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

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Abstract

We study a unique field experiment in India in which 1.5 million stock investors face lotteries for the random allocation of shares. We find that the winners of these randomly assigned initial public offering (IPO) lottery shares are significantly more likely to hold them than lottery losers 1, 6, and even 24 months after the random allocation. This finding strongly evokes laboratory findings of an “endowment effect” for risky gambles, and persists in samples of highly active investors, suggesting along with additional evidence that this behavior is not driven by inertia alone. The effect decreases as experience in the IPO market increases, but remains even for very experienced investors. Leading theories of the endowment effect based on reference-dependent preferences are unable to fully explain these and other findings in the data.

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A core idea in economics is that an agent's valuation of an object should be consistent regardless of whether or not they own the object. We study a natural experiment that provides evidence on this fundamental idea, in which millions of market participants 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, both winners and losers have equal opportunities to trade in it. Given the equivalence of information sets and background characteristics induced by the random assignment, we should expect that the holdings of this randomly allocated stock should converge rapidly over time across the two groups. On the other hand, if randomly assigned ownership induces changes in valuation, we will see a divergence in behavior between 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% of IPO winners hold the IPO stock at the end of the month after listing, while only 1% of losers hold the stock. Six months after the lottery assignment the gap decreases slightly, to 46.6% of winners holding the stock and 1.6% of the losers holding the stock, but even 24 months after the random assignment we find that winners are 35% more likely to hold the IPO stock than losers. Furthermore, we find that the propensity of lottery winners to actively purchase additional shares of the IPO stock is higher than the propensity of lottery losers to purchase the IPO stock at all.

The winner-loser divergence in IPO stock holdings that we observe evokes the large set of (primarily) laboratory findings on the endowment effect. We follow this literature, and define this effect as a gap, arising from the fact of ownership, between an economic agent's willingness to accept and their willingness to pay for an object or gamble.² The similarity between our findings and this literature raises the possibility that investors outside of the lab demonstrate significant endowment effects in a

¹We 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."

²WTA is the lowest price at which a seller is willing to sell, and WTP is the highest price a buyer is willing to pay.

high-stakes market setting. Of course, it is also possible that differences between the setting of our natural experiment and laboratory settings might induce a divergence in behavior between winners and losers even absent an endowment effect. We therefore enumerate the most important differences between our setting and the laboratory experiments that have been conducted on the endowment effect. For all of these major differences, we find auxiliary evidence that they are unable to fully explain the winner-loser divergence in holdings that we observe.

Perhaps the most important difference between our natural experiment and lab experiments of the endowment effect is that our lottery winners and losers may face formal or informal costs of trading which are large enough to cause the divergence in holdings that we observe. Such costs are typically minimized (although they cannot always be eliminated) in laboratory experiments. 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 between winner and loser holdings remains large even in groups of investors who transacted very frequently 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% more likely to hold the stock than losers. Second, we find a winner-loser divergence even in the sub-sample of investors who make a large number of trades of sizes less than or equal to the position size of the IPO stock in the months after the IPO.³ Third, we find that even in sub-samples of investors 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 using trading

³These 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).

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 We also find little evidence to suggest that other differences between our setting and laboratory experiments, such as wealth effects, capital gains taxes, or information acquisition costs can explain our results.

We do find that the divergence in holdings attenuates substantially for the most experienced traders in our setting, similar to the findings in List (2003) regarding the endowment effect. 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 90th 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% of their lottery allotments at the end of the month of randomly receiving the IPO, while losers hold 7% of the initial allocation.⁵

We next explore the extent to which leading theoretical explanations of the endowment effect can rationalize our data. 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. That said,

⁴In 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).

⁵These 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.

⁶See, 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).

we check the extent to which leading theoretical models of the endowment effect generate additional predictions that are supported by the data, to add to the body of evidence on these models of individual decision-making.

The leading class of explanations for the endowment effect is that agents have reference-dependent preferences, as originally proposed by Kahneman and Tversky (1979).⁷ We consider two variants of reference-dependent preference explanations that are suitable to our context.⁸ These models differ in their precise formulation and timing of the reference point, and as a result, are quite different from one another in terms of their implications for the behavior that we study. First, we evaluate a model in which the IPO issue price serves as a fixed reference point for agents (Weaver and Frederick, 2012), i.e., the model is backward-looking in the sense that the reference point is set at the IPO issue date, following which the agent makes decisions. In this model, lottery losers endogenously lower their valuation for the IPO stock because they often have to purchase it at a price which is higher than the price at which lottery winners purchase it.⁹ This model predicts 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 purchase 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.

Second, we consider a broader framework where the referent is the entire distribution of the agent's expected outcomes (Kőszegi and Rabin, 2006, 2007), i.e., the reference point is forward-looking, in the sense that it depends on the agent's expectations about future payoffs. This formulation makes the prediction that choices between gambles and certain amounts exhibit an "endowment effect for risk."

⁷See 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.

⁸Appendix B discusses evidence on a series of non-reference dependent theories.

⁹Note 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.

That is, when considering the decision of whether to take on a risky lottery, decision-makers already endowed with a risky lottery will be less risk-averse than decision-makers that are endowed with a certain amount.¹⁰ New lab work finds significant evidence for this effect (Sprenger, 2015).

We develop two models which apply expectations-based reference-dependent preferences to our setting. The first is the Sprenger (2015) model, in which agents evaluate the comparison between the IPO stock (which we treat as a risky gamble in the model) and cash. In this model, we find that that a plan to hold the IPO stock only as a winner of the IPO lottery is not a preferred personal equilibrium (PPE) because if a plan to hold the stock after the lottery delivers the highest utility, then this plan should be pursued regardless of whether or not the agent wins the lottery. The model can, however, deliver the endowment effect as a personal equilibrium (PE), though the range of parameters required to deliver this result are narrow and run contrary to the pattern of actual returns experienced by Indian IPOs.¹¹ To be more specific, the model requires that agents expect IPOs that they apply for will deliver “medium-sized” returns in the future, which is strongly counterfactual in the historical data in India (and more generally for a broad range of markets), in which IPOs have delivered significantly negative (raw and adjusted) returns.

The second model in this class more closely matches features of our real-world experimental environment – agents in this augmented model evaluate both the initial risky gamble of the lottery assignment of the IPO, as well as the subsequent comparison between the IPO stock and cash. We again find a very limited possible range of beliefs about IPO stock returns that could generate the endowment effect plan as a PE or PPE. As we describe more fully in the text, an additional prediction of this augmented model is that low anticipated probabilities of winning the lottery are more likely to gen-

¹⁰Put 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. For lottery losers, loss-aversion acts to reduce risk-taking because losers compare the potential loss on the stock to their reference point of holding cash. For lottery winners, however, loss-aversion has both positive and negative effects on risk-taking. Loss-aversion increases risk-taking when the reference point is holding the stock and the lottery winner compares selling the stock for cash, because the stock might go up after he has sold it. On the other hand, loss-aversion reduces risk-taking when the investor considers holding the stock when his plan was to hold the stock, because the stock could go down and the investor compares this to the possibility that the stock could have gone up. These two forces offset each other, making the total risk-taking propensity of the winner lower than the lottery loser. This is the same intuition as in Sprenger (2015).

¹¹A plan is a PE if the agent does not want to deviate from their plan. A PPE requires that both the agent does not want to deviate from their plan, and that the plan offers the highest possibility utility among all PEs.

erate the endowment effect. However, while we do find in the data that estimated endowment effects become smaller as the probability of winning the lottery increases, the quantitative magnitude of this relationship is very small. Overall, the evidence suggests that expectations-based reference-dependent preferences are unlikely to be the only explanation for the winner-loser divergence in holdings that we observe.

To summarize, we find that 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. This is novel evidence which strongly evokes the endowment effect in a naturally occurring market outside of the laboratory.¹² We do not find conclusive evidence that our results can be fully explained by leading theoretical explanations, such as reference dependent preferences, that have proven useful in explaining lab endowment effects. Other theoretical explanations, such as “warm glow” models (e.g., Morewedge et al., 2009, Bordalo et al., 2012) seem to hold more promise to explain our findings, and we discuss these possibilities in greater detail in the conclusion of our paper.

Our findings lend credence to previous theoretical work that explains financial market behavior based on the assumption of investors with endowment effects. In the IPO market, at a minimum, our empirical results provide evidence to support the assumption that retail investors allotted IPO shares have a strong tendency to continue to hold these shares. This is a common assumption in this literature (see, for example, Loughran and Ritter (2002)). Moreover, this assumption helps to justify more complex features of this market. For example, Zhang (2004) presents a model in which investors demonstrate the endowment effect, and shows that such a model can rationalize the otherwise difficult to explain fact that underwriters often over-allocate IPO shares and then commit to buying them back in the aftermarket.

More broadly, our findings support previous theoretical work that explains financial market behavior based on the assumption of investors with endowment effects. Baker et. al. (2007) argue that the presence of inertial investors, where inertia may be itself caused by the endowment effect, can explain the prevalence of stock for stock (versus cash for stock) mergers. In a stock for stock merger, if target

¹²This adds credibly identified, large scale evidence from a natural experiment to studies such as Shefrin and Statman (1985) and Odean (1998), which suggest that the endowment effect exists in securities markets.

firm investors demonstrate the endowment effect, then they will be less likely to sell the acquirer's shares, thus reducing the negative price impact of the merger. In a related vein, numerous papers in the behavioural asset pricing literature (Barber and Odean, 2008, DellaVigna and Pollet, 2009, Hirshleifer et al., 2009) make the point that investor inattention can cause prices to under react to news announcements. Our findings also have implications that are related: if the investors in a stock are subject to the endowment effect, they will also be less likely to sell in response to negative news about the stock, which would also cause prices to under react to such news arrival and exacerbate the effects of inattention.

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.2.¹³

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

¹³As 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.

(roughly US\$ 3,400); this value has varied over time (see Appendix Section A.1).¹⁴

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. 93% of bids are “cutoff” bids, where the retail investor commits to purchasing a stated multiple of the minimum 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.¹⁵

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. $v \gg 1$ (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

¹⁴This 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.

¹⁵The 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.

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.¹⁶

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.

For IPOs after May 2010 (32 of the total 54 IPOs in our sample) regulation mandates the following time line for the application and allotment process. Applications are received over a two-day period termed the “subscription period.” Our data provider, in conjunction with the designated stock exchange, determines the winners and losers in an IPO lottery on the seventh day after the subscription period. Investors who lost the lottery receive their refund or the amount is “unblocked” from their banks by approximately 10 days after the subscription period. Refunds may be issued through direct credit into a bank account using the National Electronic Fund Transfer Service or through mailing a physical check. All lottery losers receive a complete refund.¹⁷ The first day of trading commences two days after the refund is issued, i.e., 12 days from the close of an IPO issue. Prior to May 2010, a similar but longer timeline was mandated, with the requirement that the IPO shares list within 22 days after the subscription period. In this prior period, regulation required that refunds were processed by the 15th day after the subscription period (Das, 2015).

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

¹⁶Appendix Section A.4 shows a mathematical derivation of the probabilities of winning allotments based on the level of excess demand.

¹⁷Conversations with market participants suggest most lottery losers are refunded through electronic payments prior to the listing date, but we are not aware of any data documenting the refund process. One potential concern is that delays in receiving refunds may cause lottery losers to be credit constrained, and therefore unable to purchase their desired quantity of IPO stock. In Figure A.1.13 of the appendix we find that the winner-loser divergence in holdings is large for even the largest portfolios, making it unlikely that credit constraints due to late refunds can explain the majority of our results.

“issue price” throughout the paper, was Rs. 42 per share. The price the stock first traded at on the market, which 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 $p = \frac{c}{v}$. 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

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

¹⁹The 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.

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, the application is routed through a registrar. In the event of heavy oversubscription leading to a randomized allotment of shares, the registrar (in consultation with the stock exchange on which the shares list) performs the randomization which determines which investors are allocated. We obtain data on the full set of applicants to 85 Indian IPOs over the period from 2007 to 2012 (54 of these IPOs had at least one randomized share category), from one of India’s largest registrars. 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 In this paper, we study 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, zip codes in the U.S.), the type of bid placed by the applicant, the share depository in which the applicant has an account (more on this below), whether the applicant was an employee of the firm, and a few other application characteristics.

We match the data on application lotteries to a second major data source which allows us to characterize the equity investing behavior of the 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 ac-

²⁰Appendix Figure A.1.1 shows that our sample of IPOs tracks 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.

²¹CDSL 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.

count 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. To match the IPO applications data to the CDSL accounts data, we use anonymous identification numbers of household accounts from both data sources. We then verify the accuracy of the match by checking common geographic information fields provided by both data providers such as state and pincode.²² To provide a sense of the magnitudes in the data, 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 Appendix.

2 Documenting the Winner-Loser Divergence

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

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

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

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

²³In 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.

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, Pathak and Walters (2013) refer 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.²⁴

Randomization Check. Table 1 presents summary statistics and a randomization check comparing 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 % 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.²⁵ Table 1 shows that virtually identical fractions (38%) of

²⁴See 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 – i.e., experiments in which there are many accounts in both treatment and control groups. 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 employed in the regressions.

²⁵In 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.

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. Over half the accounts make between 1 and 10 trades in the month prior to the IPO, and roughly 5% 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.²⁶ We 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 function²⁷ – 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, roughly 33% are between 7 and 25 months old, and the remaining 37% of accounts are over 25 months old.

²⁶The fraction of experiments that show significant differences on the dummy variables for making greater than ten 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.

²⁷ $\sinh^{-1}(z) = \log(z + (z^2 + 1)^{1/2})$. 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, Magee and Robb (1988) and Browning, Bourguignon, Chiappori and Lechene (1994).

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 10% significance is around 10%. 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 provides summary statistics on the applications of winning investors, and the allotments that these investors received after winning the IPO share lottery. Column (1) of the table shows the mean across all lottery winning investors in the 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.²⁸ On average, given the balance between winners and losers, both lottery winners and losers put 1,751 dollars into an escrow account to participate in the lottery (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 US\$ 62 on average, because IPO stocks' listing price is 39% 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 US\$ 212 (150 + 62) of the IPO stock. Both winners and losers get refunds from their escrow accounts of approximately US\$ 1,600 and US\$ 1,750, 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 return²⁹ on the x-axis, while Figure 1b has the dollar value of the listing gain on the x-axis. Figures 1c and 1d plot the fractions of winners and losers that hold the IPO stock at the end of the first full month post-listing on the y-axis. Figure 1c has the percentage return on the stock to the end of the first month on the x-axis, 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

²⁸We 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).

²⁹The 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).

four figures show a sizeable gap between the holding rates for lottery winners and lottery losers, consistent with the presence of a valuation gap between winners and losers.³⁰ 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, although the gap between winners' and losers' holdings remains. These patterns are consistent with the co-existence of the well-known "disposition effect" in the winner group (first uncovered by Shefrin and Statman (1985)), alongside the holdings divergence between winners and losers that we uncover.^{31,32}

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 header marked "Dependent Variable" details 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 (*w*) and loser (*l*) groups, and the third row presents the estimated $\hat{\rho}$ from equation 1, i.e., the weighted (across experiments) difference between the winner and loser group means.

The first row header provides results when the dependent variable is an indicator for whether the account holds any of the treatment IPO stock. At the end of the first day of trading, we find that approximately 70% of lottery winners hold the IPO stock, while only 0.007% of losers hold the IPO stock. This difference is significant at the 1% level. One way to interpret this result is that approximately 30% 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.³³

At the end of the listing month (0), lottery winners are 62% more likely to hold the IPO stock than lottery losers. This divergence declines to 46% at the end of six months, with all differences

³⁰Many 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.

³¹An 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.

³²Appendix Figure A.1.7 shows the corresponding results holdings of the IPO stock at the end of the first week.

³³We 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.

significant at the 1% level. The loser group means show that it is relatively rare for lottery losers to own the stock – on average 1% of lottery losers own the IPO stock in the month in which it lists, this number only rises to 1.6% 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 while only 1% of the lottery losers hold the stock, their average fraction of the lottery allotment is 4.4%, implying that lottery losers who choose to own the stock purchase roughly four and a half times the amount of the lottery allotment.³⁴

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 hold the exact amount of the lottery allotment.

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

³⁴Suppose there are 10,000 lottery losers, the lottery allotment (to winners) was 10 shares, and 100 losers purchase the stock (1%). 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% ($.01*5+.99*0 = .05$).

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% more of their portfolio in the IPO stock in month 0, which remains 6.4% higher, 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%. 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* decisions about holding the stock.³⁵

Appendix Table A.1.4 extends the analysis to 24 months after the lottery.³⁶ We find that even 24 months after allotment, lottery winners are 36% 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% over these 24 months.

3 Relating the Winner-Loser Divergence to the Endowment Effect

The winner-loser divergence we find is reminiscent of the large laboratory literature documenting the endowment effect, which is the idea that ownership of an object has a causal effect on an agent's valuation of the object. Broadly speaking, our natural experiment resembles the "exchange paradigm"

³⁵For example, if this pattern of negative post-issue returns were predictable, then we would expect *both* lottery winners and losers to choose not to hold the stock after listing.

³⁶The 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.

of endowment effect experiments (Ericson and Fuster, 2014). In this paradigm, subjects are initially randomly assigned to receive one of two objects, A or B, of approximately equal value (e.g., a mug and a pen). In the subsequent stage of the experiment the subjects are given the opportunity to trade and potentially acquire the object that they were not originally endowed with. The extent to which the holdings at the end of this trading stage 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.

It is worth noting here that 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, Coval and Stein (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. Each of these differences opens up the possibility of an explanation for our results that does not involve a WTA-WTP gap (i.e., an explanation other than the endowment effect.) In this section we enumerate the major differences between our natural experiment and the laboratory exchange paradigm experiments, and present evidence on the extent to which these differences can explain the winner-loser divergence in holdings we observe. In the subsequent section, we return to theories that have been used to explain the endowment effect, to see whether they can explain our results.

Wealth Effects and Taxes. 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.³⁷ In contrast, in exchange paradigm experiments, the objects are typically chosen to be of equal value, so there is no wealth shock.³⁸

In our setting, the key consideration is that the US\$ 62 wealth gain lottery winners obtain over losers is very small relative to the US\$ 1,750 that all lottery applicants initially put in escrow to participate in the lottery. This small gain is unlikely to be relieving a major wealth constraint for winners relative to losers, as we know that both groups have substantial cash on hand in their escrow accounts, and indeed, prior to the commencement of trading in the IPO stock given the timing of refunds. Overall, we find little evidence to suggest that these explanations play an important role. We provide the results of further specific tests of explanations in this class in Appendix A.6.

Inertia Associated with Costs of Trading. 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 comprehensively investigate the extent to which such costs can explain the differences we find.³⁹

Relatedly, 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 these prompts 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

³⁷Lottery 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.

³⁸Our 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 the appendix for details.

³⁹While exchange experiments have no monetary costs of trading, they of course may have important informal/psychological costs of engaging in trading.

losers) the IPO stock after it begins to trade. Previous work such as Odean (1999) and Merton (1987), argues that investors will only pay attention to a limited number of stocks. 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.

We therefore evaluate the extent to which our results can be explained by inaction induced by the costs (physical or psychological) associated with implementing a trade. To do so, 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.⁴⁰

Let w_{ijt}^a 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_{ijt}^p be that same investor's willingness to pay (WTP) for the stock. This model does not include an endowment effect, so we assume $w_{ijt}^a = w_{ijt}^p$ for all investors i , for all stocks j , at any time t .

Next, we denote by c 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), or nuisance factors (e.g., a lost brokerage account password). Moreover, c also captures non-rational costs that might drive inertia, such as costs of dealing with self-control problems that lead to procrastination.⁴¹

The presence of cost c can induce inertia that inhibits trading. Such cost-induced inertia will manifest itself 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: $p_{jt} - c > w_{ijt}^a$. Rewriting this inequality, the agent sells if $p_{jt} - w_{ijt}^a > c$. Intuitively, if the gap between the market

⁴⁰Substantial 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, Lippi and Paciello (2013), Abel, Eberly and Panageas (2013) and Andersen, Campbell, Nielsen and Ramadorai (2015).

⁴¹In Appendix A.6 (Table A.6.1) 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 basis points per trade and security transaction taxes of 14.5 basis points per trade.

price and the agent's WTA exceeds the cost of selling, the agent will sell. Given a WTA amount w_{ijt}^a , the agent is less likely to sell as cost c increases. Similarly, a potential buyer with WTP w_{ijt}^p will choose to purchase the stock if $w_{ijt}^p - c > p_{jt}$. Thus, the agent is less likely to buy as cost c 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 the costs c that they incur in order to make a trade.

Case 1: No Costs of Trading. Let j now denote the IPO stock. If we assume that $c = 0$, a lottery winner i will choose to hold the IPO stock if $w_{ijt}^a > p_{jt}$. A lottery loser i will choose to hold the stock if $w_{ijt}^p > p_{jt}$. Given that $w_{ijt}^a = w_{ijt}^p$ in this model, in this case an investor i will make the same decision regarding whether to hold the stock regardless of winning or losing the lottery. Furthermore, 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 arise from a difference in WTA and WTP between winners and losers.

Case 2: Investor Specific Costs of Trading. Now consider the assumption that costs of trading are individual specific, i.e., $c = c_i$ for an investor i . In this case, a lottery winner i will choose to hold the IPO stock if $w_{ijt}^a > p_{jt} - c_i$. A lottery loser i will choose to hold the stock if $w_{ijt}^p > p_{jt} + c_i$. 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 or lost the lottery. In particular, any investor whose valuation satisfies the condition $p_{jt} - c_i < w_{ijt}^a = w_{ijt}^p < p_{jt} + c_i$ 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 identify these investors is to note that the model predicts 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:

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

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 $p_{jt} - w_{ijt}^a > c_i$. Intuitively, the number of trades made by an investor is a useful proxy for understanding an investor's costs c_i , since the more sales investor i 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:

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

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 .⁴² Therefore, if investor-specific costs c_i explain the winner-loser divergence in holdings, we would expect the divergence to approach zero as we look at sub-samples of investors with higher and higher average trading intensity.⁴³

Figure 2a presents separate estimates of the divergence in holding rates of the lottery winners and losers at the end of the first full month after listing, conditional on making a given number of trades

⁴²We also note here that heterogeneity in trading intensity could also arise from differential needs for liquidity given the association in the literature between order flow and liquidity trading (see, for example, Grossman and Miller (1988); Kaniel, Saar and Titman (2008) and Campbell, Ramadorai and Schwartz (2009)). In the appendix Figure A.1.12 we check that all the results below hold for investors who are putting net new money into the market (i.e., those unlikely to suffer from liquidity constraints). We find that our inferences are unaffected by this robustness check, suggesting that c captures variation in the data over and above heterogeneity in demands for liquidity.

⁴³Another way to evaluate the investor-specific 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% of lottery winners who sold in the first month also made a transaction of equal or lesser value than the IPO allotment; similarly, 74% 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% *less* likely to have made another small transaction.

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 at the end of the first full month after listing. 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 % confidence intervals.⁴⁴ 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 % 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.⁴⁵ 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 intensity and the divergence in winner-loser behavior once we move beyond a relatively low trading intensity 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 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.⁴⁶

⁴⁴We use the approximation presented in Cochran (1977) to estimate the standard errors of the weighted means.

⁴⁵In general, we find that portfolio turnover, as measured by the number of trades the investor makes 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.

⁴⁶We conduct the same analysis of holding behavior at the end of the first week after listing relative to trading frequency in Appendix Figure A.1.8. The results are similar.

Case 3: Investor-Time Specific Costs of Trading. We next explore the implications of a different assumption, that $c = c_{it}$. In this case, we model the costs of trading as 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 $p_{jt} - w_{ijt}^a > c_{it}$ for stocks they own, and $w_{ijt}^p > p_{jt} + c_i$ 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.⁴⁷ 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.⁴⁸ This result is useful in evaluating the potential for costs of trading that are related to attention to explain the winner-loser divergence. The investors at the right side of this figure are paying enough attention to their portfolio to make almost one trade per day on average in the month of the IPO allotment, so it seems difficult to argue that costs of paying attention could on their own 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.⁴⁹

⁴⁷For 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.

⁴⁸The 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) find that lottery winners are slightly more likely to trade in the month after listing, but the economic magnitude of these effects are very small.

⁴⁹Appendix 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.

Case 4: Investor-Time-Security Specific Costs of Trading. The final possibility that we consider is 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 IPO security are too high because the size of the position may be too small to warrant attention. 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.⁵⁰

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.⁵¹

To further investigate the importance of investor-time-security transactions costs, we focus even further on sub-samples of investors 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 in which we estimate the divergence for the treatment IPO. 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.⁵² It seems difficult to argue that transactions costs for selling IPO stocks are high for this sub-sample, as we

⁵⁰For 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.

⁵¹Appendix 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.

⁵²The fact that these differences are smaller may also reflect that this sub-sample has a smaller endowment effect, as naturally those investors who sell IPO allotments as winners are the types with lower endowment effects.

explicitly condition on having sold an allotted IPO stock. It also seems difficult to argue that these investors never actively thought about selling their IPO stock, as they actively sell another IPO stock in exactly the same month.

We next test whether the winner-loser divergence decreases with Google search intensity regarding the IPO, which prior work has used as a proxy for attention (Choi and Varian, 2012; Da et al., 2011). The Search Volume Index (SVI), which ranges between 0 and 100, measures monthly search interest as the total number of queries for keywords related to a particular IPO, relative to the highest search interest in that IPO over our sample period. A value of 100 denotes the highest point of interest during our sample. We obtain the SVI for each IPO using the firm's name and ISIN as keywords. Although the SVI is not useful to measure absolute volumes for searches, it gauges interest and mindshare in a given month relative to the month with the highest search interest during our sample. We first sort the investors in our sample by trading activity (as above), and then based on the quartile break-points of the SVI for the corresponding IPO in each event-time month. While we refer the interested reader to the Appendix Figure A.1.10 for details, we note here that the winner-loser divergence is the lowest for IPOs in the high search volume group in months two, three, and six months after listing, although the relationship between the treatment effect and Google search intensity is not monotonic. Overall, this analysis provides suggestive evidence that when IPOs receive more attention, there is a smaller winner-loser divergence, consistent with the arguments in Odean (1999). However, we find that the differences between high and low search intensity months are relatively small, suggesting that attention is unlikely to be the only driver of our results.

Finally, an important prediction of our model of costs associated with trading is that winners should be just as likely to purchase additional stock on the secondary market as lottery losers are to purchase the stock on the secondary market. This is because in this comparison, because of the randomization, both winners and losers pay the same cost to purchase these (additional shares) of the stock. 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% 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, and significant at the 1% level. When we look at sub-samples of traders with lower costs of trading (as per our model above), this effect is even larger, with lottery winners being approximately 3 percentage points more likely to buy the IPO stock than lottery losers in the listing month, regardless of the measure used.⁵³ It is difficult to see how inertia based purely on the costs of trading can be reconciled with lottery winners who more actively buy the stock on the open market than lottery losers, given that under this explanation, randomization induces equal WTP/WTB distributions and costs across groups. In contrast, the endowment effect is a more natural explanation for this, as randomly owning the stock raises the average WTP for the stock.⁵⁴ 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 costs associated with making a trade (Anagol et al., 2015).

Overall, we conclude that costs associated with initiating a transaction are unlikely to be the principal driver of the effects that we detect.

The Relationship Between the Winner-Loser Divergence and Experience. List (2003) and List (2011) document substantial reductions in the endowment effect when measured for more experienced market participants in field experiments, raising the possibility that the WTB/WTB divergences we detect may arise from inexperienced market participants.

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" indicator variable in equation (1) with a set of predetermined variables that we believe are useful proxies for experience in the IPO market. This is a descriptive analysis similar to that conducted 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 (i.e., those with high trading intensity) identified earlier.

⁵³This is an approximately 40% 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.

⁵⁴Appendix Figure A.1.11 shows a graphical comparison of propensity to purchase additional shares of the IPO stock, splitting the sample by positive and negative listing gain IPOs. We find winners are more likely to purchase additional shares for both positive and negative listing gain IPOs, although the results are noisy for negative listing gain IPOs due to the smaller sample size.

Column (1) in Table 5 takes equation (1), and adds a set of interactions between the “winner” indicator, and categorical variables based on tercile or quartile breakpoints of the proxies for investor experience that are listed in the rows. Columns (2), (3), and (4) conduct the same regression, but for the smaller samples of investors identified in our previous 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 similarly signed across all proxies of experiences in the four samples, with some differences arising in statistical significance on account of inevitable reductions in sample size.

The first set of rows show 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%), even such “experienced” IPO allottees are 60% 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 14.3% 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 returns on the treatment IPO 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.⁵⁵ Figure 1 (c) suggests that some version of

⁵⁵Appendix Tables A.1.8 and A.1.9 present this analysis at the end of the first full month and first full week after listing, respectively, and find similar results.

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 the salience of returns as measured by their rank in investors' past experiences. This appears connected to the predictions of "warm glow" models (Morewedge et al., 2009; Bordalo et al., 2012).⁵⁶

In Appendix Section A.5 we use the randomized allocation of recent lotteries to more rigorously test whether recent experiences with winning an IPO lottery cause the estimated divergence in holdings generated by subsequent random allotments to be lower. 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).⁵⁷ 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.

Advantages of the IPO Lottery Experiment for Studying Endowment Effects. We have discussed above several potential confounds in our field experiment that could generate other causes for our results other than the endowment effect. It is also worth highlighting that our natural experiment also has a few identification advantages, in addition to such potential confounds. The setting that we consider avoids four specific laboratory features that have been highlighted as spuriously producing endowment effects in Plott and Zeiler (2005), namely: 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,⁵⁸ 2) the endowed object is called a gift, or may be 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

⁵⁶Table A.1.10 shows that the winning investors have a higher holding propensity in the IPO stocks, even conditional on returns, than they do in other stocks that they purchased. While this analysis is not causal, it also lends support to the possibility that there may be an additional "warm glow" operating for IPO stocks.

⁵⁷In 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 results are similar, but for high experience samples we find substantially higher endowment effects.

⁵⁸For 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.

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 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.

We next turn to considering whether the leading class of models that have been used to explain the endowment effect, namely, reference dependent preferences models, can explain our field experiment

results.⁵⁹

4 Endowment Effect Inspired Theoretical Explanations

In this section, we consider prominent theoretical explanations of endowment effects which involve WTA/WTP gaps arising as a direct consequence of ownership. The literature has focused on one main class of theories, namely reference-dependent preferences with different formulations of reference points. We therefore concentrate on these models in our analysis. Our aims are to: 1) 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) derive additional testable predictions generated by these models to see whether they hold up in the data.

1. Issue Price as the Reference Price. The first model that we consider is one in which reference prices are fixed. A recent, useful theoretical formulation of how this can generate endowment effects in general is provided by Weaver and Frederick (2012). In their framework, consumers' valuations of objects can be distorted by how the market price of a good relates to a (given) reference price. Weaver and Frederick (2012) term this an "aversion to bad deals." To apply this model to our setting, we can think of lottery losers who focus on the issue price as the reference price. According to the theory, such losing investors would 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 relegate the formal presentation of the model of Weaver and Frederick (2012) applied 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 fall in the size of the

⁵⁹Our appendix also presents evidence on a series of non-reference dependent mechanisms, including information acquisition costs, lottery losers purchasing a substitute stock, households submitting multiple applications, wealth effects, disincentives for flipping, tax motivated behavior, the possibility that losing the lottery generates ill-feelings about the specific stock amongst losing investors, all as possible explanations for our estimated endowment effects. Overall, none of these factors appears to fully explain the winner-loser divergence we observe.

listing gain on the stock. 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 for 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 provide some support for the endowment effect that we observe being driven by lottery winners’ and losers’ valuations for the stock being influenced by different reference prices.

Another prediction of this model is that as the IPO stock price approaches the issue price over time, we should see the endowment effect go down as lottery losers become more willing to purchase the stock (assuming the reference price remains the issue price over time). In Table 4, we find that by the end of the second month after the IPO, the mean return on the IPO stocks in our sample is minus one percent relative to the issue price. Thus, if the main reason lottery losers choose not to purchase the IPO stock is because of an aversion to paying a price higher than the issue price, we should see much more buying three months after the IPO (on average). The data shows, however, that only 1.5% of lottery losers choose to own the IPO stock even when it has essentially returned back to the issue price, which is inconsistent with the sole explanation for the endowment effect being based on losers feeling that they are engaging in “bad deals” relative to the issue price.

An additional challenge for this model is that it does not predict that lottery winners should be more likely to buy the stock actively on the market than lottery losers. The intuition is that, in this model, when winners think about buying more of the IPO stock, they should also have downwardly distorted valuations of the stock in the same way that lottery losers’ valuations are distorted. Another ingredient must therefore be added to this framework to generate the prediction of winners actively purchasing more on the market.⁶⁰

⁶⁰A previous version of this paper included a simple version of a realization utility based model with loss aversion.

2. Expectations as Reference Points – Expected Distribution of Prices. Within the reference-dependent preferences 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 comparing the current price to a fixed reference price. In such a setup, 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 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.^{61, 62}

In the appendix we present a model in which 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

In that model the endowment effect resulted because lottery winners had a potential realization utility gain due to the listing gain, while lottery losers did not. On the margin, this made lottery winners more willing to hold the IPO stock than lottery losers. This model made the same prediction as “bad deals” model, in that the winner-loser divergence in holdings should increase as we look at larger and larger listing gains. It is also worth noting that a more sophisticated version of the realization utility model with either diminishing sensitivity or time discounting, as in Barberis and Xiong (2012) and Ingersoll and Jin (2013) would yield a disposition effect for winners, i.e., that the selling propensity would increase in the strength of holding period returns.

⁶¹Sprenger (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).

⁶²Kőszegi 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.

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 find that there is a range of parameters regarding the future success of the stock for which the “endowment effect plan,” i.e., 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), namely that 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, however, is quite narrow relative to the actual pattern of experienced IPO returns. 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 they win, but simultaneously has to be low enough so that the agent also sticks to holding cash if they lose the lottery. A second challenge for this model is that the endowment effect plan is only a PE, and not a preferred personal equilibrium (PPE), which is an equilibrium refinement of Kőszegi and Rabin (2006). In practice, this means that while under PE parameters the agent does not want to deviate from the endowment effect plan, from an ex-ante perspective the agent would gain higher utility from changing their plan to make a consistent holding decision on the IPO stock regardless of winning or losing the lottery.⁶³ A third challenge to this framework is that, because the mechanism works through the agent’s risk-aversion, it does not predict that lottery winners should actively purchase more of the IPO stock. A final challenge is that for the expectations based reference point model to generate the endowment effect we need to assume that the investor narrowly frames their IPO stock choices separately from their portfolio. Absent this narrow-framing assumption, we would predict that lottery winners, because they are randomly endowed with more risk, should increase their risk-taking overall, not just in the IPO stock. In Anagol, Balasubramaniam and Ramadorai (2015) however, we find that

⁶³The 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.

lottery winners do not allocate more money to the stock market. The total allocation to the market is one measure of risk-taking, and on this measure, the results are inconsistent with the broader model’s prediction on risk-taking.⁶⁴

5 Discussion and 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 explore the extent to which reference-dependent preferences, the leading explanation for laboratory endowment effects, can rationalize our empirical findings. These models differ in the precise formulation of the reference point around which agents evaluate their gain-loss utility. Overall, we conclude that neither a model in which the issue price is a fixed reference point, nor expectations-based formulations in which the expected distribution of prices serves as the (stochastic) reference point can explain our findings on their own.

While we face data-based limitations on our ability to test alternative theories of the endowment effect, one potentially promising avenue is that receiving an endowment causes an agent’s attention to shift toward its more positive attributes (i.e., “warm glow” based explanations).⁶⁵ Bordalo, Gennaioli and Shleifer (2012) present a formal theory of the endowment effect based on a similar mechanism,

⁶⁴In 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 also delivers a narrow range of parameters that can make the endowment effect plan an equilibrium. In particular, the observed pattern of negative returns on IPOs is outside of this restricted set of beliefs.

⁶⁵Morewedge, Shu, Gilbert and Wilson (2009) present laboratory evidence for such a mechanism, arguing that ownership of a good makes the positive aspects of the good salient, and therefore leads to an exchange asymmetry. Their key experiment was to endow all subjects with a mug, and then randomly choose some subjects to state their WTA for the mug, and some subjects to state their WTP for a second mug. They find no WTA-WTP gap in this comparison, suggesting that once an object is owned the subject focuses on positive features of the mug.

namely that ownership causes subjects to focus on the positive aspects of the owned good, and therefore makes them less likely to trade. In our setting, this model would suggest that lottery winners initially focus on the IPO stock's best characteristics when they compare it to the possibility of getting no shares in the lottery. This focus causes the IPO winner to over-value the stock when they contemplate selling it later, which in turn results in them holding the stock at higher rates than lottery losers.

The warm-glow approach is promising, as it appears able to rationalize at least two facts that are difficult to explain with reference-dependent preference-based accounts of the endowment effect. First, the warm glow account can explain why lottery winners have a greater tendency to actively buy the IPO stock on the secondary market when compared to lottery losers, but simultaneously do not have a greater tendency to actively buy other stocks in greater quantities. According to the warm-glow based explanations, winners will tend to focus on the positive aspects of the IPO stock that they own, and will therefore also see purchasing more of that specific stock as a good idea. In contrast, reference-dependent models can explain the increased purchase of all risky assets, but cannot (without auxiliary assumptions) explain specific additional purchases of the IPO stock.

Second, it is difficult for the reference-dependent theories to explain why agents would hold the IPO stock despite significant evidence that IPOs on average have highly negative returns - since these models require that agents have "medium-sized" expectations about returns on the IPO stock to generate an endowment effect. In contrast, since the warm glow explanation posits that agents focus on specific positive aspects of goods, it can also potentially explain the high holding rates of winners in the face of negative evidence on historical IPO returns.

The potential for warm glow explanations to explain our findings also highlights what we learn from the failure of reference dependent preferences-based explanations for our findings. In all reference-dependent preference-based explanations, being endowed with an object does not change the agent's perception of the object itself; instead, it influences valuation only when the agent considers selling the object (i.e., through the pain of losing the object or through effects on risk-aversion as in the endowment effect for risk-based explanations). Our results suggest instead that we should seek to understand how ownership changes perceptions of the specific object being owned, and how such changed percep-

tions might distort owners' valuations directly, rather than through the lens of reference-comparison-based considerations.

Overall, 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. Although our field context does not allow us to definitively determine which models best explain 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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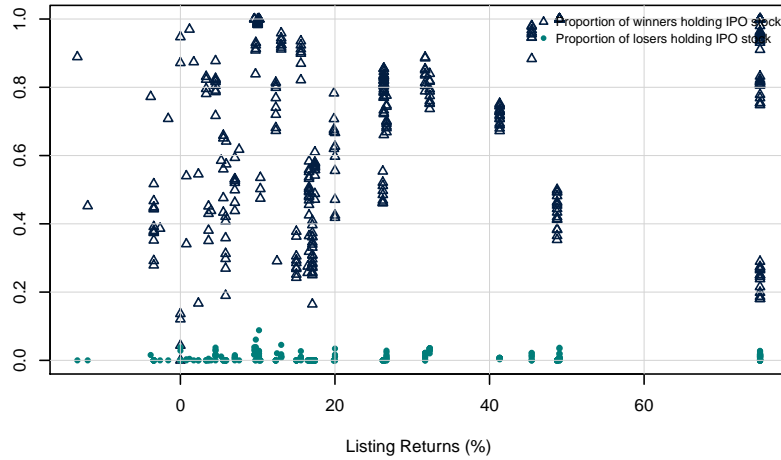
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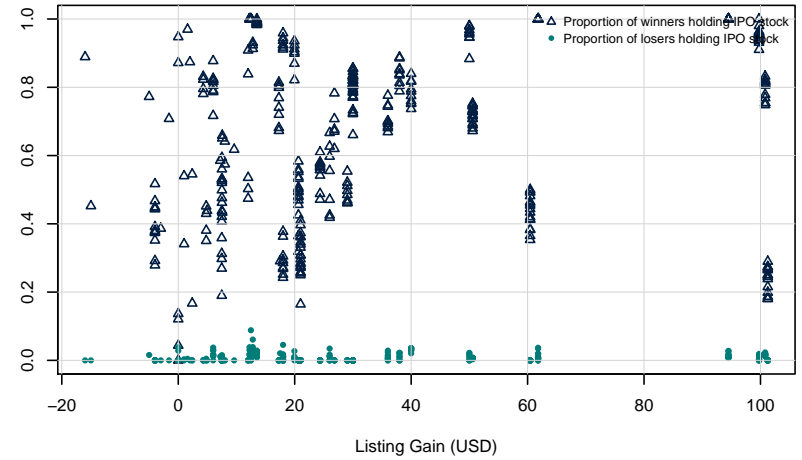
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Figure 1: Proportion of Investors Holding IPO Stock and Returns Experience

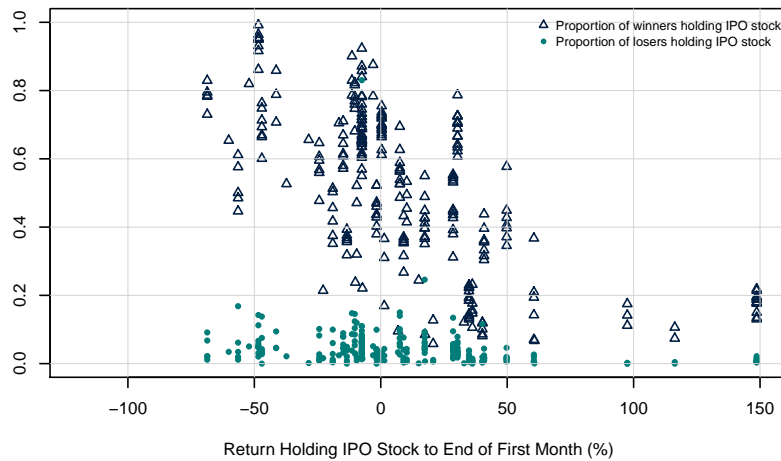
(a) Listing Returns (%)



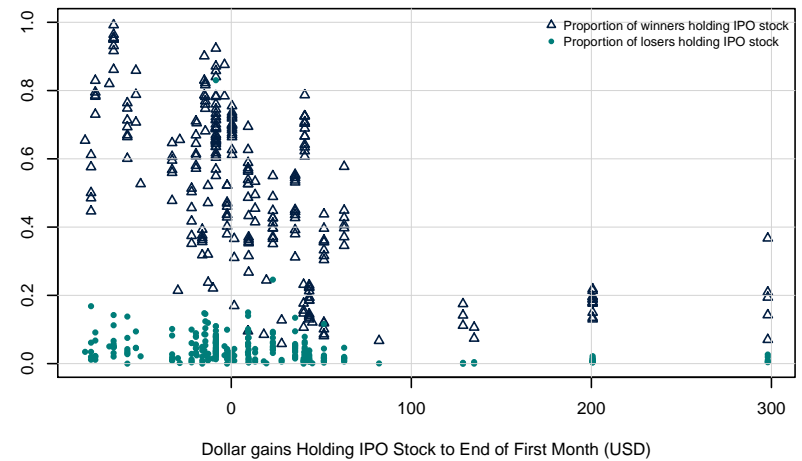
(b) Listing Gain (USD)



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



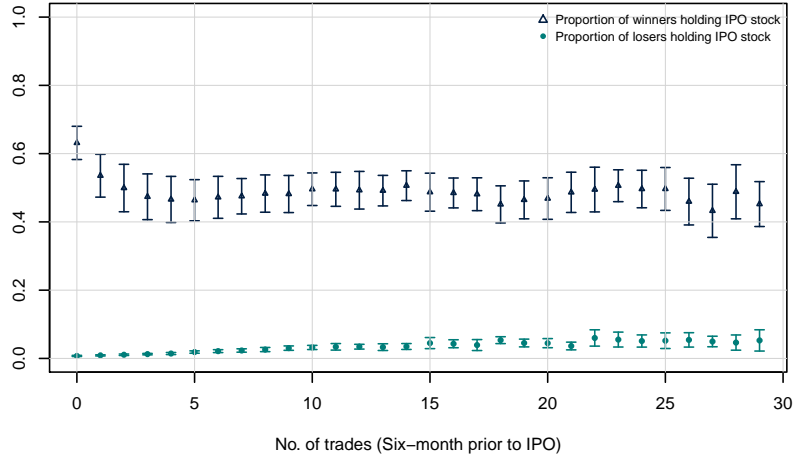
(d) Holding Gain at End of First Full Month After Listing (USD)



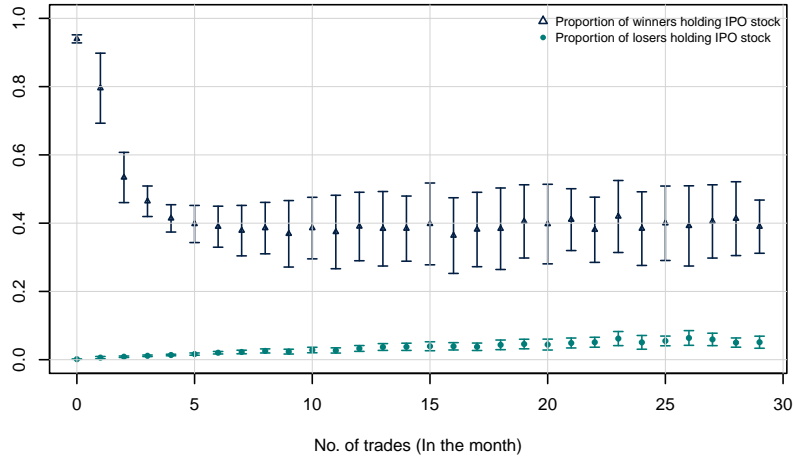
Panels (a) and (b) present estimates at the end of the first day on the y-axis and Panels (c) and (d) present estimates at the end of the first full month on the y-axis.

Figure 2: Winner-Loser Divergence by Trading Activity

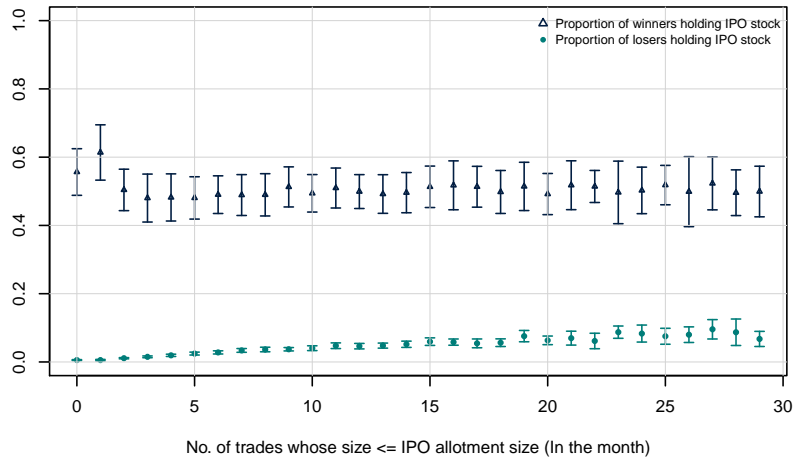
(a) i : By average number of trades per month in six months before IPO allotment



(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).

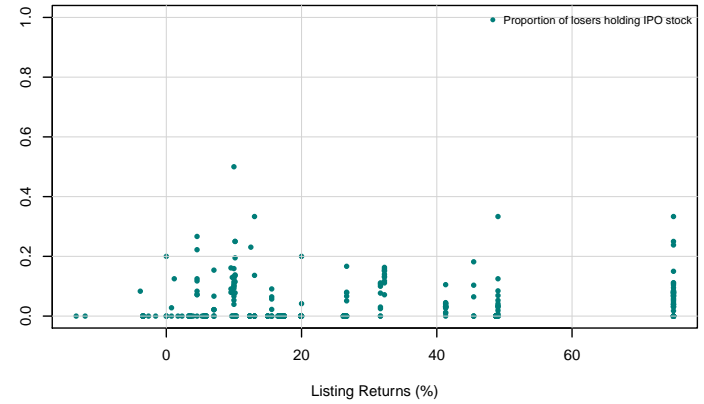
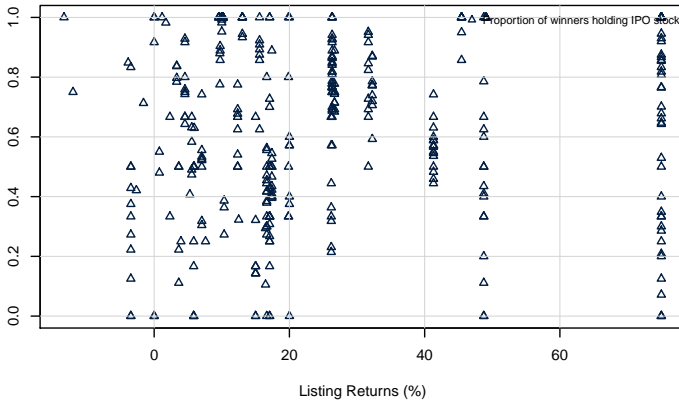
Figure 3: IPO Stock Holding Rates at End of Listing Day Against Listing Returns

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***

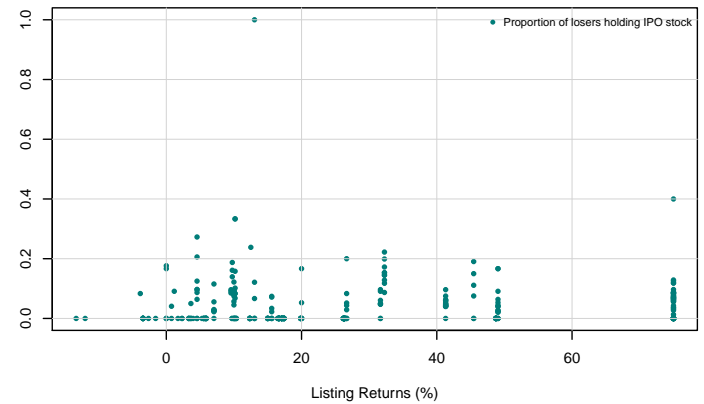
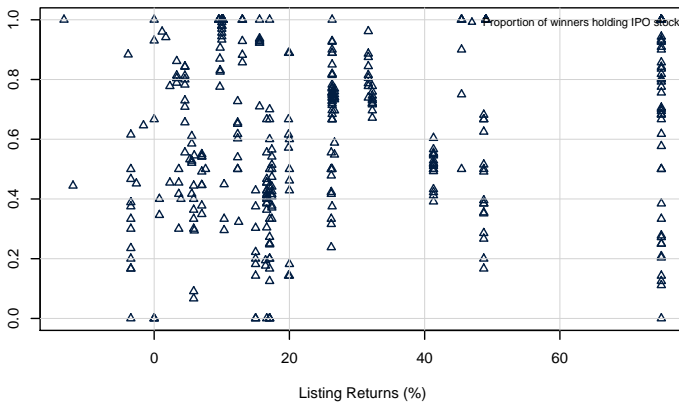


Panel B: Investors with > 20 trades in first full month after allotment

(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***

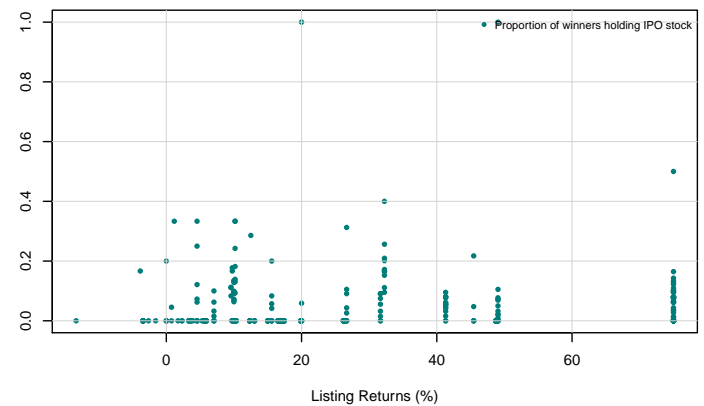
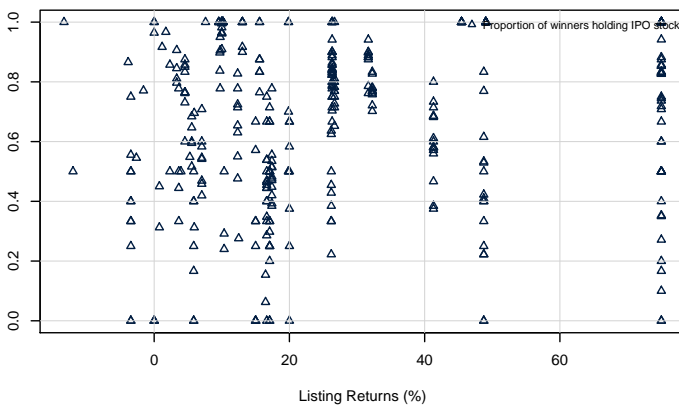


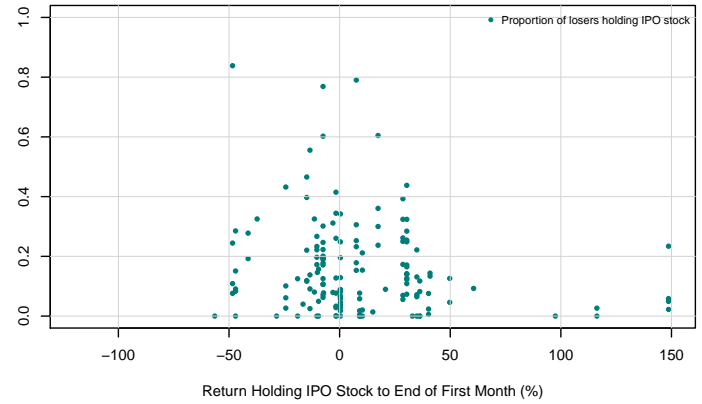
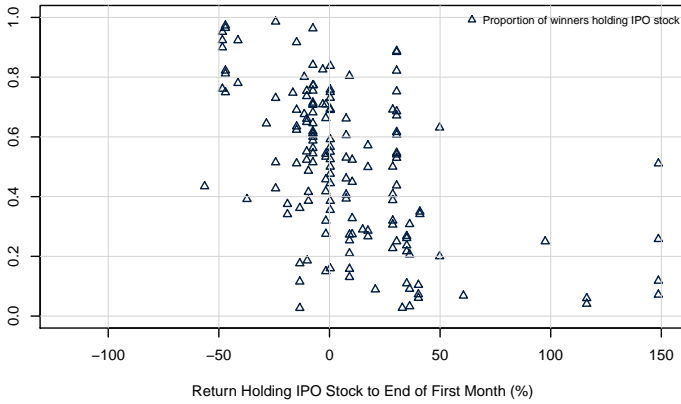
Figure 4: IPO Stock Holding Rates at End of First Full Month After Listing Against Returns

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***

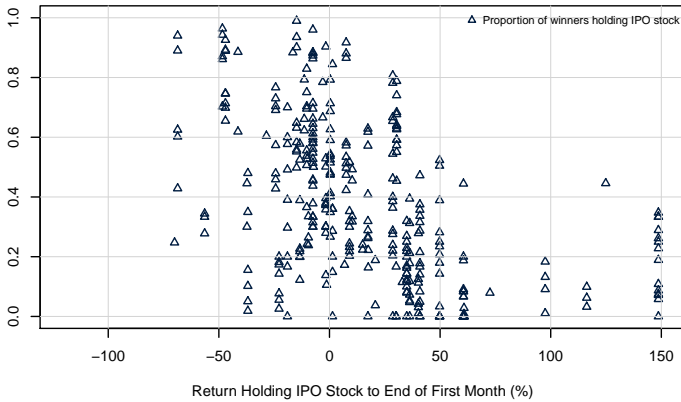


Panel B: Investors with > 20 trades in first full month after allotment

(i) Lottery Winners

(ii) Lottery Losers

Endowment effect estimate: 0.356***



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

(i) Lottery Winners

(ii) Lottery Losers

Endowment effect estimate: 0.430***

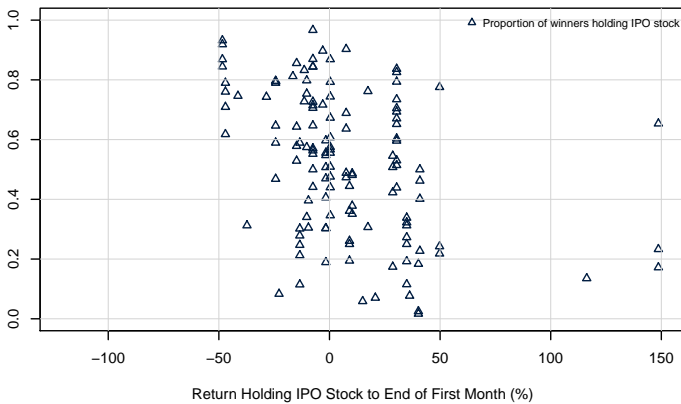
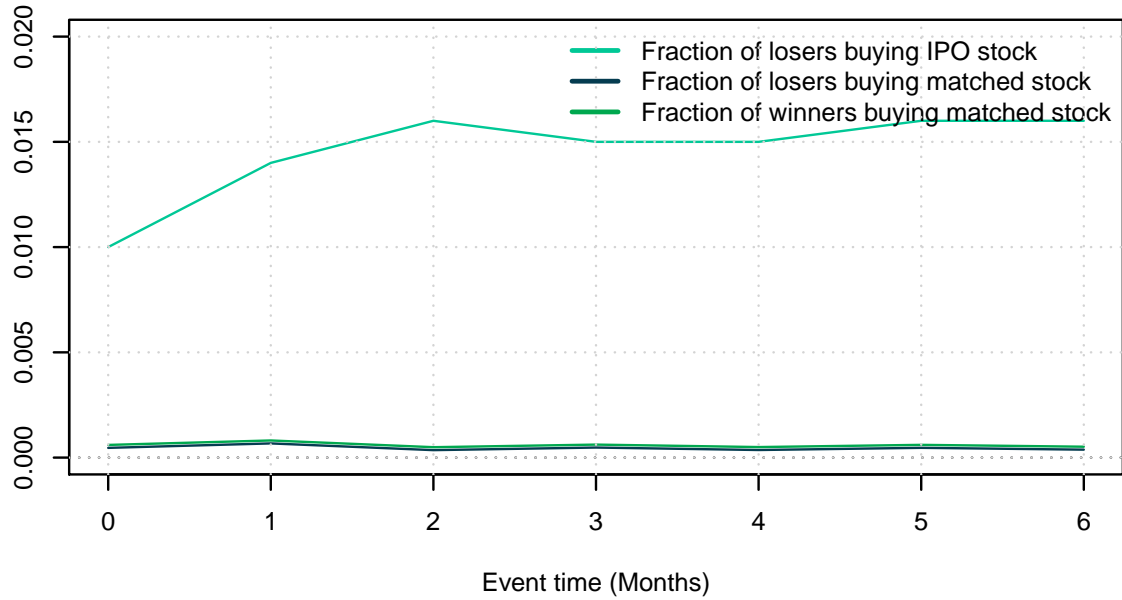


Figure 5: Winners' propensity to hold and losers' propensity to buy

(a) Losers' propensity to buy matched stock



(b) Winners' propensity to hold

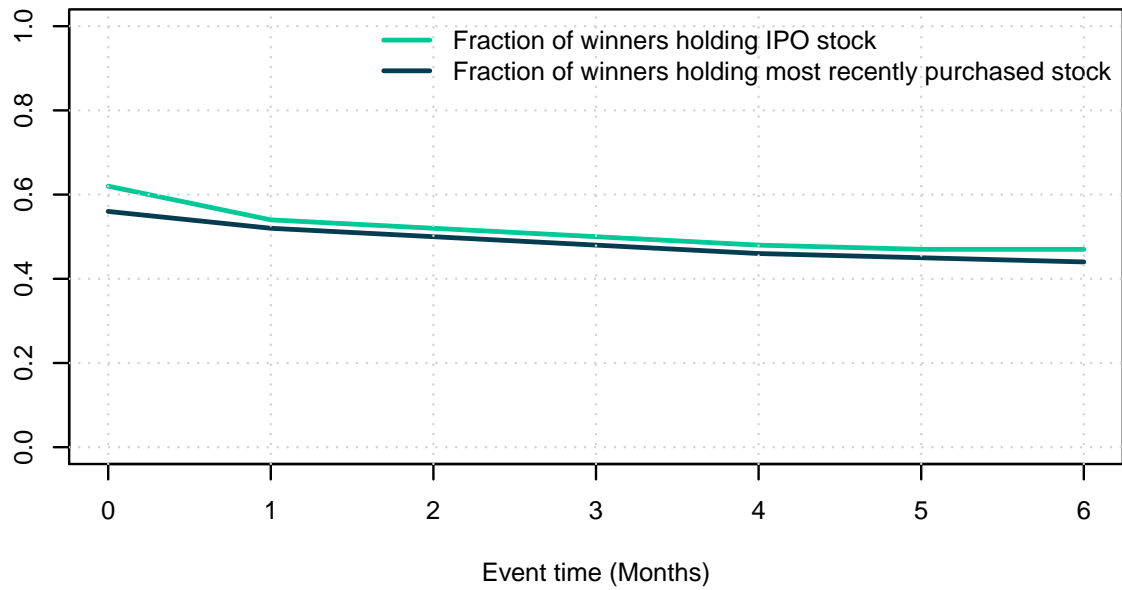


Table 1: RANDOMIZATION CHECK

	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 \leq 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	Months Since Listing						
		Day	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.