The Small IPO and the Investing Preferences of Mutual Funds

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Abstract

We examine how liquidity and return concerns at large mutual funds explain their diminished participation in small IPOs since the late 1990s. Using 5,825 IPOs and portfolio-level information for 37,052 funds, we exploit Russia's 1998 debt default as an exogenous shock to funds' liquidity concerns. After 1998, large funds invested in fewer small/illiquid IPOs and more large/liquid IPOs than smaller funds and received higher returns for small IPO investments. Given increased fund sizes since 1990, these results are consistent with fund's liquidity concerns and their demand for greater compensation when investing in transactions representing a trivial fraction of fund assets.

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I. Introduction

In this article we examine the investing preferences of large mutual fund investors in small IPOs. As we document, large mutual fund investors were historically a strong source of demand for small IPO offerings but have invested only sparingly in small IPOs since the late 1990s.

We theorize that beginning in 1998 there was a sudden shift in investment preferences among all mutual funds away from IPO risk in general. Beginning with the Asian financial crisis in 1997 and culminating with Russia's devaluation of the Ruble and subsequent debt default in August 1998, what we refer to as the "Panic of 1998", volatility within the global economic market prompted a wholesale flight to liquidity that had acute ramifications for investor demand for newly public firms. However, these events also had special significance for how large funds assessed small IPOs. Consequently, when mutual fund investors returned to the IPO market in subsequent years—in particular, from 1999 to 2000, from 2004 to 2007, and from 2012 to the present—a critical difference was the noticeable absence of large mutual funds from the small IPO marketplace.

When the volatility scare of 1998 subsided, why did large mutual funds fail to return to the small IPO market? Our central hypothesis is that while mutual funds' general appetite for IPO risk was sharply diminished in 1998, the events of 1998 also prompted a fundamental reconsideration among mutual fund portfolio managers about the liquidity risk of investing in small IPOs. In particular, the accelerated growth of the largest quartile of mutual funds throughout the 1990s and 2000s made liquidity risk ever more salient for portfolio managers given that, as shown in Pollet & Wilson (2008), portfolio managers typically deploy new fund inflows towards taking larger individual investment positions. In such an environment, the limited public float of small IPOs enhanced the challenge of moving efficiently into and out of

large positions in these transactions making it more difficult and more costly for portfolio managers at large funds to trade and manage small IPO investments.

Against this backdrop, when the Panic of 1998 induced a flight to liquidity and a related surge in mutual fund redemptions, these liquidity risks were thrown into stark relief as portfolio managers grappled with liquidating large investment positions while witnessing a collapse in the market for small capitalization equities. The extreme volatility of 1998 was also quickly followed by the technology bubble and a push to invest in large-capitalization internet stocks. Finally, we theorize that revitalized interest in small IPOs among large investors after 1998 was hampered by the sharp rise in large funds' assets under management (AUM) since the late 1990s. In light of this trend, a large fund's position in even a successful small IPO would require considerable effort to trade efficiently yet yield a vanishingly small contribution to the fund's return. The combined result of these dual concerns about illiquidity and return contribution was a swift and prolonged exodus of large mutual funds—once a core source of demand for smaller IPOs—from the small IPO marketplace, which only enhanced the real and perceived illiquidity of small IPOs.

To test this theory, we examine mutual fund investments in 5,825 IPOs between 1990 and 2014. For these purposes we segregate IPOs into small IPOs based on an IPO raising gross proceeds of less than $30 million in 1990 inflation-adjusted dollars (or $54.4 million in 2014 inflation-adjusted dollars).[1] We focus on this cut-off as it was approximately the mean offering size for IPOs conducted in 1990—the first year of our sample and a time period generally viewed as having a robust small IPO market. Because we lack reliable data on direct investments in IPOs by institutional investors, we proxy for IPO investments by mutual funds using the Thomson-Reuters Mutual Fund (S12) Database (formerly CDA/Spectrum), which tracked mutual fund

[1] We use the Consumer Price Index to make annual adjustments.

portfolio holdings during this time period on a bi-annual or quarterly basis.[2] Using this database, we examine portfolio-level data for 37,052 mutual funds using their approximately 582,000 position reports between 1990 and 2014. Assuming that any mutual fund holding an IPO security within six months of the IPO date represents a purchase by the fund in the IPO, we find an instance of an IPO investment in 63,263 (approximately 11%) of these position reports.

Our primary empirical tests focus on several difference-in-difference estimators of how mutual fund size affected annual IPO investments following the events of 1998. In particular, we classify mutual funds into annual size quartiles to examine how fund size affected IPO participation levels over time. Holding constant year fixed effects and fixed effects for individual mutual funds, we first find that the largest quartile of mutual funds invested in more IPOs per year than smaller funds both before and after 1998. Indeed, across all size quartiles, an increase in fund size is associated with more annual purchases of IPOs throughout the sample period. These findings are consistent with the basic fact that larger funds have more investment capital than smaller funds to deploy towards IPO investments.

In contrast, separate analysis of mutual fund investments in small IPOs reveals a distinctly different pattern across the four size categories of mutual funds. Whereas prior to 1998 larger funds acquired more small IPOs than smaller funds, our difference-in-difference estimator reveals a reversal of this pattern following 1998, as predicted by our theory. More specifically, compared to their purchases of small IPOs in the period prior to 1998, we estimate that mutual funds in the first, second, third, and fourth size quartiles reduced their average annual investments in small IPOs after 1998 by approximately 17%, 62%, 83% and 96%, respectively.

[2] Mutual funds have been required to disclose portfolio holdings once every quarter since 2004. Prior to 2004, mutual funds were required to disclose portfolio holdings once every six months. *See generally* Final Rule: Shareholder Reports and Quarterly Portfolio Disclosure of Registered Management Investment Companies Securities and Exchange Commission 17 CFR Parts 210, 239, 249, 270, and 274 [Release Nos. 33-8393; 34-49333; IC-26372; File No. S7-51-02], *available at* https://www.sec.gov/rules/final/33-8393.htm.

Overall, these estimates suggest a complete collapse in the demand for small IPOs among what had previously been a key component of the market for these offerings.

To isolate better the role of illiquidity considerations on mutual fund investment in small IPOs, we similarly examine how mutual fund size was associated with fund investments in illiquid IPOs. Using an interrupted time series analysis, we find that the peak of the Panic of 1998 resulted in a sudden, virtually discontinuous drop in the illiquidity of IPOs calculated using Amihud's (2002) measure of illiquidity. We attribute this finding to the withdrawal of issuers from the IPO market except for those IPOs likely to generate significant after-market trading interest. Notwithstanding this overall decline in IPO illiquidity, however, our difference-in-difference estimator indicates that after 1998, smaller funds significantly outpaced larger funds in their acquisition of IPOs ranking in the top quartile of illiquid IPOs for the year. We similarly find that, among funds that invested in IPOs in a given year, no significant difference existed among different size funds in the average illiquidity of their IPO acquisitions prior to 1998. After this date, however, we find a statistically significant decline in the average illiquidity of IPO acquisitions among larger funds relative to smaller funds.

We also examine the levels of mutual investment in individual IPOs that were completed during the sample period. With the decline in small IPOs, standard economic theory would predict heightened demand among mutual fund investors for those small IPOs that actually made it to market.[3] However, using the number of large fund investors in an IPO as a proxy for demand among the largest funds, we find instead that after 1998, the largest quartile of mutual funds displayed a dramatic increase in the demand for non-small IPOs rather than small IPOs.

[3] We assume a downward sloping demand curve for IPO securities. While such a demand curve is arguably inconsistent with the Capital Asset Pricing Model, it is not clear the assumptions of CAPM apply to IPOs. On the contrary, the standard book-building process used by underwriters for pricing new issues suggests that investors place a premium on the idiosyncratic risk associated with IPOs.

Likewise, we similarly find a significant shift among the largest quartile of investors toward the most liquid IPOs after this point in time. Both findings are consistent with the notion that the largest funds—to the extent they invested in IPOs at all after 1998—were increasingly drawn to larger, more liquid transactions. We also find that after 1998, the level of large fund investment in small IPOs is increasingly associated with higher expected short-term returns regardless of IPO liquidity, which is consistent with large funds demanding additional compensation for investing in transactions representing such a small fraction of fund assets.

Finally, we examine why the Panic of 1998 appears in our time series data to have had such a long-lasting effect on mutual fund investment in the small IPO market. We theorize that the flight away from small IPOs in 1998 due to concerns about small IPO illiquidilty likely contributed to a vicious cycle of illiquidity-begets-illiquidty for small issuers. Because liquidity itself is a function of investor demand, the rapid withdrawal from this market of funds controlling over 90% of mutual fund assets could only aggravate the illiquidity of small IPOs, further deterring large fund investors. Equally important, Ben-Rephael, Kadan, and Wohl (2015) document the disappearance of the return premium for illiquidity over the past twenty years, undermining the profitability of liquidity-based strategies by other investors that might offset this trend. In combination with the fact that illiqudity among non-IPO securities declined between 1990 and 2014, the result should have been an increase in small IPOs' relative illiquidity within the overall market. Additionally, large fund's AUM continued to grow during this period, which may have contributed to investors' concerns about small IPOs' diminishing return contribution, compounding this illiquidity-begets-illiquidity phenonomon.

Consistent with this theory, we find that while the median illiquidty of small IPOs declined with the overall market through 1998, this pattern reverses itself in subsequent years. By early

2002 the median small IPO had moved from being in the third quartile of market illiquidity to being solidly in the fourth quartile, thereby representing some of the most illiquid exchange-traded securities. The median illiquidity of larger IPOs, in contrast, generally reflected the decline in illiquidity within the general equities market since 1990.

Overall, our findings provide novel evidence that both heightened concerns about small IPO illiquidity and about their return contribution have deterred small IPO investing by the largest mutual funds since the late 1990s. To be clear, our findings do not show (nor do we claim) that these two concerns about small IPOs are solely to blame for the demise of the small IPO. However, our findings nevertheless reveal how the decline of the small IPO was accompanied by changing investment preferences of the largest mutual funds, as well as by the more familiar regulatory reforms (e.g., the Sarbanes-Oxley Act) that have been cited as deterring firms from going public. In this regard, our findings complement rather than exclude other explanations for the decline of the small IPO (e.g., Gao, Ritter and Zhu, 2013; Doidge, Karolyi and Stulz, 2013).

This paper proceeds as follows. Section II discusses our theoretical motivation. With this background in place, Section III describes our data and provides summary statistics. Section IV presents the empirical tests and the results. Section V offers a brief conclusion.

II. Theoretical Motivation

We theorize that a reason for the sudden and sustained decline in mutual funds' demand for small IPOs in the late 1990s stems from the growth of the mutual fund industry and its related effect on funds' preference for larger, more liquid IPOs. Due in part to the movement of employers from defined benefit pension plans to direct contribution plans, the assets under management by domestic equity mutual funds grew by a factor of 16 between 1990 and 2000, increasing from approximately $211 billion in aggregate AUM to nearly $3.4 trillion (Investment

Company Institute, 2015). Equally important, this growth in aggregate AUM was also accompanied by increasing concentration of mutual fund assets among the largest funds. Pollet & Wilson (2008), for instance, find that the share of mutual fund assets controlled by the largest quintile of mutual funds increased from 73% in 1980 to nearly 90% in 2000. Likewise, while the size of funds in the bottom quintile increased by less than a factor of 5 from 1980 to 2000, the size of funds in the top quintile increased by more than a factor of 10 over the same time period.

The rapid growth in AUM during the early 1990s among the largest funds had significant ramifications for how these fund managers designed their portfolios. As noted by Pollet & Wilson (2008), a fund that grows in AUM poses an important choice for a fund manager: Should the manager research a larger universe of investment ideas or should she continue to invest, to the extent feasible, in the same portfolio of stocks? Based on their analysis of mutual fund portfolio data from 1975 to 2000, Pollet & Wilson (2008) conclude managers have largely chosen the latter option, responding to asset growth by increasing their ownership percentage rather than by adding new investments to their portfolios.

In light of this finding, we posit that the largest funds can be expected to avoid smaller firms and, consequently, smaller IPOs, for several reasons. For one, to the extent a fund manager prefers to deploy new inflows toward fewer, larger positions, Section 5(b)(1) of the Investment Company Act of 1940 (the 1940 Act) should bias a large fund manager against portfolio allocations to smaller firms. Under Section 5(b)(1), a mutual fund can qualify as "diversified" only if no more than 5% of its assets is invested in any one company's securities and it holds no more than 10% of the voting shares in any single company. As such, a growing, diversified fund that invests in smaller companies would be forced to diversify into a broader number of firms given that simply investing new inflows into an existing small firm position will more readily

cause the fund to breach this 10% position limit. If portfolio managers wish to avoid looking for new investments and anticipate growth in AUM, they will accordingly avoid investing in small issuers.

Equally important, this 10% limit on an issuer's voting shares should be expected to cause managers of large funds to demand greater returns from small IPOs within their portfolios, which few IPOs may be able to provide. As a diversified fund's AUM grows, efforts to deploy new fund flows into a small issuer will increasingly be constrained by this 10% position limit, meaning a large fund's investment in the company will represent a diminishing fraction of the fund's AUM. As such, as a fund grows in AUM, its portfolio manager should be expected to demand ever greater returns of a small IPO to justify an investment, limiting the universe of attractive small IPOs.

In addition to these concerns about small IPO's return contributions, liquidity concerns associated with investing in smaller firms can be expected to weigh more heavily on funds as they grow in AUM. As summarized by Harris (2003), a stock's liquidity represents "the ability to trade large size quickly, at low cost, when you want to trade." A fund that grows by investing more capital in its existing portfolio must accordingly worry about whether its growing investment positions will become increasingly difficult to trade without significant price impact. This is especially true in light of how the 1940 Act regulates redemptions of open-end mutual funds. Under Section 22(e) of the 1940 Act, mutual funds must stand ready to redeem fund shares and must pay redeeming shareholders within seven days of receiving a redemption request—a timeline that in practice is often reduced to just three business days.[4] A large wave

[4] For example, Rule 15c6-1 under the Exchange Act establishes three business days as the standard settlement period for securities trades effected by a broker-dealer. Consequently, the rule effectively requires most funds to pay redemption proceeds within three business days after receiving a redemption request, because a broker or dealer will be involved in the redemption process. In May 2017, the SEC reduced this three day settlement period to two days.

of redemption requests could accordingly force a mutual fund to liquidate large positions on a rapid basis, accentuating the risk of price impact.

Consistent with this theory, Pollet & Wilson (2008), Yan (2008) and Edelen, Evans, and Kadlec (2013) find that increases in fund AUM adversely affect transaction costs, which they posit explains why large funds generally underperform smaller funds. Using portfolio microdata, however, Busse, Chordia, Jiang & Tang (2014) find that large fund managers do not necessarily absorb the higher transaction costs of trading larger positions but select their portfolios so that they can grow individual positions with minimum price impact. In particular, larger funds hold larger, more liquid stocks than smaller funds, causing smaller funds to outperform through earning extra return premia associated with investing in stocks characterized by lower market cap, greater book-to-market, and higher price momentum. Thus, in addition to explaining why funds are subject to diseconomies of scale, these findings highlight how a growing fund's aversion for illiquid stocks can translate into an associated aversion for smaller firms, regardless of whether a fund seeks to remain diversified under the 1940 Act.

Finally, we build on a scholarly literature finding that these liquidity-based concerns are amplified for mutual funds during periods of market volatility. For instance, in work related to our hypothesis, Rzenznik (2015) studies mutual fund holdings from January 1999 to December 2013, and finds that mutual funds exhibit a "flight-to-liquidity" when faced with market volatility by selling less liquid shares and buying more liquid shares. Ben-Raphael (2014) similarly documents a flight to liquidity during periods of market uncertainty. Reviewing ten periods of uncertainty during 1986-2008, he finds that illiquid stocks experience a larger price decline relative to liquid stocks, and that mutual funds as a group tend to reduce their holdings of illiquid stocks.

In light of these factors, we hypothesize that the Panic of 1998 represented a particularly important period of market uncertainty for mutual funds and triggered a wholesale reassessment of the liquidity risk of small firm investments among the largest funds. While returns to small capitalization investments were robust through the early 1990s, growing market uncertainty associated with the Asian financial crisis in 1997 had an especially acute effect on this sector of the market. In contrast to other periods of severe market turmoil such as the 2008 financial crisis, market commentators at the time emphasized that the primary result of the market turbulence was to prompt a flight to liquidity, rather than a simple flight to safety. As a result, returns to small cap firms relative to large cap firms began to diverge significantly during this time, as investors reallocated towards larger equities. Within this context, Russia's abrupt currency devaluation and debt default in August 1998 added considerable momentum to this flight to liquidity, resulting in an historically unprecedented divergence between returns to small cap and large cap equities.

To illustrate the singularity of this flight to liquidity, Figure 1 presents a line graph of the rolling 12-month return to the Russell 2000 (an index of the smallest 2,000 publicly traded firms), less the same return of the Russell 1000 (an index of the largest 1,000 publicly traded firms). In addition, Figure 1 also includes a scatterplot of the end-of-month level of the widely-followed VIX index, representing the market's expectation of stock market volatility.[5] As shown by the line graph of the Russell 2000's excess returns, no other period in recent history witnessed the same level of divergence between returns to large cap stocks and returns to small cap stocks due to this unique flight to liquidity. Moreover, as highlighted by the vertical line superimposed at August 1998, this divergence reached its greatest at precisely the time Russia's debt default reverberated throughout global markets. At the same time, the VIX, which began in 1990, also

[5] The CBOE commenced the VIX index in 1990, making data unavailable for dates prior to this year.

crossed above 40 in August 1998 for the first time in its history—a feat that would not occur again until the 2008 financial crisis. Indeed, its 78% increase from the end of July 1998 to the end of August 1998 is second only to its 90% increase in September 2008 following the collapse of Lehman Brothers. Meanwhile, redemptions of domestic equity funds in August 1998 experienced their first net monthly outflow since the Gulf War in 1990, with fund shareholders requesting net redemptions of approximately $6.5 billion for the month (Engen & Lehnert, 2000). Combined with the market's flight away from small firm illiquidity, we posit that this rush of redemptions underscored for fund managers the liquidity risk of significant small cap positions, particularly in their initial public offerings.

Within this context, mutual fund demand for small IPOs should accordingly be expected to drop precipitously, particularly among the largest funds. Moreover, given that liquidity itself is a function of investor demand, any drop in demand for small IPOs among the largest funds would itself be expected to further enhance the illiquidity of these transactions, potentially creating a vicious cycle of illiquidity-begets-illiquidity. At the same time, continued growth in AUM among the largest funds should be expected to cause fund managers to demand greater returns of small IPOs, further contributing to their diminished interest in small IPOs. As such, while Figure 1 indicates that small cap returns and market volatility eventually normalized, we posit that this one-time shock to the demand for small IPOs marked the beginning of the sustained collapse in investment in small IPOs among the largest mutual fund investors.

III. Sample Construction and Summary Statistics

A. Data Collection

We collect data on initial public offerings, including information on proceeds and underwriters, from Thomson Reuters Securities Data Corporation (SDC). We include in our

sample all IPOs listed in SDC as closing between January 1, 1990 and December 31, 2014 and as having been conducted by a non-financial U.S. corporation whose primary trading market was in the United States. We further restrict our sample of IPOs to transactions involving non-penny stocks that were listed on one of the three major listing venues (the NYSE, Amex, and Nasdaq, including their successor entities). Finally, we restrict our sample to IPO securities that can be matched to the daily stock prices from the Center for Research in Security Prices (CRSP) and where the first trade date in CRSP occurred within 30 days after the IPO closing date.[6] These filters result in our primary sample of 5,825 IPOs. We supplement SDC's data on IPO characteristics by cross-checking this IPO information with Capital IQ data as well as data from Professor Jay Ritter's personal website.[7]

We obtain information on mutual fund investment in these IPOs from the Thomson-Reuters Mutual Fund (S12) Database (formerly CDA/Spectrum) which tracks mutual fund portfolio holdings on a bi-annual or quarterly basis. The S12 dataset includes portfolio-level position information for 48,968 individual mutual funds during our sample period, covering a total of approximately 760,000 fund reporting periods. For each fund reporting period, we use the reported position-level information to calculate the value of the funds' total equity portfolio as of the reporting date using daily stock prices from CRSP.[8] Because we are interested in mutual funds that are actively investing in U.S. equities, we exclude from our sample any fund having an equity portfolio of less than $1 million in a given reporting period.[9] Applying this filter results

[6] This restriction results in excluding several IPOs involving unit issuances of common stock and warrants, which typically trade over-the-counter as a unit until a designated date after the IPO at which time the securities can trade separately and the common stock may be listed on an exchange. Likewise, the restriction that the first trading date in CRSP occur after the IPO closing date eliminates transactions that SDC codes as an IPO even though the company had previously been publicly-traded.
[7] This website is located at http://site.warrington.ufl.edu/ritter/ipo-data/.
[8] While the S12 database includes a data field for the stock price of a reported position, recording of this variable is inconsistent, thus requiring the use of CRSP data to calculate equity portfolio values. Where CRSP data is missing (e.g., because a security trades in the over-the-counter market), we use the stock value provided in the S12 database if one is reported.
[9] It is common in studies using the S12 database to filter the database using a fund's reported investment code objective (IOC) to isolate funds focused on U.S. equities (see Ali et al. (2008), Barras et al. (2010), Wermers (1999, 2000) and Kacperzczyk et al.

in a sample of 37,052 mutual funds which provide approximately 582,000 position reports from 1990 to 2014.[10]

We assume that any mutual fund holding the securities in the 5,825 IPOs and that first reports the position within six months of the offering date represents a purchase by the fund in the IPO. Across the 582,000 position reports, we find an instance of an IPO investment in 63,263, or approximately 11% of all fund reporting periods. These investments occur across 4,972 of our initial 5,825 IPOs.

B. Summary Statistics

Panel A of Table I provides an overview of the rate and size of IPOs during our sample period for both our full sample of IPOs and for our matched sample of IPOs where we identified at least one mutual fund investor in the S12 dataset. As shown in Column 1, the number of IPOs per year has declined over the years from a high of 684 in 1996 to 180 in 2014. As one would expect, the decline has been nonlinear, generally tracking the state of the overall economy. For instance, the peak rate of IPOs in 1996 was followed by a sharp decline through the early 2000s recession, a recovery during the lead-up to the 2008 financial crisis, and a decline to its lowest level in 2008. The years since the 2008 financial crisis have witnessed yet another recovery of the IPO market, though IPO levels are well below those of the late 1990s.

(2008)). However, inconsistent coding of IOCs in the S12 database calls into question the reliability of this approach as many funds lack an IOC code altogether (with upwards of 80% of fund observations lacking an IOC after 2005). Accordingly, we match IPOs across the entire S12 database but exclude funds that have a de minimis equity portfolio. Inspection of funds that are excluded by this filter indicates that it primarily affects funds focused on bonds and foreign equities.

[10] Within the sample, the median fund reports nine times—a number that is skewed downward by a large number of funds that report for only one (N=4,097) or two (N=3,172) periods. Inspection of the dataset reveals that some of these instances are the result of liquidated or merged funds, but many arise primarily because of the variety of data sources used to compile the S12 database. For instance, while a primary source of data are the periodic Forms N-30 required to be filed by registered investment companies, the dataset also includes information obtained directly from mutual fund sponsors. As a result, funds within the S12 dataset represent a combination of mutual funds registered under the Investment Company Act that are subject to mandatory, periodic reporting (e.g., open-end funds marketed to retail and/or institutional investors) as well as those that are not (e.g., foreign funds and funds sold exclusively to institutional clients). To avoid introducing survivorship bias, we refrain from imposing on funds a minimum reporting threshold for inclusion in the sample.

Columns 2 through 6 highlight the growing size of IPOs since 1990 with all figures being inflation-adjusted to reflect 2014 prices. During this period, mean (median) proceeds for IPOs increased from approximately $56 million ($32 million) in 1990 to $200 million ($104 million) in 2014. Of particular note is the declining incidence of the small IPO shown in Column 2. In 1990, nearly 70% of all IPOs met our definition of a small IPO in that they raised less than $54.4 million (in 2014 inflation-adjusted dollars). In contrast, just 17% of all IPOs raised less than this amount in 2014. Moreover, while median proceeds increased 325% since 1990, the twenty-fifth percentile of IPOs proceeds increased over six-fold, highlighting a general shift upwards in the distribution of IPO proceeds, particularly among smaller issuers. As with the rate of IPOs, however, this overall increase in IPO proceeds has fluctuated over time, with maximums occurring in 2001 (M=$534.5 million; Mdn=$148.5 million) and 2010 (M=$426 million; Mdn=$129.8 million) as the number of IPOs declined. These trends are consistent with the notion that a tight IPO market is limited to offerings by larger, more established firms, while a robust IPO market is more accommodating of smaller issues.

Columns 7 through 12 of Panel A illustrate that these overall patterns also appear when we match IPOs to our sample of mutual fund investors. Depending on the year, anywhere from 67% to 100% of IPOs were acquired by a fund in our investor sample. As shown in Columns 9 through 12, mutual funds generally invested in IPOs that were larger than the average IPO, indicating that most of the IPOs without a mutual fund investor were smaller transactions. For instance, 25th, 50th, and 75th percentile proceeds were higher for the matched sample in almost every year from 1990 to 2014, indicating a general preference among mutual funds for larger transactions. This preference also appears in the lower incidence of small IPOs within the matched sample.

Panel B of Table II reports average annual return data for IPOs within our matched sample, presented separately for small and non-small IPOs. The first two columns present average three-year buy-and-hold returns with the first column presenting gross returns and the second column presenting market-adjusted returns using the CRSP value-weighted market index. With the exception of a few years, IPOs within our sample generally produced positive gross cumulative three-year returns, with non-small IPOs performing slightly better than small IPOs. However, buy-and-hold returns were generally negative for all IPOs on a market-adjusted basis throughout the sample period, again with small IPOs performing worse than non-small IPOs. Overall, these results are consistent with Ritter (2011) who reports market-adjusted three-year buy-and-hold returns of 5.0% for IPOs from 1980-2008 with inflation-adjusted annual sales of less than $50 million, as compared to an average 3-year buy-and-hold return of 38.8% for IPOs with larger sales.

In theory, these poor long-term returns for small IPOs might account for the diminished interest in IPOs since the late 1990s. However, the theory is complicated by the fact that long-term returns for small IPOs occasionally exceeded those of larger IPOs, nor were their returns uniformly negative after 1998. More importantly, using proprietary microdata from Abel/Noser, Chemmanur, Hu &Huang (2010) report that most institutional investors are not buy-and-hold investors, suggesting the importance of short term returns. Accordingly, Panel B also reports cumulative, market-adjusted returns for the seven and sixty trading days following the IPO for an investor receiving an initial allocation in an IPO. Similar to long-run returns, these short-term returns are better for larger IPOs than for small IPOs; however, in both cases the returns are predominately positive. Moreover, average short-term returns for both small IPOs and larger IPOs were generally higher in the period after 1998.

Table II provides descriptive statistics showing how our sample of mutual funds grew in size during the late 1990s and early 2000s, again using inflation-adjusted 2014 dollars. In general, the table highlights how the sample reflected the significant growth of the mutual fund industry during our sample period. As shown in Columns 1 and 2, both the overall number and average size of funds increased from 1990 to 2000, with the number of active funds increasing more than seven-fold and the average size of funds nearly doubling. The number of funds and the size of funds show a more modest increase between 2000 and 2010; however, this partly reflects the effects of the financial crisis which caused mutual fund inflows and mutual fund assets to contract sharply.

Figure 2 breaks mutual funds into annual size quartiles and plots each quartile mean over the course of the sample period. As the figure shows, mutual funds—particularly those within the largest size quartile—continued to increase in size after 2000 before declining in 2008 and 2009, after which they resumed growing. As highlighted in Table II and Figure 2, an important consequence of the growth of mutual fund assets during the sample period has been to increase significantly the positive skew in the distribution of fund sizes. This was particularly true in the first decade of the sample period where the growing number of small funds caused the median to decrease from $47 million to $31 million. Evidence of increased positive skew also appears in the breakdown of funds by size quartile, which highlights how the industry's growth during this time period was reflected in both an increasing number of smaller funds as well as an expanding number of extremely large funds. For instance, while the mean and median size of funds within the 25th percentile declined by approximately one-half between 1990 and 2000, the mean size of funds in the 75th percentile jumped from $866 to more than $1,800 million while the median increased more modestly from $405 million to $475. For similar reasons, the percentage of

mutual fund assets within the largest quartile of funds increased from 87% to 95%, underscoring the increasing concentration of mutual fund assets among the largest funds.

In light of the growth of funds' AUM, Columns 5 through 8 present the number and size of funds' reported investment positions to examine how funds' growing AUM might raise heightened concerns about the liquidity of their equity investments. As noted by Pollet & Wilson (2008), if an increase in a funds' AUM results in larger individual positions, portfolio managers will incur a greater risk of price impact in trading them if the security is thinly traded or otherwise illiquid. Consistent with these concerns, Columns 5 and 6 indicate larger funds had more investment positions than smaller funds within a given year, and funds generally increased their overall number of investment positions with the increase in average fund size after 1990. Moreover, the slight decline in the median value of funds' equity positions across all size categories from 1990 to 2000 suggests that most funds managed to grow in size without increasing the size of their average equity investments. However, the doubling of the mean position value for funds in the fourth quartile from 1990 to 2000 and again from 2000 to 2010 indicates that this controlled growth did not apply to the largest funds in the sample.[11] Overall, these findings are consistent with the finding in Pollet & Wilson (2008) that large funds diversify more slowly than smaller funds in response to growth.

The final two columns of Table II examine the extent to which mutual funds in our sample invested in IPOs over time. Column 9 indicates that, except for the smallest quartile of funds, mutual funds were more likely to participate in an IPO in 2000 than in 1990, as one might expect given that 2000 represented the height of the dot-com IPO wave. However, consistent with the drop in IPO activity after 2000 shown in Panel A of Table I, participation in IPOs dropped

[11] For instance, in unreported results, the median position value for the largest tenth decile of funds increased from $13.7 million to $19.6 million between 1990 and 2000, and from $19.6 million to $27.3 million between 2000 and 2010.

considerably for all investors by 2010. Participation rates in small IPOs, in contrast, declined in both 2000 and 2010.

We next assess the liquidity characteristics for IPOs during the sample period. As noted previously, small firms pose inherent liquidity challenges for investors seeking to make large dollar-sized investments in their securities given the enhanced likelihood these investments will move the market, particularly for firms that are thinly-traded. At the same time, while small IPOs might on average be more illiquid than large IPOs, not every small IPO is necessarily illiquid. If the events of 1998 induced investors to prefer more liquid IPO securities, we should accordingly observe a decrease in IPO illiquidity immediately after the Panic of 1998 as issuers and their advisors responded to changing investor tastes. In particular, declining demand for illiquid IPOs should induce IPO self-selection such that only those issuers likely to have more liquid IPOs commence a public offering.

We assess empirically whether this was the case by turning to the widely-used measure of illiquidity developed in Amihud (2002), which estimates the expected price impact incurred in trading a given security.[12] In general, the measure is calculated as the absolute value of a stock's daily return-to-volume ratio, thereby yielding a daily measure of estimated price impact. Because we are interested in the expected illiquidity of an IPO firm in the months following its IPO, we use this daily measure to construct a six-month forward-looking moving average as of the end of the month of the IPO. Formally, we calculate *Amihud Illiquidity* for stock *i* with IPO in month *m* as:

[12] In general, Amihud's measure of illiquidity is in the spirit of Kyle's (1985) lambda in that it measures the price impact associated with trading a security. In contrast to Kyle's lambda, however, Amihud's measure of illiquidity relies on daily trading data rather an intraday microdata, thereby making it computationally feasible to analyze a large sample of securities over an extended time frame. A number of studies have found that Amihud's measure of illiquidity is closely correlated with intra-day measures of price impact. Hasbrouck (2009), for instance, compares price impact measures estimated from daily data and intraday data and finds that the Amihud (2002) measure is most highly correlated with trade-based measures, having a correlation with Kyle's lambda of 0.82. Likewise, Goyenko, Holden, and Trzcinka (2009) compare various measures of liquidity and conclude that Amihud's measure is comparable to intraday estimates using Kyle's lambda in its ability to capture the price impact of a trade.

$$Amihud\ Illiquidity_{i,m} = \frac{1}{6}\sum_{m=2}^{7}\frac{1}{D_m}\sum_{d=1}^{D_m}\frac{|R_{i,d,m}|}{DVOL_{i,d,m}} \qquad (1)$$

where $R_{i,d,m}$ is the daily return on stock *i* on day *d* for month *m*, $DVOL_{i,d,m}$ is its daily trading volume for the same day, and D_m is the number of days for which data are available for stock *i* in month *m*.[13] As an example, for an IPO closing in June, our measure provides an estimate of the firm's average monthly illiquidity from July through the following December.[14] To facilitate comparison between the illiquidity of IPOs and non-IPO firms, we calculate the measure across all IPOs occurring in any month between 1990 and 2014 as well as for all non-IPO securities with CRSP trading data for that same month.

In Figure 3A we present a basic scatterplot of the mean monthly moving average for small IPOs less the monthly mean for non-small IPOs. As shown in the figure, average monthly illiquidity for small IPOs was virtually always higher than that of non-small IPOs. Overall, the figure confirms that small IPOs issued during any month of the sample were, on average, more illiquid than non-small IPOs issued during that same month.

We next examine whether declining interest in illiquid IPOs induced issuer self-selection. In Figure 3B we present a scatterplot of the mean monthly moving average of illiquidity for IPOs and non-IPOs during the full sample period. With the exception of a brief spike in illiquidity surrounding the 2008 financial crisis, the scatterplot for non-IPO firms highlights how the expected price impact of trading a randomly-selected security has declined steadily since 1990. The scatterplot for IPO firms reveals a similar overall trend; however, a sharp, seemingly discontinuous drop in illiquidity occurs in the late 1990s, which persists for the duration of the sample period. The vertical line super-imposed at August 1998 highlights how this sudden drop

[13] Following Gao and Ritter (2010), trading volume of Nasdaq-listed stocks is adjusted to avoid double-counting trades.
[14] We commence our moving average in the month after the IPO due to the fact that IPO firms commence trading on different days within their first trading month.

in the illiquidity of IPO firms coincided with the flight to liquidity triggered by Russia's currency devaluation and debt default. Because CRSP data are limited to securities traded on a U.S. stock exchange, the sharp distinction in the level of illiquidity before and after August 1998 would appear to confirm a fundamental change in the liquidity profile of those companies willing and able to go public on a U.S. exchange at this point in time.

We test formally the hypothesis that the events of August 1998 represented a distinct change in the liquidity profile of IPO firms by conducting an interrupted time series analysis. To account for autocorrelation in the time series, our regression model takes the following form:

$$Y_t = \beta_0 + \beta_1 POST_t + \beta_2 Month_t + \beta_3 POST_t \times Month_t + \epsilon_t \qquad (2)$$

where Y_t is the overall six-month moving average for *Amihud Illiquidity* in a month during the sample period, *POST* is an indicator variable set to 1 for each month following August 1998, *Month* is a month trend, and *POST x Month* is an interaction term. The parameter β_1, our main parameter of interest, estimates the change in the level of Amihud Illiquidity that occurs in the period immediately following August 1998, while β_2 estimates a monthly time trend and β_3 estimates any difference in the slope of the time trend following August 1998. We run the model separately for IPOs and all other securities in CRSP to explore how changes in the illiquidity of IPOs compared to the rest of the market during this time period. Each regression was run using Newey-West standard errors calculated with five lags for IPO securities and with nine lags for all trading securities determined using Cumby-Huizinga tests for autocorrelation.

Panel A of Table III presents the results. The first column provides estimates for IPOs and confirms that IPOs completed after August 1998 were significantly less illiquid than those completed in prior months. In particular, the negative coefficient on *POST* indicates an estimated drop of approximately1.07 in the measure of Amihud Illiquidity for IPOs immediately after

August 1998. Moreover, the combined effect of *POST*, *Month*, and *POST* x *Month* indicates that the decline in illiquidity for these IPOs during the full period after August 1998 was isolated almost entirely to the sharp drop occurring in the late summer of 1998. In contrast, while all other securities showed a steady decline in illiquidity during the sample period, the positive coefficient on *POST* suggests an increase in illiquidity for the market as a whole at August 1998, although the coefficient is insignificant. In combination with the drop in small IPOs around this time period, these findings further confirm that the flight to liquidity in the Panic of 1998 was associated with a structural shock in the market for IPOs in which less liquid IPOs quickly receded from conducting equity offerings on U.S. exchanges.

Because the data used in Panel A covers only exchange-listed securities, Panel B of Table III supplements this analysis by summarizing the listing venues for all IPO firms in our listing of IPOs from SDC before limiting to those listed on a U.S. exchange. This expanded sample includes 6,110 IPOs during the sample period. To the extent Panel A reveals a shift in demand away from illiquid IPOs, evidence of this shift should also appear in the extent to which firms chose to list on exchanges compared to the historically less liquid pink sheets or over-the-counter (OTC) markets. Specifically, a fall-off in demand for illiquid IPOs after 1998 should appear in a decline in the percent of IPOs conducted on the pink sheets/OTC market relative to a conventional stock exchange.

Accordingly, Columns 3 through 7 of Panel B shows the percent of small IPOs listed on the three primary stock exchanges (the Nasdaq, the NYSE, and the American Stock Exchange), as well as on the OTC market or the Pink Sheets during the sample period.[15] Columns 10 through

[15] Throughout the 1990s, Nasdaq operated as an inter-dealer quotation system managed by what was then the National Association of Securities Dealers (NASD). It was eventually re-organized in 2000 as a publicly-listed company and began operating as a registered stock exchange in 2006. During the sample period, the NASD (which today operates as the Financial Industry Regulatory Authority, Inc., or FINRA) also operated the OTC Bulletin Board or OTCBB as an inter-dealer quotation system that permits the quotation of an issuer's equity securities so long as the issuer is compliant with specific requirements. In

14 presents the same information for all other IPOs. As one would expect, small IPOs have always been more likely to trade in the over-the-counter markets than larger IPOs given exchanges' listing requirements imposing minimum revenue and market capitalization levels. Consistent with diminished investor appetite for all but the most liquid small IPOs after 1998, the percent of small IPOs conducted on non-exchange venues decreases from 39.6% from 1990 through 1998 to 21.9% from 1999 through 2009. Non-exchange IPOs similarly decline from 4.1% to 1.7% during these same periods for all other IPOs. However, while this flight away from non-exchange IPOs continues for larger IPOs after the 2008 financial crisis, the trend is the opposite for small IPOs: During the post-2008 financial crisis IPO recovery, nearly 70% of all small IPOs were traded on non-exchange venues. Given that many institutional investors and mutual funds are restricted from investing in non-exchange listed securities, this transition to the OTC markets for small IPOs would appear to reflect an awareness among smaller issuers that institutional appetite for small IPOs is likely to be diminished even in a strong IPO market.

Finally, because the decision to conduct an IPO is undertaken jointly with an underwriter, Panel C of Table III presents summary statistics on IPO underwriters during the sample period for our restricted sample of IPOs that listed on an exchange. Column 1 summarizes the aggregate number of underwriters that participated in a small IPO each year from 1990 to 2014, while Column 2 provides the total number of underwriters that participated in all other IPOs. In keeping with the sharp drop in small IPOs shown in Table I, the overall number of underwriters working on small IPOs showed a similarly sharp decline from a mean of 86 during the period 1990 to 1998, to 9 from 1999 through 2009, falling to just 6 in the period following the 2008

addition to this interdealer quotation service, a second "over-the-counter" market was facilitated through the Pink Sheets (now OTC Markets, Inc.), which operated an interdealer quotation service for equity securities that were not listed on OTCBB, Nasdaq, or a national stock exchange. We classify an IPO as traded on OTC/Pink Sheets if its primary trading venue after the offering is OTCBB or the Pink Sheets/OTC Markets.

financial crisis. In contrast, column 2 shows a more modest decline for all other IPOs between the first two periods, and a negligible increase during the post-2008 financial crisis IPO recovery.

More notable than these overall numbers, however, is the distinction that emerged in the late 1990s between banks that underwrote small IPOs and those that did not. Columns 3 and 4 summarize both the number and percentage of investment banks that underwrote at least one small IPO and one non-small IPO in a given year. While the percentage of banks that did both types of transactions hovered above 45% in the early 1990s, the percentage drops sharply by the end of the 1990s where it remains for the duration of the sample period.

To the extent this pooling of banks meant small IPOs were left to smaller, less experienced banks, this trend could theoretically have adverse effects on small IPO illiquidity. At the same time, however, if banks seek to underwrite those deals where there is likely to be significant investor interest, the drop in small IPO underwriting among more experienced banks could itself reflect declining interest for small offerings among mutual funds due to growing awareness of the liquidity risks of investing in these transactions. Overall, these data are thus consistent with declining interest in illiquid IPOs undermining the incentive to provide small IPO underwriting, potentially contributing to the decision of smaller, illiquid issuers to abstain from the IPO market after 1998. The shift of investment banks towards focusing on larger transactions also highlights how a drop in interest for small IPOs might itself facilitate small IPO illiquidity. We return again to the possibility for such an illiquidity-begets-illiquidity phenomenon in Section V.

IV. Empirical Tests and Results

A. Mutual Fund Size and Small IPO Investing

Our initial test of our demand hypothesis focuses on the relation between mutual fund size and IPO investment activity surrounding the Panic of 1998. As noted previously, our central

hypothesis builds on the finding of Pollet & Wilson (2008) that the sudden growth of funds' AUM during the early 1990s induced the largest funds to seek larger investment positions across their portfolios. We conjecture that these larger positions exposed fund managers to enhanced liquidity risk, which was magnified by the Panic of 1998. In this context, the liquidity risk of investing in small IPOs should have been particularly salient for managers of the largest funds, resulting in a sharp drop in these funds' demand for small IPOs. At the same time, continued growth of fund size among the largest fund's should have induced fund managers to demand greater returns from small IPOs, further limiting the number of small IPOs that would be attractive to a large fund.

As a preliminary matter, support for this "diminished demand" hypothesis would appear to follow from the summary investment statistics presented in Table III. As shown in Column 10 of Table III, the largest quartile of mutual funds decreased their participation rate in small IPOs from 12.1% to 5.0% between 1990 and 2000, notwithstanding the fact that their participation rate for all IPOs rose 32.3% to 56.4% during the same period. In light of the significant growth in AUM among the largest funds in this quartile, this evidence is consistent with an enhanced concerns about both the liquidity risk a growing fund faces when investing in small issuers and their small return contribution to a large fund's overall portfolio return. However, the fact that the three other fund quartiles saw a decline in small IPO participation rates despite a decline in mean and median fund sizes highlights the possibility for alternative interpretations. Among other things, the growth in the number of funds from 1990 to 2000 could account for the overall decline in small IPO participation rates while efforts to participate in large, over-subscribed dot-com offerings might account for the increase in the overall IPO participation rate.

In light of this identification challenge, we leverage the panel structure of our data to isolate better the effect of fund size on IPO participation rates. Specifically, the fact that funds in our sample report positions multiple times per year permits the use investor- and time-fixed effects. These fixed effects allow us to examine the relation between a fund's growth in AUM and its investment in IPOs while controlling for investor-specific preferences for particular types of investments as well as for yearly changes in IPO investing that are unrelated to changes in fund size.

To permit comparison of fund investments in small IPOs and all other IPOs, we estimate two specifications of the following regression equation:

$$Y_{it} = \alpha_0 + \alpha_i + \beta POST_t \times SIZE_i + \delta_t + \varepsilon_{ist} \qquad (3)$$

where the subscript *i* indexes a mutual fund, and *t* indexes a year during the sample period. In the first specification, the dependent variable of interest, Y_{it}, represents the annual number of IPO investments by fund *i* during year *t*, while in the second specification, Y_{it} represents the annual number of investments by fund *i* in small IPOs. In each case, the intercept has two primary components: α_0, which is common to all investors, and α_i, which is specific to each mutual fund. The primary independent variables of interest are *POST*, a dummy variable coded as 1 for each year following 1998 and zero otherwise, and its interaction with *SIZE,* which represents the size quartile of fund *i* in year *t.* The interaction term, β, accordingly estimates the difference after 1998 in the average annual purchases in IPOs that a fund in the second, third, or fourth size quartile makes relative to average annual purchases made by a fund in the first size quartile. Yearly fixed effects, δ_t, are included to control for the number of IPO issues each year, the number of funds each year, as well as unobserved time fixed effects. Overall, comparing the two

specifications of this model allows us to evaluate how mutual funds of varying sizes invested in small IPOs relative to all IPOs in the years surrounding 1998.

Table IV presents the results. In Column 1, we provide the results for the specification modeling investments in all IPOs in our sample. As indicated in the table, the increasing size of the coefficient on each size quartile indicates that larger funds on average invested in more IPOs than smaller funds through 1998, as one might expect given the larger capital they have available to deploy. The positive, strongly significant coefficient of 2.182 on *POST* indicates that the smallest quartile of funds (the omitted category) increased their annual IPO investments after 1998, while the negative coefficients on each interaction of *POST* x *SIZE* indicates that this post-1998 increase in annual IPO investments was smaller for larger funds. However, even after 1998, the combined effect of *SIZE*, *POST* and *POST x SIZE* indicates that larger funds continued to invest in more IPOs than smaller funds.[16]

In contrast, the results of the second specification presented in Column 2 reveal a different pattern with regard to investments in small IPOs. As with the first specification, average annual small IPO investments increased with each size quartile through 1998. However, in contrast to model (1), the coefficient on POST becomes negative and loses its significance, indicating that the smallest quartile of funds showed no statistical evidence of any change in their annual purchases of small IPOs after 1998, holding constant investor- and year-fixed effects. Moreover, while the other three size categories reveal a decrease in small IPO investments after 1998, the increasing magnitude of the negative coefficient on the POST interaction term across all size quartiles indicates that the move away from small IPOs after 1998 was strongest among the

[16] Given the decline in IPOs after 1998, it may seem surprising that annual IPO investments increased after 1998 for all size categories. This result is due to the inclusion of year fixed-effects, which control for the number of annual IPOs. In unreported regressions where we omit year fixed-effects, annual IPO investments across all four size categories decline following 1998. However, even in this alternative regression framework, each size quartile keeps its ordinal ranking before and after 1998 (i.e., larger funds invest in more IPOs than smaller funds both before and after 1998).

largest funds. Indeed, while the size of the positive coefficient on each uninteracted size quartile indicates larger funds invested in more small IPOs through 1998 than smaller funds, this ordering reverses in the period after 1998. For instance, compared to their purchases of small IPOs through 1998, the model indicates that the second, third, and fourth size quartiles reduced their average annual investments in small IPOs after 1998 by approximately 62%, 83% and 96%, respectively. Overall, these estimates suggest nearly a complete collapse in investment in small IPOs among the largest group of funds—a class of funds that controlled over 90% of mutual fund assets by 2000.

To examine how the decline in large fund investment in small IPOs related to the greater illiquidity of small IPOs, we run two additional analyses focusing on changes in the illiquidity profile of funds' IPO portfolios. Both use an IPO's six-month moving average of Amihud Illiquidity as a proxy for the liquidity risk posed by investing in an offering. In the first analysis, we classify an IPO as *Illiquid* if this measure of Amihud Illiquidity ranks within the highest quartile of Amihud Illiquidity among all IPOs in a year. We then run a regression using equation (3) in which Y_{it} represents a fund's annual number of investments in illiquid IPOs. We present the results in Column 1 in Panel B of Table IV. As one would expect, given that the largest quartile of funds had significantly more capital to deploy than smaller funds, larger funds on average invested in more illiquid IPOs than smaller funds in both the pre- and post-98 periods.

However, Table IV also highlights how the sensitivity of funds to the liquidity risk of IPOs changed following 1998. First, the significant, positive coefficient of 0.171 on POST indicates that, conditional on investing in an IPO, investors after 1998 were generally more likely to invest in an illiquid IPO than before 1998. While this finding might at first blush indicate an enhanced willingness to invest in illiquid IPOs, it is important to keep in mind the sharp decline after 1998

in the average illiquidity of IPOs shown in Figure 3B. As such, IPOs that fell within the classification of an illiquid IPO after 1998 were accordingly less illiquid than IPOs that fell within this classification before then. The fact that funds were more likely to invest in an IPO ranking within the most illiquid quartile after 1998 is therefore consistent with funds' enhanced sensitivity to an offerings' illiquidity during this time period.

Moreover, the coefficients on the interaction of POST with each size category is consistent with this sensitivity to IPO illiquidity growing with fund size. Although funds' average investments in illiquid IPOs continued to scale with fund size, the increasing size of the negative coefficient on the interaction term for each size category highlights how this scaling effect diminished after 1998. For instance, whereas prior to 1998 the largest quartile of funds purchased nearly 3 times the number of illiquid IPOs as funds in the second size quartile, this ratio declined to just 1.09 in the period after 1998. In other words, average annual investments in illiquid IPOs after 1998 failed to keep pace with the growing difference in AUM between funds in the largest quartile and the second quartile, even though illiquid IPOs were more liquid after 1998 in absolute terms.

Finally, larger funds' enhanced concern with the liquidity of IPOs after 1998 is also supported by Column 2 of Panel B. There, we present the results of a regression using equation (3) in which Y_{it} represents the median annual Illiquidity Quartile of a fund's IPO investments, conditional on a fund investing in an IPO in a year. As in the prior regression, we use an IPO's six-month measure of Amihud Illiquidity to classify IPOs by illiquidity quartile for each year such that the most illiquid IPOs are in the fourth quartile. Notably, the coefficients on the uninteracted size categories indicate that prior to 1998 no statistically significant differences existed between the median illiquidity quartile of IPOs acquired by funds within different size

categories. Moreover, the insignificant negative coefficient on POST indicates no statistical difference in median IPO illiquidity among funds in the smallest quartile. However, the interaction of POST with the indicator variables for the second, third, and fourth quartiles is both negative and statistically significant at conventional levels, indicating a drop in median IPO illiquidity for these larger funds. Notably, the magnitude of these negative coefficients is also increasing in fund size, as would be expected if larger funds were more sensitive to the liquidity risks of IPO securities.

B. Estimating Mutual Fund Investment Levels in Individual IPOs

We also examine how mutual fund size affects fund investing in small IPOs by looking separately at the level of fund investments in individual IPOs between 1990 and 2014. While the foregoing results indicate the retreat from small IPOs was especially strong among the largest mutual funds, they say little about how individual issuers and underwriters might have perceived the small IPO market. For instance, even if individual funds lowered their annual purchases of small IPOs, IPO issuers and their advisers might nonetheless view the small IPO market as robust if this decline was offset by a larger number of funds making small IPO investments. Such a finding would also point towards the importance of a "supply-side" explanation for the persistent decline in small IPOs since 1998. In the face of strong investment interest in small IPOs, only diminished interest among issuers in seeking a public listing could account for the absence of small IPOs.

The possibility that the growth in the number of mutual funds might offset the diminished interest in small IPOs among individual funds is given some support by Figure 4A, which provides a simple scatter plot of the annual number of small IPOs relative to the number of funds reporting each year in the sample. Consistent with Table I, the superimposed line at 1998

highlights the significant drop in small IPOs surrounding the Panic of 1998. However, as shown by the scatterplot of active funds, this decline occurred during a secular increase in the overall number of mutual funds in the market. To the extent a meaningful portion of these funds sought small IPO investments after 1998, the combination of these factors may have meant more investors were chasing any individual small IPO.

To examine this possibility in more detail, we calculate the mean number of mutual fund investors in each IPO in the sample, focusing in particular on the number of fund investors within the largest fund size quartile. To present the overall trend, we first plot in Figure 4B the mean number of fourth quartile investors per year for small IPOs relative to all other IPOs. Figure 4C presents a similar scatter plot for illiquid IPOs and liquid IPOs.[17] Each figure highlights that the significant decline in IPOs after 1998 did in fact result in an increase in the average number of large fund investors per IPO; however, the effect was limited to larger IPOs and those IPOs that had the lowest measure of six-month Amihud Illiquidity. Small and illiquid IPOs, in contrast, experienced no notable increase in the mean number of large investors.

In Table V, we analyze the number of large investors in small and illiquid IPOs surrounding 1998 using a multivariate framework. We first estimate the number of large fund investors in a small IPO relative to all other IPOs using the following equation:

$$Y_i = \alpha_i + \beta_1 POST_t \times Small_i + \beta_2 60DayReturns_i + \beta_3 SmallerInvestors_i + \beta_4 Industry_i + \beta_5 IPOs_t + \beta_6 Funds_t + \delta_t + \varepsilon_i \qquad (4)$$

where Y_i represents the number of mutual fund investors from the fourth size quartile in *IPO i* , *POST* is a dummy variable coded as 1 for each year following 1998, and *Small* is a dummy variable coded as 1 for an IPO meeting our definition of a small IPO. The interaction of *POST*

[17] As in our prior analyses, we classify an IPO as *Illiquid* if its measure of Amihud Illiquidy ranks within the highest quartile of Amihud Illiquidity among all IPOs in a year. We classify an IPO as *Liquid* if this measure ranks within the lowest quartile of Amihud Illiquidity among all IPOs in a year.

and *Small* accordingly represents the marginal difference in the estimated number of investors in the fourth size quartile in small IPOs vs. all other IPOs after 1998. In this initial specification, we are interested in estimating the number of large fund investors in an IPO regardless of its return expectations; therefore we also add a control for the 60-day, market-adjusted returns for an investor in each IPO (*60DayReturns*). To account for industry-related factors that could influence the number of investors in an IPO, we also include controls for the total number of mutual funds investing in the IPO that rank in size quartiles 1-3 (*SmallerInvestors*), and industry fixed-effects (*Industry)* using one-digit SIC codes. Finally, to account for the overall state of the IPO market, the number of active mutual funds, and other unobserved time fixed effects, we include controls for the number of IPOs occurring for the year (*IPOs*), the number of funds reporting in the sample for the year (*Funds*), and yearly fixed effects (δ_t).

We use this same regression framework to estimate the number of investors in liquid and illiquid IPOs surrounding 1998, substituting for *Small*, the variable *IlliquidityRank*. This latter variable represents the Illiquidity quartile for IPO *i* based on its six-month Amihud Illiquidity measure relative to the illiquidity of all securities trading in the month of the IPO. We assign the first, most liquid quartile to be the omitted category in our regression specification. Therefore, the interaction of *POST* and *IlliquidityRank* represents the marginal difference in the estimated number of investors in the fourth size quartile between an IPO in the second, third, or fourth illiquidity quartile relative to one in the first quartile.

Panel A of Table V presents the results. Column 1 provides the estimates for our initial specification analyzing the number of large investors for small and non-small IPOs. As one might expect, estimates for our controls indicate that IPOs with strong short-term returns and IPOs with a greater number of mutual fund investors ranked in size categories 1-3 were

associated with more fourth quartile fund investors. IPOs occurring in years with more active mutual funds were also associated with having more of these investors, as were IPOs occurring in years with more IPOs. Notably, even after controlling for these factors, the negative, strongly significant coefficient on *Small* highlights how small IPOs had on average fewer large fund investors, while the interaction of *POST x Small* highlights how this difference widened dramatically after 1998. Overall, these findings are consistent with Figure 4B's depiction of large fund investors moving decisively to larger IPOs after 1998, to the extent they invested in IPOs at all.

Column 2 presents our estimates based on an IPO's illiquidity, which similarly confirm the simple scatterplot shown in Figure 4C. The negative, strongly significant coefficients on each of the three illiquidity quartiles highlight how the estimated number of large mutual fund investors diminished in step-like fashion for IPOs assigned to less liquid quartiles. Moreover, as with Column 1, the difference between the estimated number of large fund investors in the most liquid quartile of IPOs widens dramatically after 1998 for IPOs in any of the three highest illiquidity quartiles. As with the shift toward larger IPOs, these results are consistent with a significant shift among large fund investors to the most liquid segment of the IPO market, even after controlling for other business and time-specific factors likely to affect the number of large fund investors in a transaction.

C. Illiquidity vs. Size

While Panel A of Table V indicates that large investors have moved away from small IPOs and illiquid IPOs after 1998, a remaining question is the extent to which these findings are due to investors' illiquidity considerations as opposed concerns about a small IPO's diminished ability to affect a large fund's returns. Recall that small IPOs pose two different, but related challenges

for institutional investors with large amounts of AUM. First, as shown in Pollet & Wilson (2008), institutional investors diversify more slowly as they grow in AUM, meaning that any individual position is likely to be economically large, heightening illiquidity risks when investing in small capitalization companies. The sudden drop in small IPO investments after the Panic of 1998 among large mutual funds is consistent with theses concerns influencing investor interest in small IPOs after the late 1990s. However, as noted previously, even highly liquid small IPOs can pose challenges for large investors due to their small size relative to the investor's total portfolio. For instance, Section 5(b)(1) of the 1940 Act will require diversified funds to limit the size of their positions to 10% of the voting securities of a single company, ensuring the investment will constitute just a small percentage of a large investor's total AUM. Accordingly, large funds can be expected to pass on all but the most promising small IPOs, causing portfolio managers to focus on larger IPOs to the extent they look to IPOs at all. Indeed, it is precisely these latter considerations that appear to inform the common practice among small and mid-cap mutual funds to close themselves to new investors upon reaching a certain amount of AUM.[18]

While these concerns are not mutually exclusive, we explore the relative importance of these illiquidity- and return-based explanations by running a series of "horse-race" regressions on our sub-sample of small IPOs. In particular, because we have liquidity and return data for each small IPO, we run a sequence of regressions examining the extent to which each measure is predictive of the level of large investor interest in a small IPO before and after 1998. In all regressions, we use the same specification from Column 2 of Table V's Panel A except we substitute for *IlliquidityRank* a new variable "*Liquid IPO*" which we define as 1 if a small IPO's measure of

[18] For example, when closing its New Horizons and Small-Cap Stock Funds to new investors—funds that focus on investing in small capitalization companies—T. Rowe Price noted that "we have from time to time closed or restricted investment in funds when, in our judgment, the size or pace of cash flow impairs the portfolio manager's ability to invest effectively on behalf of existing shareholders." T. Rowe Price Closes New Horizons And Small-Cap Stock Funds To New Investors, PR Newswire, Jan. 2, 2014.

six-month Amihud Illiquidity places it below the median measure of six-month Amihud Illiquidity among all securities in the month of the IPO. Otherwise, it takes a value of zero.

We first run a baseline regression using this modified specification on all small IPOs in our sample, focusing on the interaction of *POST x Liquid IPO*. The results, which appear in the first column of Panel B of Table V, are consistent with what one would expect from Panel A of Table V: The level of large investor interest in a small IPO was increasing in IPO liquidity, especially for IPO occurring after 1998.

In Columns 2 and 3 we present the results of our primary horse-race regressions in which we add an interaction of *POST* with a small IPO's 60 days excess returns (*60DayReturns*) and its 3-year excess returns (*3YearReturns*), respectively. Assuming that actual returns are a reasonable proxy for expected returns, these two additional specifications allow us to estimate the extent to which large investors' interest in a small IPO is associated with either high expected short-term returns and higher expected long-term returns. In Column 2, adding the interaction of *POST* x *60DaysReturns* yields a strongly significant positive coefficient of 2.211. Notably, the coefficient for the interaction of *POST x Liquid* declines from 2.548 in Column 1 to 0.254 in Column 2 and is insignificant. In contrast, the results in Column 3 indicate the level of large investor interest in small IPOs has a modestly significant, positive relationship with long-run returns; however, the effect shows no difference before and after 1998. In contrast, the results for *POST x Liquid* remain roughly the same as in our baseline model.

Overall, these results suggest that while liquidity concerns affect the level of large investor interest in a small IPO, return expectations are likely to be even more important in explaining why some small IPOs still attract large investor interest after 1998. To provide a concrete example, we note that among small IPOs closing in 2014, the IPO of Celladon Corp had the

second-highest number of large investors (N=32) despite the fact that its measure of six-month Amihud illiquidity placed it in the most illiquid quartile of securities in the market. It's excess returns for in its first 60 trading days, however, were 40.2%.

While these results suggest the increasing importance of short-term returns rather than liquidity for attracting large investors to small IPOs, we caution that we cannot rule out the possibility that especially liquid small IPOs might attract more large investors even absent such returns. After 1998 only two small IPOs in our sample of IPOs are classified as among the most liquid securities in the market in the year of their offerings. As a result, small IPOs in our sample are almost by definition relatively illiquid, perhaps reflecting an increasing conflation of small IPOs and illiquid transactions among large investors. To the extent this is the case, such a development would be consistent with large investors demanding greater compensation in small IPOs after 1998 due to both liquidity and return considerations.

V. IPO Illiquidity Since 1998

In this section, we explore why the Panic of 1998 appears in our time series to have had such long-lasting effects on large fund investment levels in small IPOs. Even if the events of that year highlighted the liquidity risk small IPOs pose for large mutual funds, theory would suggest such a negative shock to mutual fund interest in small IPOs would eventually result in more aggressive pricing of small IPOs as opposed to the sustained decline in large fund investing in these transactions. In particular, aggressive pricing of small IPOs would presumably enhance expected returns for any given offering, offsetting some of the liquidity concerns of investing in these transactions. These pricing dynamics might also compensate large investors for some of the concerns about small IPOs' return contributions discussed in the prior section.

Notwithstanding this possibility, the sharp decline in small IPOs in the late 1990s may have impaired any revived interest in these offerings among large fund investors for at least two reasons. First, the continuing growth in AUM among the largest funds after 2000 may have made concerns about small IPOs' return contributions increasingly important for larger funds. For instance, even a fund willing to purchase 10% of an offering would be limited to an investment of approximately $5 million in a $50 million IPO. Considering that in 2014 the median fund in the fourth size quartile had $1 billion of AUM, such an investment would have to triple in value to produce even a 1% gross return on a median fund's portfolio. Of course, a large fund portfolio manger could in theory seek to construct a broad portfolio of these investment stakes; however, such a strategy would depend on the existence of a robust supply of promising small IPOs. As large funds demanded ever greater returns of small IPOs, there may have been fewer issuers capable of delivering these returns.

A second, related challenge impairing a recovery of the demand for small IPOs among the largest fund investors is the underlying relation between IPO illiquidity and investor interest in IPOs. Fundamentally, a central dilemma facing the small IPO market since 1998 has been that interest in small IPOs among the largest funds has been increasingly linked to concerns about their illiquidity, while their illiquidity is itself a function of investor interest. Accordingly, as the largest quartile of funds pulled away from the small IPO market, we would expect that small IPOs would become increasingly illiquid after 1998, further deterring large fund investors concerned about small IPO illiquidity. At the same time, an important paper by Ben-Rephael, Kadan, and Wohl (2015) document the disappearance of the return premium for illiquidity over

the past twenty years, undermining the profitability of liquidity-based strategies by other investors that might offset this effect.[19]

We theorize that these factors combined to create after 1998 a vicious spiral in which illiquidity-begets-illiquidity as small IPOs became increasingly unappealing to large fund investors. Moreover, as shown in Figure 3B, this illiquidity spiral would occur at the very time that the overall equities market was experiencing a secular decline in illiquidity, thus enhancing the illiquidity of any given small IPO relative to other investment opportunities in the market.

To examine more closely this possibility, Figure 5A presents a scatterplot of the natural log of the median measure of six-month illiquidity for small IPOs issued during each month of the sample relative to the market as a whole.[20] In particular, this median measure is juxtaposed with the natural log of the 25th, 50th, and 75th percentile of the same monthly measure for all other securities in CRSP. By presenting the illiquidity of a median small IPO for each month next to the illiquidity of a security sitting at 25th, 50th and 75th percentile of the monthly distribution of illiquidity for all non-IPOs, the figure permits visualization of where the majority of small IPOs fell in the market's overall illiquidity distribution during the sample period.

Consistent with Figure 3B, Figure 5A shows that the monthly measure for the 25th, 50th, and 75th percentile of six-month Amihud illiquidity for all non-IPO securities fell steadily during the

[19] These authors find that while the liquidity premium was large and robust until the mid-1980s in accordance with Amihud and Mendelson (1986), it has declined over time such that it has not been significantly different from zero since 2000. They similarly show that the alpha of a long-short liquidity-based trading strategy is not significantly different from zero after 2000. They conjecture that part of the explanation for this declining sensitivity of expected returns to liquidity may relate to the introduction of financial instruments such as index funds and ETFs. Because these instruments enable investors to indirectly hold illiquid stocks for low transaction costs, investors can gain exposure to small, illiquid stocks without bearing the costs of their illiquidity. As such, an investor will be unable to demand compensation for bearing the cost of an illiquid stock that can (effectively) be acquired through a liquid index or ETF. Moreover, because ETFs and index funds are themselves passive, long-term holders, their illiquidity-related transaction costs are also low over the long term. An alternative explanation for why an increase in illiquidity might reduce demand for a stock without decreasing its price (and thereby producing arbitrage possibilities for smaller funds) can be found in the theoretical model of Vayanos (1998). While most papers examining the effects of liquidity assume trading frequencies are exogenously determined, Vayanos (1998) emphasizes the effect of an asset's liquidity when trade frequency is endogenously determined. If greater illiquidity induces investors to hold an asset for a longer period of time, higher illiquidity can induce investors to hold fewer shares *and* to require a smaller risk premium.

[20] We use natural logs to minimize the effect of outliers.

sample period, with the exception of a few notable spikes such as during the 2008 financial crisis. Comparing these three plots with the hollow circles representing the median illiquidity of all small IPOs issued in a month highlights how small IPOs became increasingly illiquid relative to the market as a whole. To facilitate analysis of how this change related to the Panic of 1998, a vertical black line is superimposed at August 1998. Additionally, two local linear regression lines are modeled on either side of it to highlight how illiquidity changed before and after this date. For both regression lines, we use the Epanechnikov kernel and the asymptotically optimal constant bandwidth described in StataCorp (2012).

As shown in the figure, the local linear regression line to the left of August 1998 displays a slight downward trend, consistent with the overall decline in illiquidity within the market prior to 1999. Similar to Figure 3B, the period immediate following August 1998 reveals a sharp drop in small IPO illiquidity as all but the most liquid small IPOs ventured into the public equity markets. Following this initial drop, however, median small IPO illiquidity displays a modest positive trend until the 2008 financial crisis, notwithstanding an overall decline in illiquidity within the market as a whole. As a result, by 2004 the median small IPO had moved from being in the third quartile of market illiquidity to being solidly in the fourth quartile, thereby representing some of the most illiquid exchange-traded securities.

In Figure 5B, we conduct an identical analysis of the relative illiquidity of all other IPOs. As shown in the figure, the median illiquidity of non-small IPOs generally fell within the second quartile of market illiquidity until August 1998, followed by a sharp, discontinuous drop in the ensuing months. While this overall trend resembles that of small IPOs, a notable difference is that, aside from some evidence of mean reversion following the discontinuous drop in 1998, the trend continues downward, generally tracking the overall decline in market illiquidity.

This downward trend in non-small IPO illiquidity suggests these transactions have suffered less of the illiquidity-begets-illiquidity vicious cycle apparent in Figure 5A. Yet even for non-small IPOs, Figure 5B shows that the decline in illiquidity failed to keep pace with the overall decline of illiquidity within the market: By 2005, median illiquidity of non-small IPOs had risen from being solidly in the second quartile of market illiquidity to being largely in the third quartile, highlighting how even non-small IPOs have experienced an increase in illiquidity relative to the market as a whole. To the extent this is the case, even larger IPOs might experience diminished investment interest from mutual funds as their growing AUM continues to pressure managers to avoid illiquid positions, further weakening the liquidity of these larger IPOs.

Finally, in Figure 6A and 6B we present additional evidence of the growing illiquidity of both small IPOs and non-small IPOs by calculating the annual percentage of IPOs that fell into each quartile of market illiquidity as of the date of the offering. For instance, if an IPO's measure of six-month Amihud illiquidity placed it within the lowest quartile in the monthly distribution of illiquidity for all of CRSP, we classified the IPO as being in quartile 1; if an IPO's measure of illiquidity placed it within the highest quartile of illiquidity for all of CRSP, we classified the IPO as being in quartile 4; and so on. We present results separately for small IPOs and all other IPOs in Figures 6A and 6B, respectively.

As with Figures 5A and 5B, these individual IPO classifications further confirm the growing illiquidity of small IPOs, and increasingly, non-small IPOs. Of particular note are the two darkest portions of each annual bar, which represent the percentage of IPOs classified as among the most illiquid half of all CRSP securities at the time of the offering. In Figure 6A, these two bars show a gradual increase through most of the 1990s, but decline sharply in 1998 and 1999. As noted

previously, we attribute this notable decline in IPO illiquidity to issuer self-selection following the Panic of 1998: Given market concerns about liquidity, only those IPOs likely to generate significant after-market trading completed an offering. Following this initial response, however, virtually no small IPOs were classified within the most liquid half of the market for the remainder of the sample period, with the vast majority being classified as among the most illiquid quartile of securities by 2005.

Figure 6B indicates that the late 1990s witnessed fewer changes in the illiquidity of non-small IPOs, with the exception of the brief decline in illiquidity in 1999. Overall, less than 60% of non-small IPOs were classified as among the most illiquid half of CRSP upon their issuance through 2002. After 2002, however, the percentage gradually increases, with a notable increase in the percentage of non-small IPOs being classified as among the most illiquid quarter of securities after 2005. The primary exception is following the financial crisis in 2009 when, as in 1998, the "IPO window" appears to have been limited to only those firms expected to generate considerable trading interest notwithstanding highly volatile market conditions.

While our primary research inquiry has focused on the decline in mutual fund investing in small IPOs and small IPO illiquidity, we view these final findings as potentially alarming for the health of the IPO market more generally. In particular, to the extent funds' growing AUM has prompted concerns about IPO liquidity, the increasing illiquidity of non-small IPOs over time may reflect the fact that funds' ever growing amounts of AUM has meant a larger portion of IPOs have become undesirable liquidity risks for large funds. In short, given the continued growth of fund AUM, our illiquidity-begets-illiquidity hypothesis may have begun to implicate larger transactions.

To be sure, the time series nature of the data leave open other explanations as well for the increasing illiquidity of larger IPOs. Among other things, for instance, the Global Analyst Settlement occurred at roughly the time the illiquidity of non-small IPOs began to tick upward, underscoring the possibility for multiple causal factors. Even so, whatever the underlying reasons for the increase in non-small IPO illiquidity, its very increase nevertheless underscores why IPOs in general might be losing their appeal among large mutual fund investors, representing an important consideration in regulatory efforts to revitalize the IPO market.

VI. Conclusion

1998 was a seminal year in the history of IPOs. It not only marked the ascent of the technology bubble, it also marked the beginning of a notable decline in small IPO investing among the largest mutual fund investors. Using a difference-in-difference approach, we find that following the Panic of 1998, the largest quartile of mutual funds significantly reduced their investments in small IPOs relative to smaller funds. Additionally, conditional on investing in an IPO, the largest funds also demonstrated a decisive shift towards purchasing larger, more liquid IPOs after 1998. Finally, we show that after 1998, large investor interest in small IPOs is increasingly associated with whether an IPO produces high excess short-term returns.

Overall, we view this evidence as consistent with larger funds being more sensitive to IPO liquidity risk due to the rapid increase after 1990 in assets under management among the largest funds. Our findings are also consistent with large investors demanding additional compensation for investing in transactions representing a diminishing fraction of fund assets. Given that these investors account for more than 90% of mutual funds' assets under management, these findings provide important institutional context regarding the evolving demand for small IPOs and potentially, its effect on small IPO issuances.

For instance, while our data do not permit us to identify the extent to which changes in investor demand account for the demise of the small IPO, the fact that large funds increasingly favor larger IPOs points to several predictions about its relation to the small IPO market. Among other things, for example, large investors' preference for larger IPO transactions might bias underwriters and analysts towards pursuing larger IPOs to accommodate these investors' larger investment positions. Likewise, the increasing importance of short-term returns on explaining large investor participation in small IPOs may have important policy implications for current efforts to revitalize the small IPO market. Among other things, to the extent large investor increasingly demand outsized returns as an inducement to participate in a small IPO, current efforts to restore investor interest in small IPOs simply through enhancing small IPO liquidity may have disappointing effects on rekindling interest in small IPOs among large investors. Empirically exploring these questions—and how they complement existing theories for the demise of the small IPO—awaits future research.

References

Ali, Ashiq, Chen, Xuanjuan, Yao, Tong and Yu, Tong, 2008, "Do Mutual Funds Profit from the Accruals Anomaly?", *Journal of Accounting Research* 46, 1-26.

Amihud, Yakov, 2002, "Illiquidity and stock returns: Cross-section and time series effects", *Journal of Financial Markets* 5, 31–56.

Amihud, Yakov and Haim Mendelson, 1986, "Asset pricing and the bid-ask spread," *Journal of Financial Economics* 17, 223–249.

Barras, Laurent, Scaillet, O. and Wermers, Russ, 2010, "False Discoveries in Mutual Fund Performance: Measuring Luck in Estimated Alphas", *Journal of Finance* 65, 179-216.

Ben-Rephael, Azi, 2014, "Flight-to-Liquidity, Market Uncertainty, and the Actions of Mutual Fund Investors", unpublished Indiana University working paper.

Ben-Rephael, Azi, Ohad Kadan, and Avi Wohl, 2015, "The Diminishing Liquidity Premium," Journal of Financial and Quantitative Analysis 50, 197-229.

Busse, Jeffrey, Tarun Chordia, Lei Jiang, and Yuehua Tang, 2014, "How Does Size Affect Mutual Fund Performance? Evidence from Mutual Fund Trades," Working Paper.

Chemmanur, Thomas J., Gang Hu, Jiekun Huang, 2010, "The Role of Institutional Investors in Initial Public Offerings," *Review of Financial Studies* 23, 4496-4540.

Doidge, Craig, G., Andrew Karolyi & René M. Stulz, 2013, "The U.S. left behind? Financial globalization and the rise of IPOs outside the U.S.," *Journal of Financial Economics* 110, 546-573.

Doidge, Craig, G. Andrew Karolyi, and René M. Stulz, May 15 2015, "The U.S. Listing Gap," NBER Working Paper No. w21181, *available at* SSRN: http://ssrn.com/abstract=2607369

Edelen, Roger, Richard Evans, and Gregory Kadlec, 2013, "Shedding Light on "Invisible" Costs: Trading Costs and Mutual Fund Performance," *Financial Analysts Journal* 69, 33-44.

Engen, Eric M. and Andrea Lehnert, 2000, "Mutual Funds and the U.S. Equity Market," Federal Reserve Bulletin, December 2000.

Gao, Xiaohui, Jay R. Ritter, and Zhongyan Zhu, 2013, "Where Have All the IPOs Gone?", *Journal of Financial and Quantitative Analysis* 48, 1663-1692.

Gao Xiaohui, and Jay R. Ritter, 2010. "The marketing of seasoned equity offerings," *Journal of Financial Economics* 97, 33–52.

Goyenko, Ruslan, Craig Holden, and Charles Trzcinka, 2009, "Do Liquidity Measures Measure Liquidity?" *Journal of Financial Economics,* 92, 153-181.

Harris, Larry, 2003, Trading and Exchanges: Market Microstructure for Practitioners, Oxford University Press.

Hasbrouck, Joel, 2009, "Trading costs and returns for U.S. equities: Estimating effective costs from daily data", *Journal of Finance* 64, 1445-1477.

Investment Company Institute, 2015, *Investment Company Factbook*, *available at* https://www.ici.org/pdf/2015_factbook.pdf.

Kacperzczyk, M., Sialm, C. and Zheng, L., 2008, "Unobserved Actions of Mutual Funds," *The Review of Financial Studies* 21, 2379-2416.

Kyle, Albert S., 1985, "Continuous Auctions and Insider Trading", *Econometrica* 53, 1315-1335.

Pollet, Joshua M. & Mungo Wilson, 2008, "How Does Size Affect Mutual Fund Behavior?," *The Journal of Finance* 63, 2941–2969.

Ritter, Jay R., 2011, "Equilibrium in the Initial Public Offerings Market," *Annual Review of Financial Economics* 3, 347-374.

Rzenznik, Aleksandra, 2015, "Mutual Fund Flight-to-Liquidity", working paper (Copenhagen Business School).

StataCorp , 2012, "lpoly," in Stata: Release 12. Statistical Software. StataCorp LP, College Station, TX

Vayanos, Dimitri, 1998, "Transaction costs and asset prices: A dynamic equilibrium model," *Review of Financial Studies* 11, 1–58.

Wermers, Russ, 1999, "Mutual Fund Herding and the Impact on Stock Prices", *Journal of Finance* 54, 581-622.

Wermers, Russ, 2000, "Mutual Fund Performance: an Empirical Decomposition into Stock-Picking Talent, Style, Transactions Costs and Expenses", *Journal of Finance* 55, 1655-1695.

Yan, Xuemin, 2008, "Liquidity, Investment Style, and the Relation Between Fund Size and Fund Performance", *Journal of Financial and Quantitative Analysis* 43, 741-767.

Figures and Tables

Figure 1:
Russell 2000 / Russell 1000 and Market Implied Volatility (VIX), 1990-2014

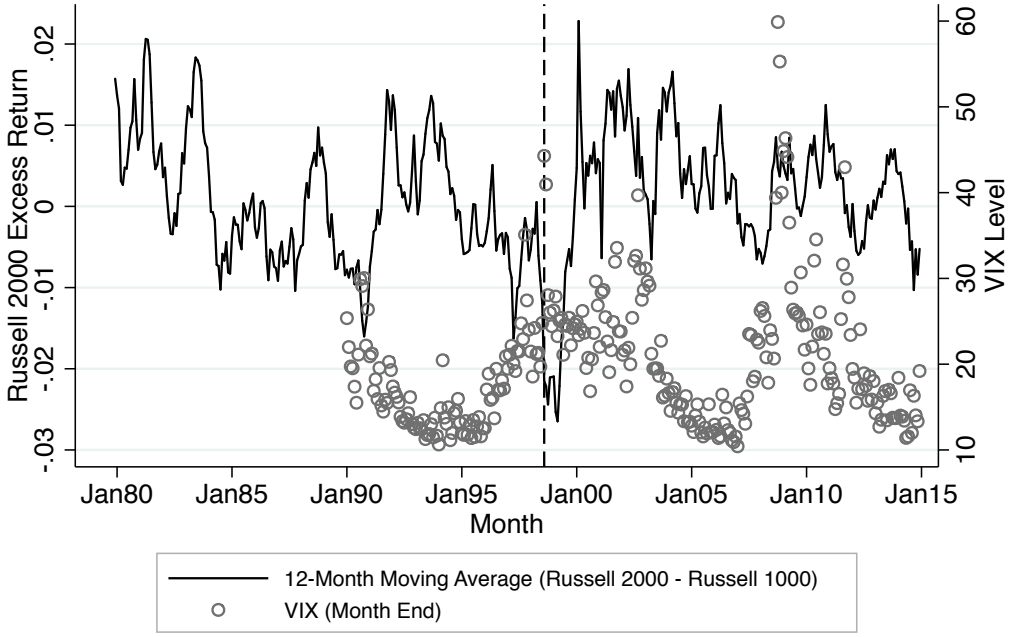

Figure 2:
Mean Size of Mutual Funds by Quartile, 1990-2014

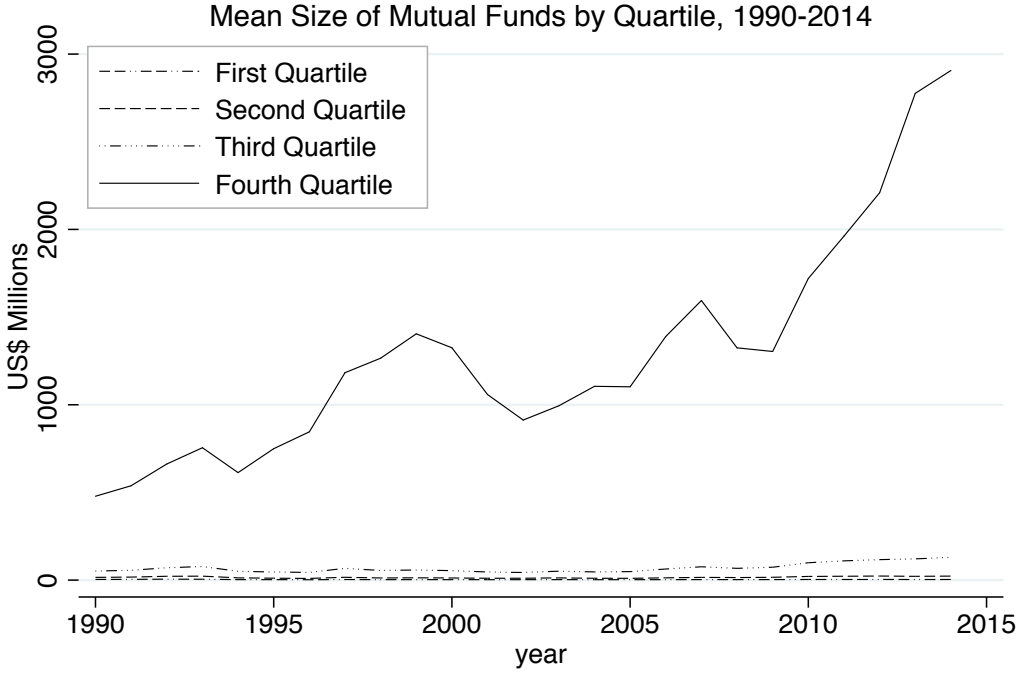

Figure 3A:
Illiquidity of Small IPOs in Month of Issue vs. Non-Small IPOs, 1990-2014

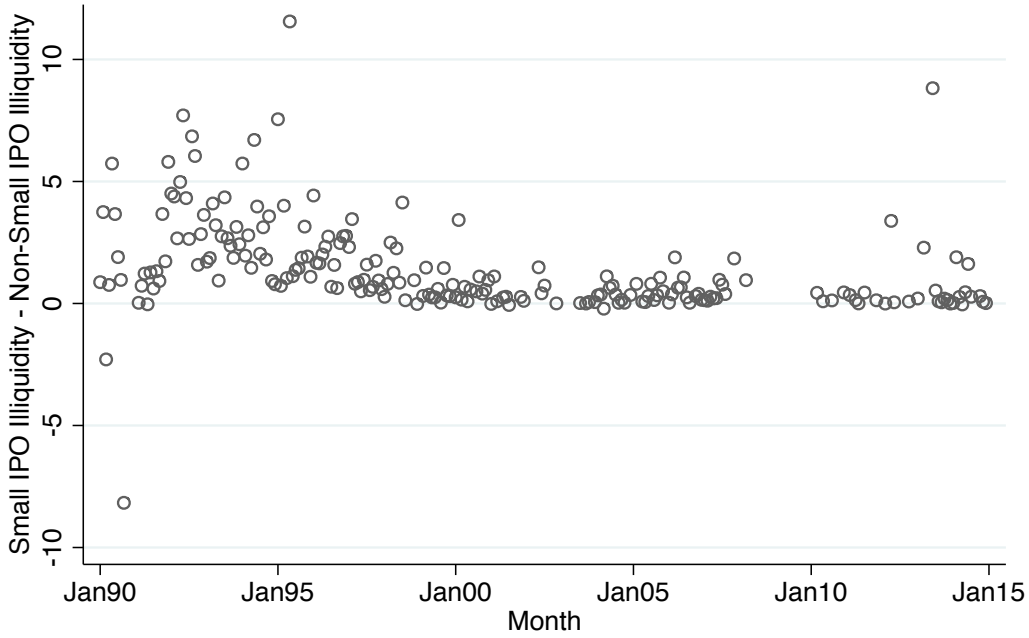

Figure 3B:
Illiquidity of IPOs in Month of Issue vs. Entire Market, 1990-2014

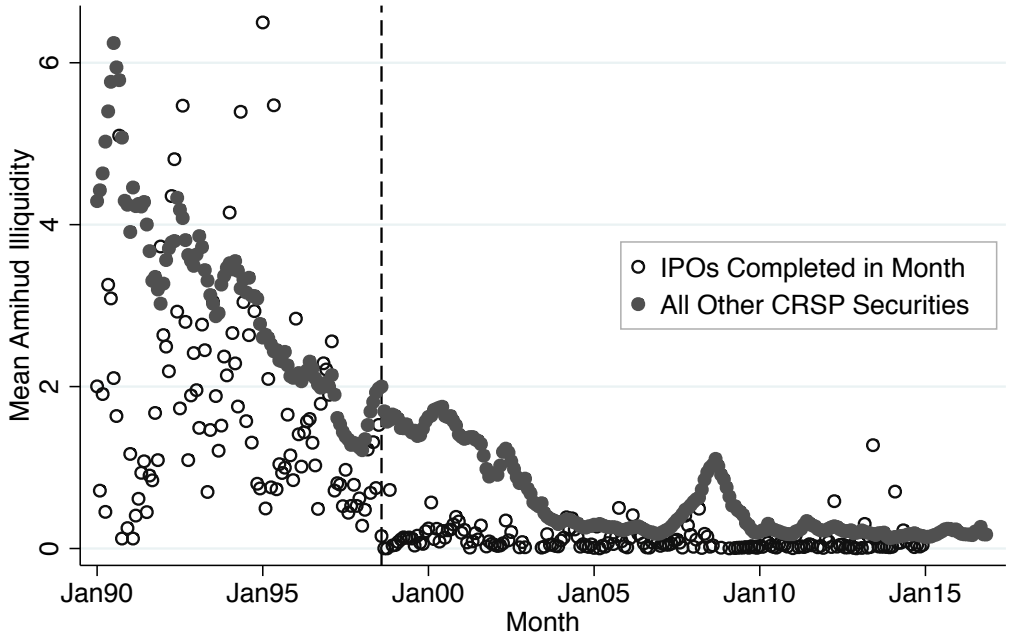

Figure 4A:
Small IPOs Vs. No. of Mutual Funds in Sample, 1990–2014

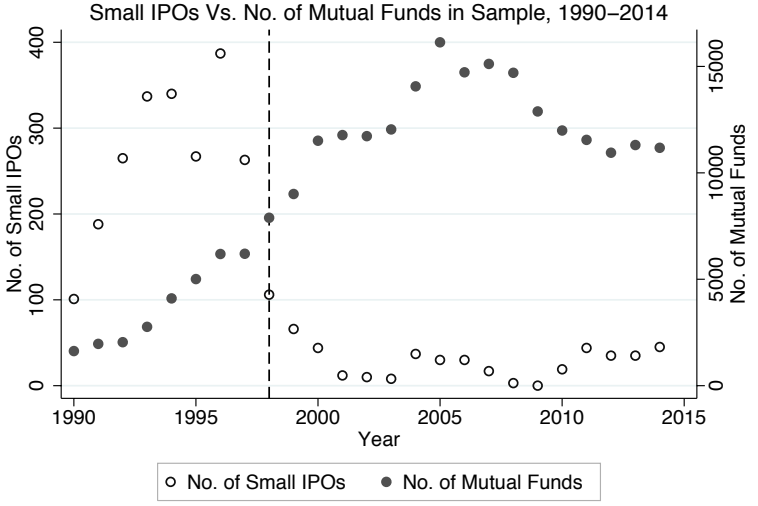

Figure 4B:
Number of Large Fund Investors Per IPO, 1990–2014

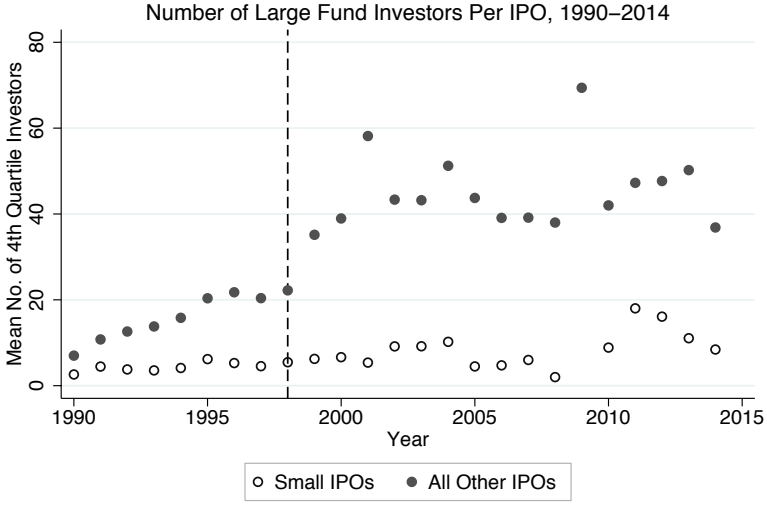

Figure 4C:
Number of Large Fund Investors Per IPO, 1990–2014

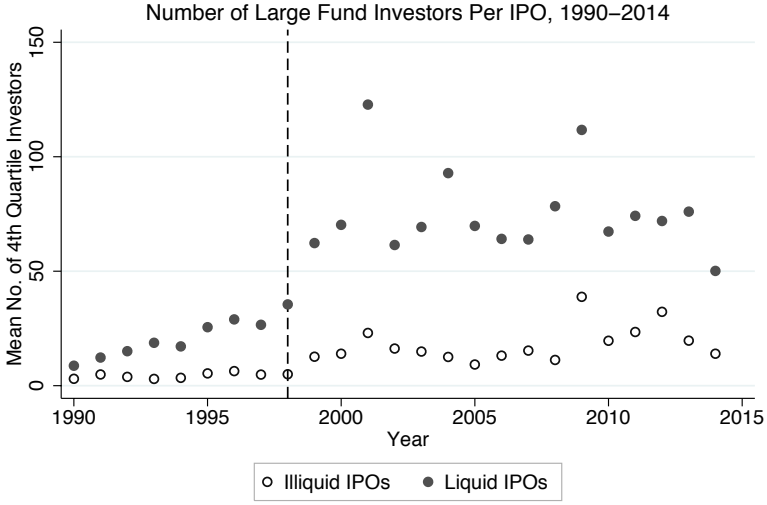

Figure 5A:
Illiquidity of Small IPOs in Month of Issue vs. Entire Market, 1990-2014

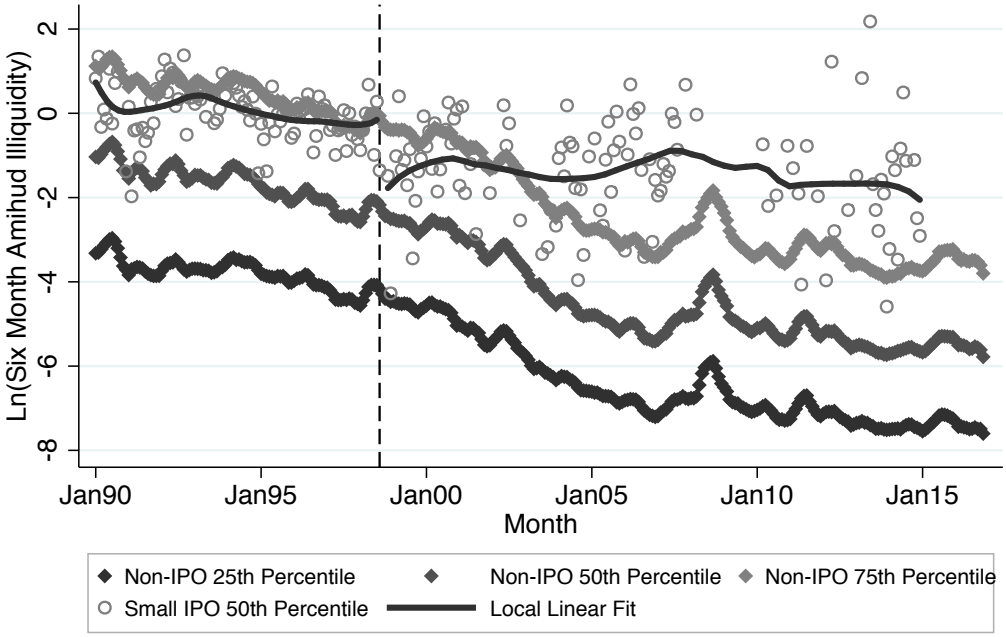

Figure 5B:
Illiquidity of Non-Small IPOs in Month of Issue vs. Entire Market, 1990-2014

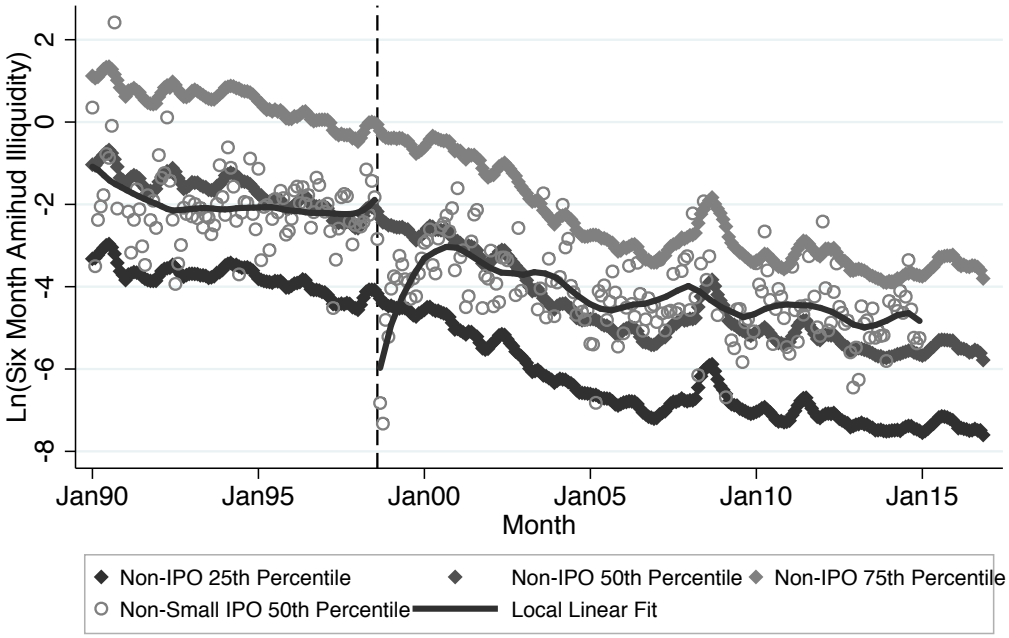

Figure 6A:
Illiquidity Classification of Small IPOs Within Entire Market, 1990-2014

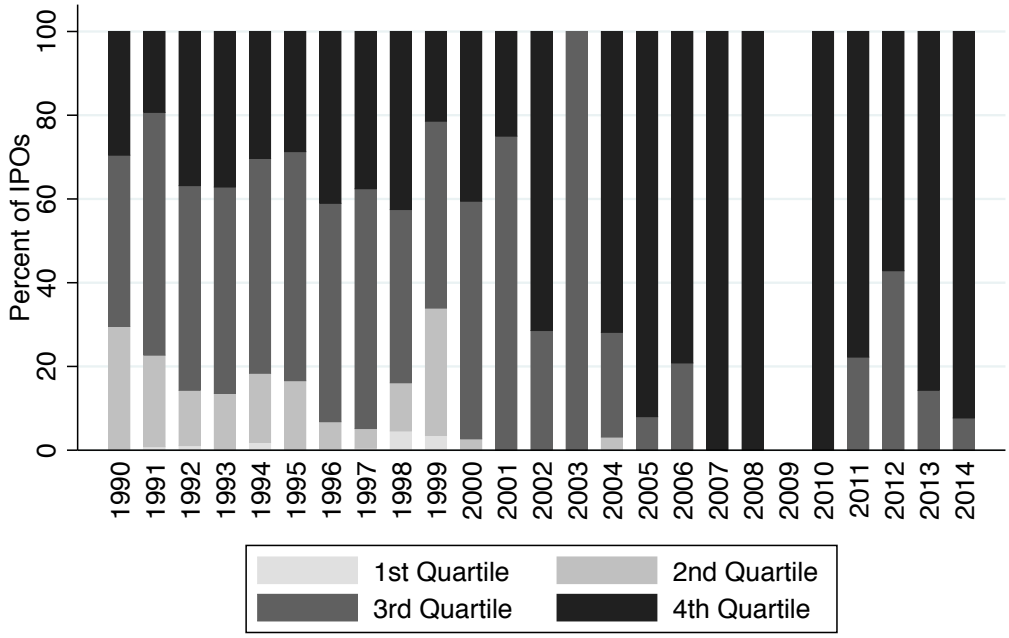

Figure 6B:
Illiquidity Classification of Non-Small IPOs Within Entire Market, 1990-2014

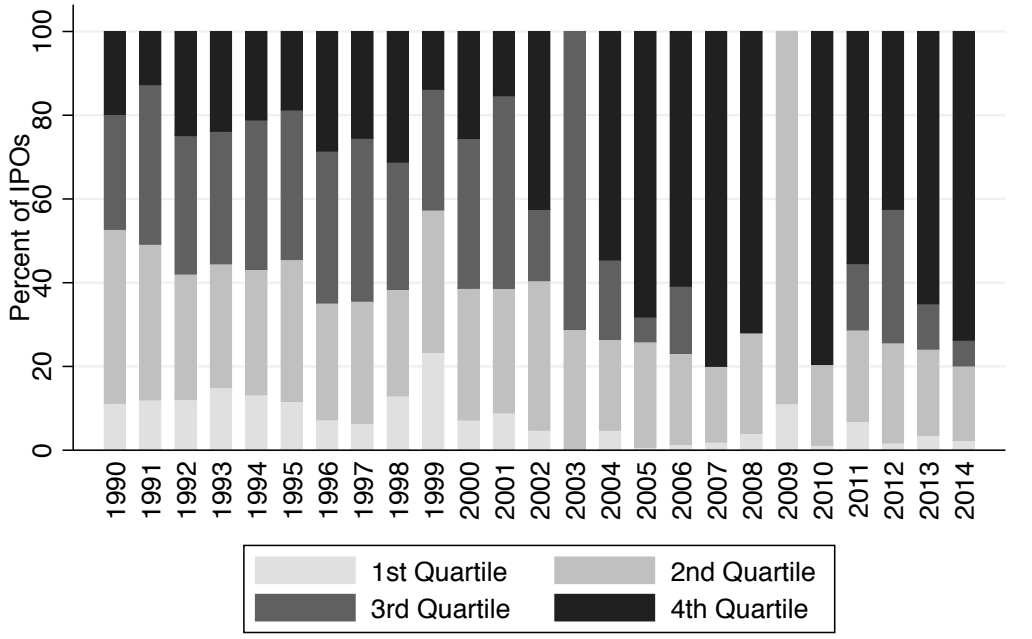

Table I: IPO Proceeds and Mutual Fund Investing (1990-2014)

Panel A provides descriptive statistics for 5,825 initial public offerings from the period 1990 through 2014 within the full sample and for a reduced sample where we require a match to at least one mutual fund investment in the S12 dataset. *Small IPO* references an IPO which received less than $54.4 million in net proceeds using 2014 dollars. *25%, 50%*, and *75% IPO Proceeds* reflect the size of IPOs at the 25th, 50th, and 75th percentile of the overall size distribution of IPOs in a given year. All dollar figures are inflation adjusted to 2014 dollars. Panel B provides summary return statistics for the full sample of 5,825 IPOs. *3 Year Cumulative Return* is the gross 3-year buy-and-hold return from an IPO measured from the first day the security is listed in CRSP until the earlier of the third anniversary of the IPO or the last date the security is included in CRSP. *Market Adjusted 3 Year Returns* are excess 3-year buy-and-hold returns over the cumulative returns on the CRSP value-weighted index over the same time period. *Market Adjusted 7 Day Returns* and *Market Adjusted 60 Day Returns* are excess buy-and-hold returns from investing at the IPO offer price through the seventh trading day and sixtieth trading day, respectively, after the IPO over the cumulative returns on the CRSP value-weighted index over the same time periods.

Panel A

	Full IPO Sample						Matched S12 Sample					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Year	**Total # of IPOs**	**% Small IPOs**	**Mean Proceeds**	**25% IPO Proceeds**	**50% Proceeds**	**75% IPO Proceeds**	**IPOs with at least 1 Fund Investor**	**% Small IPOs**	**Mean Proceeds**	**25% IPO Proceeds**	**50% Proceeds**	**75% IPO Proceeds**
1990	139	69%	$55.6	$10.4	$32.0	$65.8	93	55%	$73.3	$29.0	$50.3	$81.5
1991	303	61%	$71.9	$18.3	$44.4	$79.7	235	51%	$85.6	$33.7	$54.0	$89.9
1992	404	63%	$73.8	$14.0	$38.8	$74.2	271	45%	$103.7	$37.8	$58.2	$95.1
1993	520	62%	$73.9	$19.0	$39.3	$75.8	395	50%	$92.8	$33.0	$54.1	$93.3
1994	441	72%	$60.2	$14.4	$31.1	$57.0	306	61%	$77.8	$26.0	$45.5	$77.9
1995	470	54%	$85.8	$19.5	$49.3	$77.5	380	44%	$103.1	$37.8	$57.2	$95.1
1996	684	54%	$87.8	$23.5	$50.9	$86.3	580	46%	$98.4	$34.3	$57.3	$94.2
1997	442	55%	$88.7	$27.1	$49.4	$85.5	387	50%	$97.1	$33.9	$54.9	$93.7
1998	252	40%	$174.5	$37.0	$64.9	$111.5	226	34%	$190.8	$46.8	$72.0	$125.6
1999	431	14%	$195.6	$68.6	$100.7	$163.4	420	12%	$200.3	$71.1	$103.0	$164.3
2000	339	12%	$221.6	$75.9	$116.9	$182.6	331	10%	$226.7	$75.9	$118.6	$183.4
2001	72	13%	$534.5	$77.1	$148.5	$235.2	70	10%	$549.4	$83.0	$156.4	$239.8
2002	63	14%	$230.3	$72.5	$141.2	$317.8	58	12%	$246.5	$85.5	$152.4	$320.6
2003	51	16%	$192.1	$79.3	$125.8	$227.5	49	12%	$199.3	$83.6	$134.6	$227.5
2004	147	22%	$212.3	$60.3	$103.0	$192.4	145	22%	$214.4	$61.3	$103.0	$192.4
2005	133	20%	$227.3	$66.9	$137.5	$272.7	130	18%	$232.2	$67.0	$140.1	$273.2
2006	141	20%	$217.9	$69.9	$129.6	$234.1	138	18%	$222.3	$70.2	$132.9	$237.8
2007	144	11%	$208.6	$78.8	$124.3	$247.8	138	7%	$216.9	$84.0	$128.3	$256.2
2008	21	10%	$311.3	$91.0	$198.2	$377.6	20	5%	$326.6	$97.4	$202.2	$385.6
2009	38	0%	$400.1	$135.4	$197.3	$482.8	28	0%	$423.3	$139.1	$200.4	$479.4
2010	80	10%	$426.0	$73.0	$129.8	$248.7	74	9%	$435.0	$72.6	$116.1	$234.1
2011	84	12%	$349.4	$95.4	$173.4	$322.5	80	13%	$325.9	$92.8	$164.3	$272.1
2012	99	11%	$362.7	$79.1	$123.7	$248.7	99	11%	$362.7	$79.1	$123.7	$248.7
2013	147	10%	$318.5	$86.4	$140.2	$319.0	144	10%	$317.6	$85.4	$138.6	$311.9
2014	180	17%	$200.0	$64.3	$104.0	$196.1	176	16%	$196.8	$64.4	$104.0	$192.9
Mean	233	30%	$215.2	$58.3	$103.8	$199.3	199	25%	$224.7	$65.0	$108.9	$202.6

Panel B

	Small IPOs				Non-Small IPOs			
Year of IPO	3 Year Cumulative Return	Market Adjusted 3 Year Return	Market Adjusted 7 Day Return	Market Adjusted 60 Day Return	3 Year Cumulative Return	Market Adjusted 3 Year Return	Market Adjusted 7 Day Return	Market Adjusted 60 Day Return
1990	20.0%	-27.4%	-20.9%	-20.8%	22.8%	-22.8%	-7.6%	-7.2%
1991	15.1%	-17.8%	-4.1%	7.3%	42.9%	9.9%	13.4%	24.5%
1992	41.4%	4.9%	2.3%	1.5%	33.2%	-3.1%	10.2%	10.4%
1993	53.6%	1.0%	7.6%	12.4%	47.5%	-6.1%	14.7%	24.2%
1994	102.6%	19.4%	6.8%	-1.0%	93.9%	8.0%	11.0%	16.9%
1995	29.3%	-59.2%	15.5%	19.9%	39.3%	-46.5%	26.3%	32.8%
1996	11.7%	-72.5%	7.1%	4.4%	41.1%	-39.2%	22.1%	25.7%
1997	52.6%	-8.4%	5.2%	6.3%	88.7%	31.4%	19.9%	19.2%
1998	49.8%	28.4%	18.3%	16.6%	21.4%	4.8%	22.6%	32.5%
1999	-52.5%	-38.4%	19.2%	63.4%	-48.5%	-33.3%	86.5%	148.6%
2000	-46.1%	-19.7%	5.5%	-2.2%	-60.5%	-31.0%	61.0%	42.4%
2001	340.4%	338.5%	7.2%	-6.0%	13.6%	10.3%	14.4%	16.6%
2002	4.0%	-26.1%	-1.2%	-24.5%	71.6%	42.7%	8.9%	16.2%
2003	-3.4%	-37.7%	27.9%	42.9%	22.6%	-17.5%	10.3%	15.3%
2004	77.5%	32.1%	7.6%	19.4%	47.7%	3.6%	16.0%	21.0%
2005	-56.9%	-66.9%	-0.1%	-4.0%	18.5%	8.4%	12.1%	16.0%
2006	-36.7%	-19.8%	4.9%	-10.2%	-26.0%	-8.0%	13.7%	12.2%
2007	-28.5%	-15.0%	-4.3%	-12.9%	-12.1%	3.7%	15.8%	18.2%
2008	-20.6%	-30.7%	24.7%	20.8%	49.3%	41.6%	5.5%	3.8%
2009					60.6%	17.2%	9.4%	5.3%
2010	1.9%	-44.9%	-4.9%	-4.6%	45.8%	-1.6%	8.3%	14.3%
2011	136.6%	100.1%	-3.9%	-12.9%	33.9%	-17.1%	16.7%	20.1%
2012	74.6%	24.1%	12.8%	53.1%	71.5%	21.5%	19.8%	23.4%
2013	-36.7%	-64.3%	9.4%	12.7%	15.1%	-11.4%	22.9%	39.3%
2014	-19.9%	-37.8%	16.0%	-3.3%	10.4%	-7.3%	21.2%	28.8%
Mean ('90-'98)	43.1%	-20.2%	6.1%	6.7%	49.0%	-10.6%	17.9%	23.1%
Mean ('99-'09)	-8.9%	-9.1%	8.7%	18.9%	-18.8%	-13.0%	44.3%	61.1%
Mean ('10-'14)	14.9%	-15.4%	9.3%	5.2%	30.3%	-3.9%	19.0%	27.5%

Table II: Mutual Fund Sample Summary Statistics

Descriptive statistics for the sample of mutual fund investors for the years 1990, 2000 and 2010 broken down by size quantiles. The first three columns set forth the number of funds in each quantile in terms of aggregate fund size as of year-end as well as the mean and median size within the quantile. *% of All Fund Assets* represents the percentage of fund assets for each quantile as a percentage of total assets for all funds. *Mean No. Equity Positions* and *Median No. Equity Positions* refer to the mean and median number of equity investments held by funds within each quantile. *Mean Position Value* and *Median Position Value* are the mean and median dollar value of all equity positions disclosed by funds within a quantile. *% of Funds Investing IPOs* and *% of Funds Investing in Small IPOs* are the percentage of funds in column 1 that disclose at least one investment in the sample of all IPOs and small IPOs for the given year, respectively. All dollar figures are inflation adjusted to 2014 dollars.

Year	Size Quantile	(1) Number of Funds	(2) Mean Fund Size	(3) Median Fund Size	(4) % of All Fund Assets	(5) Mean No. Equity Positions	(6) Median No. Equity Positions	(7) Mean Position Value	(8) Median Position Value	(9) % of Funds Investing in IPOs	(10) % of Funds Investing in Small IPOs
1990											
	1	406	$6.6	$6.0	0.66%	26.6	20.1	$0.5	$0.3	18.2%	6.4%
	2	406	$28.1	$26.8	2.82%	40.6	36.0	$1.2	$0.8	21.9%	9.4%
	3	406	$93.2	$86.7	9.38%	55.8	44.1	$2.5	$1.9	28.3%	14.5%
	4	406	$866.0	$405.6	87.13%	94.6	65.1	$11.5	$7.3	32.3%	12.1%
	Overall:	*1,624*	*$248.5*	*$47.9*	*100.00%*	*54.4*	*40.0*	*$3.9*	*$1.3*	*25.2%*	*10.6%*
2000											
	1	2,878	$3.6	$3.2	0.19%	23.5	13.1	$0.7	$0.2	16.7%	0.3%
	2	2,877	$16.5	$15.5	0.86%	50.3	30.5	$1.2	$0.5	26.5%	0.9%
	3	2,878	$74.2	$65.1	3.87%	82.5	48.0	$2.5	$1.4	38.1%	2.2%
	4	2,877	$1,821.5	$476.9	95.08%	140.6	74.0	$21.2	$7.0	56.4%	5.0%
	Overall:	*11,510*	*$478.9*	*$31.4*	*100.00%*	*74.2*	*38.4*	*$6.4*	*$1.1*	*34.4%*	*2.1%*
2010											
	1	2,997	$3.9	$3.3	0.19%	21.6	5.0	$1.3	$0.6	3.0%	0.1%
	2	2,997	$22.6	$20.7	1.13%	53.3	24.0	$3.4	$0.9	7.3%	0.3%
	3	2,997	$107.5	$96.5	5.37%	100.5	47.0	$5.9	$2.2	14.8%	0.6%
	4	2,997	$1,867.6	$624.6	93.30%	164.2	66.5	$42.4	$10.2	25.7%	1.7%
	Overall:	*11,988*	*$500.4*	*$44.5*	*100.00%*	*84.9*	*31.1*	*$13.3*	*$2.0*	*12.7%*	*0.7%*

Table III: IPO Liquidity, 1990-2014

Descriptive statistics of the liquidity of IPO and non-IPO firms between 1990 and 2014. Panel A reports results from two interrupted-time series regressions examining the illiquidity of IPOs and all non-IPO securities, respectively, surrounding the flight to liquidity that peaked in August 1998. The unit of observation is the mean six-month forward moving average of Ahmihud Illiquidity for each month between 1990 and 2014. *POST* is a dummy variable coded as one for all months in the sample period following August 1998. *MONTH* is a time trend for months. Newey-West standard errors (in parentheses) were calculated with five lags in model 1 and with nine lags in model 2 determined using Cumby-Huizinga tests for autocorrelation. Panel B provides descriptive statistics of IPO trading venue from 1990-2014 based on data from SDC and includes OTC stocks (6,110 IPOs). Panel C provides statistics for lead underwriters of IPOs based on data from SDC. ***, **, and * indicate statistics are significant at the 1%, 5%, and 10% levels, respectively

Panel A. Illiquidity of IPOs, Small IPOs, and All Other CRSP Securities, 1990-2014

	All IPOs	All Other Firms
	(1)	(2)
Post	-1.064***	0.034
	(0.263)	(0.200)
Month	-0.010*	-0.035***
	(0.006)	(0.003)
Post x Month	0.010*	0.029***
	(0.006)	(0.004)
Constant	2.29***	4.91***
	(0.418)	(0.229)
N	285	323

Panel B. Choice of Trading Venue Among IPO Firms, 1990-2014

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Trading Venue of Small IPOs							Trading Venue of Non-Small IPOs						
Year	**Total # of Small IPOs**	**% of All IPOs**	**% Nasdaq**	**% NYSE**	**% Amex**	**% Nasdaq, NYSE, AMEX (Combined)**	**% OTC/ Pink**	**Total # of Other IPOs**	**% of All IPOs**	**% Nasdaq**	**% NYSE**	**% Amex**	**% Nasdaq, NYSE, AMEX (Combined)**	**% OTC/ Pink**
1990	74	50.3%	60.8%	2.7%	5.4%	68.9%	31.1%	73	49.7%	67.1%	23.3%	4.1%	94.5%	5.5%
1991	110	35.6%	70.0%	0.0%	4.5%	74.5%	24.5%	199	64.4%	72.9%	19.1%	2.5%	94.5%	5.5%
1992	177	41.9%	65.5%	1.7%	2.8%	70.1%	29.4%	245	58.1%	71.8%	20.8%	2.0%	94.7%	5.3%
1993	215	39.6%	56.3%	1.9%	3.7%	61.9%	37.7%	328	60.4%	76.2%	18.6%	0.9%	95.7%	4.3%
1994	242	52.0%	62.4%	0.8%	3.3%	66.5%	32.6%	223	48.0%	72.6%	21.5%	1.3%	95.5%	4.5%
1995	165	34.2%	45.5%	0.0%	2.4%	47.9%	51.5%	317	65.8%	81.7%	14.2%	1.3%	97.2%	2.8%
1996	229	32.4%	45.4%	0.0%	3.1%	48.5%	51.1%	477	67.6%	78.4%	15.7%	2.7%	96.9%	3.1%
1997	142	30.6%	40.1%	0.0%	8.5%	48.6%	51.4%	322	69.4%	76.4%	17.7%	2.8%	96.9%	3.1%
1998	57	22.1%	36.8%	0.0%	14.0%	50.9%	47.4%	201	77.9%	73.6%	22.9%	1.0%	97.5%	2.5%
1999	31	7.1%	54.8%	0.0%	12.9%	67.7%	32.3%	406	92.9%	88.7%	7.9%	0.7%	97.3%	2.7%
2000	18	5.2%	61.1%	0.0%	22.2%	83.3%	16.7%	326	94.8%	89.9%	5.8%	0.3%	96.0%	4.0%
2001	8	10.7%	25.0%	0.0%	12.5%	37.5%	62.5%	67	89.3%	59.7%	37.3%	0.0%	97.0%	3.0%
2002	4	6.3%	50.0%	25.0%	0.0%	75.0%	0.0%	60	93.8%	56.7%	40.0%	0.0%	96.7%	3.3%
2003	4	7.7%	0.0%	0.0%	50.0%	50.0%	25.0%	48	92.3%	77.1%	20.8%	2.1%	100.0%	0.0%
2004	12	7.8%	58.3%	0.0%	25.0%	83.3%	8.3%	142	92.2%	71.1%	26.1%	1.4%	98.6%	1.4%
2005	17	12.3%	47.1%	5.9%	35.3%	88.2%	11.8%	121	87.7%	60.3%	38.8%	0.0%	99.2%	0.8%
2006	14	9.7%	64.3%	7.1%	21.4%	92.9%	7.1%	130	90.3%	72.3%	26.2%	0.8%	99.2%	0.8%
2007	9	6.2%	66.7%	11.1%	0.0%	77.8%	22.2%	136	93.8%	69.9%	27.9%	1.5%	99.3%	0.7%
2008	3	13.6%	66.7%	0.0%	0.0%	66.7%	33.3%	19	86.4%	47.4%	52.6%	0.0%	100.0%	0.0%
2009	0	0.0%						38	100.0%	50.0%	50.0%	0.0%	100.0%	0.0%
2010	14	15.2%	28.6%	0.0%	0.0%	28.6%	57.1%	78	84.8%	50.0%	48.7%	1.3%	100.0%	0.0%
2011	35	29.7%	2.9%	0.0%	0.0%	2.9%	91.4%	83	70.3%	50.6%	48.2%	1.2%	100.0%	0.0%
2012	28	22.4%	21.4%	0.0%	0.0%	21.4%	75.0%	97	77.6%	43.3%	53.6%	0.0%	96.9%	3.1%
2013	26	15.4%	30.8%	0.0%	0.0%	30.8%	69.2%	143	84.6%	49.7%	49.0%	0.0%	98.6%	1.4%
2014	27	13.7%	55.6%	0.0%	0.0%	55.6%	44.4%	170	86.3%	57.6%	41.8%	0.0%	99.4%	0.6%
Mean ('90-'98)	157	37.7%	53.7%	0.8%	5.3%	59.7%	39.6%	265	62.3%	74.5%	19.3%	2.1%	95.9%	4.1%
Mean ('99-'09)	12	7.9%	49.4%	4.9%	17.9%	72.2%	21.9%	146	92.1%	69.3%	28.3%	0.7%	98.3%	1.7%
Mean ('10-'14)	26	19.3%	27.8%	0.0%	0.0%	27.8%	67.4%	114	80.7%	50.2%	48.2%	0.5%	99.0%	1.0%

Panel C. IPO Underwriters, 1990-2014

	(1)	(2)	(3)	(4)
	# I-Banks IPOs < 30MM	# I-Banks IPOs > 30MM	Overlap	Overlap % (% of Banks Doing Large IPOs also Doing Small IPOs)
1990	20	40	7	35.00%
1991	37	68	19	51.35%
1992	41	104	23	56.10%
1993	53	102	25	47.17%
1994	54	111	26	48.15%
1995	50	90	18	36.00%
1996	58	123	36	62.07%
1997	68	93	24	35.29%
1998	42	44	6	14.29%
1999	51	22	7	13.73%
2000	42	17	2	4.76%
2001	26	6	2	7.69%
2002	22	3	0	0.00%
2003	23	4	0	0.00%
2004	34	11	4	11.76%
2005	29	15	3	10.34%
2006	30	14	2	6.67%
2007	36	9	0	0.00%
2008	13	2	0	0.00%
2009	16	0	0	0.00%
2010	24	3	1	4.17%
2011	27	1	0	0.00%
2012	28	7	3	10.71%
2013	35	6	2	5.71%
2014	38	11	3	7.89%
Mean ('90-'98)	47	86	20	43.50%
Mean ('99-'09)	29	9	2	6.21%
Mean ('10-'14)	30	6	2	5.92%

Table IV: Mutual Fund Investment in IPOs

This table examines investment in IPOs between 1990 and 2014 by mutual fund investors in a sample of 37,052 funds where the unit of observation is a fund's annual investments across 5,825 IPOs. Panel A presents regression results where the dependent variable is either the annual number of IPO investments by a fund (column 1) or the annual number of small IPO investments by a fund (column 2). Panel B presents regression results where the dependent variable is either the annual number of *Illiquid IPO* investments by a fund (column 1) or the median *Illiquidity Quartile* of those IPOs acquired by a fund in a given year (column 2). In Panel A, a *Small IPO* is defined as an IPO raising net proceeds of less than $54.4 million using 2014 dollars. In Panel B, an *Illiquid IPO* is defined as an IPO whose six-month Amihud Illiquidity places it in the fourth quartile of IPOs in a year when ranked by six-month Amihud Illiquidity, while *Illiquidity Quartile* represents an IPO's quartile according to the same ranking. *POST* is a dummy variable coded as 1 for each year following 1998 and zero otherwise. *Size Quartile* represents the size quartile of a fund during the year. All models include year-fixed effects. Robust standard errors clustered on individual funds are in parentheses, with ***, **, and * denoting statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: IPO Investing by IPO Size

	(1)	(2)
Second Size Quartile	0.219***	0.096***
	(0.042)	(0.012)
Third Size Quartile	0.653***	0.277***
	(0.075)	(0.025)
Fourth Size Quartile	1.486***	0.487***
	(0.176)	(0.052)
POST	2.182***	-0.014
	(0.148)	(0.032)
POST x Second Size Quartile	-0.189***	-0.097***
	(0.044)	(0.012)
POST x Third Size Quartile	-0.482***	-0.284***
	(0.077)	(0.025)
POST x Fourth Size Quartile	-1.175***	-0.534***
	(0.180)	(0.054)
Fund Fixed Effects	Y	Y
Year Fixed Effects	Y	Y
Obs.	238,308	238,308

Panel B: IPO Investing by IPO Liquidity

	(1)	(2)
Second Size Quartile	0.027***	0.037
	(0.006)	(0.038)
Third Size Quartile	0.078***	0.053
	(0.011)	(0.039)
Fourth Size Quartile	0.145***	-0.012
	(0.022)	(0.040)
POST	0.171***	-0.100
	(0.020)	(0.068)
POST x Second Size Quartile	-0.022***	-0.093*
	(0.006)	(0.052)
POST x Third Size Quartile	-0.060***	-0.097*
	(0.011)	(0.053)
POST x Fourth Size Quartile	-0.120***	-0.106**
	(0.023)	(0.052)
Fund Fixed Effects	Y	Y
Year Fixed Effects	Y	Y
Obs.	238,308	41,050

Table V: Large Fund Investing in Individual IPOs

This table examines the number of large fund investors in individual IPOs that closed between 1990 and 2014. In Panel A, the unit of observation is an individual IPO and the dependent variable is the number of mutual fund investors in the transaction that rank among the largest quartile of mutual funds for the year. Panel A examines how the number of large fund investors changed after 1998 as a function of the size of an IPO (column 1) and the illiquidity of an IPO (column 2). Panel B presents results of "horse-race" regressions that examine the relative association after 1998 of a small IPO's illiquidity and short-term returns on predicting the number of large investors in a small IPO. *POST* and *Small IPO* have the definitions given in Table IV. *IlliquidityRank* is an IPO's illiquidity quartile based on its six-month Amihud Illiquidity relative to all securities in the month of its IPO. *Liquid IPO* is an indicator variable coded as 1 if an IPO's six-month Amihud Illiquidity is below the median for all securities traded in the month of the IPO. *SmallerInvestors* is the number of mutual fund investors in the sample that invested in an IPO but which did not rank among the largest quartile of mutual funds for the year. *IPOs* and *Funds* are the total number of IPOs and the total number of reporting mutual funds in the year of the IPO, respectively. *60 Day Returns* and *3YearReturns* have the definitions given in Table I. All models include industry-fixed effects using one digit SIC codes and year fixed-effects. Robust standard errors clustered on individual funds clustered on IPOs are in parentheses, with ***, **, and * denoting statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Large Fund Investors by IPO Size and IPO Illiquidity

	(1)	(2)
Small IPO	-3.626***	
	(0.435)	
Post x Small	-11.305***	
	(0.889)	
IlliquidityRank 2		-3.637***
		(0.649)
IlliquidityRank 3		-5.857***
		(0.672)
IlliquidityRank 4		-7.886***
		(0.921)
POST x IlliquidityRank 2		-9.986***
		(1.018)
POST x IlliquidityRank 3		-19.390***
		(1.098)
POST x IlliquidityRank 4		-27.638***
		-3.637***
60DayReturns	2.395***	0.818***
	(0.192)	(0.195)
SmallerInvestors	0.894***	0.825***
	(0.007)	(0.008)
IPOs	0.013***	0.000
	(0.004)	(0.004)
Funds	0.001***	0.002***
	(0.000)	(0.000)
Year Fixed Effects	Y	Y
Industry Fixed Effects	Y	Y
N	4,837	4,836

Panel B: Large Fund Investors in Small IPOs

	(1)	(2)	(3)
Liquid IPO	0.431	0.650**	0.617**
	(0.266)	(0.268)	(0.254)
POST x Liquid IPO	2.548***	0.254	2.883***
	(0.864)	(0.967)	(0.839)
60DayReturns	0.531***	0.163	
	(0.166)	(0.180)	
POST x 60DayReturns		2.211***	
		(0.432)	
3YearReturns			0.086*
			(0.045)
POST x 3YearReturns			0.081
			(0.126)
SmallerInvestors	0.763***	0.755***	0.779***
	(0.025)	(0.024)	(0.024)
IPOs	0.012***	0.013***	0.013***
	(0.005)	(0.004)	(0.005)
Funds	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Year Fixed Effects	Y	Y	Y
Industry Fixed Effects	Y	Y	Y
N	1,609	1,609	1,646