Endowment Effects in the Field: Evidence from India's IPO Lotteries*

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Abstract

Winners of randomly assigned initial public offering (IPO) lottery shares are significantly more likely to hold these shares than lottery losers 1, 6, and even 24 months after the random allocation. This finding persists in samples of highly active investors, suggesting along with additional evidence that this "endowment effect" is not driven by inertia alone. The effect decreases as experience in the IPO market increases, but remains even for very experienced investors. These results provide field evidence derived from the behavior of 1.5 million Indian stock investors consistent with the laboratory literature that documents endowment effects for risky gambles.

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Numerous laboratory studies have documented that the simple fact of owning an object causes subjects to become reluctant to part with it. These lab findings of an "endowment effect" call into question the fundamental neoclassical assumption that preferences and beliefs are independent of ownership, and augur important implications for a wide variety of field contexts.

However, significant challenges confront the literature on endowment effects. Three important ones are that (1) market participants are likely to have more relevant experience than laboratory subjects, and the limited field evidence available suggests that experience appears to attenuate or even eliminate the measured endowment effect (see, for example, List (2003) and List (2011)); (2) lab findings of endowment effects appear sensitive to experimental procedures, which makes it difficult to generalize these results to the field (Plott and Zeiler, 2005); and (3) new lab evidence on the endowment effect shows that it also appears in gambles, and not just in physical objects with fixed payoffs (Isoni et al., 2011; Sprenger, 2015), though there is as yet little field evidence on the prevalence of the endowment effect for gambles.

Broadening the evidence base on endowment effects outside the lab faces a fundamental obstacle: it is essentially impossible to draw inferences in the absence of random assignment of endowments to market participants. Any comparison of agents' behavior without random assignment of ownership is potentially subject to selection bias – those who selected into ownership have almost surely done so because they value the object or gamble more in the first place.

To surmount this obstacle, we study a natural experiment in which millions of market participants outside of the lab are randomly assigned risky gambles. Owing to regulation, in many cases Indian initial public offering (IPO) shares are randomly assigned to applicants. This randomization means that winners and losers in these IPO lotteries should have virtually identical preferences, beliefs, and information sets before the shares are allotted. While lottery losers do not have the opportunity to buy the shares at the IPO issue price, they receive cash back which is equivalent to the IPO issue price.[1] Once the stock begins to trade freely, the groups of winners and losers have equal opportunities to trade in it. Given the equivalence of information sets and background characteristics induced by

[1] We refer to the price that lottery winners pay for the IPO stock as the "issue price," and the first price that the stock trades at on the exchange as the "listing price."

the random assignment, we should expect that the holdings of this randomly allocated stock should converge rapidly over time across the two groups. If randomly assigned ownership induces changes in valuation, however, we should see a divergence in the behavior of the randomly chosen winners and losers.

We document that the winners of IPO lotteries are substantially more likely to hold the randomly allocated IPO shares for many months and even years after the allocation. In our main results we find that 62.4 percent of IPO winners hold the IPO stock at the end of the month after listing, while only 1 percent of losers hold the stock. Six months after the lottery assignment the gap decreases slightly, to 46.6 percent of winners holding the stock and 1.6 percent of the losers holding the stock, but even 24 months after the random assignment we find that winners are 35 percentage points more likely to hold the IPO stock than losers.

For our results to be a manifestation of the endowment effect, randomly induced ownership must cause winners' willingness to accept (WTA) to become greater than losers' willingness to pay (WTP) for the IPO stock.[2] Accepting this interpretation requires ruling out explanations for the winner-loser divergence that do not produce a gap between winner WTA and loser WTP. Perhaps the most plausible alternative is that lottery winners and losers face formal or informal costs of trading which are large enough to cause the divergence in holdings that we observe. In our setting, such costs might include brokerage commissions, transactions costs, taxes, or inertia generated by cognitive processing costs of paying attention to the stock, accessing the brokerage account, or placing trades.

We study this issue in detail, developing a formal framework which we describe later in the paper, but note here that a number of empirical findings are inconsistent with this explanation. First, we find that the divergence persists strongly even as we look at investors who made more and more trades on average prior to the IPO – lottery winners at the 99th percentile of the trading distribution (more than 30 trades per month on average in the six months prior to the lottery) are still approximately 30 percent more likely to hold the stock than losers. Second, we find a large divergence amongst the sub-sample of lottery winners who make a large number of trades of sizes less than or equal to the

[2] WTA is the lowest price that a seller is willing to sell at. WTP is the highest price a buyer is willing to pay.

position size of the IPO stock in the months after the IPO.[3] Third, we find that even in sub-samples of lottery winners and losers that have actively sold another previously allotted IPO stock, winners are still substantially more likely to hold the current IPO stock than losers, casting doubt on the idea that the divergence is due only to investors who do not pay attention to the IPO stocks in their portfolio. Fourth, we find that lottery winners are more likely to make the active decision of buying additional shares of the IPO stock than lottery losers, which is consistent with the idea that lottery winners have a higher WTP for the stock than lottery losers. This is particularly difficult to explain via transactions costs, even if such costs are investor, time, and security-specific. Finally, lottery losers are not more likely to purchase another substitute stock, confirming that the winner-loser divergence in ownership is not undone by transactions in other stocks.

Overall, we conclude that most reasonable models of inertial behavior driven by costs of trading are unlikely to explain our results.[4] As we report in detail later, we also find little evidence to suggest that wealth effects, capital gains taxes, information acquisition costs, or other alternative explanations can explain our results.

We do find that the divergence in holdings attenuates substantially for the most experienced traders in our setting, as in List (2003). For each investor, we observe the number of IPOs they have previously been allotted over the past 10 years, a measure of experience which varies from 0 previous experiences up to 30 previous experiences at the 90^{th} percentile of the distribution. Consistent with List (2003), we find a strong negative correlation between this experience measure and the difference in holdings between lottery winners and losers, even after controlling for many investor and IPO characteristics. However, while List (2003) finds that endowment effects become negligible amongst his sample of experienced traders (sports card dealers and very experienced non-dealers), we find substantial endowment effects even amongst investors who have participated in over 30 IPOs – on average these highly experienced winners still hold 27 percent of their lottery allotments at the end of

[3]These findings also assuage concerns that our results are being driven by "trade uncertainty"– the idea that investors are uncomfortable with trading in general and therefore stick to the status quo (Engelmann and Hollard, 2010).

[4]In related work, we find that lottery winners have a higher trading intensity of the non-IPO stocks in their portfolio than lottery losers, and tend to tilt their portfolios in the direction of the industry sector in which the IPO stock is situated, suggesting that winning the lottery appears to reduce the (cognitive) transaction costs associated with making trades (Anagol et al., 2015).

the month of randomly receiving the IPO, while losers hold 7 percent of the initial allocation.[5]

We explore potential theoretical underpinnings for the endowment effect that we detect in our setting, noting that while carefully and cleverly designed laboratory experiments have been successful in distinguishing theoretical explanations of endowment effects,[6] our field setting (and very likely most field settings) does not allow for precise conclusions regarding mechanisms. Nevertheless, we check the extent to which leading theoretical models of the endowment effect generate additional predictions that are supported by the data.

A leading explanation for the endowment effect is that agents have reference-dependent preferences, as originally proposed by Kahneman and Tversky (1979).[7] Most of the empirical literature has focused on the case of consumption goods, where specifying the reference point as current ownership can lead to owners valuing goods more than non-owners. More recently, Kőszegi and Rabin (2006, 2007) propose a broader framework where the referent is the entire distribution of the agent's expected outcomes. This formulation makes the prediction that choices between gambles and certain amounts exhibit an "endowment effect for risk," that is, decision-makers endowed with a risky lottery will be less risk-averse regarding the lottery than decision-makers that are endowed with a certain amount, and considering the same risky lottery.[8] New lab work finds significant evidence for this effect (Sprenger, 2015).

Motivated by this literature, we develop two models which apply expectations-based reference-dependent preferences to our setting. The first of the two models in this class is the Sprenger (2015) "endowment effect for risk" model, in which agents evaluate the comparison between the IPO stock (which we treat as a risky gamble in the model) and cash. The second model in this class more closely matches features of our real-world experimental environment – agents in this augmented model eval-

[5]These results are also interesting in light of Haigh and List (2005), who find that professional futures traders exhibit greater myopic loss aversion and raise the possibility that market experience might exacerbate behavioral anomalies. Our evidence rejects the idea that more experienced market participants exhibit the endowment effect anomaly more strongly.

[6]See, for example, (Engelmann and Hollard, 2010; Ericson and Fuster, 2014; Weaver and Frederick, 2012; Goette et al., 2014; Heffetz and List, 2014; Sprenger, 2015; Song, 2015).

[7]See Pope and Schweitzer (2011) for field evidence on reference-dependent preferences, and Pope and Sydnor (2016) for a recent review of field evidence on behavioral anomalies more broadly.

[8]Put differently, agents endowed with a gamble and given the choice of a certain amount in the gamble's outcome support are predicted to exhibit near-risk-neutrality, while those endowed with the certain amount are predicted to exhibit risk-aversion when given the choice of taking the gamble.

uate both the initial risky gamble of the lottery assignment of the IPO, as well as the subsequent comparison between the IPO stock and cash. In both models, we find the range of parameter values (for the extent of loss aversion, the expected return on the stock, and in the second model, the expected probability of winning the IPO lottery) for which the same agent would choose to hold the stock if they won the lottery, but not purchase the stock if they lost the lottery.[9]

We find that both models that employ expectations-based reference-dependent preferences are able to deliver the endowment effect plan as a personal equilibrium (PE) within plausible parameter ranges. In both models, the endowment effect PE requires that agents expect medium-size returns on the risky gamble. These medium-size return expectations are achievable through a combination of beliefs about skewed payoffs on the lottery and beliefs about the likelihood of experiencing gains versus losses. Put differently, medium-size return expectations can be delivered either through small probabilities of large gains or through large probabilities of small gains.

In the augmented model which includes the initial risky gamble of the lottery assignment of the IPO, we also find that low anticipated probabilities of winning the lottery are more likely to generate the endowment effect. This is because the agent compares how she feels when she wins the lottery to how she feels when she loses, and as the probability of winning the lottery becomes higher, this comparison becomes less and less important because the agent's reference points are less and less affected by her expectations of losing the lottery. Consistent with this prediction, we find in the data that estimated endowment effects do become smaller as the probability of winning the lottery increases.

Next, we evaluate a different theoretical mechanism, in which the endowment effect is founded on agents' "aversion to bad deals" as in Weaver and Frederick (2012). In this model, lottery losers endogenously lower their valuation for the IPO stock because they often have to purchase it at a price higher than the price at which lottery winners purchase it.[10] The bad deals model predicts

[9]In the language of Kőszegi and Rabin (2006), we find the range of parameter values where we would observe an endowment effect in our experiment because agents are playing their "personal equilibrium" (PE) strategies. In several cases, we also consider whether the plan generates the highest expected utility of all possible PE plans, i.e., whether it is a "preferred personal equilibrium" or PPE.

[10]Note that a standard expected utility decision maker does not consider the issue price in choosing whether to purchase the stock as a lottery loser. She will just compare her valuation for the stock with the market price, and purchase if her valuation is higher.

large endowment effects if the price lottery losers pay is far higher than the issue price, and small endowment effects when the trading price is close to the issue price. We find mixed evidence for this prediction. On the first day of trading, lottery losers almost never puchase the stock irrespective of the difference between the market price and the issue price. However, by the end of the first full month of trading, lottery losers do appear more likely to purchase IPO stocks with smaller gaps between the current market price and the issue price, particularly in samples of more active traders. That said, the estimated winner-loser divergence even for these small listing gain stocks does not go to zero.

Finally, we consider the possibility that the divergence in winner and loser holdings is an artefact of agents knowing that they are subject to a lottery allocation. For example, lottery losers might lower their WTP for the IPO stock simply because they lost the lottery – we dub this the "sour grapes" hypothesis. A few features of the data suggest that this explanation is not the main driver of our results. First, we find that lottery losers are more, not less, likely to purchase the IPO stock that they lost in the lottery, when compared to their propensity to purchase a size-and-industry matched stock.[11] Second, under the sour grapes hypothesis, we might naturally expect that lottery losers would also have a distaste for future IPO lotteries. We find, however, that losers are only very marginally less likely than winners to apply for future IPO allocations.[12]

To summarize, we find evidence of an endowment effect for risky gambles in a major market outside of the laboratory. Even after controlling for IPO market and trading experience, many market participants act as if they have higher valuations for a gamble when they are randomly endowed with it. Our evaluation of theoretical models shows that the Kőszegi and Rabin (2006, 2007) models offer a potential explanation for our findings,[13] indicating that our findings may be an "in-the-field" manifestation of the endowment effect for risk.

[11]Lottery winners purchase the matched stock at similar rates to the lottery losers, suggesting that there is nothing in particular that makes lottery losers dislike the matched stock.

[12]An analogous explanation in this category is that winners choose to hold the IPO stock because of some positive emotions associated with winning the lottery. This explanation also does not seem satisfactory; we find that investors tend to hold the IPO stock for very similar durations as their most recently purchased (non-IPO) stock. Taken together, these results suggest that our finding of an endowment effect in this setting is unlikely to be just an artefact of the experimental setting that we study.

[13]We note, as in Sprenger (2015), that the personal equilibrium (PE conditions) are supported by our results, but not the preferred personal equilibrium (PPE) refinement. We leave these details to the online appendix.

1 The Experiment: India's IPO Lotteries

Our experiment uses the Indian retail investor IPO lottery as a naturally occurring setting in which some agents are randomly endowed with an asset while others are not, and where we can observe agents' choices to trade the asset following the random endowment. In this section we describe the circumstances in which these lotteries occur (including a specific example), and in the next section describe how they can be used to estimate endowment effects. We provide the precise details of the IPO lottery process and associated regulations in Appendix Section A.1.[14]

To summarize, these IPO lotteries arise in situations in which an IPO is oversubscribed, and the use of a proportional allocation rule to allocate shares would violate the minimum lot size of shares set by the firm. In these situations, the lottery is run to give investors who applied for shares their proportional allocation *in expectation*. The outcome of the lottery is that some investors who applied receive the minimum lot size, while others who applied receive zero shares. The fundamental reason for the lottery is that in India, regulations require that a firm must set aside 30% or 35% of its shares (depending on the type of issue) to be available for allocation to retail investors at the time of IPO. For the purposes of the regulation, "retail investors" are defined as those with expressed share demands beneath a preset value. At the time of writing, this preset value is set by the regulator at Rs. 200,000 (roughly US $3,400); this value has varied over time (see Appendix Section A.1).[15]

The share allocation process in an Indian IPO begins with the lead investment bank, which sets an indicative range of prices. The upper bound of this range (the "ceiling price") cannot be more than 20% higher than the lower bound (or "floor price"). Importantly, a minimum number of shares (the "minimum lot size") that can be purchased at IPO is also determined at this time. All IPO bids, and ultimately, share allocations, are constrained to be integer multiples of this minimum lot size.

Retail investors can submit two types of bids for IPO shares. Ninety-three percent of the sample submit a "cutoff" bid, where the retail investor commits to purchasing a stated multiple of the mini-

[14]As with many other details of regulation in the country, the Indian regulatory process for IPOs is quite complex. Several papers (e.g., Anagol and Kim, 2012; Campbell et al., 2015) have used this complexity of the Indian regulatory process to cleanly identify a range of economic phenomena.

[15]This regulatory definition technically permits institutions to be classified as retail when investing amounts smaller than the limit, but over our sample period, we verify using independent account classifications from the depositories that this very rarely occurs.

mum lot size at the final issue price that the firm chooses within the price band. To submit the bid, the retail investor deposits an amount into an escrow account, which is equal to the ceiling of the price band multiplied by the desired number of shares. If the investor is allotted shares, and the final issue price is less than the ceiling price, the difference between the deposited and required amounts is refunded as cash to the investor.[16]

Once all bids have been submitted the total levels of demand and supply of shares are set and regulation determines how shares will be allotted in the case that demand exceeds supply. We define retail over subscription v as the ratio of total retail demand for a firm's shares to total supply of shares by the firm to retail investors. There are then three possible cases:

1. $v \leq 1$. In this case, all retail investors are allotted shares according to their demand schedules.

2. $v > 1$, and shares can be allocated to investors *in proportion to their stated demands without any violation of the minimum lot size constraint*. There is no lottery involved in this case.

3. $v >> 1$ (the issue is substantially oversubscribed), and a number of investors under a proportional allocation scheme would receive an allocation which is lower than the minimum lot size. This constraint cannot be violated by law, and therefore, all such investors are entered into a lottery. In this lottery, the probability of receiving the minimum lot size is proportional to the number of shares in the original bid and lottery applicants receive their proportional allotment in expectation.[17]

This third case, in which the lottery takes place, provides the random variation that we exploit to test for the endowment effect. Far from being an unusual occurrence, in our sample alone (which is a subset of all IPOs in the Indian market over the sample period), roughly 1.5 million Indian investors participate in such lotteries over the 2007 to 2012 period in the set of 54 IPOs that we study.

[16]The remaining investors in our sample submitted "full demand schedule" bids. In this type of bid the investor specifies the number of lots that they would like to purchase at each possible price within the indicative range, once again depositing in escrow the maximum monetary amount consistent with their demand schedule at the time of submitting their bid, with a cash refund processed for any difference between the final price and the amount placed in escrow.

[17]Appendix Section A.3 shows a mathematical derivation of the probabilities of winning allotments based on the level of excess demand.

The time line of the application and allotment process is as follows. Applications are received over a two-day period termed the "subscription period." Shares are allotted to the winner's accounts approximately 12 days after the applications are received. The shares typically list approximately 21 days after the subscription period. Refunds of the escrow amounts begin to be processed after the allotments are made, usually 14 days after the allotments are made. Lottery losers receive a complete refund on their escrow amounts.

An Example: Barak Valley Cements IPO Allocation Process. Barak Valley Cements' IPO opened for subscription for the two day period October 29, 2007 through November 1, 2007. The stock was simultaneously listed on the National Stock Exchange (NSE) and the Bombay Stock Exchange (BSE) on November 23, 2007. The price that lottery winners paid for the stock, which we refer to as the "issue price" throughout the paper, was Rs. 42 per share. The price the stock first traded at on the market, which we we refer to as the "listing" price, was 62 rupees per share. The stock closed on the first day of listing at Rs. 56.05 per share, for a 33.45% listing day gain. The retail over subscription rate v for this issue was 37.62. Given this high v, all retail investors that applied for this IPO were entered into a lottery.

Appendix Table A.1.1 shows the official retail investor IPO allocation data for Barak Valley Cements.[18] Each row of column (0) of the table shows the share category c, associated with a number of shares applied for given in column (1), which, given the minimum lot size $x = 150$ for this offer is just cx. In this case, the total number of share categories (C) equals 15, meaning that the maximum retail bid is for 2,250 shares.[19] Column (2) of the table shows the total number of retail investor applications received for each share category, and column (3) is the product of columns (1) and (2). Column (4) shows the investor allocation under a proportional allocation rule, i.e., $\frac{cx}{v}$. Given that these proportional allocations are all below the minimum lot size of 150 shares, regulation requires the firm to conduct a lottery to decide share allocations.

Column (5) shows the probability of winning the lottery for each share category c, which is $p = \frac{c}{v}$.

[18] These data are obtained from `http://www.chittorgarh.com/ipo/ipo_boa.asp?a=134`.

[19] The number of share categories is capped at 15 here because $C = 16$ would correspond to 2,400 shares, and a subscription amount of Rs. 100,800 at the issue price of Rs. 42. This subscription amount would violate the prevailing (in 2007) regulatory maximum retail investor application constraint of Rs. 100,000 rupees per IPO.

For example, 2.7% of investors that applied for the minimum lot size of 150 shares will receive this allocation, and the remaining 97.3% of investors applying in this share category will receive no shares. In contrast, 40.6% of investors in share category $c = 15$ receive the minimum lot size $x = 150$ shares. For this particular IPO, *all* retail investors are entered into a lottery, and ultimately receive either zero or 150 shares of the IPO. Column (6) shows the total number of shares ultimately allotted to investors in each share category, which is the product of x, column (2), and column (5). Columns (7) and (8) show the total sizes of the winner and loser groups in each share category for the Barak Valley Cements IPO lottery, respectively.

It is perhaps easiest to think of our data as comprising a large number of experiments, in which each experiment is a share category within an IPO. *Within* each experiment the probability of treatment is the same for all applicants, and we exploit this source of randomness, combining all of these experiments together to estimate the average causal effect of winning an IPO lottery on future holdings of the IPO stock.

Data. When an individual investor applies to receive shares in an Indian IPO their application is routed through a registrar. In the event of heavy over subscription leading to a randomized allotment of shares, the registrar will, in consultation with one of the stock exchanges, perform the randomization to determine which investors are allocated. We obtain data on the full set of applicants to 85 Indian IPOs over the period from 2007 to 2012 from one of India's largest registrars. 54 of these IPOs had at least one randomized share category. This registrar handled the largest number of IPOs by any one firm in India since 2006, covering roughly a quarter of all IPOs between 2002 and 2012, and roughly a third of all IPOs over our sample period.[20] This paper studies only the category of retail accounts, as the IPO lottery only applies to this group of investors. For each IPO in our sample, we observe whether or not the applicant was allocated shares, the share category c for which they applied, the geographic location of the applicant by pincode (similar, but larger than, zipcodes in the U.S.), the type of bid placed by the applicant, the share depository in which the applicant has an account

[20] Appendix Figure A.1.1 shows that our sample of IPOs tracks the aggregate Indian IPO waves, with a decline in 2009, and high numbers of IPOs in 2008 and 2010. Appendix Table A.1.2 presents summary statistics on our sample of IPOs. Our sample accounts for 22% of all IPOs over this period by number, and US$ 2.65 BN or roughly 8% of total IPO value over the period.

(more on this below), whether the applicant was an employee of the firm, and a few other application characteristics.

Our second major data source allows us to characterize the equity investing behavior of these IPO applicants. We obtain these data from a broader sample of information on investor equity portfolios from Central Depository Services Limited (CDSL). Alongside the other major depository, National Securities Depositories Limited (NSDL), CDSL facilitates the regulatory requirement that settlement of all listed shares traded in the stock market must occur in electronic form.[21] Every applicant for an IPO must register to open (or already have) an account with either of the two depositories (CDSL and NSDL), as the option to receive allocated shares in an IPO in physical form does not exist. We match the IPO applications data to the CDSL accounts data using anonymous identification numbers of household accounts from both data sources. We verify the accuracy of the match by checking common geographic information fields provided by both data providers such as state and pincode.[22] When adjusted for per-capita GDP differences between the US and India, the account value distribution and trading activity for the universe of investors in the CDSL data and the lottery sample are similar to those in the US (see Appendix Figure A.1.3 (a) and (b)).

All CDSL trading accounts are associated with a tax related permanent account number (PAN), and regulation requires that an investor with a given PAN number can only apply once for any given IPO.[23] Thus no investor account may simultaneously belong to both the winner and loser group, or be allocated twice in the same IPO. However, it is possible that a household with multiple members with different PAN numbers could submit multiple applications for a given IPO in an attempt to increase the household's likelihood of winning. While we do not directly control for this possibility, we believe that this is unlikely to materially affect our inferences, as we discuss in more detail in the section covering potential explanations for our results.

[21] CDSL has a significant market share – in terms of total assets tracked, roughly 20%, and in terms of the number of accounts, roughly 40%, with the remainder in NSDL. While we do also have access to the NSDL data (these data are used extensively and carefully described in Campbell et al., 2014), we are only able to link the CDSL data with the IPO allocation information.

[22] We are able to match 99.5 percent of our IPO lottery applicants to our data on portfolio holdings.

[23] In July 2007 it became mandatory that all applicants provide their PAN information in IPO applications. (SEBI circular No.MRD/DoP/Cir-05/2007 came into force on April 27, 2007. Accessed at http://goo.gl/OB61M2 on 19 September 2014.) We confirm there are no violations of this regulation in our data, by checking across all brokerage accounts associated with the anonymized tax identification number of each investor.

Using IPO Lotteries to Estimate Endowment Effects. The method of estimating the endowment effect in our natural experiment bears important similarities and differences to the laboratory methods used before. Broadly speaking, our method resembles the "exchange paradigm" of endowment effect experiments (Ericson and Fuster, 2014). In this paradigm, subjects are randomly assigned to receive one of two objects A or B of approximately equal value (e.g. a mug and a pen). Later in the experiment the subjects are given the opportunity to trade for the object they were not originally endowed. The extent to which the holdings depart from equal proportions in groups initially assigned goods A and B provides a quantitative estimate of the endowment effect.

As a starting point, it is useful to think of good A as the IPO stock which is randomly assigned to our lottery winners, and good B as the cash from the escrow account that is returned to lottery losers. For identification purposes, the key similarity of our setting with the laboratory exchange paradigm is that the subjects who receive the IPO stock are randomly chosen. This removes the standard selection problem of owners of objects having higher valuations for the object than non-owners. The second important similarity is that we can subsequently observe the holding behavior of the randomly endowed objects in a setting where the participants can trade at relatively low cost; when the stock lists on the market, this is analogous to the experimenter giving the laboratory subjects the opportunity to exchange. The final important similarity is that to estimate the size of the endowment effect, we compare the fraction of lottery winners who hold the IPO stock to the fraction of lottery losers who hold the IPO stock after both groups have had the opportunity to exchange. In our setting as well as in the laboratory exchange paradigm, it is not possible to estimate the magnitude of the gap between the WTA of owners and the WTP of losers. However, we argue that the holding behavior of stock investors is an intrinsically interesting outcome in itself (see Baker et al. (2007), for example), even if the WTA-WTP gap is small.

Our natural experiment has a number of important differences with the laboratory exchange paradigm, and several of these differences make it relatively harder for us to identify endowment effects. First, the participants in our natural experiment who are randomly endowed with the IPO stock also receive a wealth shock relative to the lottery losers, since winners are allowed to purchase the IPO stock at the issue price and then sell it at the listing price.[24] In contrast, in exchange paradigm experiments, the objects are typically chosen to be of equal value, so there is no wealth shock.

Second, in exchange paradigm experiments, the explicit/formal cost of trading is zero. In our setting, there are monetary costs of transacting, such as brokerage fees and securities transactions taxes. The presence of these costs makes it possible that a divergence in lottery winner and loser holdings could emerge even in the absence of a WTA-WTP gap. This motivates us to focus heavily on the extent to which such costs can explain the differences we find.[25]

Third, subjects in exchange paradigm experiments are explicitly prompted about whether they would like to trade one good for the other. This makes it plausible to believe that laboratory subjects have actively thought about whether they would like to exchange good A for good B (although it cannot, of course, guarantee that this is the case). In our setting, there is no experimenter encouraging the investor to actively consider whether they want to sell (lottery winners) or buy (lottery losers) the IPO stock after it begins to trade. Thus, we need to be careful to rule out the possibility that costs associated with paying attention to the IPO stock might generate differences in the holding behavior of winners and losers even in the absence of an endowment effect.

Fourth, participants in our natural experiment know that they have been randomly endowed the IPO stock or returned the cash. Subjects in exchange paradigm experiments are typically not told that they might have received the other object. This opens the possibility that changes in WTA or WTP could be induced by participants' reactions to the event of either winning or losing the lottery itself, separately from the act of owning the object. For example, lottery losers might lower their valuation of the IPO stock when the state of winning the IPO lottery becomes unattainable – the "sour grapes" hypothesis. We also note here that the presence of any such factor might make it *less* likely to observe a divergence in holdings across winners and losers, if both groups realize that their ownership of the stock is only due to chance.

[24] Lottery losers cannot purchase the stock at the issue price, meaning that the change in value of the allotted stock between listing and issue prices constitutes a wealth gain (or loss) for lottery winners (62 dollars on average). The wealth gain is not equal to the total amount of the endowment because lottery losers receive a refund equal to the amount of the allotted stock, valued at the issue price.

[25] While exchange experiments have no monetary costs of trading, they of course may have important informal/psychological costs of engaging of trading.

Our natural experiment also has a few identification advantages. The setting avoids four specific laboratory features that have been highlighted as spuriously producing endowment effects in Plott and Zeiler (2005): 1) the endowed object is placed physically in front of the subject, and therefore endowed subjects might gain more information about the endowed versus non-endowed object,[26] 2) the endowed object is called or interpreted as a gift, 3) the procedure measuring WTA and WTP is not properly incentivized, and 4) the subject is not guaranteed anonymity when making choices. In our setting, 1) lottery winners do not have access to any information about the IPO security that lottery losers cannot obtain through publicly available sources, 2) there is little reason to believe winners would frame receiving the IPO stock as a gift given that they put down large escrow amounts to apply for the shares, and have to pay the issue price, 3) we measure the endowment effect by measuring the actual divergence in holdings of the IPO stock, which investors are clearly incentivized to choose optimally, and 4) the anonymous nature of financial markets makes it unlikely that investors are concerned about others observing their choices.

Three other advantages of our setting are worth noting. First, participants in our setting have a far longer time period to consider their potential decisions regarding the endowed gamble, including the period before the allotment (when they could make a plan regarding what to do in the event of winning or losing the lottery); the period immediately following the allotment; and the many months when we can track their behavior after the stock starts trading. For example, it would be easy for lottery applicants to avoid the endowment effect in our setting by making a plan to sell the stock immediately after it lists if they win the lottery, and to not buy the stock if they lose the lottery. In contrast, subjects in exchange experiments typically consider these choices for much shorter periods of time. For example, in the List (2003) study, subjects were given a piece of sports memorabilia by the experimenter, took a five minute survey, and then were immediately asked if they would like to trade for another piece of sports memorabilia. Second, our participants have many more learning opportunities to exploit during this longer time period (such as peers, message boards, broker advice, etc.) that subjects in the previous field and lab experiments do not have access to. In this sense our

[26]For example, in List (2003), sports cards traders were physically given the sports memorabilia, asked to fill out a survey, and then prompted for whether they want to trade.

results can be viewed as a joint test of the hypothesis that individual market participants demonstrate an endowment effect, and also that market sources of information do not eliminate this anomaly. Third, because we observe the investor's full portfolio of trades, we can observe whether the investor actively chooses to buy more of the randomly endowed gamble, in addition to whether they hold the randomly endowed gamble. This is a useful direct test that most laboratory and field experiments do not permit.

2 Documenting the Winner-Loser Divergence

We estimate the causal effect of winning an IPO lottery on various measures of holdings of the IPO stock for each (event) month t, by estimating cross-sectional regressions of the form:

$$y_{ijc} = \alpha + \rho I_{\{success_{ijc}=1\}} + \gamma_{jc} + \varepsilon_{ijc}. \tag{1}$$

Here, y_{ijc} is an outcome variable of interest, such as an indicator for whether the account holds the IPO stock, for applicant i in IPO j, share category c. $I_{\{success_{ijc}=1\}}$ is an indicator variable that takes the value of 1 if the applicant was successful in the lottery for IPO j in category c (investor is in the winner group), and 0 otherwise (investor is in the loser group). ρ are the estimated treatment effects in each event-month t. γ_{jc} are fixed effects associated with each IPO share category experiment in our sample. Angrist et al. (2013) refers to these experiment-level fixed effects as "risk group" fixed effects. Conditional on the inclusion of these fixed effects, variation in winning the lottery is random, meaning that the inclusion of controls should have no effect on our point estimates of ρ. We run this regression separately for different months after the IPO stock is allotted to examine how the winner-loser divergence varies over time.[27]

Randomization Check. Table 1 presents summary statistics and a randomization check comparing

[27] See Chapter 3 of Angrist and Pischke (2008) for a discussion of how regression with fixed effects for each experimental group identifies the parameter of interest using only the experimental variation. Angrist (1998) shows that our estimated treatment effect ρ is a weighted average of the treatment effects from each separate share category experiment. Intuitively, the regression weights give more importance to experiments in which the probability of treatment is closer to $\frac{1}{2}$, and experiments with larger sample sizes – experiments in which there are many accounts in both treatment and control groups. Note that in our summary statistics tables described below and throughout the remainder of the paper, mean values for lottery winner and loser groups are calculated across share categories using the same weighting scheme implied in our regression.

our lottery winner and loser groups. Columns (1) and (2) present the means of variables listed in the row headers in winner and loser groups respectively, and Column (3) presents the difference across the two samples. All of these variables are measured the month before allotment of the IPO. If the allocation of IPO shares is truly random, we would expect few statistically significant differences across winner and loser groups prior to the assignment of the IPO shares. Column (4) calculates the percent of our 383 share category experiments in which the winner and loser groups were significantly different at the 10% level. Under the null hypothesis that winning the lottery is random, we expect that roughly 10% of these experiments will exhibit a significant difference at the 10% level.

The first variable we check for balance on is whether accounts that won the current lottery were also more likely to have been successful in receiving IPO shares in the past. If it was possible to "game" the lottery and increase one's probability of winning we would expect current winners to have also been more successful in the past.[28] Table 1 shows that virtually identical fractions (38%) of both winner and loser investors applied to an IPO with our registrar, or were allotted shares in an IPO not covered by our registrar, in the month prior to allotment.

The next set of variables describes the trading behavior of our winner and loser groups. 68.2% of lottery applicants made a trade in the month prior to the lottery. Half of the accounts make between 1 and 10 trades in the month prior to the IPO, and 5 percent of accounts made over 20 trades in that month. The next variables present summary statistics on the fraction of accounts that made trades in position sizes less than or equal to the value of the IPO allotment. This is useful to look at because the lottery allotments are the minimum lot size, so we would like to have a sense of how common it is for our lottery participants to trade in such "small" position sizes. In fact, we find that 63.5% of applicants made a trade of a size less than or equal to the size of the lottery allotment in the month prior to the IPO. This result shows that while the lottery allotments appear small in dollar terms, it is actually very common for these investors to trade in amounts that are of equal or smaller size.[29] We

[28] In the case of IPOs for which our data provider was the registrar, we can directly measure whether or not an account *applied* to an IPO in each of periods $+1$ to $+6$. For IPOs where our data provider was not the registrar, we can observe whether the account was *allotted* shares since we see allotments for the entire universe of IPOs from the CDSL data. We set the outcome variable to one in either case – if we see an application for IPOs for which our data provider was the registrar, or if we see an allotment for IPOs not covered by our registrar – and zero otherwise. We focus on this combined measure because it includes all of the information available to us.

[29] The fraction of experiments that show significant differences on the dummy variables for making greater than ten

also look at the propensity of both winner and loser group investors to "flip" IPOs that they had been allotted in the past. We define flipping as selling an allotted IPO in the allotment month. We find that close to 30% of investors in both winner and loser group investors have this propensity, which is striking in light of our later results on the divergence between the post-allotment ownership patterns of winners and losers.

The remaining rows of the table summarize other account characteristics. 78% of winner and loser investors had an account value greater than zero in the month prior to the IPO. Portfolio value amounts are highly skewed so we transform this variable using the inverse hyperbolic sine function[30] – we find that the mean (US$ 530 on average) and distribution of portfolio values are very similar across winner and loser accounts. Winner and loser accounts on average hold 9 securities in their portfolio before allotment. Approximately 30% of accounts are less than six months old, 33% are between 7 and 25 months old, and 37% are over 25 months old.

Overall, we find that the differences across winner and loser groups are small and typically not statistically significant at standard levels. The fraction of experiments with greater than ten percent significance is around ten percent. Given the similarity of winner and loser groups across this wide set of background characteristics, we confirm that the IPO shares allocated through the lottery mechanism are indeed randomly assigned to investors.

Characterizing the Treatment. Table 2 characterizes the application and allotment experience the investors in our analysis received upon being randomly chosen to receive IPO shares. Column (1) of the table shows the mean across all investors in the winner groups of IPOs in our 383 share category experiments for each of the variables listed in the row headers. Columns (2) through (6) present the percentile of each variable in terms of the distribution across all of the experiments.[31] On average, both lottery winners and losers put 1,751 dollars into an escrow account to participate in the lottery

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transactions less than the allotment size are large primarily in experiments that have small sample sizes. The large sample basis for this statistical test is less applicable in these cases.

[30] $\sinh^{-1}(z) = \log(z + (z^2+1)^{1/2})$. This is a common alternative to the log transformation which has the additional benefit of being defined for the whole real line. The transformation is close to being logarithmic for high values of the z and close to linear for values of z close to zero. See, for example, Burbidge et al. (1988) and Browning et al. (1994).

[31] We first calculate the mean within each experiment, and then report the corresponding percentile across the experiments. For example, the median share category experiment had a mean application amount of 792 dollars (first row of Table 2).

(row 1, Table 2). Lottery winners receive an average of 150 dollars worth of the IPO stock in the IPO lottery (row 3). They also receive an instant gain of 62 dollars on average, because IPO stocks' listing price is 39 percent higher than the issue price on average (row 5). Lottery losers cannot purchase the stock at the issue price, so the average endowment that the winners receive (which the losers do not) is 212 dollars (150 + 62) of the IPO stock. Both winners and losers get refunds from their escrow accounts of approximately 1,600 and 1,750 dollars, respectively.

Full Sample: Graphical Analysis. Figure 1 presents our main result in graphical form. Figures 1a and 1b plot the fraction of winners (black triangles) and fraction of losers (green circles) that hold the IPO stock in a given share category experiment at the end of the first day of trading. Figure 1a plots this measure against the percentage listing return on the x-axis, while Figure 1b uses instead the dollar value of the listing gain on the x-axis.[32] Figures 1c and 1d plot the fraction that hold the IPO stock at the end of the first full month post-listing on the y-axis. Figure 1c has on the x-axis the percentage return on the stock to the end of the first month, and Figure 1d replaces this with the change in the dollar value of the IPO allotment over the same interval on the x-axis. All four figures show a sizeable gap between between the holding rates for lottery winners and lottery losers, consistent with the presence of a valuation gap between winners and losers.[33] In Figures 1c and 1d we also observe that lottery winners are less likely to hold the stock as the stock's realized return increases; this is consistent with the well-known "disposition effect" first uncovered by Shefrin and Statman (1985).[34]

Full Sample: Estimation Results. Table 3 presents our main estimates. The first column presents statistics as of the end of the first day of trading ("Listing Day"). The remaining columns show the portfolio behavior observed at the end of each event month following the IPO listing (month zero is the listing month). Each row employs a different measure of the holdings of the IPO stock. Within each row header, the first and second rows present the estimated weighted mean of the variable in the winner and loser group respectively and the third row presents the estimated $\hat{\rho}$ from equation 1, i.e.,

[32] The listing return is the percentage price change from the price the lottery winners pay for the stock (issue price) to the first trading price (listing price).

[33] Many of the vertically aligned points represent different share categories of the same IPO. We exploit this variation later in testing how the winner-loser divergence varies with the probability of winning.

[34] An endowment effect in our setting is conceptually distinct from the disposition effect. It is possible that owning a stock has a causal effect on the investor's valuation of it regardless of whether an investor's experienced return on a stock affects their propensity to sell.

the weighted difference between winner and loser group experimental means.

The first row considers an indicator for whether the account holds any of the IPO stock as the dependent variable. At the end of the first day of trading, we find that approximately 70 percent of lottery winners hold the IPO stock, while only .007 percent of losers hold the IPO stock. The difference is significant at the 1 percent level. One way to interpret this result is that approximately 30 percent of applicants, on average, do not show an endowment effect because their behavior is consistent regardless of whether they randomly won or lost the lottery. In contrast, 69.3 percent of applicants demonstrate an endowment effect at the end of the first day.[35]

At the end of the listing month (0), lottery winners are 62 percent more likely to hold the IPO stock than lottery losers. This divergence declines to 46 percent at the end of six months, with all differences significant at the 1 percent level. The loser group means show that it is relatively rare for lottery losers to own the stock – on average 1 percent of lottery losers own the IPO stock in the month in which it lists, this number only rises to 1.6 percent six months post-listing.

The second row header defines the dependent variable as the fraction of the potential IPO allotment that the account holds. For example, if winners in a particular share category lottery won ten shares and a given account holds five shares, the dependent variable would be defined as 0.5. For lottery losers this variable is also defined as the number of shares of the IPO stock they hold divided by the allotment they *would* have received had they won the lottery. For example if winners won ten shares, then a loser account that chose to purchase five shares on the market would have this measure equal to 0.5. For this measure, the divergence is slightly smaller at the end of month 1, but otherwise very similar to the first row. However, a comparison of lottery loser means across the first and second variables reveals that conditional on holding the IPO stock, lottery losers choose to hold a substantially larger fraction than the lottery allotment. In particular, Column (1) for month 0 shows that one percent of the lottery losers hold the stock, but their average fraction of allotment is 4.4 percent, implying that lottery losers who choose to own the stock purchase roughly four and a half times the amount of

[35]We only present the first day results for the indicator for holding the IPO stock (I(Holds IPO Stock)) because this variable is the most reliably estimated given our data. Appendix A.7 describes the assumptions we need to make to determine whether an account held the IPO stock at the end of the listing day using our monthly holdings data.

lottery allotment.[36]

The third row of the table is an indicator for whether the account holds exactly the number of shares allotted to winners in the relevant share category. Results here are similar to those in the first row, suggesting that most of the divergence between winners and losers arises from lottery winners continuing to hold initial allotments, while losers are unlikely to purchase the exact allotment they did not receive in the lottery.

The fourth row shows the US$ value of the IPO stock held in the portfolio at the end of the month. Lottery winners hold US$ 108 more of the stock than losers on average at the end of the first month, US$ 84 more at the end of the second month, and US$ 55 more at the end of the sixth month. This measure includes differences in chosen holdings between winners and losers as well as returns earned on those shares, meaning that some of the decline in this measure is attributable to significant negative returns on these IPO stocks on average, as we describe below. The fifth row shows the weight of IPO stock in the investor's portfolio, and shows that lottery winners hold 13 percent more of their portfolio in the IPO stock in month 0, which remains substantially higher at 6 percent six months after allotment.

The final rows of the table show average percentage returns to holding the IPO stock to the end of each month. On average the listing return is 42 percent. The next two rows show cumulative returns from holding the stock assuming that the stock was (1) won in the lottery, or (2) purchased at the listing price, and the final row shows the average returns from holding the Indian market portfolio measured over the same intervals. The returns data show that lottery winners on average lost money based on their choice to continue to hold the stock after it was initially listed, since (raw or market-adjusted) returns measured from the listing price are large and negative. In this sense, lottery losers in our sample make a relatively good decision (on average) to not purchase these IPO stocks at the first trading price. Clearly, what constitutes a good decision depends on the realization of returns in any particular sample, but the key result is that the two groups chose to make substantially *different*

[36]Suppose there are 10,000 lottery losers, the lottery allotment (to winners) was 10 shares, and 100 losers purchase the stock (1 percent). Also suppose that those 100 losers choose to purchase 50 shares. Then, the average fraction of the allotment held by lottery losers will be 5 percent (.01*5+.99*0 = .05).

decisions about holding the stock.[37]

Appendix Table A.1.4 extends the analysis to 24 months after the lottery.[38] We find that even 24 months after allotment, lottery winners are 36 percent more likely to hold the IPO stock than the lottery losers. However, lottery losers' propensity to hold the stock stays relatively constant, at around 1.5 to 1.7 percent over these 24 months.

3 Standard Expected Utility Explanations

In this Section we evaluate possible explanations for the large divergence in holdings of the IPO lottery winners and losers, assuming that winners and losers have the *same* distribution of valuations for the stock. These explanations can generate our empirical results even in the absence of an endowment effect.

Inertia Associated with Costs of Trading. We evaluate the extent to which our results can be explained by inaction induced by the costs associated with implementing a trade.[39] We begin with a model of inertial behavior that arises due to such costs (as separate from inertia induced by an endowment effect) to guide our empirical evaluation.

Let w^a_{ijt} represent investor i's willingness to accept (WTA) for stock j at time t. This level of WTA could be due to portfolio diversification motives, liquidity shocks, psychological factors, or anything else that determines whether the investor wants the stock in her portfolio. Let w^p_{ijt} be that same investor's willingness to pay (WTP) for the stock. Because this model does not include an endowment effect, $w^a_{ijt} = w^p_{ijt}$ for all investors i, for all stocks j, at any time t.

Now assume that c captures all costs associated with making a trade in the stock. This includes the cognitive cost of paying attention to the stock or to the act of trading, standard monetary costs (brokerage commissions, transactions costs, and security transaction taxes), nuisance factors (lost

[37] For example, if this pattern of negative post-issue returns is predictable, then we would expect *both* lottery winners and losers to choose not to hold the stock after listing.

[38] The results for periods one and four months after IPO listing are slightly different from those in Table 3 because we restrict this analysis to those IPOs where we can observe the portfolios of lottery winners and losers at least 24 months after the IPO allotment.

[39] Substantial evidence exists that in practice investors are sluggish, acting as if they face significant costs associated with taking action (Baker et al., 2007; Mitchell et al., 2006; Madrian and Shea, 2001) Recent papers have attempted to characterize optimal decision rules in the presence of both standard fixed costs and information processing costs – see, for example, Alvarez et al. (2013), Abel et al. (2013) and Andersen et al. (2015).

brokerage account password), etc. Moreover, c also includes non-rational costs that might drive inertia, such as costs of dealing with self-control problems that lead to procrastination.[40]

The presence of this cost c can induce inertia that inhibits trading, both when investors hold a stock as well as when they are contemplating buying a stock. Let p_{jt} be the market price of stock j at time t. A potential seller will choose to sell the stock if the revenue from selling, including the transaction cost, is greater than their WTA: $p_{jt} - c > w^a_{ijt}$. Rewriting this inequality, the agent sells if $p_{jt} - w^a_{ijt} > c$. Intuitively, if the gap between the market price and the agent's WTA exceeds the cost of selling, the agent will sell. Given a WTA amount w^a_{ijt}, the agent is less likely to sell as the transaction cost increases. Similarly, a potential buyer with WTP w^p_{ijt} will choose to purchase the stock if $w^p_{ijt} - c > p_{jt}$. The agent is less likely to buy as the transaction cost increases.

We now apply this framework specifically to lottery winners' and losers' choices of whether to hold, sell, or buy the IPO stock under different assumptions about transactions costs.

Case 1: No Costs of Trading. Let $j = \gamma$ denote the IPO stock. Under the assumption of no transactions costs, a lottery winner i will choose to hold the IPO stock if $w^a_{ijt} > p_{jt}$. A lottery loser i will choose to hold the stock if $w^p_{ijt} > p_{jt}$. Given that $w^a_{ijt} = w^p_{ijt}$ in this model, in this case an investor i will make the same decision regarding whether to hold the stock regardless if she won the lottery. Further, due to the randomization in our natural experiment, the distributions of WTA for winners and WTP for losers will be identical, and the fraction of lottery winners and losers holding the IPO stock will be the same. Under this assumption, our baseline results (Figure 1), in which we detect a divergence between the behaviour of 1,561,497 winners and losers (treatment: 468,519, control: 1,092,977), directly reflect a gap in WTA and WTP across winners and losers.

Case 2: Investor Specific Transactions Costs. Now consider the assumption that costs of trading are individual specific, $c = c_i$ for each investor i. In this case, a lottery winner i will choose to hold the IPO stock if $w^a_{ijt} > p_{jt} - c_i$. A lottery loser i will choose to hold the stock if $w^p_{ijt} > p_{jt} + c_i$. These conditions show that the same investor i could potentially make a different decision about whether to hold the stock based on whether they won the lottery. In particular, any investor's whose valuation

[40] In Appendix A.6. we present data on the levels of brokerage commissions and security transactions taxes, which are the two main forms of monetary transaction costs. We find both of these to be very low, with commissions ranging from .3 to .9 of a percent per trade and security transaction taxes of .145 of a percent.

satisfies the condition $p_{jt} - c_i < w^a_{ijt} = w^p_{ijt} < p_{jt} + c_i$ will choose to hold the stock as a lottery winner, but not choose to hold the stock as a lottery loser.

This issue becomes quantitatively less important as we focus on samples of investors with relatively low costs c_i. A simple way to do this is to note that investors with low c_i will have high trading volume in *all* stocks j. To understand this idea better, consider a seller in the model who owns N stocks. The total number of stocks N_s that they will sell is:

$$N_s = \sum_{j=1}^{N} I(p_{jt} - w^a_{ijt} > c_i),$$

where $I(\cdot)$ is the indicator function. This equation shows that the number of stocks sold corresponds exactly to those in the investor's portfolio for which $p_{jt} - w^a_{ijt} > c_i$. Intuitively, the number of trades made by an investor is a useful proxy for understanding an investor's transaction costs, since the more sales an investor makes, the more likely it is that this investor tends to have gaps between the market price and the agent's WTA that exceed the cost of selling. Similarly, suppose the investor considers buying N_b stocks. The number of purchase transactions is:

$$N_b = \sum_{j=1}^{N} I(w^p_{ijt} > p_{jt} + c_i)$$

Again, the model shows that an investor who buys a lot of stocks is the type who has WTP deviations above the market price that are generally large relative to their transactions costs. Taken together, the model shows that by looking at investors who trade more, we are narrowing in on the types of investors who are on average likelier to have lower costs of trading c. Therefore, if investor-specific transactions costs explain the winner-loser divergence in holdings, we would expect the divergence to approach zero as we look at sub-samples of higher and higher average trading intensity.[41]

[41] Another way to evaluate the investor based transaction cost story is to consider one simple way that investors could eliminate this anomalous behavior: lottery winners could always sell the stock after listing. Is it plausible that lottery winners who hold the stock are a particularly high transaction cost group, and this is what explains why they do not sell sooner? This does not appear to be the case in the full sample, as 75.2 percent of lottery winners who sold in the first month also made a transaction of equal or lesser value than the IPO allotment; similarly, 74 percent of lottery winners who did not sell made the same size transaction. Comparing these groups in a regression with IPO share category fixed effects, we find that lottery winners who sold the IPO stock are 2.1 percentage points *less* likely to have made another small transaction.

Figure 2a presents separate estimates of the divergence in holding rates of the lottery winners and losers conditional on making a given number of trades per month, on average, in the six months prior to the lottery. The x-axis represents bins of increasingly higher numbers of trades, in steps of 2. For example, the black triangle at the zero point on the x-axis shows, for the group of lottery winners who made less than two trades per month on average in the six months prior to the lottery, the fraction that hold the IPO stock. Similarly, the green circle corresponds to the fraction of lottery losers with the same pre-IPO average trading intensity who held the IPO stock at the end of the same month. The black triangle and green circle at the 20 marker on the x-axis are the corresponding fractions for investors who made between 20 and 22 trades per month on average in the six months prior to the IPO. The bars indicate 95 percent confidence intervals.[42] The last estimates at the right-end of the x-axis include investors that made more than 29 trades per month on average in the six months prior to the IPO. (98.4 percent of the sample made less than 32 trades on average per month, so the points shown in this figure cover the vast majority of our data.) The figure shows that as we look at sub-samples who have traded larger amounts, there is some convergence, but there is little suggestion that the effect goes to zero for even the most frequent traders in the sample.[43] It is also interesting to note that the slope of this curve is essentially flat beyond the five trades per month mark, suggesting little relationship between trading propensity and the divergence in winner-loser behavior once we move beyond a relatively low trading propensity threshold.

Figure 3a plots the experiment by experiment winner-loser ownership divergences (in the same fashion as Figure 1) estimated for a group of 54,678 investors (treatment: 16,545, control: 38,133) who made an average of 20 trades per month in the 6 months prior to the random allotment. Figure 3a(ii) shows that heavy-trading lottery losers in IPOs with realized returns through the end of the first month between -50% and 0% do appear substantially more likely to buy the IPO stock than lottery losers in the full sample, consistent with our motivation for looking at this sub-sample. Overall, however the figures still show a clear divergence in the holding behavior of lottery winners and losers.

[42] We use the approximation presented in Cochran (1977) to estimate the standard errors of the weighted means.

[43] In general, we find that portfolio turnover, as measured by the number of trades the investor does relative to the number of positions held, increases as the number of trades increases, so these results can also be interpreted as separate estimates by amount of turnover.

Case 3: Investor-Time Specific Transaction Costs. Next, suppose $c = c_{it}$, so that the costs of trading are investor-time specific. For example, there may be months where the investor is busy at work, and c_{it} is correspondingly high, but in other months, she has more time to focus on her stock portfolio. To analyze the importance of this form of transactions costs, we focus on the sub-sample of investors *i at each time t* who tended to have $p_{jt} - w^a_{ijt} > c_{it}$ for stocks they own, and $w^p_{ijt} > p_{jt} + c_i$ for stocks that they considered purchasing. Our approach is to identify this sample by inspecting the behavior of lottery winners and losers who have high trading intensity *in the specific month* in which we estimate the winner-loser divergence in holdings of the IPO stock.

Figure 2b estimates the divergence in holdings between lottery winners and losers, based on the exact number of trades made in the first full month after the IPO lottery.[44] Similar to Figure 2a, we find that the gap between winner and loser holding rates does decline as we focus on applicants who traded more in the first month, but there is again little suggestion that this divergence is limited to those who make a small number of trades.[45] This result is useful in evaluating the potential for transaction costs related to attention to explain the winner-loser divergence. The investors at the right side of this figure are paying attention to their portfolio enough to make almost one trade per day on average in the month of the IPO allotment, so it seems difficult to argue that the cost of paying attention alone could generate such a large winner-loser divergence in the IPO stock. Figure 3b plots the experiment by experiment winner-loser ownership rates estimated for a group of 85,358 investors who made 20 or more trades in the month following random allotment (treatment: 27,216, control: 58,142). Again, the lottery losers in these figures do appear substantially more likely to purchase the IPO stock relative to the full sample, but the average divergence between winners and losers is clear in the raw comparison of winner and loser mean holdings.[46]

Case 4: Investor-Time-Security Specific Transaction Costs. The final possibility that we consider is

[44]For example, the black triangle (green circle) at the 20 mark on the x-axis is the fraction of winners (losers) who held the stock and made exactly 20 trades in non-IPO stocks in the first full month after listing. This figure covers over 98 percent of the sample.

[45]The number of trades made in the first full month after the IPO are potentially affected by whether the applicant wins the lottery. Anagol et. al. (2015) finds that lottery winners are slightly more likely to trade in the month after listing, but the economic magnitude of these effects are very small.

[46]Appendix Table A.1.5 estimates the divergence by trading intensity over the first six months after listing, and finds the pattern of decline is similar to the full sample.

that the costs of trading are specific to investors at particular times and pertain to particular types of positions within their portfolios. For example, some investors might find that the costs of initiating a trade in the small position in the IPO security are too high to warrant action. To consider this possibility, we condition on a set of investors who recently traded in sizes less than or equal to the size of the IPO allotment.[47]

Figure 2c separately estimates the divergences for applicants who made the number of trades (specified on the x-axis) of sizes less than or equal to the size of the IPO allotment. Again, we find the divergence reduces as we look at more active investors, but remains economically and statistically significant for even the most active investors. Figure 3c plots the winner loser ownership divergences estimated for the group of 36,467 investors who made at least 20 trades of sizes less than or equal to the size of the IPO allotment amount in the month following random allotment (treatment: 13,235, control: 23,232). Again, we find lottery losers appear more likely to purchase the stock in more active samples, but the divergences in the raw data continue to be clear.[48]

To investigate the importance of investor-time-security transactions costs, we can also focus even further on sub-samples that sold, in the month of analysis, another IPO allotment. In Appendix Table A.1.7 we estimate the divergence for the sub-sample of investors who were allotted at least one other IPO in the past six months prior to the current IPO, and chose to sell at least one of these previously allotted IPO stocks in the month where we estimate the divergence. For example, in Column (2) of this table, 21,113 investors in the sample actively sold another IPO allotment that they received in the past six months. The divergence in holdings between the lottery winners and losers in this sub-sample remains large and statistically significant.[49] It seems difficult to argue that transactions costs for selling IPO stocks are high for this sub-sample, as we explicitly condition on having sold an allotted IPO stock. It also seems difficult to argue that these investors never actively thought about

[47]For example, suppose IPO A allotted lottery winners 150 dollars worth of shares. In this case, we check the prevalence of winner-loser divergences only for those investors who made at least one purchase of size (in a non-IPO stock) less than 150 dollars, made at least one sale less than 150 dollars, or met both these criteria in the month following the random allotment.

[48]Appendix Tables A.1.6 shows these divergences over the first six months for investors who made at least one trade in a position less than the IPO allotment value. The pattern of decline is similar to that in the full sample.

[49]The fact that these differences are smaller may also reflect that this sub-sample has a smaller endowment effect, as naturally those who sell IPO allotments as winners are the types who have lower endowment effects.

selling their IPO stock, as they actively sell another IPO stock in exactly the same month.

Active Purchase of Additional IPO Stock. Another type of analysis that is helpful in distinguishing the inertia due to transactions costs model from the endowment effect explanation is to focus on future active choices regarding the IPO stock itself. In Table 4 we test whether lottery winners are more likely to purchase the IPO stock on the open market after it lists, compared to the propensity of lottery losers to do so. Panel A shows results for the full sample. In the month of listing, we find that lottery winners are 0.6 percentage points more likely to purchase the stock on the open market than lottery losers are to purchase the stock at all. The size of this effect declines in the months after listing, although even six months after listing, the probability that lottery winners purchase the IPO stock again is twice that of lottery losers, significant at the 1 percent level. When we look at sub-samples that we expect to have lower transactions costs (as discussed above), this effect is even larger, with lottery winners being approximately three percentage points more likely to buy the IPO stock than lottery losers in the listing month, regardless of the measure used.[50] It is difficult to see how a pure transactions costs based inertia story would produce lottery winners who want to actively buy the stock more on the open market than lottery losers, given that under the transactions cost explanation the randomization induces equal WTP/WTA distributions and transactions costs across the groups. In contrast, the endowment effect explanation offers a natural explanation for this: randomly owning the stock raises the average willingness to pay for the stock. In related work we also find that lottery winners are more likely to trade non-IPO stocks in their portfolio than lottery losers, suggesting that, if anything, winning the lottery reduces the transactions costs associated with making a trade (Anagol et al., 2015). This result also goes against the idea that inertia induced by transactions costs is responsible for our results.

Overall, we conclude that these results do not support a model in which costs associated with initiating a transaction are the principal driver of the effects that we detect.

Wealth Effects and Taxes. We consider the extent to which wealth effects, disincentives for flipping (i.e., investors might believe they will be penalized in future IPOs if they flip the stock), and tax mo-

[50]This is an approximately 40 percent higher proportion of buying the IPO stock relative to the 7 to 8 percent of lottery losers that purchase the IPO stock in these active trading samples.

tivated behavior are possible explanations for our estimated endowment effects.[51] Regarding wealth effects, the key consideration is that the 62 U.S.D wealth gain lottery winners obtain over losers is very small relative to 1,750 U.S.D all lottery applicants had to put in escrow to participate in the lottery in the first place; this small gain is unlikely to be relieving a major wealth constraint for winners relative to losers, as we know both groups have substantial cash on hand in their escrow accounts. Overall, we find little evidence to suggest these explanations play an important role. We provide the results of specific tests of each of these additional explanations in Appendix A.6.

Simple Substitution Effects. One possibility is that investors who lose the IPO lottery decide to buy a substitute stock that takes the place of the IPO stock that they lost in the lottery. This behavior could potentially generate a winner-loser ownership divergence without any shift in valuations; lottery winners would tend to hold the IPO stock because winning that IPO satisfied their demand, and lottery losers would own a different stock with potentially similar characteristics.

Contrary to this hypothesis, however, we find that at the end of the month after the IPO stock lists, the lottery winners hold almost exactly one additional stock relative to the lottery losers. This means that lottery losers are not buying different stocks to close the gap in the number stocks of held (Appendix Figure E.4). Moving forward in time in Appendix Figure E.4, we also see that the trends in the lottery winner and loser groups are almost exactly parallel, once again suggesting that the lottery losers do not make differential purchases in substitute shares. Finally in Anagol et al. (2015) we find that lottery winners are actually 5 to 7 percentage points more likely to buy non-IPO stocks than lottery losers. If lottery losers substituted their lottery loss with other shares, we should observe lottery *losers* being more likely to buy non-IPO stocks in the future.

Information Acquisition Costs and Incentives. Van Nieuwerburgh and Veldkamp (2010) present a model where investors' decisions to learn about assets are jointly determined with their choices to hold those assets. In particular, the mechanism in their model is that investors choose to invest in information about securities they *expect* to hold; once they have acquired information about the stock it becomes optimal to hold more of the stock, and then once they hold more of the stock it is optimal

[51] Our discussion of wealth effects also includes the possibility of a "house money effect" explaining our results, as both are unlikely to explain our results for similar reasons. See appendix for details.

to invest more in learning about it because a given information signal is more valuable if the investor owns more shares.

In our setting, both lottery winners and losers should have the same expectations of holding the stock before the randomized allotment is made, so their incentives to learn about the stock should be the same before the allotment is made. Therefore, at the time of allotment, winners and losers should be balanced in the amount of information they have about the IPO stock. However, once winners are endowed with the stock, the model predicts that their incentive to acquire additional information about the IPO stock should be higher, which might be an explanation for the divergence that we observe.[52] On the other hand, one important feature of our results runs contrary to this explanation for our observed endowment effect. Lottery winners continue to hold the IPO stock even though it produces negative 33 percent returns on average, 6 months after issuance, and negative 62 percent, 24 months after issuance. In other words, if lottery winners are acquiring more information about the IPO stock, they appear to be acquiring particularly poor quality information that is causing them to hold an underperforming asset.

Multiple Applications Per Household. As discussed earlier, households may have an incentive to submit multiple applications through different brokerage accounts to increase their probability of winning. Could this behavior explain the endowment effect? First, it is not obvious that submitting multiple applications is a good strategy as only about one-third of IPOs end up being over-subscribed enough to initiate the lottery procedure. By submitting multiple applications with the intention of only holding the ones that are allocated, households would take on the substantial risk of their applications being fully allotted. Note also that this behavior would have to be common in almost every IPO share category in our dataset, as the endowment effect on the listing day is large in almost all share categories (See Figure 1a and 1b), and since some of these share categories had quite large probabilities of allotment (see Table 2). Nevertheless, we explore this possibility further in the appendix, and find other features of this explanation appear strongly inconsistent with our results.[53]

[52]Note that for this explanation to apply, it must be the case that there are some transactions costs associated with purchasing the IPO stock; if there are no transactions costs then the lottery losers could costlessly acquire the IPO stock and therefore have roughly the same incentives (modulo the listing gain, which they cannot access) to acquire information about it.

[53]For example, because the randomization is orthogonal to households' application behavior, this explanation would

The Relationship Between the Endowment Effect and Experience. List (2003) and List (2011) document substantial reductions in the endowment effect when measured for more experienced market participants, raising the possibility that WTA/WTP divergences are simply an artefact of a lack of market experience.

We therefore document how differential holding patterns in the IPO stock vary with plausible proxies of investors' experience in the IPO market. To do so, we interact our main Winner variable in equation 1 with a set of predetermined variables that we believe are interesting proxies for the amount of experience in the IPO market, in a descriptive analysis similar to that in List (2003). Table 5 presents the results of this exercise for the full sample of winner and loser investors, as well as for the samples of "non-inertial" investors before.

Column (1) in Table 5 takes equation (1), and adds a set of interactions between the Winner dummy and dummy variables based on tercile or quartile breakpoints of proxies of investors' experience, listed in the rows. Columns (2), (3), and (4) conduct the same regression, but for the smaller samples of investors in cases 2, 3, and 4 in our discussion of inertia (corresponding, respectively, to c_i, c_{it}, c_{ijt}). Our discussion below mainly focuses on Column (1), but we note here that estimated coefficients are very similarly signed across all proxies of experiences in the four samples, with some differences arising in statistical significance on account of large reductions in sample size.[54]

The first set of rows shows that the estimated endowment effect is highly correlated with the number of IPOs that the winner had been allotted in the past. Accounts which received over 8 (random and nonrandom) allotments in the past have estimated endowment effects that are 17 percentage points smaller than investors with no past IPO experience. However, relative to the base rate listed in the very first row (77.9 percent), even such "experienced" IPO allottees are 60 percent more likely to hold the IPO stock at the end of the first month.

Similarly, the next set of rows show that experience measured by trading activity also reduces the observed endowment effect. Winners with more than 6 trades in the month before IPO allotment are

predict there should be a large amount of buying amongst households where all of the accounts were not allocated – we do not observe this in the data.

[54]Note that the reason that the addition of the portfolio and age controls in Columns (2) and (4) changes the winner treatment effect is because this specification includes winner interactions with a set of pre-existing variable.

14.3 percent less likely to hold the IPO stock compared to those with no past trades. Moreover, high numbers of trades are also associated with greater buying activity by lottery losers.

We then measure past return experience by constructing the fraction of *realized* returns in the preceding six months to the IPO allotment that is greater than the listing return observed in the IPO. We find that if the IPO returns are substantially greater than most previously experienced returns, the endowment effect reduces considerably. Interestingly, the reverse seems to be true for the control group – they appear to have a higher propensity to hold IPOs which have higher listing returns than most they have ever experienced, and vice versa. These effects appear to become far stronger for the group of "non-inertial" investors in columns (2), (3), and (4), especially when explaining winners' propensities to trade the IPO stock. Figure 1 (c) suggests that some version of the disposition effect may be in operation for lottery winners, and this finding on the role of the past return experiences of lottery winners and losers in explaining their propensity to hold or buy suggests an intriguing link between the observed disposition effect and personal experience.

In Appendix Section A.4, we use the randomized allocation of recent lotteries to test whether recent experiences with winning an IPO lottery lower the estimated divergence in holdings generated by subsequent random allotments. We find that recent lottery winners show smaller divergences in holdings, but that these differences are slight. Overall, these results suggest that there is a correlation between measures of investor experience and smaller endowment effects, consistent with the findings in List (2003).[55] However, having experienced many allotments in the past does not appear to lead to quick and complete elimination of the endowment anomaly in this setting.

4 Explanations that Generate WTA-WTP Gaps

In the previous Section, we focused on explanations for our results where lottery winners and losers have identical distributions of valuations for the IPO stock following the lottery, none of which seem completely able to explain our results. In this section, we therefore consider a series of prominent theoretical explanations of endowment effects which involve WTA/WTP gaps as a result of the fact

[55] In Appendix Table A.1.3. we present a comparison of the effect sizes in our natural experiment to previously run field and lab exchange experiments. For low experience samples are results are similar, but for high experience samples we find substantially higher endowment effects.

of ownership. We aim 1) to determine the extent to which these models can generate a WTA-WTP gap when set up and solved in environments approximating our real-world setting, and 2) to derive additional testable predictions to see whether they hold up in the data.

1. Expectations as Reference Points – Constant Prices: Kőszegi and Rabin (2006) present a theory where recently formed expectations about future outcomes determine an agent's reference points. In the case of exchange experiments, one simple prediction is that subjects might *expect* to not have the opportunity to trade the endowed good, and so ownership of the good is the relevant recently-formed reference point. Relative to this reference point, the option of trading the good away is encoded as a loss, and subjects thus tend to hold endowed objects more than would be predicted by standard expected utility preferences. In our stock market setting, however, investors almost surely enter the lottery assuming that the stock price will vary in the aftermarket, meaning that models of reference points geared towards lotteries are likely to be more realistic characterizations of our setting.

An additional issue here is that investors in our setting very likely also enter the lottery with the expectation that they will be able to trade the stock after it is listed, given that these stocks are traded on the exchange daily. The idea that winners tend to hold the stock because they expect to own the stock in the future, discounting heavily that they will have the option to trade, is less plausible. This also means that the endowment effect cannot be a preferred personal equilibrium (PPE) when applying this model in our setting.[56] Our results suggest, at a minimum, that endowment effects are possible in markets outside the lab even when agents fully expect to have the opportunity to trade the endowed objects in the future.

2. Expectations as Reference Points – Expected Distribution of Prices. Within the Kőszegi and Rabin (2006) framework, an alternative potential reference point agents might have is ownership of the stock evaluated using the *expected distribution of future prices* of the IPO stock, rather than a constant future price. Interestingly, the expectations based reference point theory of Kőszegi and Rabin (2006) predicts an "endowment effect for risk." Decision makers will be less risk-averse when the reference point is stochastic and they face the choice of a constant alternative, and more risk averse

[56]For more details see the Appendix, where we present a formal model of a reference point based on expectations with constant prices based on Ericson and Fuster (2014). For recent empirical tests of the expectations as reference points theory of endowment effects see Ericson and Fuster (2014); Goette et al. (2014); Heffetz and List (2014).

when the reference point is fixed and they face the choice of a stochastic alternative. The fact that lottery winners take greater risk by continuing to hold the IPO stock, while lottery losers choose not to purchase the IPO stock appears consistent with this prediction of the model, under this formulation of reference points.[57]

In the appendix we present a model where lottery participants have expectations based stochastic reference points. In the model, reference points are determined by expectations, which in turn are determined by the lottery participant's plan of action (which is chosen prior to the stock listing). Lottery losers consider two possible plans; one where they do not buy the IPO stock after it lists, and one where they do buy the stock. Similarly, lottery winners consider a plan to sell the stock versus a plan to hold the stock. We derive the conditions necessary for an endowment effect to appear: the same agent should want to stick to the plan of holding the stock if they win the lottery, but simultaneously want to stick to the plan of not holding the stock if they lose the lottery.

We find that that there is a range of parameters regarding the future success of the stock for which the "endowment effect plan" to hold the stock if the agent wins and not buy the stock if the agent loses the lottery is a personal equilibrium (PE) in the language of Kőszegi and Rabin (2006). The main intuition for this result is the same as in Sprenger (2015); agents demonstrate an "endowment effect for risk" – they exhibit lower risk aversion when endowed with a gamble and consider trading it for cash, than when they are endowed with cash and consider trading it for a gamble.

The range of parameters that can deliver the result control the beliefs of the agent regarding the future performance of the stock. To provide intuition for this result, these parameters need to deliver a "medium sized" expected return. If the expected return is too high (low), the model predicts that losers will buy the IPO stock (winners will sell), eliminating any endowment effect. In particular, the probability of the up state has to be high enough so that the agent sticks to holding the stock when

[57] Sprenger (2015) and Song (2015) both present laboratory evidence confirming this prediction of the KR theory. Note that neither standard expected utility theory nor disappointment aversion (another leading theory of reference point determination where the reference point is based on the certainty equivalent of a gamble), predict this so called "endowment effect for risk." In addition, previous laboratory research has found that subjects' risk aversion decreases regarding a given lottery depending on whether they are initially endowed with the lottery (see Sprenger (2015) for a detailed summary). For example, Knetsch and Sinden (1984) and Kachelmeier and Shehata (1992) find higher WTA than WTP for gambles, and survey estimates of risk-aversion are sensitive to whether the subject is endowed with the risk and trading for a sure amount or vice-versa (Schoemaker, 1990).

they win, but simultaneously has to be low enough so that the agent also sticks to holding cash if they lose the lottery. Our model in the appendix assumes that the stock can go up or down a fixed amount with probability q and $1-q$, and that the gain and loss on the stock are proportional, with factor of proportionality k (gains are k times losses on the stock). Given this setup, medium size expected returns can either be delivered by expectations of low probabilities of relatively high gains, or high probabilities of low gains. That is, the agent will demonstrate an endowment effect for a wide range of q values, but k must be negatively correlated with q for the endowment effect to hold.[58,59]

3. Expectations as Reference Points – Model Including Lottery and the IPO After Market. The reference dependent models presented so far abstracts away from the fact that the random assignment in our empirical setting occurs in lotteries with different probabilities of winning, and in IPOs with different listing gains. In Appendix B, we present a model of an agent with expectations based reference dependent preferences who has chosen to enter the lottery for an IPO stock, experiences a listing gain, and decides on a plan of action based on whether or not she wins the lottery, as well as on how the stock performs in the aftermarket. This model is a more realistic characterization of our empirical setting.[60] This model delivers similar predictions to the model that we describe above, about the negative relationship between k and q required to deliver an endowment effect. Another prediction of the model is that the range of values in which an endowment effect holds decreases as p, the probability of winning the lottery, increases. The intuition for this result is that as p approaches 1 in this model, the comparisons agents make across winning and losing the lottery become less and less important, because it is unlikely that they will lose the lottery. As the comparison across winning and losing becomes less important, decision making depends more and more on the expected return of the stock, which pushes agents towards either always selling the stock if the expected return is low, or always purchasing if the expected return is high. This result has some support in the data – looking

[58]For example, if $0.2 < q < 0.4$, depending on the extent of loss aversion, $k = 2.6$ delivers an endowment effect, but if $0.8 < q < 1$, k must be 0.2 to see an endowment effect.

[59]The PE condition satisfied by these parameter values only guarantees that the agent does not wish to deviate from the endowment effect plan. However, it does not guarantee that pursuing this plan delivers the agent the highest expected utility of all possible plans. When we derive these conditions (for a "preferred personal equilibrium" or PPE (Kőszegi and Rabin (2006))), as in Sprenger (2015), we confirm that there is no endowment effect for risk. See the Appendix for more details on why the endowment effect plan is not a PPE in our setting.

[60]We refer the reader to Appendix B for the details of the model, but focus on presenting the basic setup and the intuition for our results in the paper.

at our empirical estimates of how the endowment effect varies with the probability of winning a given lottery in Table 6, we find that when p goes from zero to 1, we find that the estimated endowment effect also falls, from 0.73 to 0.59.

4. Aversion to Bad Deals. A candidate explanation for endowment effects in general (including those in our setting) is that lottery losers have an "aversion to bad deals" as described in Weaver and Frederick (2012); in particular, lottery losers might see purchasing the stock after the IPO as a bad deal because the stock typically trades higher than the issue price even though the issue price is irrelevant for the future performance of the stock. We formally apply the model of Weaver and Frederick (2012) to our setting in the appendix, but summarize the main results of the model here.

The model can generate an endowment effect because lottery losers' valuations of the stock are distorted downwards due to their disutility from having to pay a price higher than the issue price. However, this distortion does not occur for lottery winners because they already own the stock, and therefore do not have to transact at the listing price to add it to their portfolio. In addition to predicting an endowment effect, the model also predicts that the endowment effect should get smaller as the listing gain gets smaller. The intuition for this result is that as the listing gain gets smaller, lottery losers have the opportunity to buy the stock at a price closer and closer to the price that lottery winners paid. The motivation for lottery losers to feel like they are getting a "bad deal" when they purchase the stock in the aftermarket therefore declines as the listing gain decreases.

We find mixed evidence on this prediction. On the day of listing, we find in the full sample (Figure 1 Panels (a) and (b)) as well as in highly active trading samples (Figure 2, (i) figures), that there is little evidence of a relationship between the size of the listing gain and the endowment effect. However, when we look at the end of the first full month of trading, the tendency of lottery losers to hold the stock does decline as the absolute value of the return on the IPO stock increases. These results suggest that at least part of the reason an endowment effect exists in this setting is that lottery winners' and losers' valuations for the stock are influenced by different reference prices.

5. Sour Grapes. In general, the idea of "sour grapes" is that agents will endogenously lower their valuation of a good they desire if external forces make that good unattainable; in our setting, lottery losers might lower their willingness to pay for the IPO lottery stock because it is not allocated to them in the lottery.[61] Note that, for this explanation, we have to assume that the sour grapes effect does not go away once the stock starts trading, because obviously the IPO stock is no longer unattainable once it is traded on the market. Other related mechanisms that fall under this category would be cognitive dissonance factors that cause losers to lower their valuations, or any other general feature of losing the lottery that makes lottery losers value the stock less.

One way to evaluate the sour grapes hypothesis is to see whether lottery losers are less likely to purchase the IPO stock than they are to purchase a similar stock that they did not randomly lose. Figure 5a plots the probability that the lottery loser purchase the IPO stock in the months following the IPO, as well as the probability that the lottery loser purchases the closest stock in terms of size in the same industry (a "matched" stock). We find that lottery losers are more, not less, likely to purchase the IPO stock than a similar sized stock in the same industry. In Appendix Figure A.1.5 we also find that winners and losers are equally likely to purchase any stock in the same sector, again suggesting that losers are not substituting to another similar stock because they have sour grapes regarding the IPO stock. One weakness with these tests is that it is possible that lottery losers, ex-ante, had a strong preference for the IPO stock relative to the matched sample or same sector stock, and so the sour grapes motivation reduces their potentially higher demand down to the level of their demand for a similar stock that they did not lose in a lottery.

A second approach to evaluating the sour grapes hypothesis is to test whether lottery losers are less likely to apply to future IPOs, under the (arguably natural) assumption that an investor who loses a lottery develops sour grapes for stocks allocated in IPOs in general. In Anagol et. al. (2015) we find that lottery losers are approximately one percent less likely to apply to future IPOs, but this effect is very small relative to the baseline. For example, 46 percent of lottery losers go on to participate in an IPO in the next month (47 percent of winners do so), again suggesting that losing the lottery is not in general causing lottery losers to feel "sour grapes" for IPO lottery stocks. If sour grapes explain the fact that winners are 30 to 60 percent more likely to hold the IPO stock than losers, it is puzzling that the divergence in future IPO application behavior is so small. This test, however, cannot rule out the

[61] One unappealing feature of this explanation is that there is a related theory, the "forbidden fruit hypothesis," which argues that agents will raise their valuation of items that are unattainable; thus, taken together, the sour grapes and forbidden fruit theories are not falsifiable.

possibility that lottery losers develop sour grapes only for the specific IPO stock they lost currently, but do not develop sour grapes for IPO stocks in general.

A third way is to examine the relationship between the estimated divergence between winners' and losers' holdings, and experience in the IPO market. Under the sour grapes explanation, the endowment effect is primarily caused by losers choosing to not purchase the stock. It seems plausible that, under this explanation, IPO lottery participants would learn over time that having "sour grapes" in a situation where the initial allotment is randomized is not sensible. A related argument is that, due to diminishing sensitivity to repeated stimulus, experienced lottery losers would feel the sour grapes less over time. Either way, under the sour grapes explanation the reason we would expect experience to reduce the endowment effect is by causing experienced lottery losers to buy the stock more. However, empirically we find that the endowment effect primarily reduces by more experienced winners being less likely to hold the stock going forward, as opposed to more experienced losers being more likely to buy the stock. In particular, in Table 6, Column (3) we find that a lottery loser who has participated in more than eight IPOs is 1.6 percent more likely to hold the IPO stock (relative to an investor who has never participated in an IPO), whereas a lottery winner who has participated in more than eight IPOs is 8.4 percentage points less likely to hold the stock. We note, however, that this fact does not rule out the possibility that all investors, including more experienced ones, have sour grapes.

6. Winning the Lottery Effect. Winners might feel particularly good about the stock because they won in a lottery and therefore choose to hold it longer than other stocks. One simple way to ascertain the importance of this kind of explanation is to compare the holding behavior of the IPO stock that was won, to stocks the investor *chose* to purchase on their own. We do so by taking the most recent stock an IPO winner purchased on their own, and plotting the probability that they sold this stock in the months after they purchased it. Figure 5(c) plots this alongside the probability that the lottery winner holds the IPO stock that they were allocated. The figure shows that the probability of holding the IPO stock is slightly higher than the recently purchased one, but overall the levels are very similar. This casts doubt on the possibility that winning a stock in a lottery itself has a large impact on future holding behavior.[62]

[62]It also suggests that our results may have external validity beyond just IPO lottery market (although we cannot test

7. Optimal Expectations. Brunnermeier and Parker (2005) present a theory where agents choose their expectations optimally to trade-off the true expectations with the anticipatory utility that comes from having optimistic beliefs. It seems plausible that, in our setting, lottery winners might get some anticipatory utility from the possibility that the IPO stock will turn out to be a "home-run" investment. These optimistic beliefs would cause lottery winners to hold the stock at greater rates, and could also explain why lottery winners are more likely to actively buy the stock as well. Of course, this theory assumes that agents engage in formulating optimal expectations about an asset that is in their portfolio, but do not form optimal expectations about an asset they are considering purchasing. A more practical concern is that testing this theory would require data on expectations, which are not available in our setting.[63]

5 Conclusion

In the absence of wealth effects or transactions costs, standard economic theories predict a fundamental symmetry: the same person should not make different decisions about whether to hold a gamble depending on whether he or she is endowed with the gamble. Data on the behavior of applicants to Indian IPO lotteries refutes this prediction. We find that randomly receiving shares in an IPO increases the probability that an applicant holds these shares for many months after the allotment, and that standard factors such as transaction costs, wealth effects, and taxes are unlikely to explain these effects.

We highlight two broad contributions of our work. First, our results suggest that endowment type effects may have important in-the-field implications for asset markets, in addition to the consumer (mugs, pens) and durable goods (sports cards, collectors pins) markets where they have most commonly been studied. Second, our results lend credence to theoretical frameworks, such as those presented in Thaler (1980), Kőszegi and Rabin (2006), and Bordalo et al. (2012) where an agents'

for external validity explicitly).

[63] Optimal expectations is a sub-category of the broader "motivated taste-change" explanation of the endowment effect (Strahilevitz and Loewenstein, 1998; Morewedge, Shu, Gilbert and Wilson, 2009). Under this explanation subjects value an endowed object more because possessions are regarded as an extension of the self, and subjects tend to value objects associated with the self more highly than disassociated objects. Testing this theory would require data on the strength of participants association with the IPO stock, which we naturally cannot measure in our setting.

decision process regarding an asset fundamentally changes once the asset enters their portfolio; lottery winners do not have any standard reasons to value the IPO stock more than lottery losers in our setting, but yet continue to hold it at much higher rates. Although our field context does not allow us to definitively determine which variant of these models best explains our evidence, exploring the empirical validity (in other settings) and general equilibrium implications of this type of buyer/seller divergence appears to be a fruitful area for future research.

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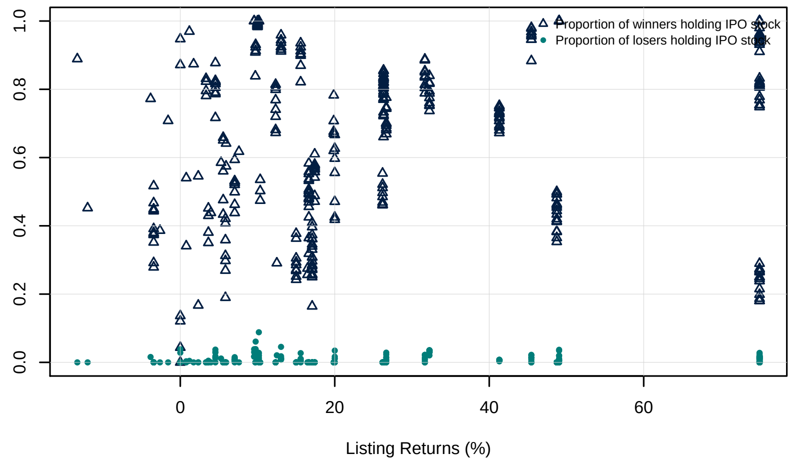
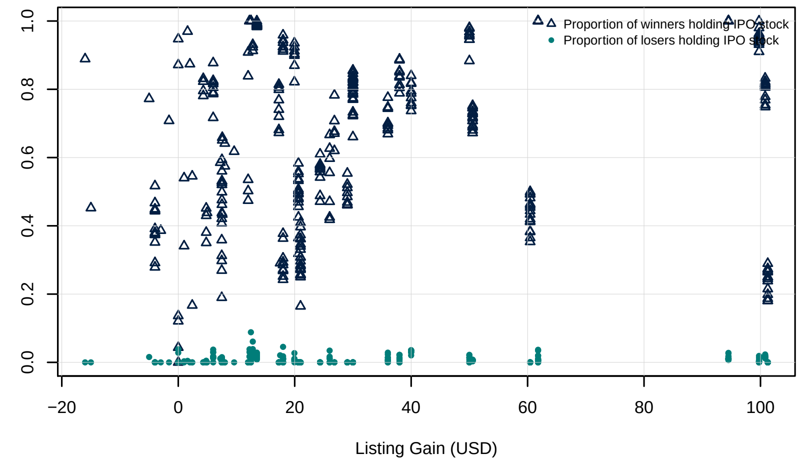
Figure 1: Proportion of Investors Holding IPO Stock and Returns Experience

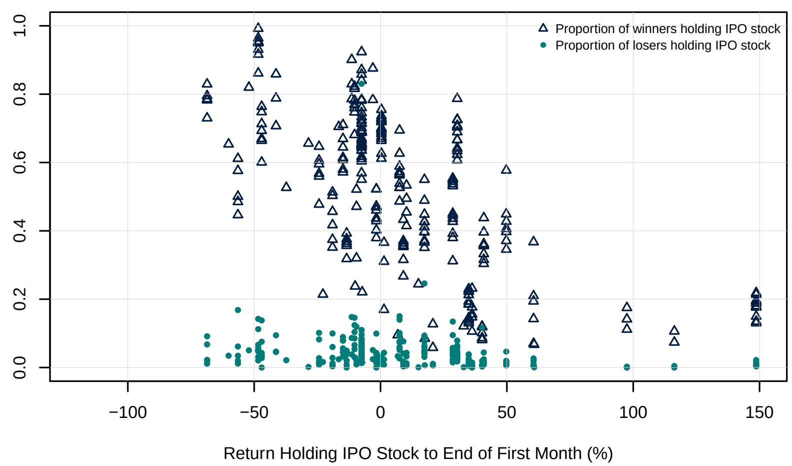
(a) Listing Returns (%)



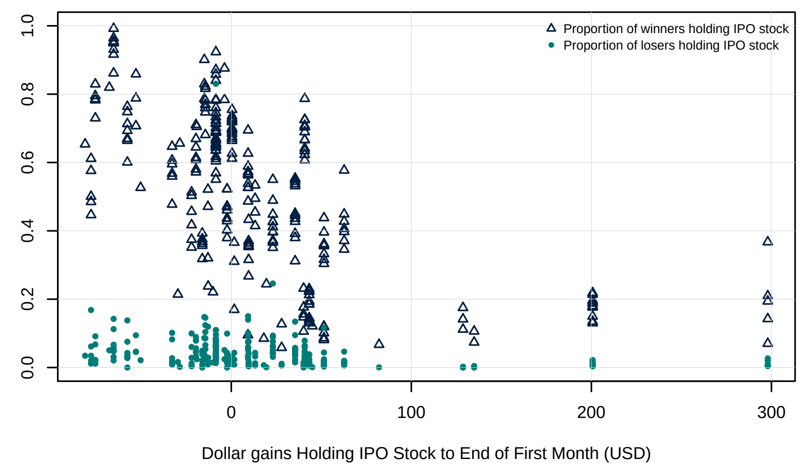
(b) Listing Gain (USD)



(c) Holding Returns at End of First Full Month After Listing (%)



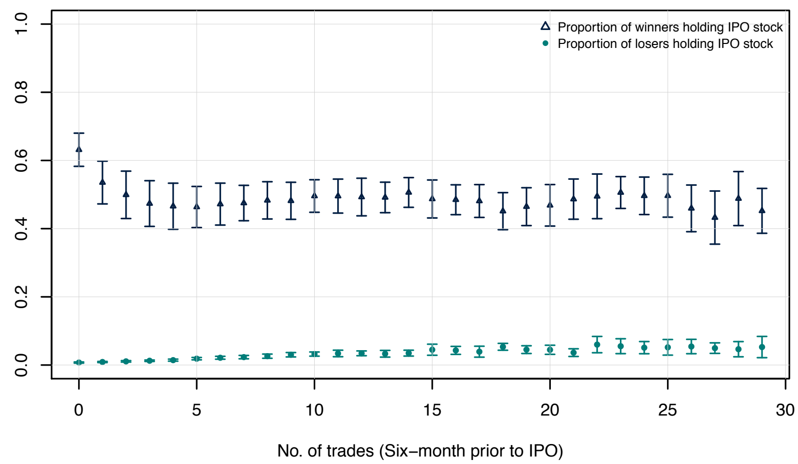
(d) Holding Gain at End of First Full Month After Listing (USD)



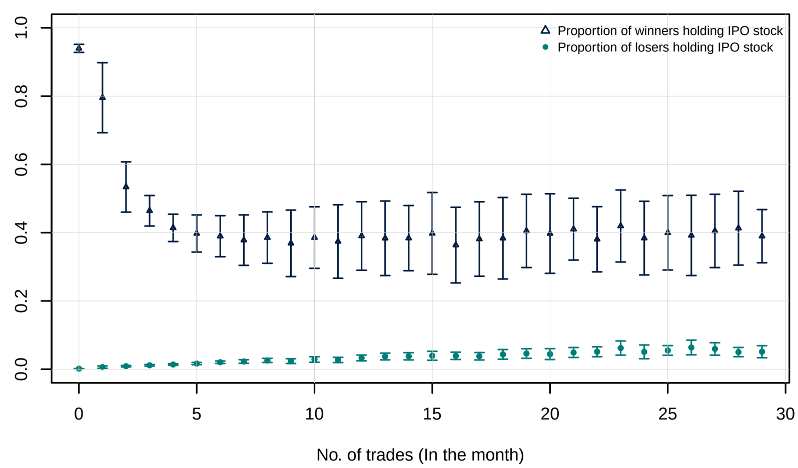
Panels (a) and (b) present estimates at the end of the first day on the y-axis and Panels (c) and (d) present estimates at the end of the first full month on the y-axis.

Figure 2: Winner-Loser Divergence by Trading Activity

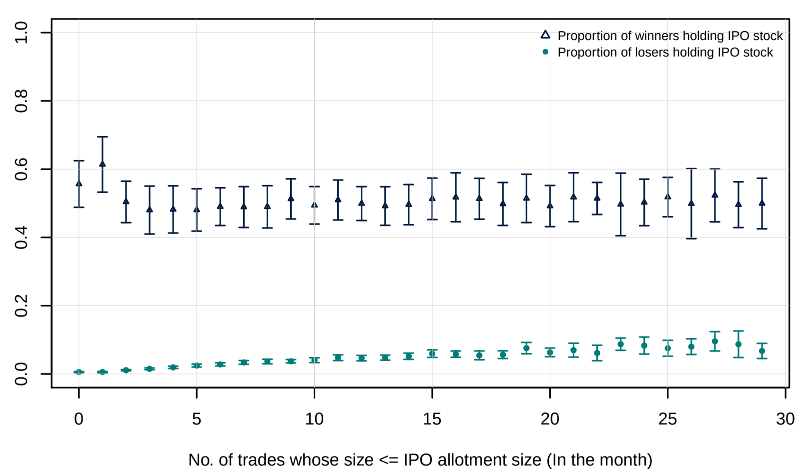
(a) i: By average number of trades per month in six months before IPO allotment



(b) i,t: By number of trades in first full month after listing



(c) i,j,t: By number of trades whose size $\leq$ IPO allotment size in first full month after listing



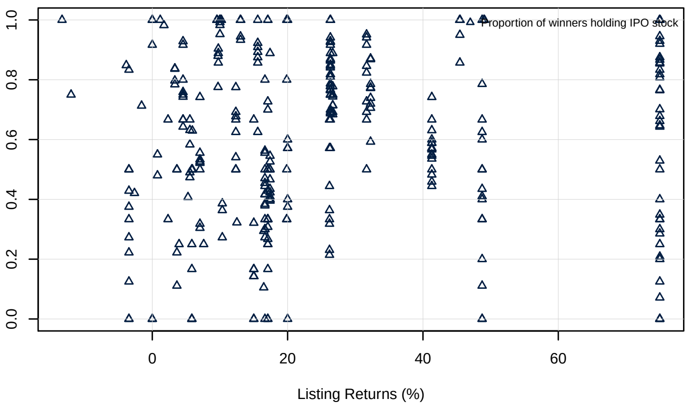
Note: The 95% confidence interval are constructed using standard errors for weighted mean as in Cochran (1977).

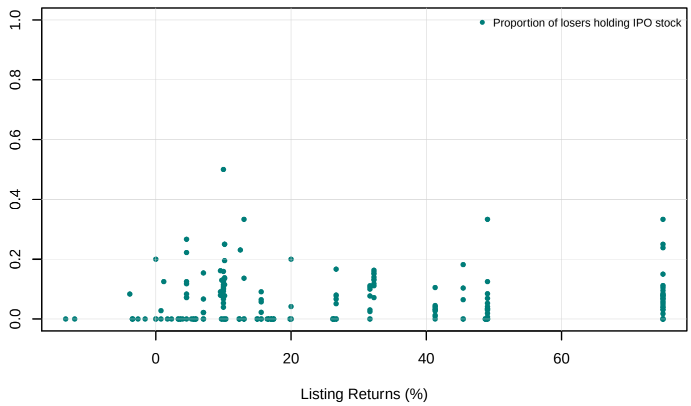
Figure 3: IPO Stock Holding Rates at End of Listing Day Against Listing Returns

Panel A: Investors with > 20 trades per month on average in six months before lottery

(i) Lottery Winners (ii) Lottery Losers

Endowment effect estimate: 0.617^{***}

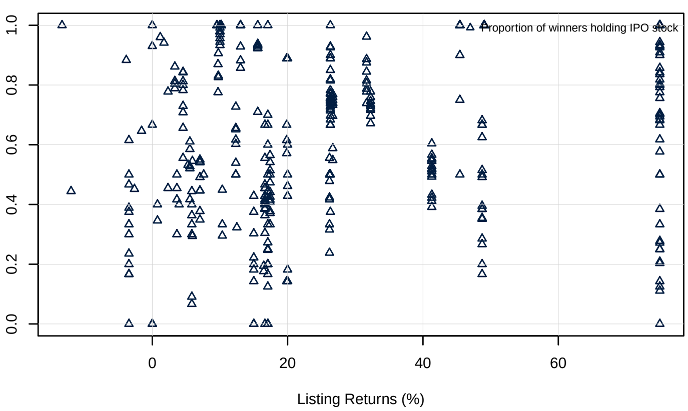


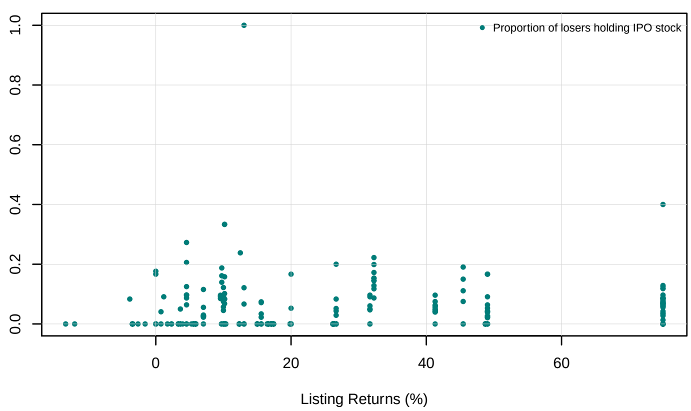


Panel B: Investors with > 20 trades in first full month after allotment

(i) Lottery Winners (ii) Lottery Losers

Endowment effect estimate: 0.588^{***}

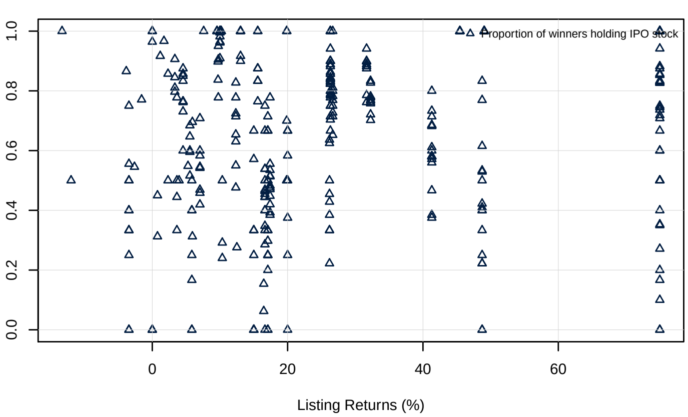




Panel C: Investors with at least 20 trades <= IPO allotment size in first full month after allotment

(i) Lottery Winners (ii) Lottery Losers

Endowment effect estimate: 0.747^{***}



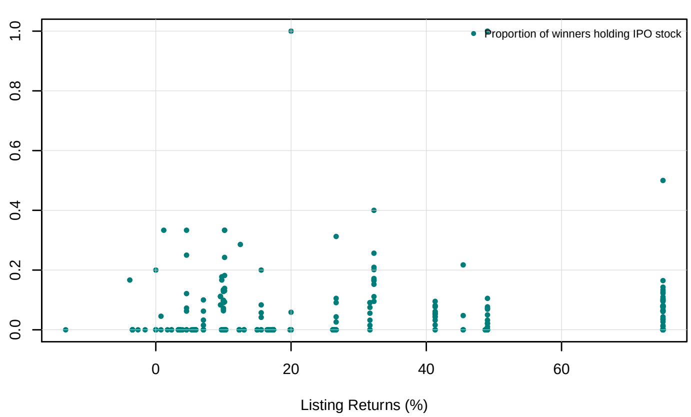
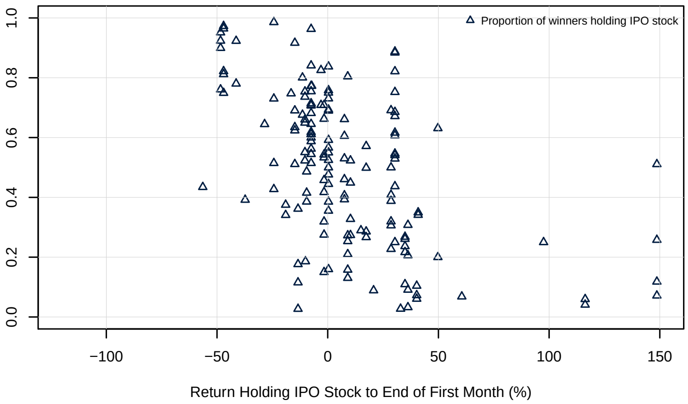


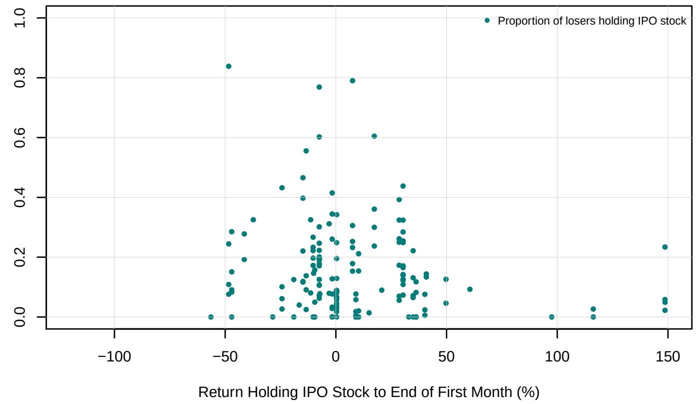
Figure 4: IPO Stock Holding Rates at End of First Full Month After Listing Against Returns

Panel A: Investors with > 20 trades per month on average in six months before lottery

(i) Lottery Winners (ii) Lottery Losers

Endowment effect estimate: 0.427***

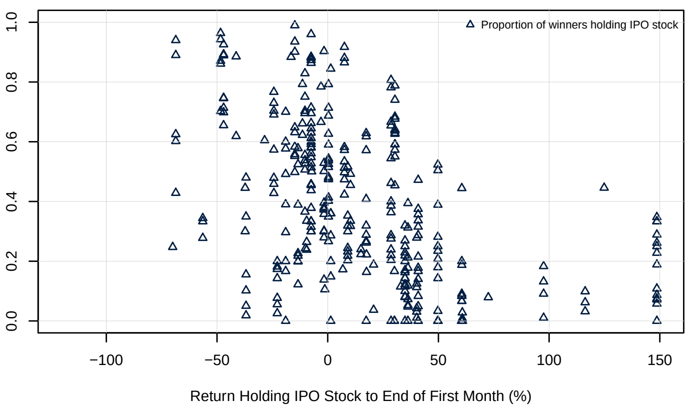


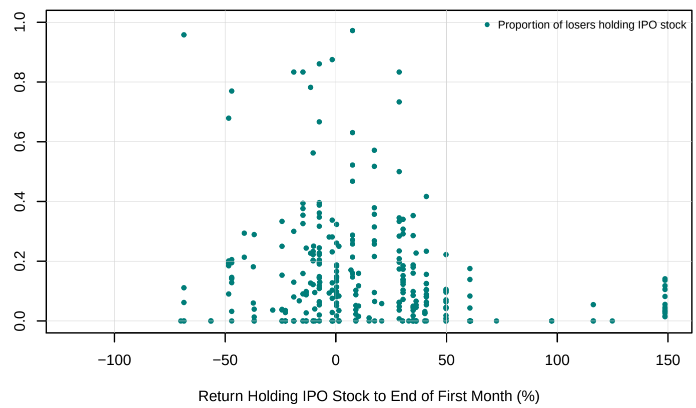


Panel B: Investors with > 20 trades in first full month after allotment

(i) Lottery Winners (ii) Lottery Losers

Endowment effect estimate: 0.356***

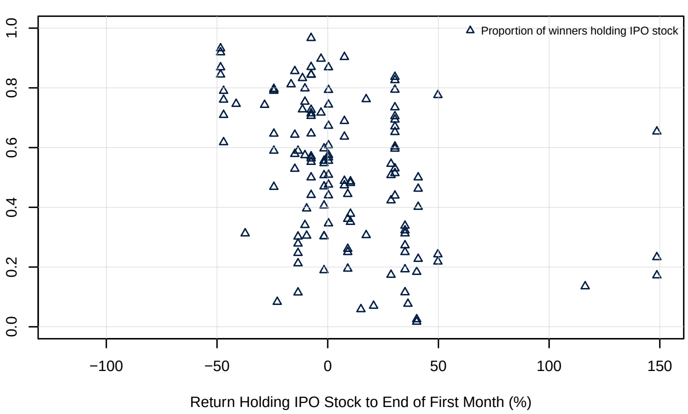




Panel C: Investors with at least 20 trades <= IPO allotment size in first full month after allotment

(i) Lottery Winners (ii) Lottery Losers

Endowment effect estimate: 0.430***



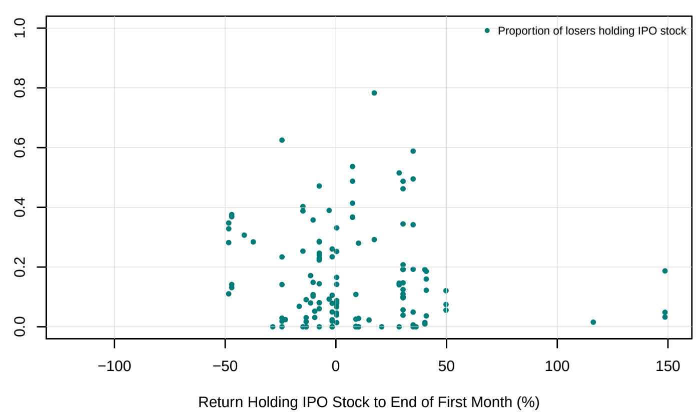
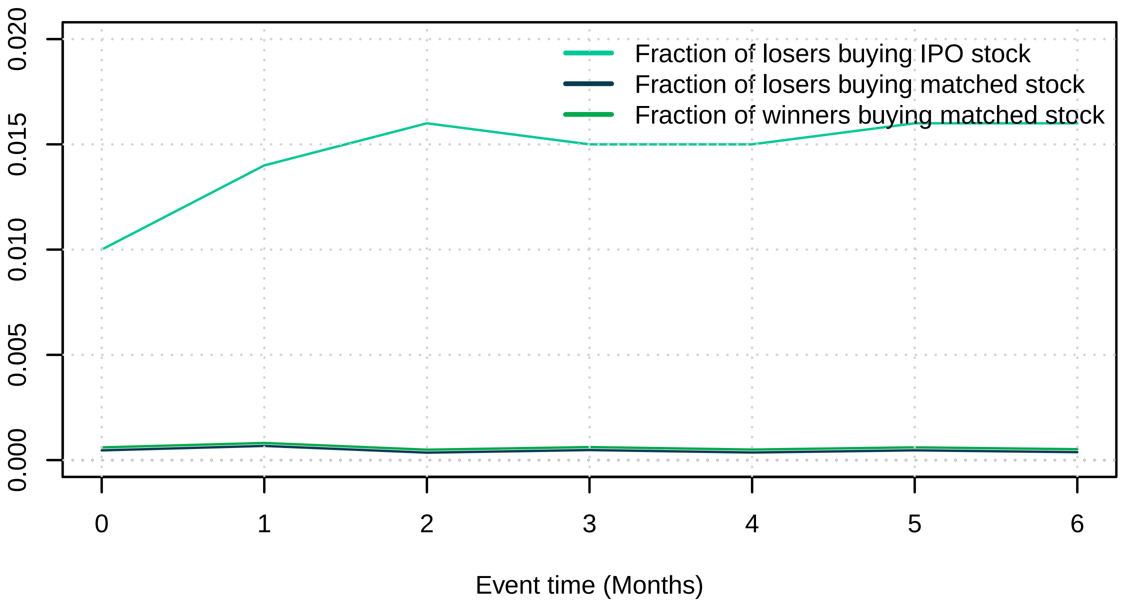


Figure 5: Winners' propensity to hold and losers' propensity to buy

(a) Losers' propensity to buy matched stock



(b) Winners' propensity to hold

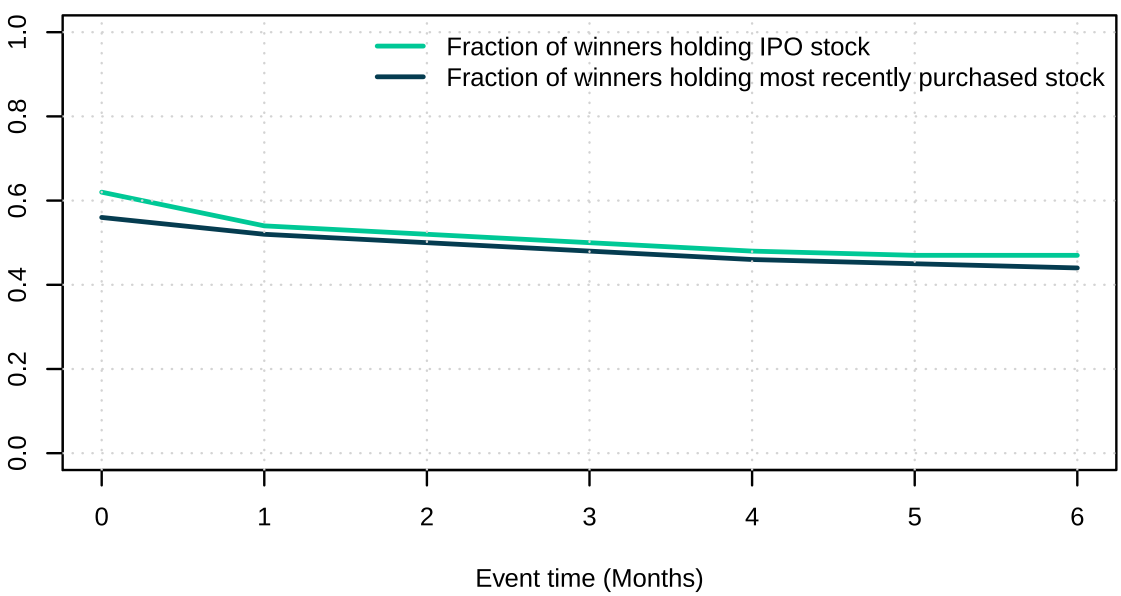


Table 1: RANDOMIZATION CHECK

	Winner Mean (1)	Loser Mean (2)	Difference (3)	% Experiments > 10% significance (4)
Applied/Allotted an IPO	0.379	0.379	0.000	8.97
Cutoff Bid	0.926	0.925	0.001	10.96
Gross No. of Transactions				
No. of Transactions > 0	0.682	0.683	-0.001	9.66
No. of Transactions = 1 to 5	0.449	0.451	-0.002	8.35
No. of Transactions = 6 to 10	0.116	0.115	0.000	11.22
No. of Transactions = 11 to 20	0.070	0.069	0.000	8.87
No. of Transactions > 20	0.048	0.047	0.000	9.92
Gross No. of Transactions ≤ IPO Allotment Value				
No. of Transactions > 0	0.635	0.618	0.017	5.48
No. of Transactions = 1 to 5	0.477	0.483	-0.006	7.83
No. of Transactions = 6 to 10	0.087	0.077	0.011	7.66
No. of Transactions = 11 to 20	0.047	0.041	0.006	23.24
No. of Transactions > 20	0.025	0.019	0.007	34.46
IHS Portfolio Value	6.673	6.667	0.006	13.05
Portfolio Value = 0	0.214	0.215	0.000	10.18
Portfolio Value = 0 to 500$	0.129	0.129	0.000	12.94
Portfolio Value = 500 to 1000$	0.087	0.087	0.000	10.18
Portfolio Value = 1000 to 5000$	0.317	0.317	0.000	8.09
Portfolio Value > 5000$	0.252	0.252	0.000	9.39
Flipper	0.287	0.286	0.001	13.21
No. of Securities Held	9.091	9.013	0.077**	10.96
IHS Account Age	3.148	3.143	0.005*	12.53
New Account	0.055	0.055	0.000	5.74
1 Month old	0.067	0.067	0.000	9.14
2-6 Months old	0.191	0.192	-0.001	8.87
7-13 Months old	0.141	0.141	0.000	8.87
14-25 Months old	0.167	0.167	0.000	9.92
> 25 Months old	0.375	0.373	0.002**	12.01

N = 1,561,497. All variables are measured one month prior to the lottery allotment. *,**,*** denote significance at the 10, 5 and 1 percent levels. The flipper dummy takes the value 1 if the account had ever received an IPO and sold it in the month of receiving it.

Table 2: CHARACTERIZING LOTTERY APPLICATION AND ALLOTMENT EXPERIENCE

Treatment Characteristics		Percentile Across Experiments				
	Mean	10	20	50	75	90
	(1)	(2)	(3)	(4)	(5)	(6)
Application Amount ($)	1,750	155	343	791	1,397	2,093
Probability of Treatment	0.36	0.09	0.20	0.37	0.64	0.84
Allotment Value ($)	150	125	130	142	158	169
First Day Gain/Loss (%)	39.18	-7.57	6.10	17.13	37.08	87.77
First Day Gain/Loss ($)	61.89	-11.14	8.49	24.78	53.03	136.94
Median Portfolio Value (t-2,$)	1,748	722	1,088	1,594	2,270	2,999

Table 3: Effect of Winning IPO Lottery on Ownership Of IPO Stock

Dependent Variable:		Listing Day	Months Since Listing 0	1	2	3	4	5	6
I(Holds IPO Stock)	$\bar{y_w}$	0.700	0.624	0.542	0.519	0.497	0.484	0.474	0.466
	$\bar{y_l}$	0.007	0.010	0.014	0.016	0.015	0.015	0.016	0.016
	ρ	0.693***	0.613***	0.527***	0.503***	0.482***	0.468***	0.458***	0.449***
Fraction of Allotment	$\bar{y_w}$		0.645	0.576	0.562	0.543	0.533	0.529	0.522
	$\bar{y_l}$		0.044	0.058	0.061	0.061	0.064	0.065	0.065
	ρ		0.601***	0.518***	0.501***	0.481***	0.470***	0.464***	0.457***
I(Holds Exactly IPO Allotment)	$\bar{y_w}$		0.587	0.501	0.477	0.456	0.442	0.432	0.423
	$\bar{y_l}$		0.001	0.002	0.002	0.002	0.002	0.002	0.002
	ρ		0.586***	0.499***	0.475***	0.454***	0.440***	0.429***	0.420***
Value of IPO Shares Held (USD)	$\bar{y_w}$		108.818	84.037	72.500	70.226	59.546	53.168	54.717
	$\bar{y_l}$		7.232	8.197	7.767	7.995	7.621	7.004	7.418
	ρ		101.582***	75.835***	64.727***	62.230***	51.927***	46.164***	47.296***
Portfolio Weight of IPO Stock	$\bar{y_w}$		0.133	0.093	0.080	0.077	0.070	0.064	0.064
	$\bar{y_l}$		0.001	0.002	0.002	0.002	0.001	0.001	0.001
	ρ		0.132***	0.091***	0.079***	0.075***	0.069***	0.063***	0.063***
Mean Listing Return		42							
Mean Return Over Issue Price			19	6	- 1	2	- 5	- 6	- 6
Mean Return Over Listing Price			-15	-24	-29	-27	-31	-33	-33
Mean Market Return			2	4	3	1	8	10	9

The sample size is 1,561,497 accounts in each month. *,**,*** denote significance at 10, 5 and 1 percent levels. $\bar{y_w}$ denotes the winner group average, $\bar{y_l}$, the loser group average and ρ the coefficient estimated from equation 1. Market returns are computed over the holding period and obtained from `http://www.iimahd.ernet.in/~iffm/Indian-Fama-French-Momentum/DATA/20160831_FourFactors_and_Market_Returns_Monthly.csv`.

Table 4: PROPENSITY TO BUY ADDITIONAL QUANTITY OF IPO STOCK

		Months Since Listing						
		0	1	2	3	4	5	6
Panel A: Full Sample								
I(Buy IPO Stock)	$\bar{y_w}$	0.0166	0.0098	0.0065	0.0047	0.0038	0.0051	0.0041
	$\bar{y_l}$	0.0110	0.0055	0.0030	0.0021	0.0014	0.0020	0.0017
	ρ	0.0055***	0.0043***	0.0035***	0.0026***	0.0023***	0.0031***	0.0024***
Panel B: Investors $\geq$ Average 20 Trades in Six Months Prior to IPO Allotment								
I(Buy IPO Stock)	$\bar{y_w}$	0.094	0.055	0.035	0.029	0.023	0.027	0.022
	$\bar{y_l}$	0.067	0.037	0.025	0.018	0.013	0.015	0.013
	ρ	0.027***	0.019***	0.011***	0.011***	0.011***	0.012***	0.008***
Panel C: Investors $\geq$ Trades in Current Month								
I(Buy IPO Stock)	$\bar{y_w}$	0.106	0.079	0.064	0.051	0.040	0.051	0.046
	$\bar{y_l}$	0.077	0.064	0.045	0.032	0.026	0.033	0.032
	ρ	0.029***	0.015***	0.019***	0.019***	0.014***	0.018***	0.014***
Panel D: Investors $\geq$ 20 Trades of $\leq$ Size to IPO Allotment								
I(Buy IPO Stock)	$\bar{y_w}$	0.108	0.058	0.039	0.033	0.025	0.031	0.025
	$\bar{y_l}$	0.080	0.039	0.029	0.020	0.014	0.019	0.016
	ρ	0.027***	0.019***	0.010***	0.012***	0.011***	0.013***	0.009***

The sample sizes in panels A,B,C, and D are 1,561,497, 54,678, 85,358, 36,467 respectively. *,**,*** denote significance at 10, 5 and 1 percent levels. $\bar{y_w}$ denotes the winner group average, $\bar{y_l}$, the loser group average and ρ the coefficient estimated from equation 1.

Table 5: HETEROGENEOUS FIRST-DAY WINNER EFFECTS BY PRE-EXISTING ACCOUNT CHARACTERISTICS

Dependent Variable: First Day I(IPO Stock Held)	Full Sample	i (Avg. 6 mnths)	i,t All trades (Month after allotment)	i,j,t (Small trades) (Month after allotment)
Winner	0.779***	0.562***	0.745***	0.782***
# of IPOs Allotted				
1 to 2 IPOs	0.000	-0.002	0.000	-0.002
3 to 8 IPOs	0.003**	-0.005	-0.001	-0.003
$>$ 8 IPOs	0.009***	-0.002	0.009***	0.003
Winner ×				
# of IPOs Allotted				
1 to 2 IPOs	-0.052***	-0.048***	-0.027***	-0.036***
3 to 8 IPOs	-0.095***	-0.054***	-0.043***	-0.038***
$>$ 8 IPOs	-0.165***	-0.098***	-0.094***	-0.064***
# of Trades Made				
1 to 2 trades	0.002***	0.000	0.008	0.006
3 to 6 trades	0.001***	0.005	0.018***	0.012
$>$ 6 trades	0.010***	0.011	0.012**	0.032***
Winner ×				
# of Trades Made				
1 to 2 trades	-0.031***	-0.140	-0.057***	-0.006
3 to 6 trades	-0.096***	-0.026	-0.153***	-0.072
$>$ 6 trades	-0.143***	-0.122	-0.119***	-0.140***
Fraction Past Returns $>$ Listing Returns				
0.01 to 0.15	0.008***	0.001	-0.002	0.008
0.16 to 0.50	-0.007***	-0.002	-0.009***	-0.008
$>$ 0.50	-0.017***	0.001	-0.027***	-0.026***
Winner ×				
Fraction Past Returns $>$ Listing Returns				
0.01 to 0.15	-0.100***	-0.008	-0.018*	-0.076***
0.16 to 0.50	-0.047***	0.060***	0.025**	-0.021
$>$ 0.50	0.018***	0.166***	0.133***	0.080***
Winner ×				
Listing Returns (%)				
$<=$ 0	-0.217***	-0.310***	-0.295***	-0.342***
26 to 41 percent	-0.053***	-0.144***	-0.157***	-0.138***
$>$ 41 percent	-0.056***	-0.015	-0.052***	-0.037***
Winner ×				
Probability of Treatment				
33 to 66 percent	0.004*	0.031***	-0.009	0.014
$>$ 66 percent	-0.033***	0.039***	0.032***	0.032***
Controls				
Portfolio Size	Yes	Yes	Yes	Yes
Age	Yes	Yes	Yes	Yes
IPO Share Category Fixed Effects	Yes	Yes	Yes	Yes
Adjusted R-squared	0.64	0.51	0.48	0.54
Number of observations	1,561,497	54,678	85,358	36,467

Dummies are based on quartile breakpoints of the respective distributions.