure, though remains above 25% among the top quartile.

We also consider trading frequency, measured as the number of trades executed per month. This measure includes all buy and sell trades, whether single stock or multiple stock. A large number of studies have examined the relationship between trading frequency and performance, typically finding that frequent trading tends to result in lower returns (Barber and Odean, 2001). Figure 5 Panel B shows the box plot illustration across quartiles of trading frequency. The cut values of trades per month are 25% : 0.9 trades, 50% : 1.8 trades; 75% : 9.2 trades. As can be seen from the figure, the most frequent traders are much less likely to choose a $1/N$ buy-day allocation. Among the top quartile sub-sample, fewer than 20% of multiple stock buy-days are within the $1/N$ range compared to approximately 35% in the lowest quartile. Figure A10 confirms this pattern in the histogram plots.

5 1/N Buying and Investment Characteristics

In this sub-section we explore how the propensity of investors to make $1/N$ stock buying allocations varies by the financial characteristics of the buy-day investment. The tendency to adopt a $1/N$ buying heuristic might reflect investor inattention to a low financial stakes decision. If investors face fixed optimisation frictions (such as a fixed cognitive cost of optimising a portfolio allocation), then we would expect the $1/N$ buy-day allocation to become less prevalent as the financial stakes increase and thus the incentive to devote attention and cognitive resource to the investment task rises. We consider the financial stakes of the investment choice in terms of the performance of the stocks purchased on the multiple stock buy-day and the total amount invested on the day.

5.1 Investment Amount on the Day

We also consider the total amount invested on the day. As this total investment rises and financial stakes increase, we might expect investors to become more attentive to their stock buying decisions, which may make them less likely to adopt the simple $1/N$ buy-day allocation rule. In a fixed optimisation cost model, the magnitude of the potential returns from a big investment will make it worth paying the optimisation cost (e.g. time cost) in order to achieve improved portfolio allocations.

The total amount invested on the day is the simple sum of the two stock purchases. We again illustrate the proportion of buy-days adopting the $1/N$ buy-day allocation rule across quartile sub-samples. Among the sample the median investment amount on the day is £5,200. The quartile cut values are 25% : £2400, 50% : £5,200 and 75% : £11,200. Figure 6 Panel A shows the box plot illustration by quartiles of investment amount on the day. The proportion of buy-days exhibiting $1/N$ buy-day investing falls as the investment amount increases, but this relationship is notably not monotonic, with the proportion increasing between the second and third quartiles, before falling at the fourth quartile. Figure A13 shows the histogram plots and confirms this non-monotonic pattern, which is attributable to less bunching at the centre of the distribution in the second quartile.

This pattern appears inconsistent with a fixed optimization cost model, in which case we would expect to see a monotonic decline in the use of a $1/N$ heuristic as the financial stakes increase. Later in our analysis we return to this pattern in behavior, which appears to arise due to investors making joint decisions over their investment amount on the day and the number of stocks purchased - in particular a tendency for investors to choose a total investment amount in order to simplify the $1/N$ calculation. This results in high value investment amounts (e.g. at higher around number multiples of 2 such as £10,000 and £20,000) being more popular among investors making $1/N$ allocations compared with lower value investment amounts.

5.2 Difference in Past and Future Returns

If investors anticipate that the stocks under consideration on the buy-day are likely to yield large differences in future returns then we might expect the simple $1/N$ buy-day allocation heuristic to be a less common allocation choice. To examine this, we explore how $1/N$ buy-day allocation relates to the difference in past returns, or the difference in future returns, between the two stocks purchased on the two-stock buy-day. We use the simple difference in gross returns over the previous 3 months, excluding dividend payments, capital gain taxes due or trading fees. This is a simple measure of recent stock performance. We then separate the sample into quartiles by the difference in returns.

Figure 6 Panels B and C shows the box plot illustration for past returns. The quartile cut values are 25% : 6.1% , 50% : 14.2% and 75% : 29.6%. The proportion of buy-days adopted the $1/N$ buy-day allocation rule declines with the difference in past returns and is notably lower in the top quartile sub-sample compared with the third quartile. A similar pattern in seen in Figure 4b for future returns, with quartile cut values of 25% : 6.1%, 50% : 13.6% and 75% : 26.7%. Again, the proportion of buy-days adopting the $1/N$ buy-day allocation rule drops in the top quartile sub-sample compared with the third quartile. Figure A11 and Figure A12 show the histogram plots in each quartile, confirming the drop in the central mass at the top quartile sub-samples.

6 1/N Buying and Portfolio Characteristics

We also examine $1/N$ buy-day allocation behaviour by characteristics of the individual's existing portfolio. We can undertake this analysis for new accounts only. This is because we can reconstruct buy-day portfolios from transaction history only for new accounts because existing accounts will in most cases contain stocks before the beginning date of the available transaction data. Hence we can only build complete portfolios from transaction data for new accounts, as old accounts have a composition which is not seen by us at the beginning our of data period. We replicate our main result among new accounts in Figure A14, which shows that approximately 34% of two-stock buy-days are made in the 49%–51% interval among the sample of new accounts.

6.1 Portfolio Value

We next consider the relationship between $1/N$ buy-day allocation behavior and the total value of the individual's portfolio with the brokerage.[7] The cut points for quartiles by portfolio value are, 25% : £5,200, 50% : £13,800 and 75% : £34,800. Figure 7 Panel A illustrates that individuals with high value portfolios are less likely—but only a little less likely—to adopt a $1/N$ buy-day allocation rule: at the top quartile 28% of buy-days in involve a $1/N$ buy-day allocation, compared with 36% in the bottom quartile. Figure A16 confirms this pattern in the histogram illustrations.

6.2 Number of Stocks

Finally, we explore the relationship between $1/N$ buy-day allocation behavior and the number of stocks in the individual investor's portfolio. It is well documented that individual investors tend to hold only a few stocks (Barber and Odean, 2013). In our data the cut points for quartiles of the number of stocks held are 25% : 3, 50% : 5 and 75% : 8. Figure 7 Panel B shows the box plot illustration by number of stock held. Due to the smaller sample size of new accounts the confidence intervals from the bootstrap estimation are

[7] In our data we only observe the value of the portfolio held with one discount brokerage. Individual investors in our data may hold investments in common stock in other brokerage accounts, and we do not observe any information about investments held in other asset classes.

typically larger than in the analysis of all accounts. The box plot shows a tendency for the proportion of $1/N$ buy-day allocation buy-days to fall with the number of stocks held in the individual's portfolio. However, this decline is only modest with the proportion of buy-days in which the individual splits $1/N$ at 30% in the top quartile compared with 36% in the bottom quartile — the $1/N$ allocation heuristic is prevalent event for the largest portfolios. Figure A15 confirms this pattern in the histogram illustrations.

7 Taking Stock of 1/N Behavior

Taking stock of the results so far, what relationships do we seen between $1/N$ buy-day allocations in investor buying behavior and investor characteristics, investment characteristics, and portfolio characteristics? The results are consistent with $1/N$ behavior being unrelated to individual characteristics (gender and age) and non-financial characteristics of the trade (day of week / month of year), and only weakly sensitive to the financial stakes. As the stakes of the investment allocation decision increase, adopting a $1/N$ buy-day allocation becomes a less prevalent, but none-the-less persists even for the largest differences in returns and the largest investments. This is also true as the overall stakes of the portfolio rise, in terms of portfolio value, number of stocks held and trading frequency. Hence while these relationships exist, the slopes are not as steep as one might expect when financial stakes increase.

To draw together our results and compare strength of relationship of different factors influencing $1/N$ buy-day investing, we estimate cross-section regression models. The dependent variable is a dummy variable indicating whether the two-stock buy-day allocation follows a$1/N$ rule, again using the 49%–51% interval to define an approximate $1/N$ allocation.

Results are shown in Table 2. In the first column, the probit regression model includes only investor characteristics: gender, decade of birth and account tenure. Results indicate a lower likelihood of making a $1/N$ buy-day allocation among the oldest investors and among individuals who have held their brokerage accounts for longer period. In subsequent columns additional covariates are added to the model. Results confirm the pattern that the probability of investors making a $1/N$ buy-day allocation falls are the financial stakes increase, with negative marginal effects on portfolio value, the number of stocks purchased, difference in recent and future returns and the number of trades made per month.

8 Is 1/N a Buy-Day Heuristic or a Portfolio Allocation Rule?

In this section we explore whether investors use the $1/N$ heuristic as a buy-day rule for allocating monies across investments, or alternatively whether they use it as target portfolio balancing rule. In other words, do investors simply decide to split their new monies invested $1/N$ on the buy-day, or do they have $1/N$ in mind as a target for their allocation across their portfolio positions? This distinction is important for understanding why investors use the $1/N$ rule. As a target portfolio balancing rule, the $1/N$ rule is arguably a rule that performs well for investors. DeMiguel et al. (2009) compare the performance of a $1/N$ portfolio allocation rule against 14 alternative models and find that none is consistently better than $1/N$ in achieving a Sharpe ratio, certainty-equivalent return or turnover.

When we observe a new investor adopting a $1/N$ rule on a multiple stock buy-day, we do not know whether the investor is aiming for a $1/N$ allocation in his or her portfolio, or instead is adopting $1/N$ as a buying rule, as both are achieved in the snapshot of the day's trading. Perhaps the cleanest way to distinguish between these two reasons for achieving a $1/N$ allocation is to observe how an investor behaves when they enter the buy-day with existing positions in multiple stocks within their portfolio and then "top up" multiple positions on the day. Do investors split the top-up investment $1/N$ across new monies invested, or do they top-up such that the portfolio is balanced $1/N$ after the day's trades have been taken place?

To investigate this, Table 3 presents a breakdown of the starting positions, buying allocations, and ending positions of all two-stock buy-day accounts, with allocations measured at the end of the buy-day, using the sample of new accounts. In each panel the rows summarize eight mutually exclusive scenarios for account positions at the start of the day and activity during the day. The three panels use the same three intervals for defining the $1/N$ range as those used earlier (0.02, 0.05 and 0.10).

The first four rows in each panel summarize activity among accounts which begin the buy-day with $1/N$ allocations (defined as falling within the interval). Given the volatility of prices of common stock, unsurprisingly in Panel A only in 1.4% of observations does the investor's portfolio begin the day with a $1/N$ allocation. Of these 1.0% engage in $1/N$ buying and 0.9% engage is non-$1/N$ buying. At the day end, in 0.5% of cases the portfolio is balanced $1/N$ whereas in 1.8% of cases the portfolio is not within the $1/N$ range.

The vast majority of accounts (98.2%) fall within the bottom rows, beginning the day with allocations outside of the $1/N$ interval. Among these, in 29.7% of cases investors split their buy-day allocation $1/N$ and 68.5% of cases they choose some other allocation. In only 0.2% of cases does the portfolio position at the end of the day sit within the $1/N$ range. In Figure 9 we plot histograms with 1% bin width of the proportion of the buy-day investment allocated to (randomly chosen) Stock A shown in Panel A and the market value of Stock A over the total portfolio value (of holdings of Stocks A and B) at the end of the buy-day in Panel B. Panel A shows clear heaping around $1/N$ which is absent in Panel B.

This analysis makes clear that on buy-days investors do not buy additional stock such that they achieve a $1/N$ portfolio allocation. The $1/N$ allocation is popular as a buy-day strategy among investors topping-up positions, but is a very uncommon portfolio allocation at the end of the day. Therefore, we conclude that the vast majority of investors using a $1/N$ rule adopt it as a buy-day rule for allocating monies invested on the day evenly across purchases and not as a portfolio target allocation.

We interpret investors' use of the $1/N$ rule as a buy-day rule as an example of choice bracketing (Read et al., 1999) in which investors construe their task narrowly. When engaging in narrow bracketing, individuals tend to consider a single cognitive episode of choice separately from the wider choice context. This simplifies the immediate choice task, but can lead to unexpected and sub-optimal behaviors. Instead of addressing the normative question of how their whole portfolio might be rebalanced, they are addressing the cognitive easier (but more narrow) question of which new stocks they should purchase.

9 Do Investors Jointly Choose Investment Amounts and N?

In this section we explore the relationship between $1/N$ investor behavior and the size of the investment amount on the multiple stock buy-day. Investors who use the $1/N$ rule as a simple rule-of-thumb may also take other steps to simplify their investment calculations. In particular, they might jointly choose a total £amount to invest on the day and N stocks in order to make the division calculation simpler, say choosing to invest approximately £15,000 in three stocks with a simple calculation of approximately £5,000 in each stock. Of course, investors cannot achieve exactly £5,000 in each stock due to the non-divisibility of individual stocks, but they may use £5,000 as an approximate target value.

In Figure 10 we plot the investment amount on the multiple stock buy-day for different value of N. The striking feature of the plot is the heaping of investment amounts around simple round-number multiples of N. Beginning at Panel A with N=2, one observes heaping at values of £1,000, £2,000, £4,000, £10,000 and £20,000 – values which simply divide by two into large round number units. By contrast, in Panel B with N=3 we see investment amounts dominated by numbers which are simple multiples of 3, £1,500 £3,000, £6,000, £7,500, £9.000,£15,000 and £30,000. We further see this patterns when N=4 in Panel C with heaps at £2,000, £4,000, £8,000, £10,000, £12,000, £20,000, and £40,000 and when N=5 in Panel D with heaps at £2,500, £5,000, £10,000, £25,000 and £50,000. It is further striking that the modal investment bin is £2,000 when N=2, £3,000 when N=3, £4,000 when N=4 and £5,000 when N=5.

From these results we therefore cannot rule out the hypothesis that investors are not only utilizing $1/N$ as a simply rule for allocating monies across N stocks, but that they are choosing a total amount to be allocated on the multiple-stock buy-day such that $1/N$ becomes a simple calculation. An example of a compelling pattern pointing in this direction is the observation that people tend to buy 2 not 3 stocks with a spend of £2,000, 3 not 2 stocks with a spend of £3,000, but then 2 not 3 stocks with a spend of £4,000, suggesting that the total sum of money available for investment may be determining the number of stocks purchased in a very non-monotonic way. As discussed earlier on, the non-divisibility of individual stock implies that investors at the point of buying will only approximate $1/N$ allocations, as we saw earlier. Of course, we do not have experimental or natural sources of exogenous variation in either the total investment amount or N within or across investors. We therefore cannot rule out that an investor who invests, say, £4,000 when N=4 would also invest £4,000 when N=3 and have in mind equal amounts of £1333.33. However, these seem unlikely to us in the context of our broader results on the behavior of the investors in these data.

10 Do Any Investors Use a $1/N$ Portfolio Allocation Rule?

In this final section we explore more broadly whether investors buying single stocks appear to use a $1/N$ rule for portfolio allocation. Our earlier analysis shows this is only rarely achieved by investors buying multiple stocks. We now extend this analysis to all single-stock buy-days. Table 4 replicates the analysis from Table 3 for the sample of all single-stock buy-days for investors with at least two existing positions in common stock. As with the previous analysis, results are presented in the three panels for different ranges of stock allocations.

Panel A of Table 4 shows that very few investors begin or end a single-stock buy-day with portfolio allocations within the $1/N$ range. 1.7% of single-stock buy-days begin with a $1/N$ allocation. Of these, 0.3% end the buy-day with a $1/N$ allocation, with the remaining 1.4% ending the buy-day with an allocation outside of the $1/N$ range. Hence 18% of investors who enter the buy-day with their portfolio shares in the $1/N$ range end the buy-day with a $1/N$ allocation. Of the remaining 98.3% who begin the day without a $1/N$ allocation, only 0.3% end with a $1/N$ allocation. Only 0.6% of buy-days end with a $1/N$ allocation in the portfolio. In Panels B and C we see by the same calculations in Panel B that 26% of investors who begin a buy-day with a $1/N$ allocation buy such that they end the day with the same allocation (1% of all buy-days) and in Panel C this percentage is 35% (2.4% of all buy-days).

In Table 5 we replicate this analysis of single-stock buy-days for investors who make at least one $1/N$ buy-day allocation within the sample period. Here we find similar patterns, with only 0.4% of buy-days resulting in $1/N$ allocations, but 23% of those who begin the day with $1/N$ allocations also ending the day with $1/N$ allocations, compared to fewer than 1% of those who do not begin the day with $1/N$ allocations.

To summarize our results on $1/N$ portfolio allocations, Table 6 shows the percentage of buy-days resulting in end-of-day $1/N$ portfolio allocations by number of stocks held in the portfolio at the start of the day and the number of stocks purchased on the day. The top row shows that, among days on which investors begin the day with no positions in their portfolio, $1/N$ end of day portfolio allocations are common. In subsequent rows, among days on which investors begin the day with existing positions in their portfolio, $1/N$ end of day portfolio allocations are much rarer. This illustrates our central result that a $1/N$ portfolio allocations are rare, in the majority of cases only arising among investors adopting a $1/N$ buy–day rule in otherwise empty portfolios.

11 Conclusion

In this paper we investigate how individuals go about approaching a common, yet complex, financial choice: splitting investments across multiple stocks. Portfolio theory guides investors towards holding optimally diversified portfolios comprising multiple stocks (Markowitz, 1952). We explore how individual investors go about building their stock portfolios in practice. Specifically, we study "buy-days" on which investors purchase multiple stocks and therefore face the decision of how to allocate monies invested on the day across those multiple stocks. We find that a very large fraction of investors reduce the complexity of this problem applying a $1/N$ rule-of-thumb to their new purchases, equalizing the money amount invested across several stocks. In our data, over 45% of individual investors adopt this *naive diversification* rule-of-thumb.

In further analysis we show that the propensity to use the $1/N$ rule–of–thumb falls only modestly as the financial stakes increase. Among top quartile of buy-days by financial characteristics (including portfolio value, number of stocks in the portfolio and differences in returns across stocks) the proportion of investments made $1/N$ is above 20%. Hence $1/N$ investing is only modestly sensitive to the economic stakes of investing.

We go on to show that, on subsequent multiple stock buy-days, investors continue to use a $1/N$ rule-of-thumb to split the monies invested on the day, resulting in them creating portfolio shares for individual stocks in their portfolio that are some distance away from a $1/N$ allocation. That is, investors appear to be using the $1/N$ rule only to split monies over new purchases and not as a rule for determining portfolio shares. Hence the net effect of many buy-days is to create portfolios far from the $1/N$ allocation, in many cases appearing quite complex. Unless one looks at individual buy-days, the use of the $1/N$ heuristic for buying is hidden in the resulting portfolio positions, in part due to movements in the prices of the stocks within the investor's portfolio. We interpret this behavior as an example of *narrow bracketing* of tasks, whereby invests approach the buy–day task of allocating monies across stocks in a detached way without considering their existing portfolio positions.

Finally, we examine the joint decision investors make in determining the number of stocks to be purchased on the day and the total buy–day investment. Strikingly, investors appear to adjust both margins in order to make the $1/N$ task mathematically simple. When N=3, the distribution of total investment amounts is dominated by round number multiples of 3, with heaping at £3,000, £6,000, £15,000 and £30,000. When N=4, the distribution shows heaping at £4,000, £8,000, £20,000 and £40,000. We cannot reject the notion that investors make a joint decision to highly simplify their investment tasks, even when this results in large monetary value shifts in the monies invested on the day.

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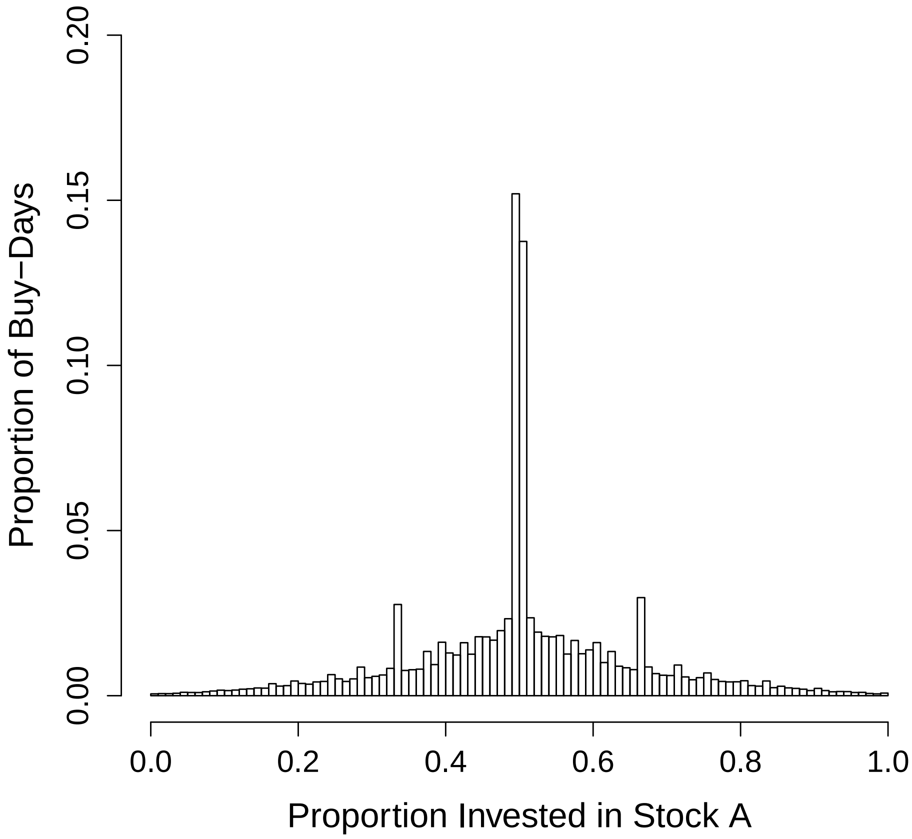
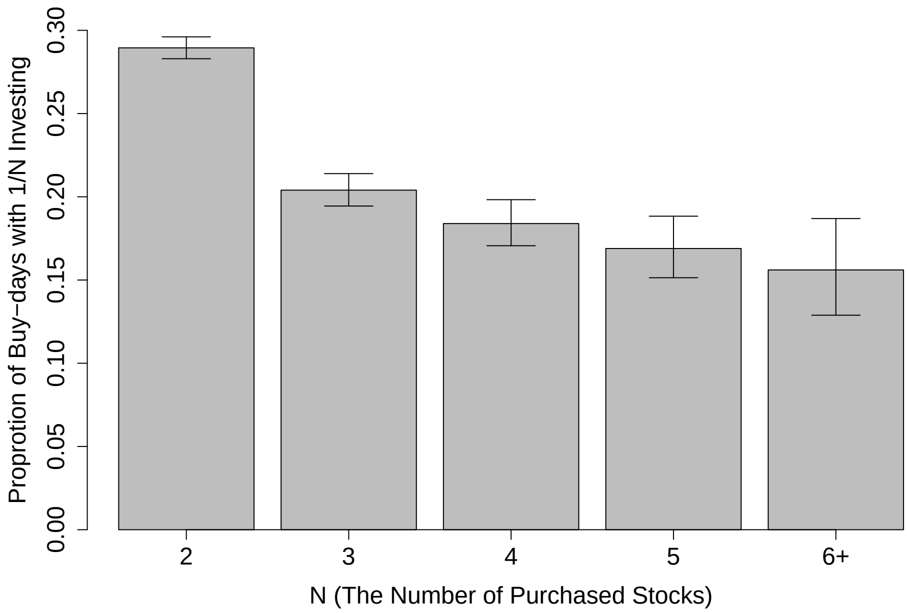
Figure 1: Proportion of Buy-Day Monies Invested in Random Stock A, Two-Stock Buy-Days, All Accounts Sample



Note: Figure shows a histogram of the proportion of the total buy-day investment (in pounds) which is invested in Stock A, where Stock A is a randomly chosen stock from the pair of stocks purchased. Bin width is 0.01.

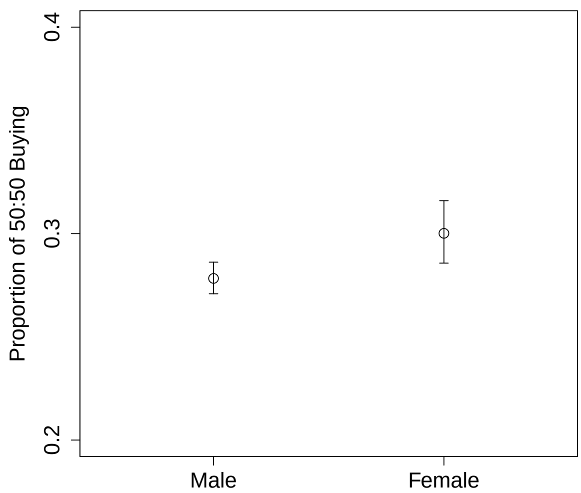
Figure 2: Proportion of Buy-Day on Which Investors Adopt 1/N Rule of Thumb



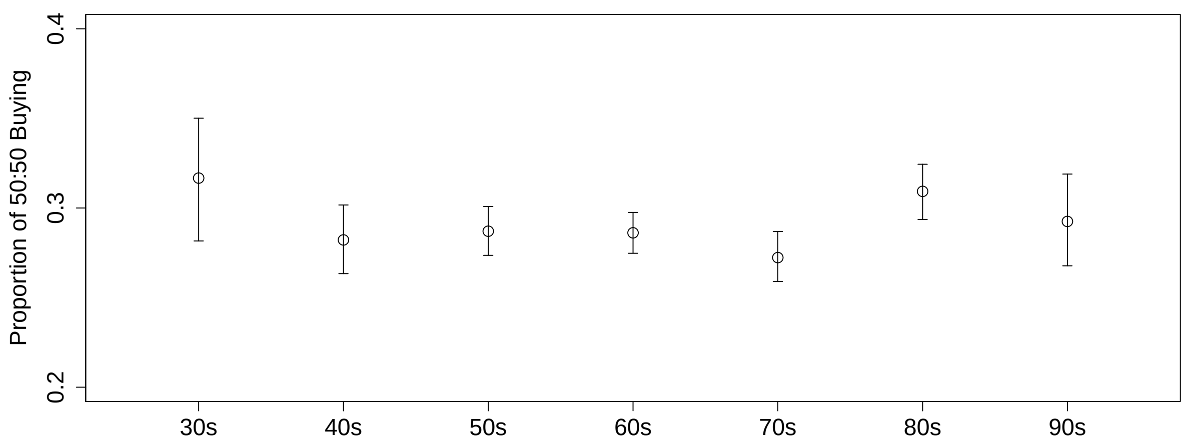
Note: Figure show bar chart with bar heights illustrating the proportion of all N-stock buy-days in which buy-day investments are split equally (in pounds) across the N stocks purchased. Equal is defined in the range 49% to 51%. 95% confidence intervals illustrated in error bars.

Figure 3: Proportion of $1/N$ Splitting Two-Stock Buy-Days Among All Accounts by Investor Characteristics

(A) Gender



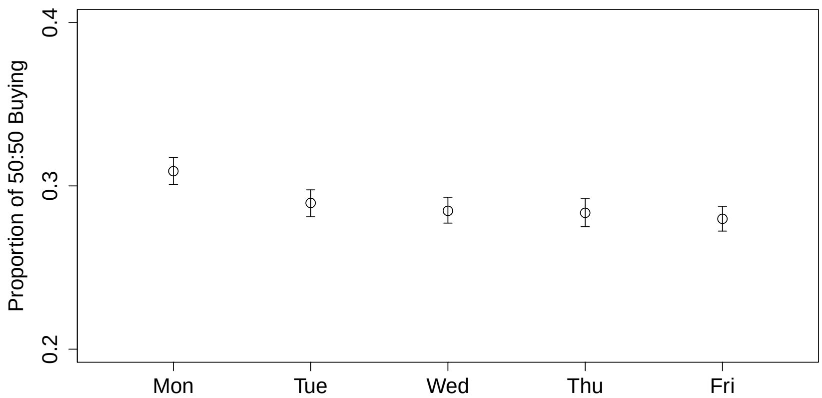
(B) Decade of Birth



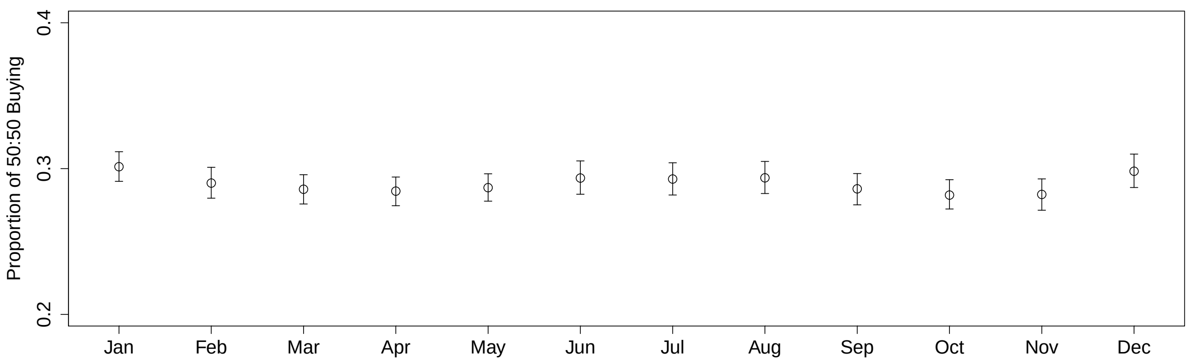
Note: Figure shows proportion of all two-stock buy-days in which the buy day investments are split equally (in pounds) across the two stocks. Equal is defined in the range 49% to 51%. 95% confidence intervals illustrated in error bars.

Figure 4: Proportion of $1/N$ Splitting Two-Stock Buy-Days Among All Accounts by Day of the Week and Month of the Year

(A) Day of the Week

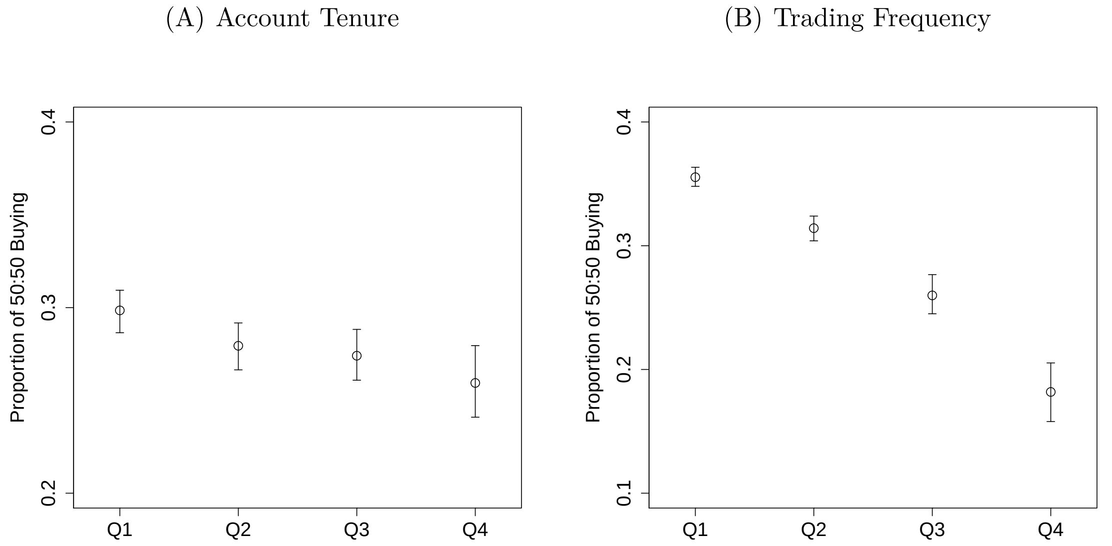


(B) Month of the Year



Note: Figure shows proportion of all two-stock buy-days in which the buy day investments are split equally (in pounds) across the two stocks. Equal is defined in the range 49% to 51%. 95% confidence intervals illustrated in error bars.

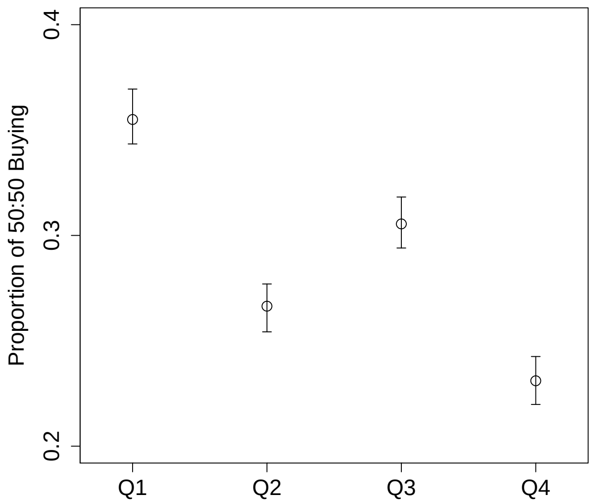
Figure 5: Proportion of $1/N$ Splitting Two-Stock Buy-Days Among All Accounts by Account Tenure and Trading Frequency



Note: Figure shows proportion of all two-stock buy-days in which the buy day investments are split equally (in pounds) across the two stocks. Equal is defined in the range 49% to 51%. 95% confidence intervals illustrated in error bars.

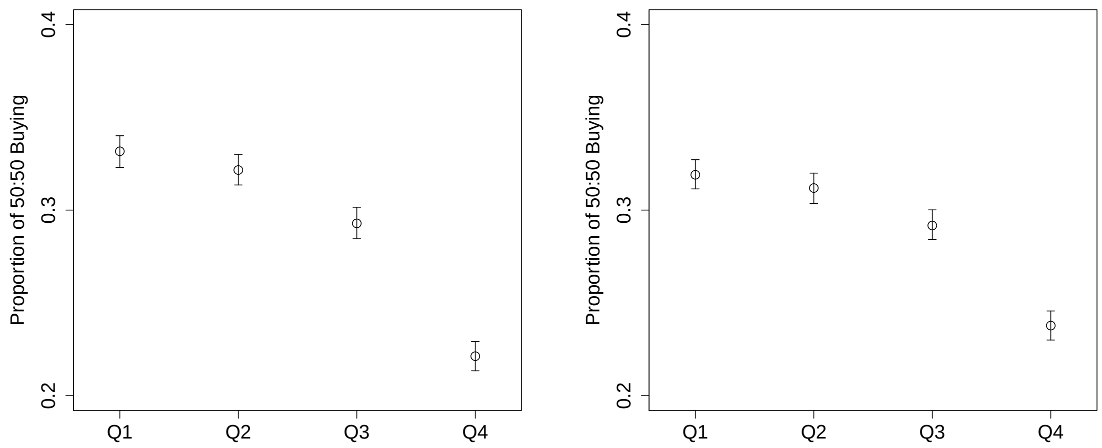
Figure 6: Proportion of 1/N Splitting Two-Stock Buy-Days Among All Accounts by Investment Amount of the Day and Simple Past 3 Month and Next 3 Month Returns

(A) Investment Amount on the Day



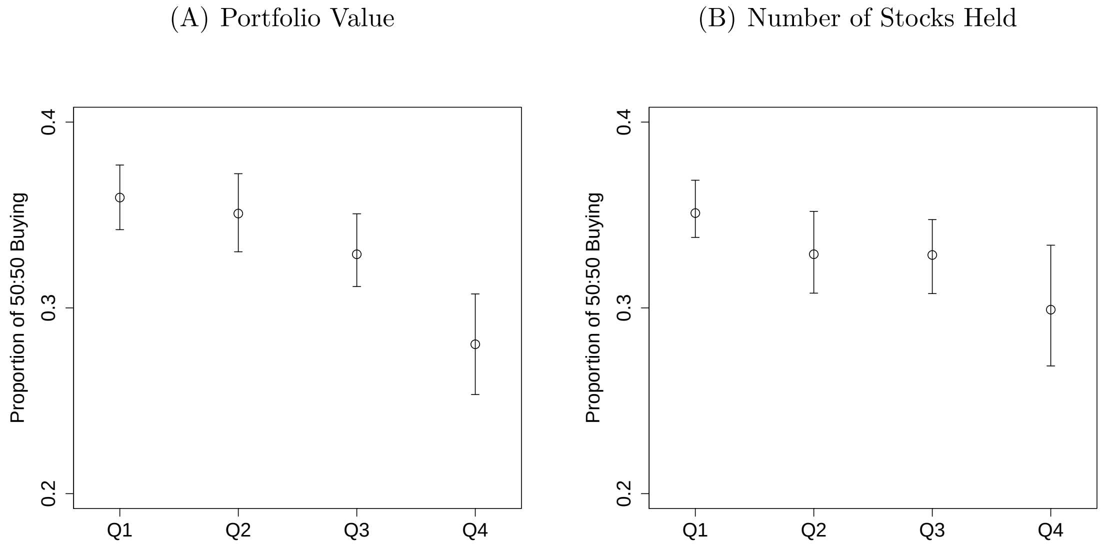
(B) Past 3 Month Returns

(C) Next 3 Month Returns



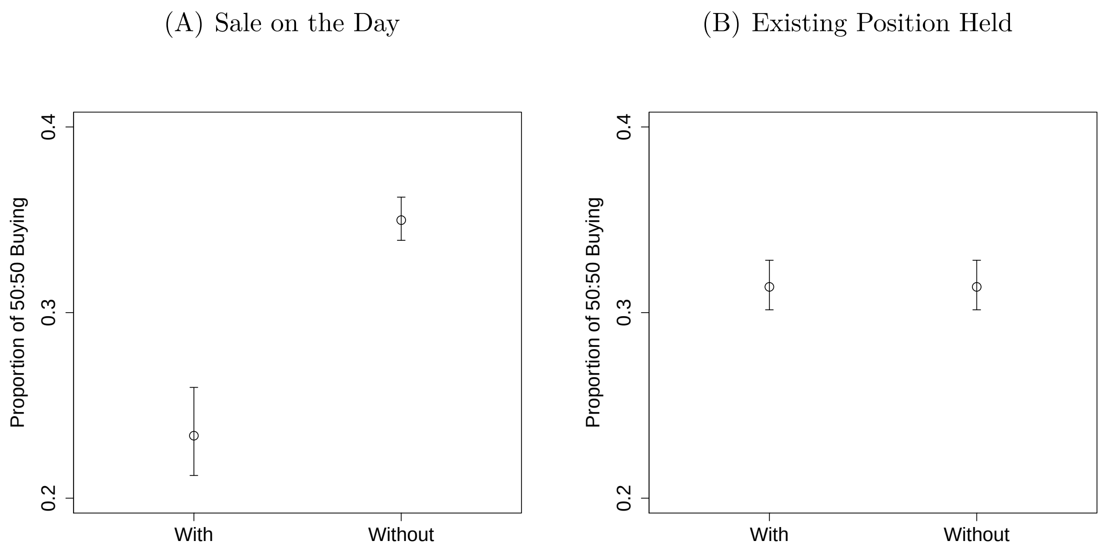
Note: Figure shows proportion of all two-stock buy-days in which the buy day investments are split equally (in pounds) across the two stocks. Equal is defined in the range 49% to 51%. 95% confidence intervals illustrated in error bars.

Figure 7: Proportion of $1/N$ Splitting Two-Stock Buy-Days Among New Accounts by Portfolio Value and Number of Stocks Held



Note: Figure shows proportion of all two-stock buy-days in which the buy day investments are split equally (in pounds) across the two stocks. Equal is defined in the range 49% to 51%. 95% confidence intervals illustrated in error bars.

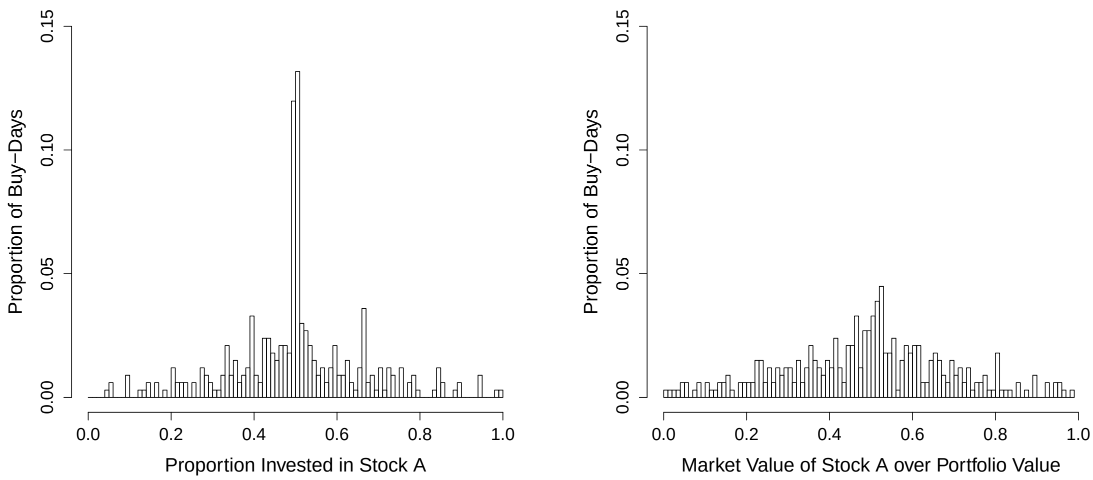
Figure 8: Proportion of $1/N$ Splitting Two-Stock Buy-Days Among New Accounts by Same Day Sale and Existing Position Held



Note: Figure shows proportion of all two-stock buy-ays in which the buy day investments are split equally (in pounds) across the two stocks. Equal is defined in the range 49% to 51%. 95% confidence intervals illustrated in error bars.

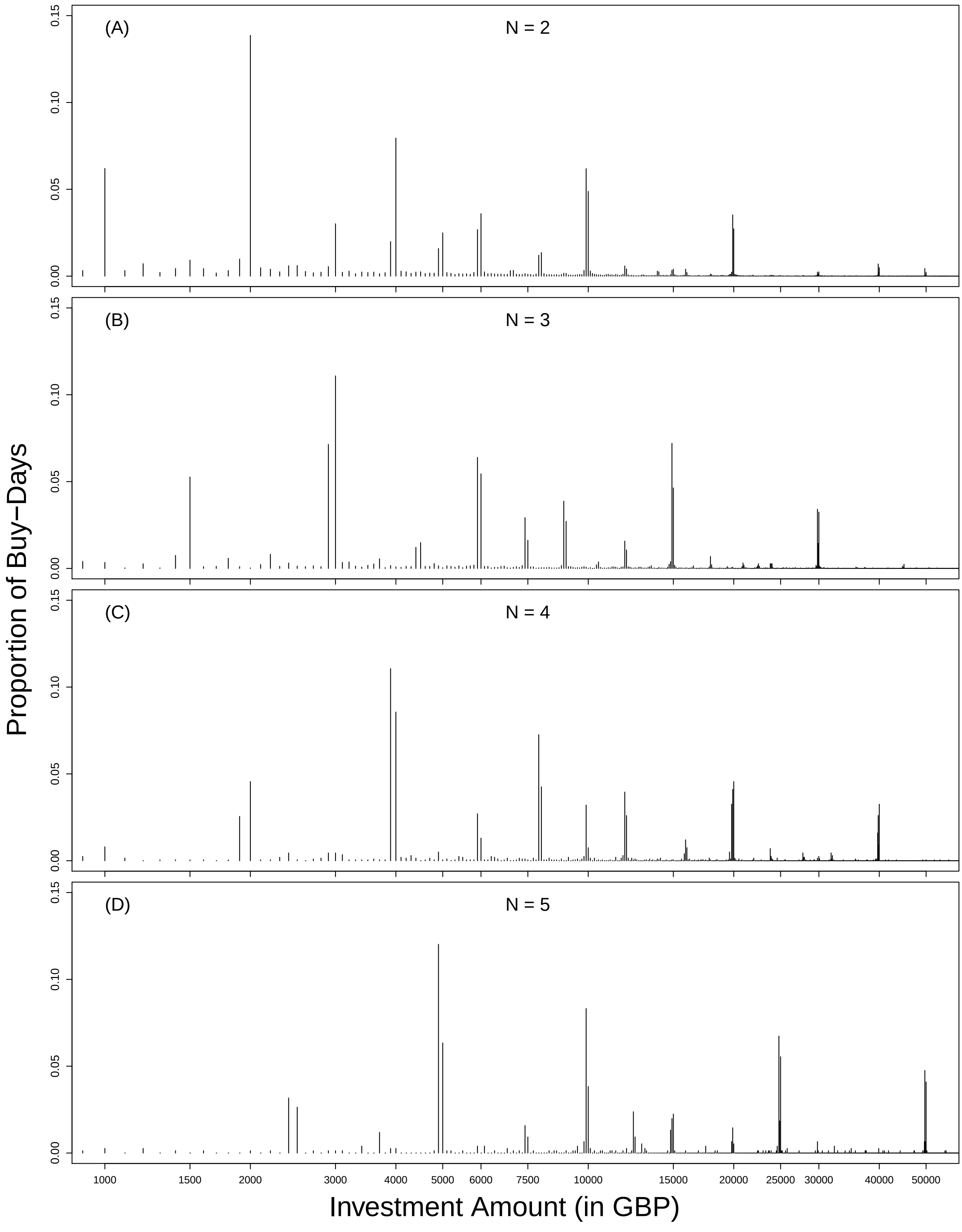
Figure 9: Histograms of the Buy-Day Allocation and in the End of Day Portfolio Allocation for Investors Topping-Up Existing 2-Stock Portfolio Positions

(A) Buy-Day Allocation (B) End of Day Portfolio Allocation



Note: Panel A figure shows a histogram of the proportion of the total buy-day investment (in pounds) which is invested in Stock A, where Stock A is a randomly chosen stock from the pair of stocks purchased. Bin width is 0.01. Panel B shows a histogram of the proportion of the end of day investment in the portfolio that is allocated to Stock A, where Stock A is a ramdonly chosen stock from the pair of stocks purchased. Bin width is 0.01.

Figure 10: Distribution of Total Buy Day Investment (in £) by Number of Stocks Bought on the Buy-Day



Note: Panels illustrate the distribution (density) of monies invested on the buy-day (in pounds) for multiple stock buy days involving 2 – 5 stocks.

Table 1: Proportion of Buy-Days on Which Investor Splits Purchases $1/N$, Buy Days with N = 2 − 6+

Panel (A) (£$P/N \times (1 \pm 0.02)$)

N (Num Purchased Stocks)	Prop 1/N investing (%)	LL	UL	Num Purchase-days
2	28.9	28.3	29.6	134020
3	20.4	19.4	21.4	32672
4	18.4	17.1	19.7	10858
5	16.9	15.1	18.7	4481
6+	15.6	12.9	18.7	5267
All	26.2	25.5	26.9	187298

Panel (B) (£$P/N \times (1 \pm 0.05)$)

N (Num Purchased Stocks)	Prop 1/N investing (%)	LL	UL	Num Purchase-days
2	35.6	35.0	36.2	134020
3	23.4	22.4	24.4	32672
4	20.9	19.4	22.4	10858
5	19.2	17.2	21.2	4481
6+	18.5	15.2	21.9	5267
All	31.7	31.0	32.5	187298

Panel (C) (£$P/N \times (1 \pm 0.1)$)

N (Num Purchased Stocks)	Prop 1/N investing (%)	LL	UL	Num Purchase-days
2	44.6	43.9	45.1	134020
3	27.5	26.5	28.6	32672
4	23.8	22.1	25.4	10858
5	21.5	19.3	23.9	4481
6+	20.4	17.0	24.1	5267
All	39.2	38.3	39.9	187298

Note: Table shows summary data for multiple-stock buy days. Each row reports the percentage of buy-days involving N stocks in which the proportion invested in each stock falls within the $1/N$ range, for differing ranges. Lower limit and upper limit values of 95% confidence intervals from bootstrap mean estimate reported in LL and UL columns.

Table 2: Probit Regression Marginal Effects: Determinants of 50:50 Splitting on Two-Stock Buy Days

	Model 1		Model 2		Model 3		Model 4		Model 5	
(intercept)	-0.111	**	-0.114	**	-0.106	**	-0.058		-0.034	
	[-0.372,0.152]		[-0.357,0.159]		[-0.336,0.152]		[-0.324,0.169]		[-0.306,0.235]	
Year of Birth 1930s	-0.133	**	-0.134	**	-0.103	*	-0.103	*	-0.104	*
	[-0.441,0.147]		[-0.430,0.152]		[-0.383,0.177]		[-0.358,0.219]		[-0.363,0.191]	
Year of Birth 1940s	-0.069	.	-0.069	.	-0.062		-0.068		-0.059	
	[-0.345,0.186]		[-0.338,0.168]		[-0.328,0.177]		[-0.302,0.207]		[-0.300,0.208]	
Year of Birth 1950s	-0.065		-0.066		-0.061		-0.057		-0.033	
	[-0.330,0.187]		[-0.340,0.179]		[-0.314,0.182]		[-0.287,0.212]		[-0.285,0.233]	
Year of Birth 1960s	-0.057		-0.057		-0.049		-0.037		-0.018	
	[-0.327,0.200]		[-0.320,0.182]		[-0.303,0.189]		[-0.263,0.230]		[-0.265,0.243]	
Year of Birth 1970s	-0.075	.	-0.076	.	-0.073	.	-0.061		-0.050	
	[-0.337,0.173]		[-0.349,0.160]		[-0.329,0.173]		[-0.291,0.205]		[-0.299,0.207]	
Year of Birth 1980s	-0.064		-0.064		-0.066	.	-0.054		-0.044	
	[-0.335,0.194]		[-0.321,0.172]		[-0.323,0.180]		[-0.282,0.217]		[-0.292,0.214]	
Year of Birth 1990s	-0.078	.	-0.078	.	-0.082	*	-0.068		-0.063	
	[-0.353,0.188]		[-0.344,0.159]		[-0.342,0.170]		[-0.303,0.210]		[-0.308,0.198]	
Year of Birth 2000s	-0.014		-0.015		-0.018		-0.030		-0.010	
	[-0.311,0.262]		[-0.316,0.258]		[-0.315,0.265]		[-0.298,0.252]		[-0.302,0.270]	
Male	-0.003		-0.003		-0.001		0.009	.	0.019	***
	[-0.042,0.037]		[-0.041,0.039]		[-0.038,0.039]		[-0.029,0.051]		[-0.024,0.060]	
Account Tenure	-0.001	***	-0.001	***	0.000		-0.001	***	0.000	
	[-0.002,0.000]		[-0.002,0.000]		[-0.001,0.001]		[-0.002,0.001]		[-0.001,0.002]	
Feb			0.000		-0.001		-0.004		-0.001	
			[-0.051,0.053]		[-0.055,0.053]		[-0.056,0.052]		[-0.052,0.053]	
Mar			0.011		0.010		0.008		0.006	
			[-0.040,0.064]		[-0.038,0.066]		[-0.045,0.063]		[-0.046,0.060]	
Apr			-0.002		-0.004		-0.005		-0.008	
			[-0.055,0.050]		[-0.053,0.051]		[-0.056,0.050]		[-0.061,0.045]	
May			-0.022	*	-0.023	*	-0.022	*	-0.020	.
			[-0.079,0.036]		[-0.074,0.035]		[-0.084,0.044]		[-0.073,0.047]	
Jun			0.003		0.002		-0.006		-0.005	
			[-0.052,0.058]		[-0.054,0.058]		[-0.064,0.053]		[-0.056,0.051]	
Jul			0.015		0.015		0.011		0.014	
			[-0.044,0.070]		[-0.039,0.074]		[-0.041,0.071]		[-0.039,0.068]	
Aug			-0.001		-0.001		-0.004		-0.003	
			[-0.055,0.058]		[-0.056,0.052]		[-0.059,0.052]		[-0.054,0.051]	
Sep			0.035	***	0.036	***	0.034	***	0.034	***
			[-0.021,0.094]		[-0.018,0.097]		[-0.023,0.089]		[-0.021,0.086]	
Oct			-0.001		0.001		0.001		0.001	
			[-0.054,0.053]		[-0.052,0.059]		[-0.056,0.057]		[-0.053,0.054]	
Nov			0.015		0.018	.	0.022	*	0.025	*
			[-0.039,0.071]		[-0.038,0.075]		[-0.039,0.084]		[-0.036,0.086]	
Dec			0.015		0.016		0.018	.	0.024	*
			[-0.041,0.072]		[-0.041,0.078]		[-0.038,0.077]		[-0.033,0.082]	
Monday			-0.004		-0.006		-0.008		-0.009	
			[-0.043,0.031]		[-0.038,0.030]		[-0.046,0.030]		[-0.047,0.029]	
Tuesday			0.001		0.000		-0.004		-0.006	
			[-0.037,0.040]		[-0.037,0.038]		[-0.043,0.036]		[-0.043,0.031]	
Wednesday			-0.004		-0.005		-0.013	*	-0.012	.
			[-0.042,0.034]		[-0.039,0.033]		[-0.052,0.026]		[-0.051,0.026]	
Thursday			-0.003		-0.005		-0.011	.	-0.009	
			[-0.044,0.030]		[-0.040,0.030]		[-0.050,0.028]		[-0.046,0.030]	
Portfolio Value (x 10000)					-0.001	***	-0.003	***	-0.002	***
					[-0.004,0.000]		[-0.007,0.000]		[-0.006,0.000]	
Num of Stocks in the Portfolio					-0.001	***	0.001	*	0.002	***
					[-0.008,0.002]		[-0.006,0.005]		[-0.003,0.006]	
Inv Amount on the Day (x 10000)							0.008	***	0.008	***
							[-0.002,0.022]		[-0.003,0.021]	
N (Num of Bought Stocks)							-0.012	***	-0.016	***
							[-0.029,0.004]		[-0.034,0.000]	
Range in Past 60-Days Returns							-0.007	***	-0.006	***
							[-0.023,0.000]		[-0.019,0.001]	
Range in Next 60-Days Returns							-0.129	***	-0.114	***
							[-0.187,-0.071]		[-0.169,-0.059]	
Existing Position Dummy									-0.047	***
									[-0.080,-0.004]	
Same-Day Sale Dummy									-0.082	***
									[-0.114,-0.042]	
Ave Num of Trades Per Day									-0.003	***
									[-0.009,-0.001]	
Log-Likelihood	-31209.88		-31187.27		-31109.15		-28957.19		-28663.48	

Note: Table reports marginal effects from probit regression model estimates. Dependent variable is a 1/0 dummy indicating whether the buy-day investment falls within the $1/N$ range, defined as £$P/N \times (1 \pm 0.02)$. Covariates are account characteristics. Sample of new accounts only. In a later version of this paper we hope to extend this analysis to the sample of all accounts.

Table 3: Starting and Ending Portfolio Positions on Multiple-Stock Buy-Days

Panel (A) (£$P/N \times (1 \pm 0.02)$)

1/N Existing Positions	1/N Buying	1/N Resulting Positions	Proportion of Buy-Days	LL	UL
Yes	Yes	Yes	0.4	0.3	0.5
Yes	Yes	No	0.6	0.4	0.7
Yes	No	Yes	0.0	0.0	0.0
Yes	No	No	0.9	0.7	1.1
No	Yes	Yes	0.1	0.0	0.1
No	Yes	No	29.6	28.2	31.0
No	No	Yes	0.1	0.0	0.1
No	No	No	68.4	67.0	69.9

Panel (B) (£$P/N \times (1 \pm 0.05)$)

1/N Existing Positions	1/N Buying	1/N Resulting Positions	Proportion of Buy-Days	LL	UL
Yes	Yes	Yes	1.3	1.1	1.6
Yes	Yes	No	1.3	1.0	1.5
Yes	No	Yes	0.1	0.0	0.1
Yes	No	No	1.7	1.4	1.9
No	Yes	Yes	0.2	0.1	0.3
No	Yes	No	33.5	32.1	35.0
No	No	Yes	0.2	0.1	0.3
No	No	No	61.9	60.2	63.4

Panel (C) (£$P/N \times (1 \pm 0.1)$)

1/N Existing Positions	1/N Buying	1/N Resulting Positions	Proportion of Buy-Days	LL	UL
Yes	Yes	Yes	2.5	2.1	2.9
Yes	Yes	No	2.3	2.0	2.6
Yes	No	Yes	0.2	0.1	0.3
Yes	No	No	2.5	2.3	2.8
No	Yes	Yes	0.3	0.2	0.4
No	Yes	No	38.2	36.6	39.6
No	No	Yes	0.3	0.2	0.4
No	No	No	53.8	52.2	55.3

Note: Table shows summary data for multiple-stock buy days. Each row reports the percentage of buy-days by combinations of existing positions at the beginning of the day, buying split, and resulting positions in the $1/N$ range, for differing ranges. Lower limit and upper limit values of 95% confidence intervals from bootstrap mean estimate reported in LL and UL columns.

Table 4: Starting and Ending Portfolio Positions on Single-Stock Buy Days

Panel (A) (£$P/N \times (1 \pm 0.02)$)

1/N Existing Positions	Single-Stock Buying	1/N Resulting Positions	Proportion of Buy-Days	LL	UL
Yes	Yes	Yes	0.3	0.3	0.4
Yes	Yes	No	1.4	1.3	1.5
No	Yes	Yes	0.3	0.2	0.3
No	Yes	No	98.0	97.9	98.1

Panel (B) (£$P/N \times (1 \pm 0.05)$)

1/N Existing Positions	Single-Stock Buying	1/N Resulting Positions	Proportion of Buy-Days	LL	UL
Yes	Yes	Yes	1.0	0.9	1.1
Yes	Yes	No	2.8	2.6	2.9
No	Yes	Yes	0.6	0.5	0.6
No	Yes	No	95.7	95.4	95.9

Panel (C) (£$P/N \times (1 \pm 0.1X)$)

1/N Existing Positions	Single-Stock Buying	1/N Resulting Positions	Proportion of Buy-Days	LL	UL
Yes	Yes	Yes	2.4	2.2	2.6
Yes	Yes	No	4.4	4.2	4.6
No	Yes	Yes	1.0	0.9	1.1
No	Yes	No	92.2	91.8	92.5

Note: Table shows summary data for single-stock buy days. Each row reports the percentage of buy-days by combinations of existing positions at the beginning of the day, buying split, and resulting positions in the $1/N$ range, for differing ranges. Lower limit and upper limit values of 95% confidence intervals from bootstrap mean estimate reported in LL and UL columns.

Table 5: Starting and Ending Portfolio Positions on Single-Stock Buy-Days, Sample of Investors Who Make $1/N$ Allocations on Multiple-Stock Buy-Days

Panel (A) (£$P/N \times (1 \pm 0.02)$)

1/N Existing Positions	Single-Stock Buying	1/N Resulting Positions	Proportion of Buy-Days	LL	UL
Yes	Yes	Yes	0.5	0.4	0.6
Yes	Yes	No	1.5	1.3	1.7
No	Yes	Yes	0.1	0.1	0.2
No	Yes	No	97.9	97.7	98.1

Panel (A) (£$P/N \times (1 \pm 0.05)$)

1/N Existing Positions	Single-Stock Buying	1/N Resulting Positions	Proportion of Buy-Days	LL	UL
Yes	Yes	Yes	1.4	1.3	1.6
Yes	Yes	No	2.7	2.5	2.9
No	Yes	Yes	0.4	0.3	0.5
No	Yes	No	95.5	95.2	95.9

Panel (A) (£$P/N \times (1 \pm 0.1)$)

1/N Existing Positions	Single-Stock Buying	1/N Resulting Positions	Proportion of Buy-Days	LL	UL
Yes	Yes	Yes	3.0	2.7	3.3
Yes	Yes	No	3.9	3.7	4.2
No	Yes	Yes	0.7	0.6	0.8
No	Yes	No	92.4	91.9	92.9

Note: Table shows summary data for single-stock buy-days by investors who make at least one $1/N$ allocation multiple stock buy-day. Each row reports the percentage of buy-days by combinations of existing positions at the beginning of the day, buying split, and resulting positions in the $1/N$ range, for differing ranges. Lower limit and upper limit values of 95% confidence intervals from bootstrap mean estimate reported in LL and UL columns.

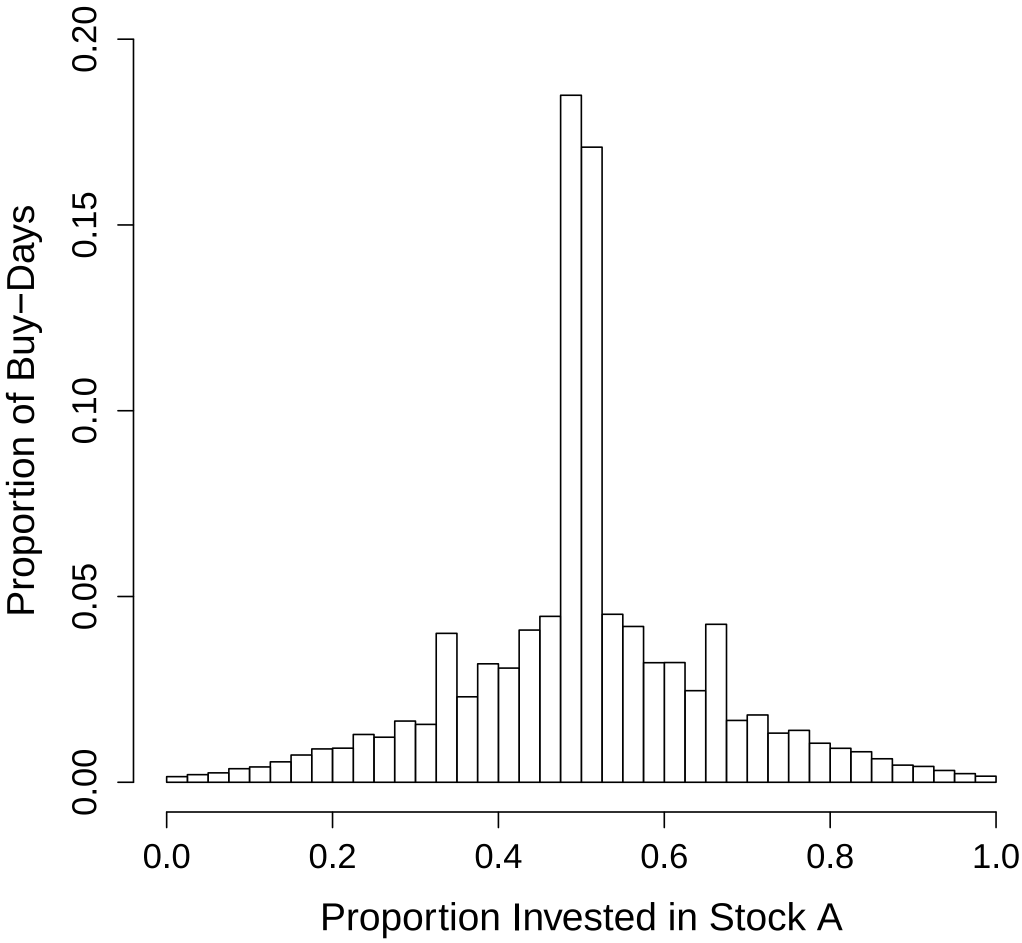
Table 6: Percentage of Buy–Days Resulting in End-of-Day $1/N$ Portfolio Allocations by Number of Stocks in Portfolio at Start of the Day and Number of Stocks Purchased

	Single Stock Purchase	2 Stock Purchase	3 Stock Purchase	4 Stock Purchase	5 Stock Purchase	6+ Stock Purchase
0 Existing Positions	NA	37.2	25.4	28.3	22.9	15.5
		[35.2,39.2]	[22.5,28.4]	[23.6,33.0]	[16.2,30.1]	[11.0,20.2]
1 Existing Position	8.3	6.7	5.5	9.1	10.0	0.0
	[7.8, 8.7]	[5.5, 8.0]	[3.1, 8.4]	[3.7,15.3]	[0.0,22.6]	[0.0, 0.0]
2 Existing Positions	2.0	2.7	1.4	0.0	0.0	0.0
	[1.8, 2.2]	[1.9, 3.5]	[0.3, 2.8]	[0.0, 0.0]	[0.0, 0.0]	[0.0, 0.0]
3 Existing Positions	0.5	0.5	1.7	1.5	0.0	0.0
	[0.4, 0.6]	[0.2, 0.9]	[0.0, 4.2]	[0.0, 5.6]	[0.0, 0.0]	[0.0, 0.0]
4 Existing Positions	0.2	0.3	0.0	1.2	0.0	0.0
	[0.1, 0.2]	[0.0, 0.6]	[0.0, 0.0]	[0.0, 4.1]	[0.0, 0.0]	[0.0, 0.0]
5 Existing Positions	0.1	0.3	0.0	0.0	5.9	0.0
	[0.0, 0.1]	[0.0, 0.7]	[0.0, 0.0]	[0.0, 0.0]	[0.0,20.0]	[0.0, 0.0]
6+ Existing Positions	0.0	0.0	0.1	0.2	0.0	0.5
	[0.0, 0.0]	[0.0, 0.0]	[0.0, 0.3]	[0.0, 0.8]	[0.0, 0.0]	[0.0, 1.6]

Note: Table shows data for all buy days. Each cell reports the percentage of buy days which end in $1/N$ allocations by number of existing positions at the start of the buy day and number stocks purchased on the day. Cell [0,1] empty as it takes a value of 100% by construction. Values in square brackets report lower limit and upper limit values of 95% confidence intervals from bootstrap mean estimate.

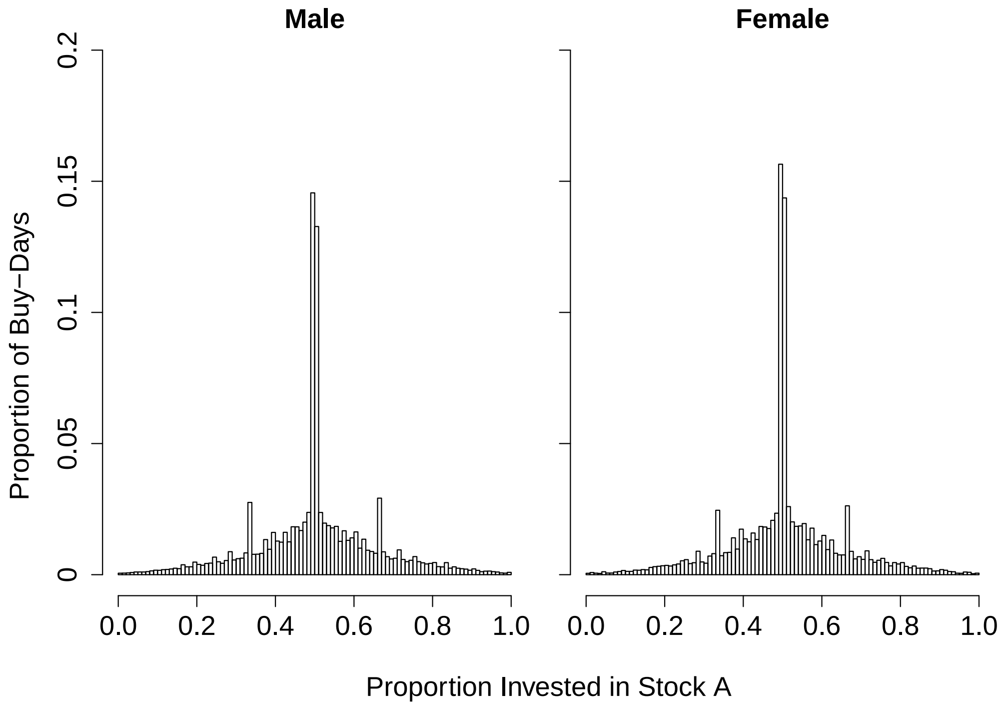
Appendix

Figure A1: Proportion of Buy-Day Monies Invested in Random Stock A, Two-Stock Buy Days Among All Accounts with 2% Bin Width



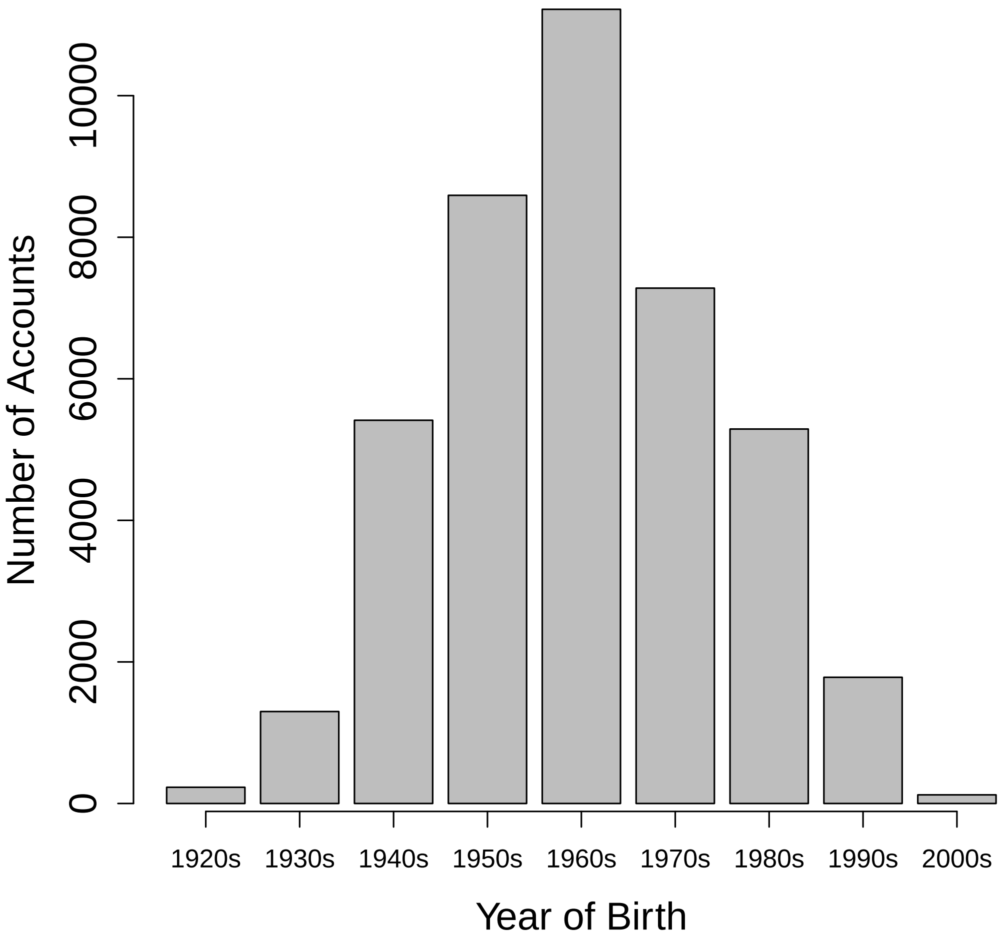
Note: Figure shows a histogram of the proportion of the total buy-day investment (in pounds) which is invested in Stock A, where Stock A is a randomly chosen stock from the pair of stocks purchased. Bin width is 0.02.

Figure A2: Proportion of Buy-Day Monies Invested in Random Stock A, Two-Stock Buy Days By Gender



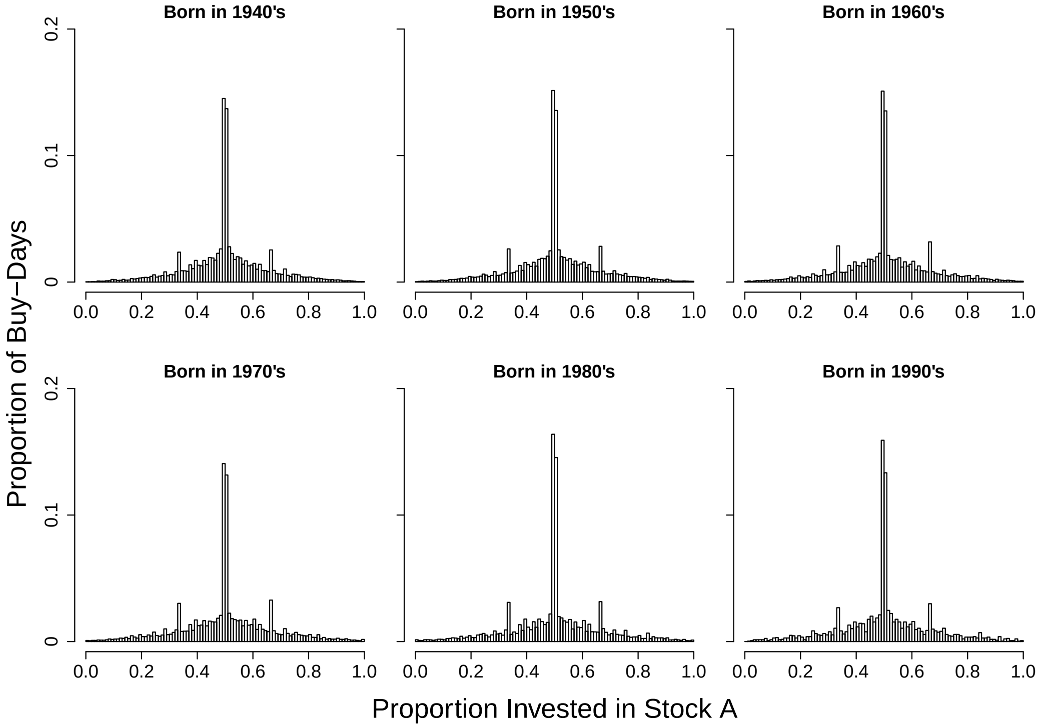
Note: Figures show histograms of the proportion of the total buy-day investment (in pounds) which is invested in Stock A, where Stock A is a randomly chosen stock from the pair of stocks purchased. Bin width is 0.01.

Figure A3: Distribution of Investor Decade of Birth, All Accounts



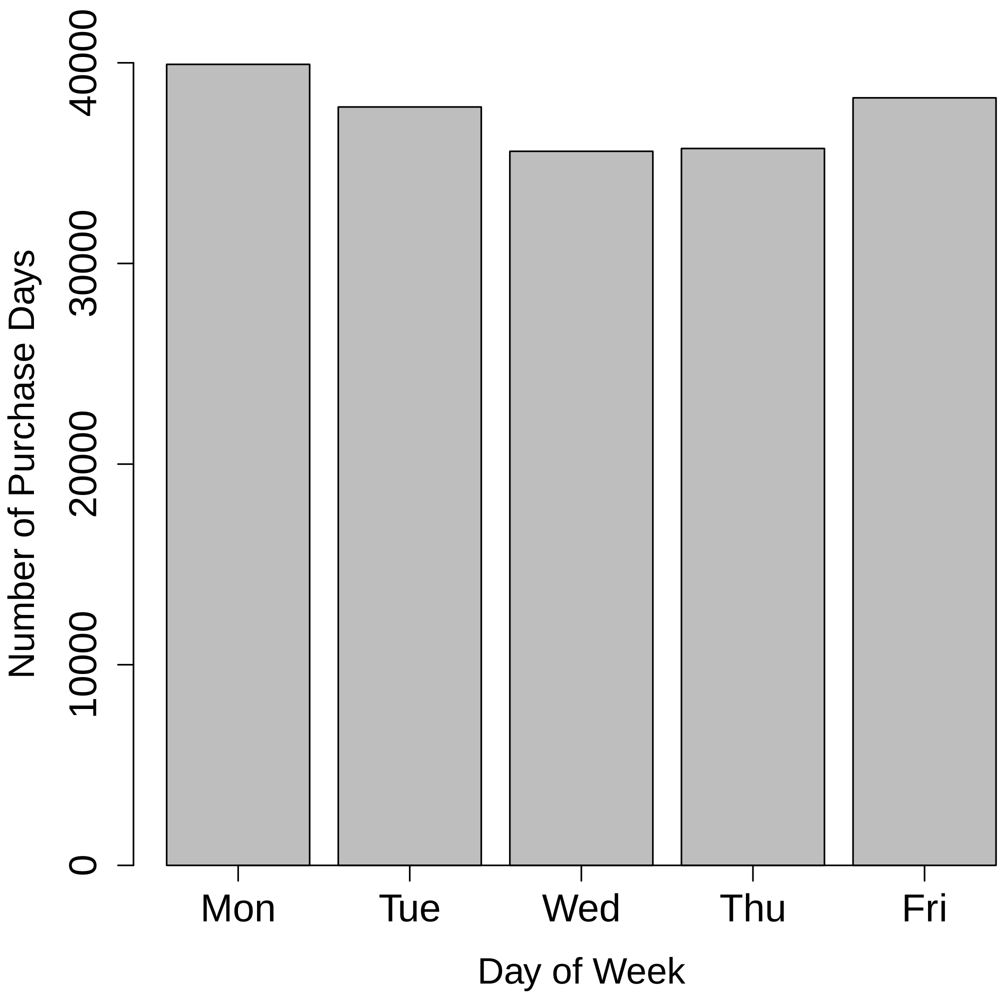
Note: Figure shows a histogram (frequency) of two stock buy days by decade of birth of the brokerage account holder.

Figure A4: Proportion of Buy-Day Monies Invested in Random Stock A, Two-Stock Buy Days By Age of Investor



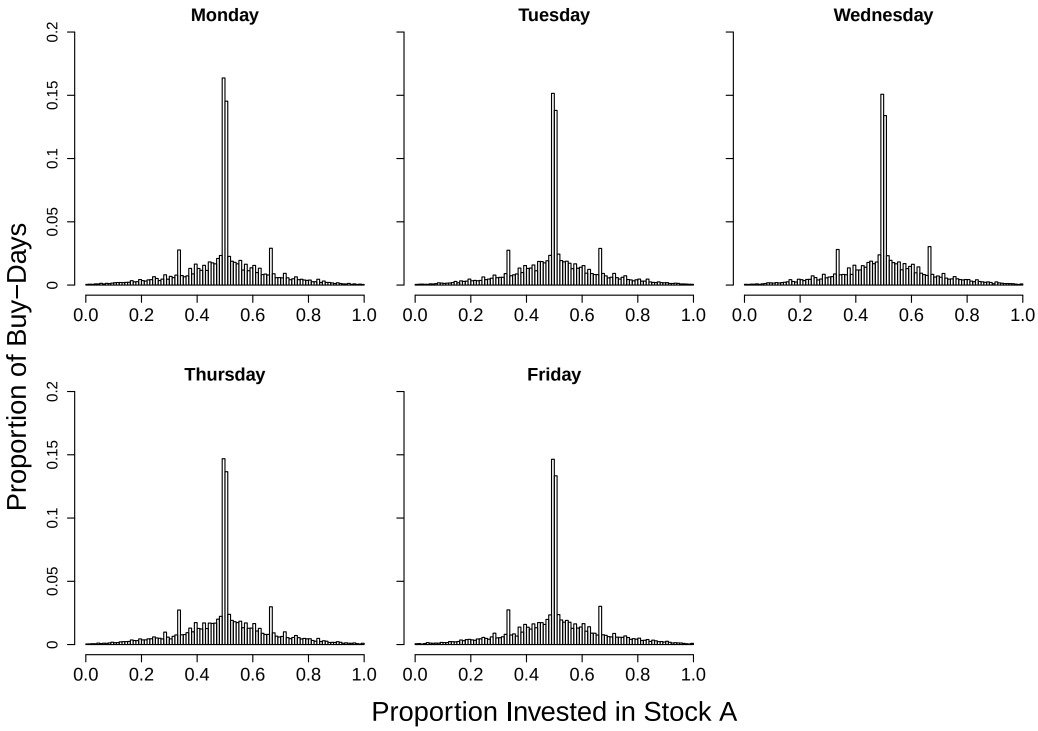
Note: Figures show histograms of the proportion of the total buy-day investment (in pounds) which is invested in Stock A, where Stock A is a randomly chosen stock from the pair of stocks purchased. Bin width is 0.01.

Figure A5: Distribution of Investment Day of Week, All Accounts



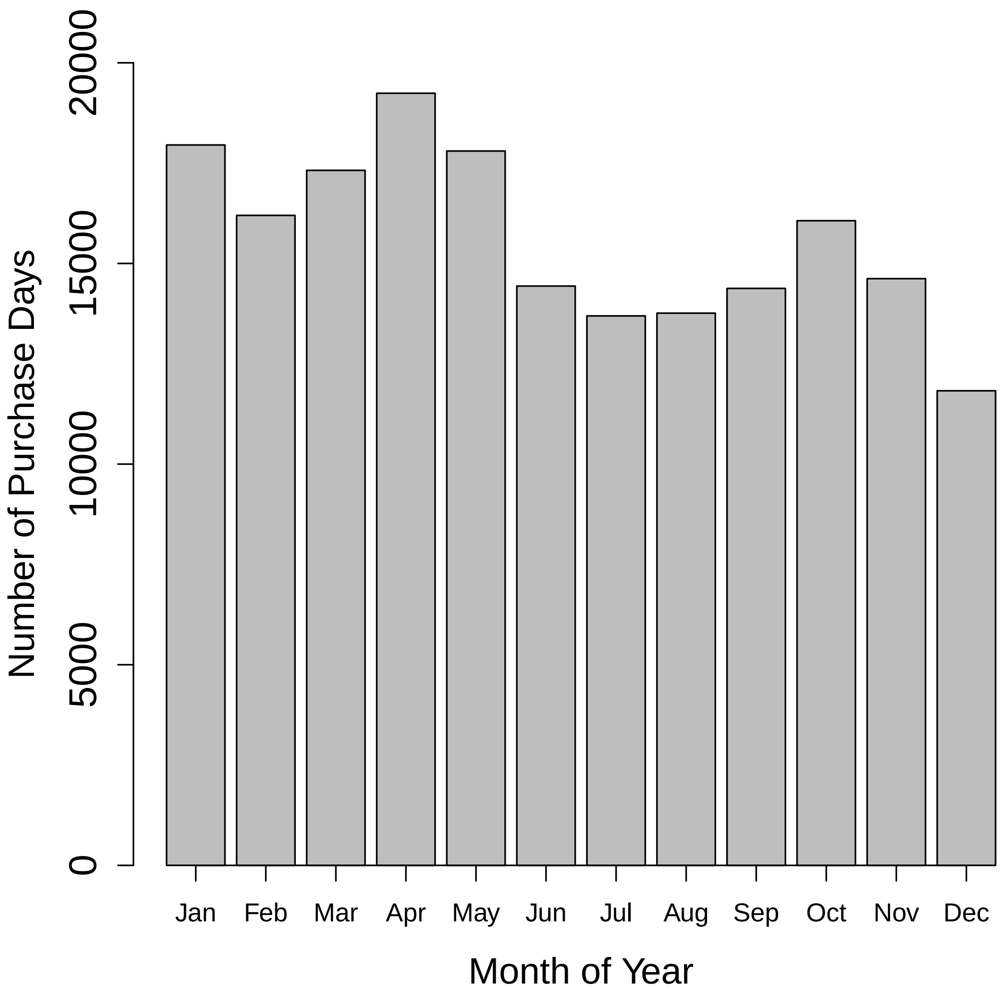
Note: Figure shows a histogram (frequency) of two stock buy days by day of the week.

Figure A6: Proportion of Buy-Day Monies Invested in Random Stock A, Two-Stock Buy Days By Day of the Week



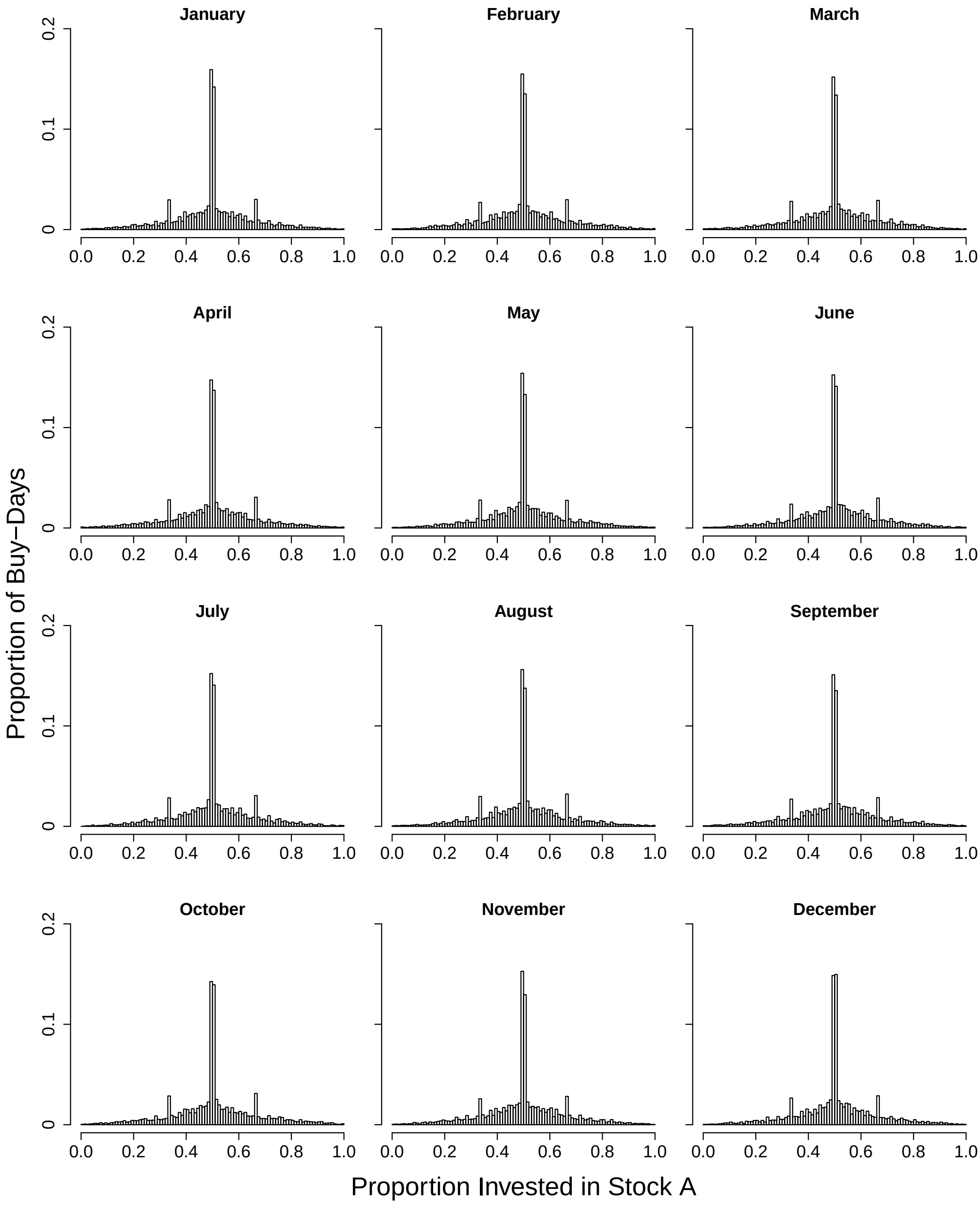
Note: Figures show histograms of the proportion of the total buy-day investment (in pounds) which is invested in Stock A, where Stock A is a randomly chosen stock from the pair of stocks purchased. Bin width is 0.01.

Figure A7: Distribution of Investment Month of Year, All Accounts



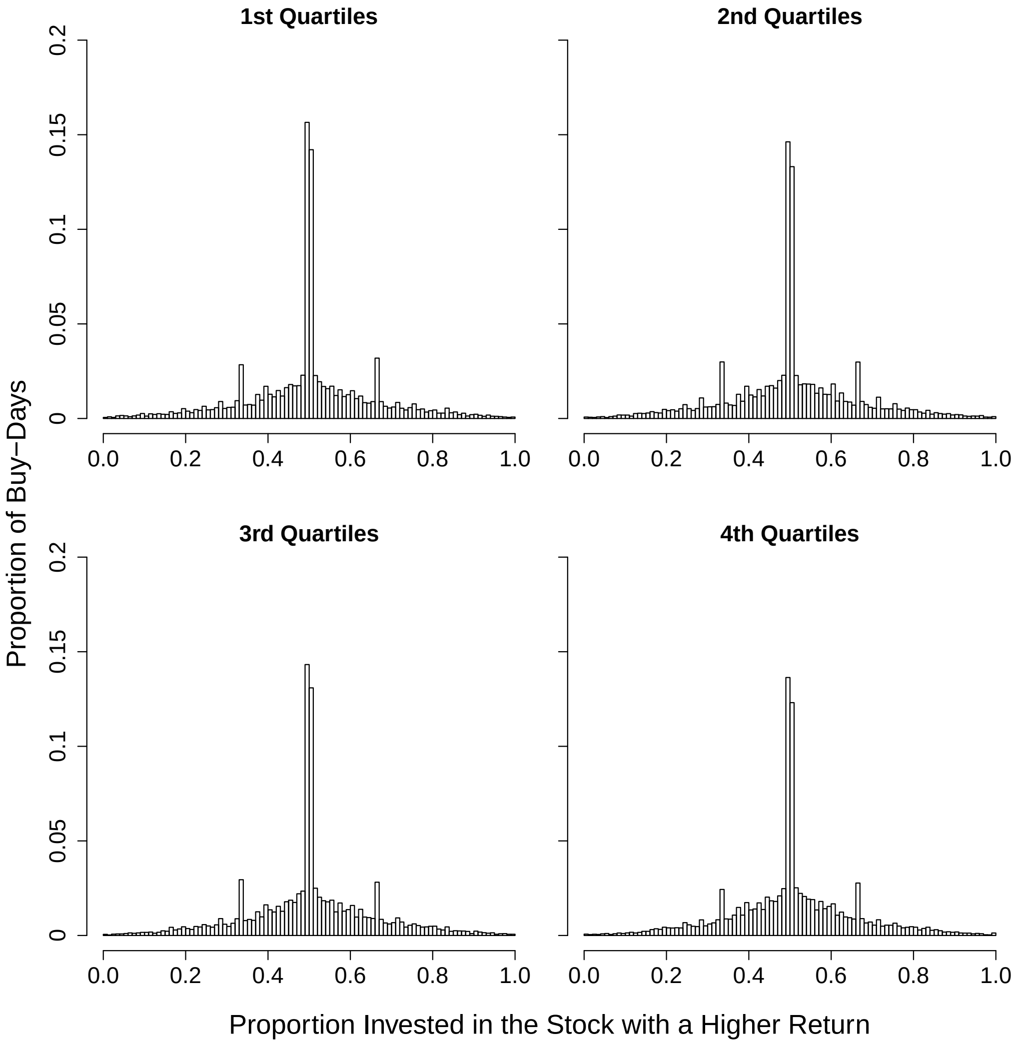
Note: Figure shows a histogram (frequency) of two stock buy days by month of the year.

Figure A8: Proportion of Buy-Day Monies Invested in Random Stock A, Two-Stock Buy Days By Month of the Year



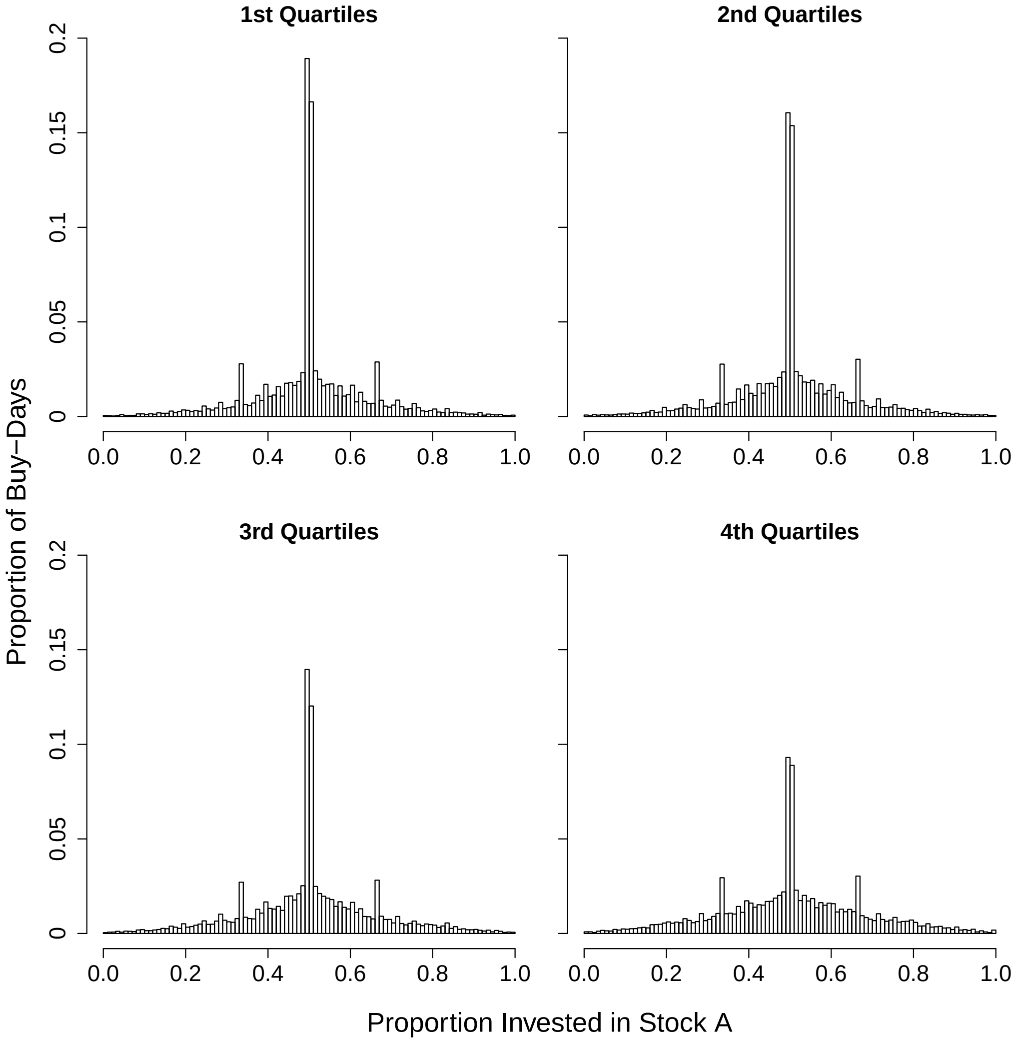
Note: Figures show histograms of the proportion of the total buy-day investment (in pounds) which is invested in Stock A, where Stock A is a randomly chosen stock from the pair of stocks purchased. Bin width is 0.01.

Figure A9: Proportion of Buy-Day Monies Invested in Random Stock A, Two-Stock Buy Days By Account Tenure



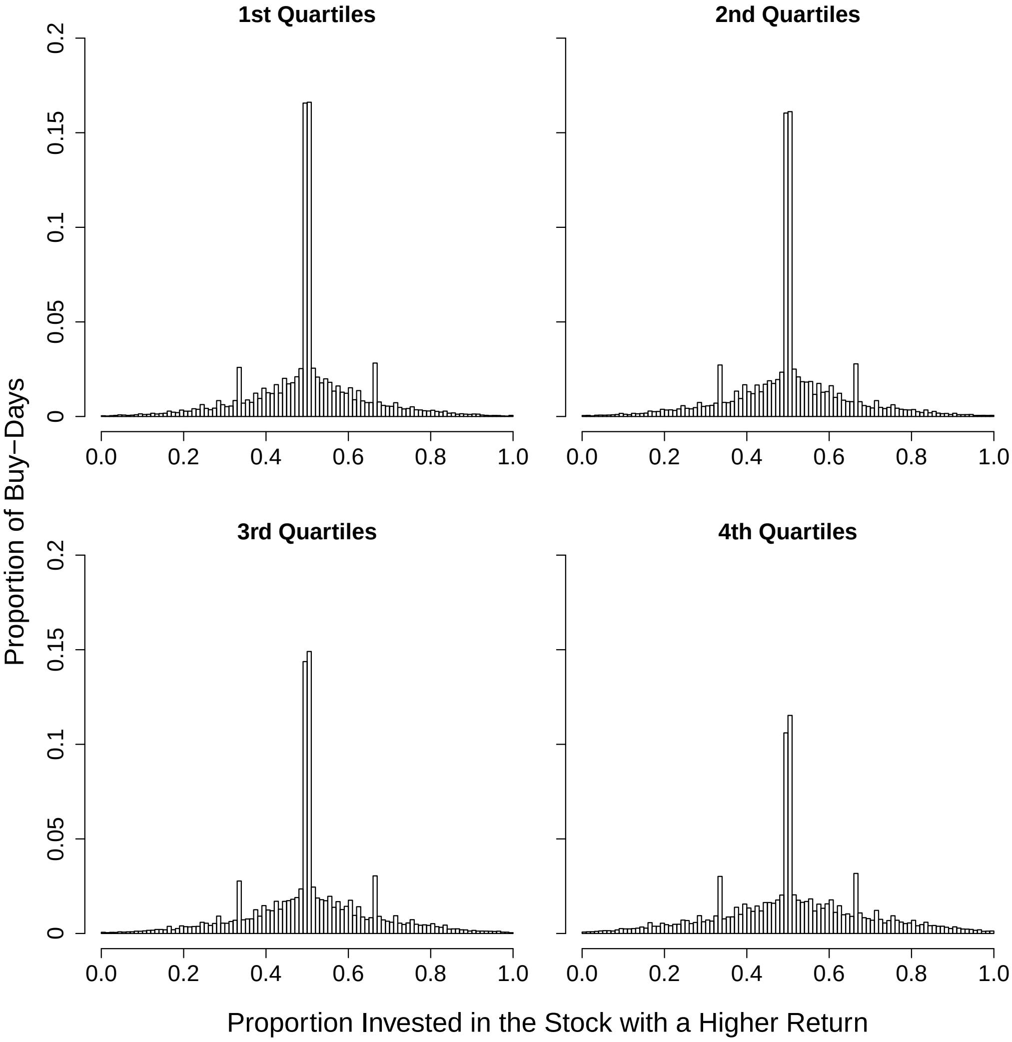
Note: Figures show histograms of the proportion of the total buy-day investment (in pounds) which is invested in Stock A, where Stock A is a randomly chosen stock from the pair of stocks purchased. Bin width is 0.01.

Figure A10: Proportion of Buy-Day Monies Invested in Random Stock A, Two-Stock Buy Days By Trading Frequency



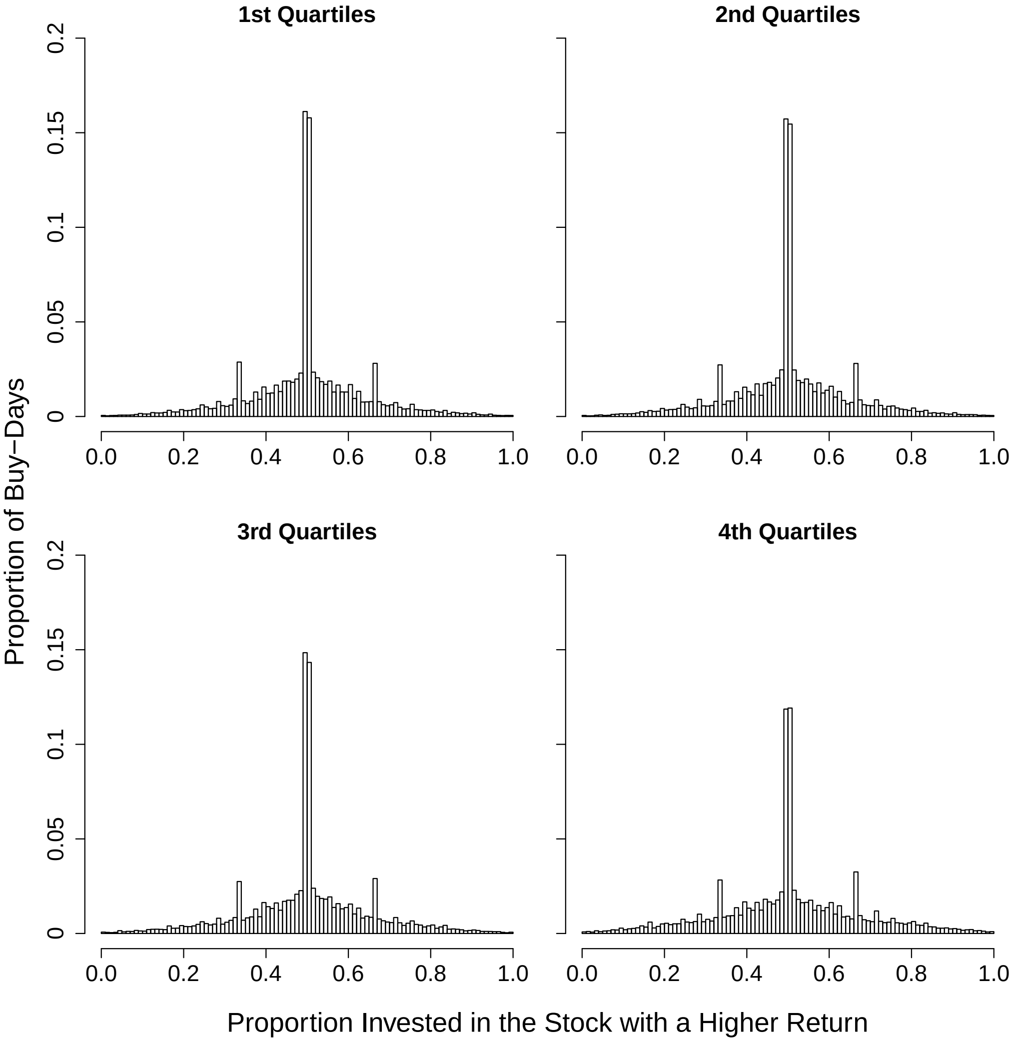
Note: Figures show histograms of the proportion of the total buy-day investment (in pounds) which is invested in Stock A, where Stock A is a randomly chosen stock from the pair of stocks purchased. Bin width is 0.01.

Figure A11: Proportion of Buy-Day Monies Invested in Higher-Return Stock, Two-Stock Buy Days By Difference in Past 3 Month Stock Returns



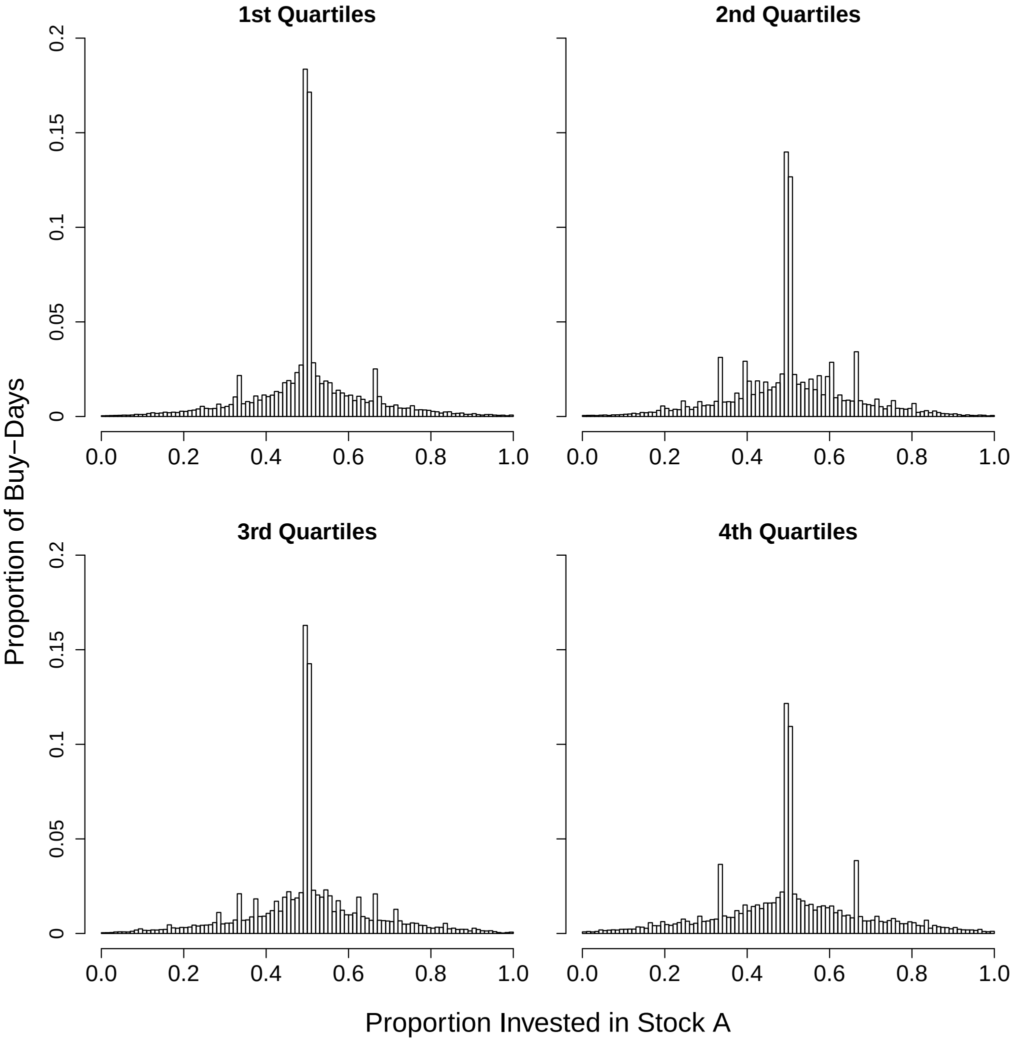
Note: Figures show histograms of the proportion of the total buy-day investment (in pounds) which is invested in Stock A, where Stock A is the stock from the pair of stocks purchased which has the higher gross returns over the previous 3 month period. Bin width is 0.01.

Figure A12: Proportion of Buy-Day Monies Invested in Higher-Return Stock, Two-Stock Buy Days By Difference in Next 3 Month Stock Returns



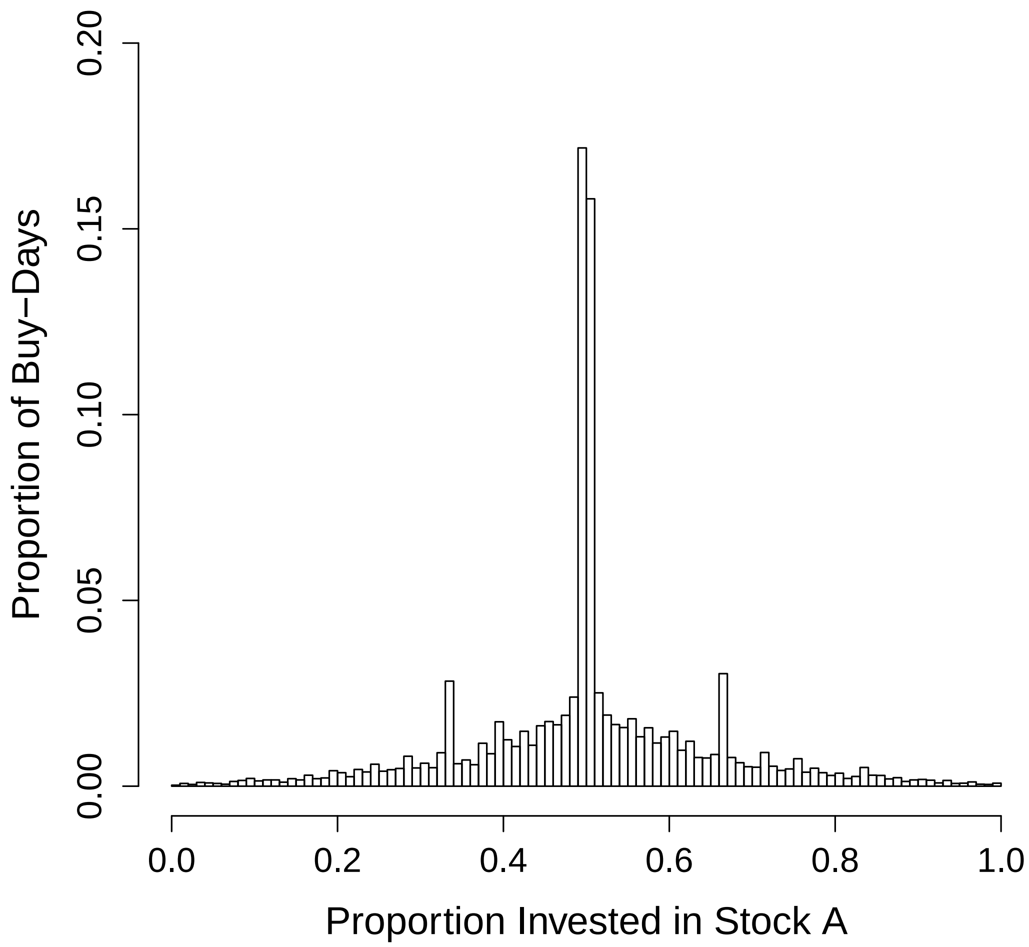
Note: Figures show histograms of the proportion of the total buy-day investment (in pounds) which is invested in Stock A, where Stock A is the stock from the pair of stocks purchased which has the higher gross returns over the next 3 month period. Bin width is 0.01.

Figure A13: Proportion of Buy-Day Monies Invested in Random Stock A, Two-Stock Buy Days By Investment Amount on the Day



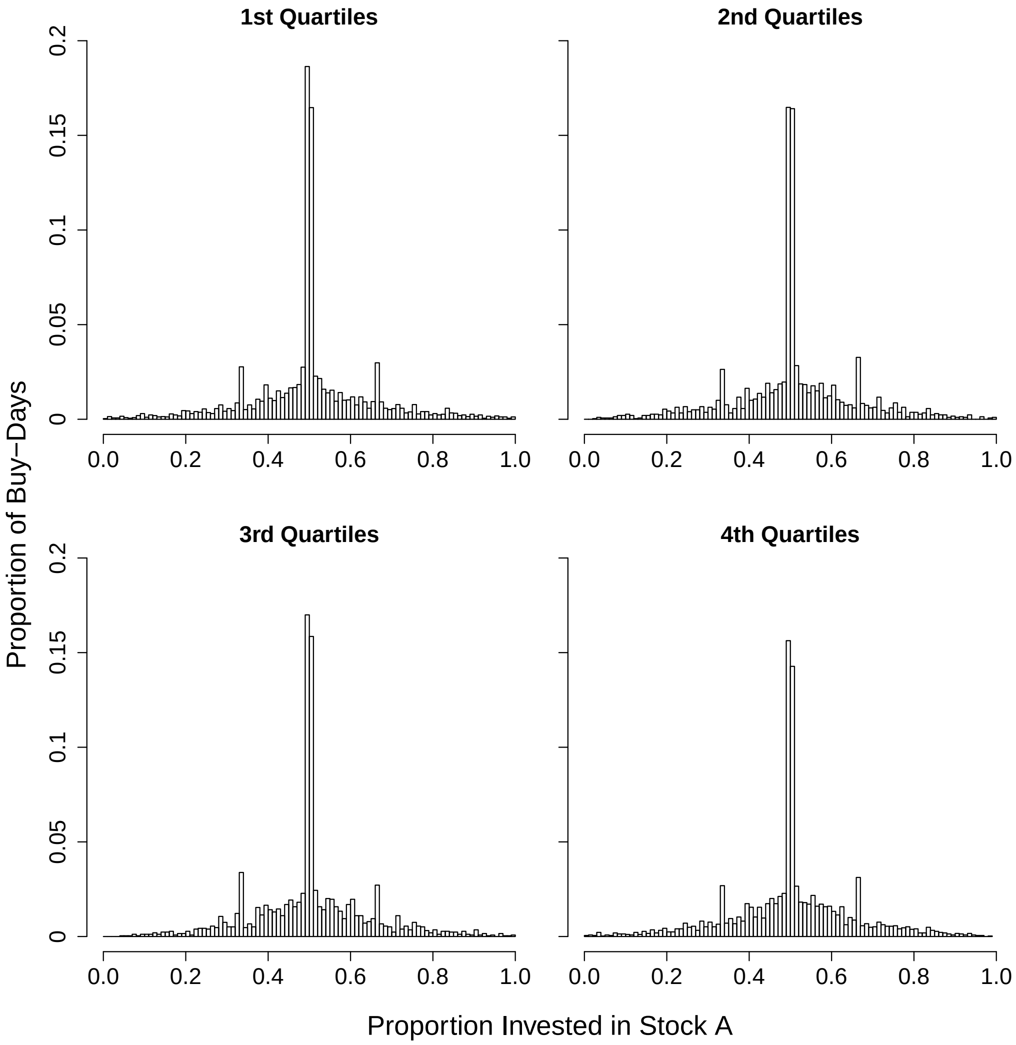
Note: Figures show histograms of the proportion of the total buy-day investment (in pounds) which is invested in Stock A, where Stock A is a randomly chosen stock from the pair of stocks purchased. Bin width is 0.01.

Figure A14: Proportion of Buy-Day Monies Invested in Random Stock A, Two-Stock Buy Days Among New Accounts



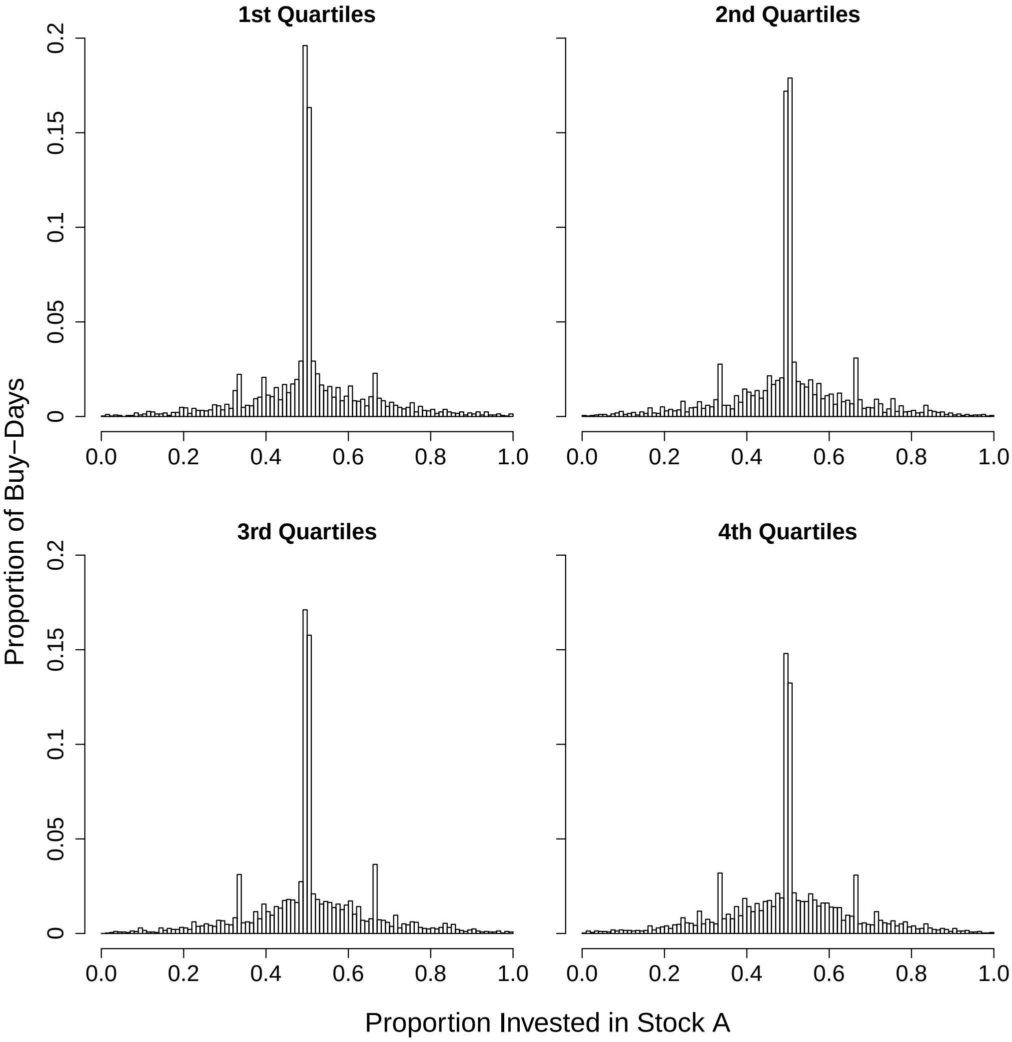
Note: Figures show histograms of the proportion of the total buy-day investment (in pounds) which is invested in Stock A, where Stock A is a randomly chosen stock from the pair of stocks purchased. Bin width is 0.01.

Figure A15: Proportion of Buy-Day Monies Invested in Random Stock A, Two-Stock Buy Days By Number of Stocks in Portfolio, New Accounts Only



Note: Figures show histograms of the proportion of the total buy-day investment (in pounds) which is invested in Stock A, where Stock A is a randomly chosen stock from the pair of stocks purchased. Bin width is 0.01.

Figure A16: Proportion of Buy-Day Monies Invested in Random Stock A, Two-Stock Buy Days By Portfolio Value, New Accounts Only



Note: Figures show histograms of the proportion of the total buy-day investment (in pounds) which is invested in Stock A, where Stock A is a randomly chosen stock from the pair of stocks purchased. Bin width is 0.01.

Table A1: Summary Statistics for All Multiple-Stock Buy-Days

Panel (A)

	Mean	SD	25th percentile	Median	75th percentile
Account Tenure	68.45	49.12	24.27	61.27	111.97
Investment Amount on the Day	13,600.96	36,945.53	2,839.75	5,992.68	13,627.26
Range of Past 60-days Returns	0.39	1.60	0.08	0.17	0.34
Range of Next 60-days Returns	0.25	0.30	0.08	0.17	0.31

Panel (B)

	Male	Female	Unknown
Number of Accounts	30,074.00	7,732.00	4,651.00

Panel (C)

	Mean	SD	25th percentile	Median	75th percentile
Ave. Num. of Trades per Month	1.58	4.61	0.30	0.63	1.41

Note: Table reports summary statistics for sample of multiple-stock buy-days. Unit of data is a single buy-day. Account tenure is number of months since account openig. Range of Past / Next 60–day returns is the difference (in percent) in simple gross returns between stocks purchased on the buy-day.

Table A2: Summary Statistics for New Account Multiple Stock Buy-Days

Panel (A)

	Mean	SD	25th percentile	Median	75th percentile
Account Tenure	11.74	11.27	2.03	8.53	18.63
Investment Amount on the Day	9,044.45	19,245.47	1,969.42	4,345.69	9,802.09
Portfolio Value	44,446.12	131,000.94	5,720.23	14,660.86	37,494.10
Num. of Stocks in the Portfolio	7.83	8.59	3.00	5.00	9.00
Range of Past 60-days Returns	0.45	1.95	0.08	0.18	0.35
Range of Next 60-days Returns	0.25	0.30	0.08	0.17	0.32

Panel (B)

	Male	Female	Unknown
Number of Accounts	6,806.00	1,364.00	23.00

Panel (C)

	Mean	SD	25th percentile	Median	75th percentile
Ave. Num. of Trades per Month	1.43	3.65	0.29	0.61	1.32

Note: Table reports summary statistics for sample of multiple-stock buy-days among the new accounts sample only. Unit of data is a single buy day. Account tenure is number of months since account opening. Range of Past / Next 60–day returns is the difference (in percent) in simple gross returns between stocks purchased on the buy-day.