Stereotypical IPO Underpricing

Rogier Hanselaar*

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ABSTRACT

I investigate the extent to which IPO underpricing in the U.S. can be explained by stereotypes formed by investors based on past industry underpricing. I apply the theory of stereotype formation put forward by Bordalo, Coffman, Gennaioli, and Shleifer (2016) for the construction of stereotypes. I find that IPO underpricing, as well as IPO demand as proxied by first-day turnover and IPO price revisions, are positively and significantly related to stereotypical industry underpricing. The effect of stereotypical industry underpricing is stronger for IPOs with more retail ownership. It is not significantly affected when controlling for other explanations. Price changes due to stereotypical industry underpricing are negatively related to post-IPO stock performance. These findings challenge the view that underpricing is fully a result of rational deliberations and support the view that underpricing is partly driven by boundedly rational demand side factors.

JEL classification:.

*Rogier Hanselaar is a PhD Candidate at the Rotterdam School of Management, Erasmus University Rotterdam; e-mail: hanselaar@rsm.nl. I thank Renée Adams, José Albuquerque de Sousa, Dion Bongaerts, Mathijs Cosemans, Mathijs van Dijk, Egemen Genc, Yigitcan Karabulut, Kris Mitchener, Oguzhan Ozbas, Amiyatosh Purnanandam, Uday Rajan, Peter Roosenboom, Tyler Shumway, Francisco Urzúa Infante, Roy Verbeek, Toni Whited, Stefan Zeume, seminar participants at Erasmus University Rotterdam, and participants in the FMA European Meeting Doctoral Student Consortium for helpful comments and feedback. I am grateful for the hospitality of the Department of Finance at the Ross School of Business (University of Michigan) where some of the work on this paper was performed.

Pricing an IPO is tough. It is hard to form expectations about future cash flows and growth opportunities of firms that are young, opaque and without track record. Historical data show that IPOs exhibit underpricing on average: share prices tend to jump up on the first day of trading. From 1990 until 2014, IPOs were underpriced on average by 21%; in the years 1999 and 2000 this increased to an average of 67%. While these figures may suggest that IPO prices are too low, there is a large literature arguing underpricing compensates for risk and prices are right on average (e.g., Rock, 1986; Tinic, 1988), and there are even papers arguing IPO prices are higher than they should be (e.g., Purnanandam and Swaminathan, 2004). Given that IPO supply is inelastic relative to investor demand, understanding demand is crucial to understanding IPO prices. So how do investors set their demand? While sophisticated investors may estimate future cash flows, growth opportunities and risks, empirical work by Kaustia and Knüpfer (2008) shows that retail investors base their demand for future IPOs on underpricing in previous IPOs; past underpricing (co-)determines expectations about future IPOs.

In this paper, I investigate the role of stereotypes in the formation of these expectations. Bordalo, Coffman, Gennaioli, and Shleifer (2016) show how humans form stereotypes about groups (of people, industries, etc.) by overemphasizing more representative outcomes of these groups. I apply their model in the context of IPOs to structure how investors form expectations about industries based on underpricing. I expect stereotypes to be particularly relevant in the context of IPOs, as the IPO market is deemed especially sensitive to sentiment (e.g., Helwege and Liang, 2004; Ritter and Welch, 2002). My main finding is that IPOs in industries with higher stereotypical industry underpricing draw higher demand from investors and show higher underpricing.

This paper is the first to look at the role of stereotyping in the IPO market, and one of the first to empirically apply the stereotype model of Bordalo, Coffman, Gennaioli, and Shleifer. There are several reasons why I believe it is of interest. First, while there is a rich literature on IPO underpricing (e.g. Rock (1986), Benveniste and Spindt (1989), Tinic (1988), Ritter (1991), Hughes and Thakor (1992), Brennan and Franks (1997), Stoughton and Zechner (1998), Loughran and Ritter (2002), Purnanandam and Swaminathan (2004) Ljungqvist, Nanda, and Singh(2006)), there have only been a few papers in the IPO literature that explicitly test behavioral models (e.g. Loughran and Ritter (2002), Kaustia and Knüpfer (2008)). The results in this paper challenge the view that underpricing is solely a result of rational deliberations regarding e.g. information

asymmetries or risk. Second, the null hypothesis of rational expectations can be explicitly tested, as rational expectations exist as a special case within the stereotype framework. Third, the pricing of securities in the IPO market is crucial for the efficiency with which capital is allocated in the economy. Any irrational behavior that affects pricing, may result in overall welfare loss because positive NPV projects are potentially not undertaken, while negative NPV projects potentially are. Finally, the results provide an explanation for why IPOs in some industries are more 'fashionable' than IPOs in other industries at certain times.

Using data on 5,197 U.S IPOs from 1990 to 2014, I calculate stereotypical industry underpricing using the 5 Fama-French industries for each IPO in the sample. In line with the theory by Bordalo, Coffman, Gennaioli, and Shleifer (2016), I define stereotypical industry underpricing as the set of most representative returns within an industry at a particular point in time. I split up the distribution of underpricing in a particular industry into three parts: a low, medium and high first-day return. I calculate representativeness by dividing the probability density of a particular first-day return in the industry of interest by the probability density of that first-day return in other industries. The most representative first-day returns together form the stereotype, the others are discarded. Whether the one, two or three most representative first-day returns end up in the stereotype is estimated empirically. This allows me to test whether the stereotypes are equal to fully rational expectations (the case when all three first-day returns end up in the stereotype), or whether limits to recall are present (the case when only the one or two most representative first-day returns end up in the stereotype).

I first relate IPO underpricing to stereotypical industry underpricing. I find that IPO underpricing is significantly positively related to stereotypical industry underpricing, both economically and statistically; a 1% increase in stereotypical industry underpricing is associated with an increase in IPO underpricing of about 0.32% depending on the specification. This result are robust to the inclusion of a divers set of controls, consisting of firm characteristics, offer characteristics, insider trading, and general market conditions

In each of the regressions, I estimate the limits to recall parameter and test whether I can reject full recall, i.e. the situation in which all parts of the underpricing distribution are taken into account and expectations are fully rational. In each regression full recall is rejected, which implies that stereotypical industry underpricing is significantly different from rational expectations about

industry underpricing and that the stereotype narrative is different from a story of underpricing persistence.

To examine whether this effect stems from an increase in demand, I subsequently run regressions with share turnover on the first day of trading as the dependent variable rather than underpricing. I find that share turnover on the first day of trading is also significantly and positively related to stereotypical industry underpricing. A 1 % increase in stereotypical industry underpricing is associated with an increase in IPO underpricing of about 0.30% depending on the specification. For each specification full recall is rejected.

So why do issuers not take full advantage of any excess demand arising from these stereotypes? The work by Ljungqvist, Nanda, and Singh (2006) explains why this may be optimal from an issuer's point of view. Regular (in the sense of repeat involvement in the IPO market) institutional investors to whom shares are allocated in an IPO sell them on to occasionally exuberant investors not involved in the initial allocation. The issuer only *partly* capitalizes on the trading gains of the regular investors, as regular investors need to be compensated for the risk involved with the fact that exuberance is fleeting. Underpricing follows as a result. Cornelli, Goldreich, and Ljungqvist (2006) provide empirical evidence in support of this idea, by showing that small, less sophisticated investors seem to exhibit irrational behavior that is related to increased underpricing and decreased long-run performance.

According to Ljungqvist, Nanda, and Singh's model, there are three additional hurdles to clear for the stereotype hypothesis: first, excess demand generated by stereotypical industry underpricing should also be associated with an increased IPO offer price, as issuers do *partly* capitalize on investor exuberance. To test this implication, I run regressions with the offer price revision as the dependent variable rather than underpricing. I find that stereotypical industry underpricing is also significantly and positively related to price revisions, economically as well as statistically, and that full recall is again rejected.

Second, underpricing generated by stereotypical industry underpricing should be more present around IPOs with little institutional investor ownership post-IPO, given that irrational non–institutional investors are the source of the excess demand in the model. To test this, I split up the sample of IPOs based on institutional ownership post-IPO and rerun the regressions for a sample with high institutional ownership and a sample with low institutional ownership. For the sample

with high institutional ownership, I find that there is no consistent effect of stereotypical industry underpricing and that full recall cannot be rejected. For the sample with low institutional ownership, I find stronger effects than for the full sample.

Third, underpricing and price revisions that arise because of excess demand generated by stereotypical industry underpricing should be associated with decreased post-IPO stock performance, as excess demand is fleeting and stock prices are expected to revert to their fundamental value in the long run. To test this implication, I run two-stage least squares regressions of IPO long-run performance on underpricing and price revision, in which I instrument underpricing and price revision by stereotypical industry underpricing. I find that the parts of underpricing and price revision explained by stereotypical industry underpricing positively affect long-run performance over a one year horizon and negatively over a 2 and 3 year horizon, as expected.

In robustness tests, I look at whether in-sample overfitting is driving the results by comparing out-of-sample predictions of the stereotype model versus a fully rational model without limits to recall; I find that the stereotype model produces significantly better predictions. Next, I look at whether the effect is stronger in hot markets than in cold markets and find that the effect is stronger in hot markets, and absent in cold markets. I then look at whether stereotypes are particular to the tech-years 1999 and 2000 and absent in other years, but find the effect of stereotypes to be strong in both. Finally, I look at whether stereotypes are stronger in specific industries, and find that stereotypes are predominantly concentrated in the tech industry and the health industry, and that the effect is absent in the consumer and manufacturing industries.

This paper proceeds as follows. In section 1, I develop the hypotheses tested in the paper. In section 2, I describe the data and methods used. In section 3, I present results showing that IPO underpricing is related to stereotypical industry underpricing. In section IV I wrap up with some concluding remarks.

I. Hypothesis Development

Explanations for IPO underpricing have been sought in multiple directions. Ljungqvist (2007) and Ritter and Welch (2002) have each grouped these explanations in different categories: asymmetric information, institutional characteristics, control considerations, and agency and bounded

rationality explanations. Asymmetric information theories explain underpricing by showing what dynamics may arise out of different information sets held by the issuer, underwriter and investors (e.g., Benveniste and Spindt, 1989; Rock, 1986). Institutional characteristics theories explain why underpricing may be present as a result of features of the market place, such as litigation risk or limited investor protection (e.g., Tinic, 1988; Hughes and Thakor, 1992). Theories centering around control considerations show how underpricing may be used by the management to influence monitoring by shareholders or to extract private benefits (e.g., Brennan and Franks, 1997; Stoughton and Zechner, 1998). Agency and behavioral theories argue that the behavior of issuers or investors may be influenced by incentive conflicts or by bounded rationality, and that underpricing may arise as a result (e.g., Loughran and Ritter, 2002; Ljungqvist et al., 2006).

While there is evidence that theories on asymmetric information, control considerations and institutional settings partly explain the underpricing puzzle, Ritter and Welch (2002) argue that it is debatable whether these explanations can sufficiently explain the large variation in underpricing across time and industries. Illustrative is the underpricing in the years 1999-2000; in these years underpricing not only jumped up with respect to other years, it also did so unevenly across industries. Ritter and Welch (2002) and Ljungqvist (2007) deem agency and behavioral theories to be promising in explaining such underpricing behavior. However, there are only few behavioral theories tested in the IPO context.

In the behavioral paradigm, investors use shortcuts, often called heuristics, when they need to make quick decisions with only limited cognitive resources (Hirshleifer, 2014). A basic heuristic is classification, in which an investor evaluates the features of the category to which an investment belongs rather than the features of the investment itself. In the context of underpricing, an investor who is judging whether an IPO is likely to have a good first-day return, looks at the category to which the IPO belongs rather than the IPO itself to form expectations about its performance. A likely way in which IPOs are categorized is by industries, as IPOs in the same industry have more in common relative to those in other industries, industry categorizations are widely used in finance practice, and there is ample anecdotal evidence of bounded rational investor behavior along industry lines in the IPO context, e.g. the dot-com bubble.

In setting their demand for an IPO, investors likely form expectations about performance. The most prominent performance measure of IPOs is underpricing; underpricing is eye-catching as it

produces large returns in absolute terms over a short time-span, it is often reported on in news articles (see e.g., Financial Times, 2014, 2015b,a, 2016), and it has a large influence on other performance measures such as holding period returns. Moreover, Kaustia and Knüpfer (2008) show that retail investors determine their demand for upcoming IPOs based on underpricing of past IPOs.

In line with Bordalo, Coffman, Gennaioli, and Shleifer's theory, I form stereotypical industry underpricing based on the most representative parts of the recent underpricing distribution of IPOs in a particular industry relative to the recent underpricing distribution of IPOs in other industries. These stereotypes are not necessarily accurate, in that the most representative parts of the distribution are not necessarily the most likely parts. However, they contain *stereotypical* past IPO performance and are in that way hypothesized to drive future industry demand.

To illustrate how stereotypes about IPOs may work, consider the following stylized example regarding tech IPOs in Table I. Assume that an IPO may have either a low, medium or high first-day return [1], and that the distributions of past first-day returns are given in Table 1 below.

First-day return	Low	Medium	High
Tech IPOs	35%	45%	20%
Other IPOs	20%	70%	10%
Representativeness	1.75	0.64	2.00

Table I: Stylized stereotypical first-day returns.
This table shows stylized probability density distributions of IPO first-day returns of Tech IPOs and Other IPOs. Representativeness is calculated by dividing the probability densities of Tech IPOs by the probability densities of non-tech IPOs. The most representative first-day returns form the stereotype.

The rows labeled 'Tech IPOs' and 'Other IPOs' contain the distribution of first-day returns of tech IPOs and the distribution of first-day returns of non-tech IPOs, respectively. The last row of the table contains the representativeness of each return, calculated by dividing the probability density of tech IPOs by the probability density of non-tech IPOs. The last row shows that the high first-day return is the most representative first-day return for tech IPOs. For the purpose of this example, assume investors suffer from limited recall, and are only able to recall the most

[1] I use underpricing and first-day returns interchangeably.

representative return for tech-IPOs: the high return. However, only about 20% of tech IPOs have high first-day returns; the bulk of the tech IPOs has medium sized first-day returns. Moreover, closer inspection shows that on average tech IPOs do not have higher returns, but rather *lower* returns.[2] Thus, in this example tech IPOs are stereotypically IPOs with high first-day returns, but the stereotype is inaccurate.

Such stereotypes may influence demand for IPOs in a particular industry. As the expected first-day return of tech IPOs is lower than the expected first-day return of other IPOs, there should be no reason to *rationally* prefer tech IPOs over other IPOs. Rather, demand for other IPOs should be higher than demand for tech IPOs. However, if investors form stereotypes, investors will only focus on the most representative parts of the first-day return distribution and will prefer tech IPOs over other IPOs, depending on the severity of the limits to recall. In that case, stereotypes may generate excess demand for tech IPOs, resulting in higher underpricing for those IPOs.

In this framework, investors suffer to a varying degree from limits to what they can recall about recent underpricing. If limits to recall are present, expectations formed by investors incorporate only the most representative first-day returns, as these are easier to recall, and discard the least presentative first-day returns. Expectations formed in this way are not rational, in that they consist only of a selection of all relevant information. If limits to recall are not present, investors do recall the whole first-day return distribution and the expectations they form do take into account all information; in that special case the expectations can be said to be rational. The fact that rational expectations are nested in the stereotype framework, allows for the testing of the presence of limits to recall.

Representativeness is closely related to salience as in Bordalo, Gennaioli, and Shleifer (2013) in that often the most representative attributes are also the most salient. However, the concepts work through slightly different mechanics. While salience describes how attention is allocated between attributes *that are already in mind*, representativeness accounts for which attributes *come to mind* in the first place. Moreover, while the salience of an attribute is determined by how much it differs from other attributes, the representativeness of an attribute is determined by how frequently it is encountered relative to other attributes. So it could be that an industry has a high first-day return

[2]Here, low and high first-day returns are equally distant from the medium first-day return, i.e. $|R_{low} - R_{med}| = R_{high} - R_{med}$

that is much larger than the other first-day returns (very salient), but that the high first-day return is just as frequent as a medium or low first-day return (not representative). In such a situation, a high return for that industry would be salient but not stereotypical.

The accuracy of stereotypes about IPO underpricing is determined by the extent to which returns that are objectively most likely are included in the stereotype. If the most representative returns of an industry are its least likely returns, then the stereotype formed on these most representative returns is inaccurate. If the most representative returns of an industry are its most likely returns, the stereotype is more accurate. In the case of full recall the stereotype is fully accurate in that it takes into account all information.

In the case that there are limits to recall, stereotypes may produce time- and industry-varying base rate neglect and confirmation bias. In the light of IPO pricing, base rate neglect may be an important driver of underpricing in that it dictates that investors may tend to act on specific information (up-side potential of IPOs in an industry at a certain time) while neglecting general information about IPO performance (average riskiness); confirmation bias may be important as well, as investors may tend to stick to their original judgments even when given new information contradicting these judgments.

As stereotypes may influence expectations investors hold about IPO performance, they may increase demand for IPOs in industries with stereotypically high underpricing and decrease demand for IPOs in industries with stereotypically low underpricing. As demand is positively related to underpricing and IPO supply is inelastic, stereotypical industry underpricing may positively affect underpricing in future IPOs. Hence I hypothesize that:

H1: Stereotypical industry underpricing is positively related to underpricing

Similarly, if stereotypical industry underpricing affects demand, then it should also be positively related to a demand proxy such as share turnover on the first-trading day. Hence I hypothesize that:

H2: Stereotypical industry underpricing is positively related to demand as proxied by share turnover on the first-trading day.

If these hypotheses hold, a new question arises: how come that issuers do not take advantage of situations in which there is excess demand, by adjusting offer prices such that any excess demand

is taken advantage of? Ljungqvist, Nanda, and Singh (2006) explain why issuers may choose not to *fully* take advantage of excess demand. In their model, there are two type of investors. The first type of investors is an institutional investor that buys IPO stocks directly from the issuer against the offer price. This type of investor is a regular investor, in the sense that he or she is repeatedly involved in the IPO market. The second type of investors is a retail investor who can only obtain IPO stock by buying it from the regulars after the initial offering has taken place. This second type of investor is occasionally exuberant about IPOs, but his or her exuberance may disappear relatively quickly. The regular investors obtain trading gains by buying stocks at the IPO offer price, and selling these on to the exuberant retail investors who offer them prices above the offer price.

Ljungqvist, Nanda, and Singh (2006) show that it is optimal for issuers to only *partly* capitalize on these trading gains, as the regular investors need to be compensated for the risk involved with the fact that the exuberance of the retail investors is fleeting. The regular investors run the risk of ending up with expensive shares in their inventory for which there is little demand. As the issuers only partly capitalize on the excess demand, underpricing follows.

Ljungqvist, Nanda, and Singh's (2006) model contains three additional testable predictions. First, the model implies that issuers do *partly* capitalize on excess demand by adjusting offer prices. Hence I expect the following hypothesis to hold:

H3: Stereotypical industry underpricing is positively related to price revisions

Second, according to the model, any excess demand is generated by retail non-institutional investors. Thus, the effect of stereotypical industry underpricing should be stronger for IPOs with little institutional investor ownership post-IPO and should be weaker for IPOs with much institutional ownership post-IPO. Hence I expect the following hypothesis to hold:

H4: The effect of stereotypical industry underpricing on underpricing is stronger for IPOs with less institutional ownership and weaker for IPOs with more institutional ownership.

Third, according to the model, any excess demand is fleeting and stock prices are expected to revert to their fundamental value in the long run. Hence I expect the following hypothesis to hold:

H5: Stereotypical industry underpricing is negatively associated with long-run stock performance.

II. Data and Methods

I obtain data on all U.S. IPOs for the period from 1990 until 2014. I obtain IPO dates, SIC codes, offer prices, price revisions, and IPO related control variables from SDC and age data from the Field-Ritter dataset of company founding dates accessed via Jay Ritter's website [3]. I remove all non-main tranches, and all firms that had more than one IPO in the sample, had SIC codes 49 or 60 (financial firms and utilities), or did not offer primary shares.

Subsequently I obtain return data, delisting returns and trading volume for all domestic common non-penny stock in the CRSP universe. I remove all IPOs that did not have a match in CRSP. In the merged data, I compare all IPO dates from SDC with the dates at which CRSP coverage begins and remove all IPOs for which these do not match.

Finally, I download market returns from CRSP. I take industry definitions from Kenneth French's website. My final sample consists of 5197 IPOs.

A. Underpricing

To calculate the underpricing (UP_{i,j,t_i}) of a particular IPO i in industry j at time t_i, I follow the literature (e.g., Ritter and Welch, 2002) and compute the return between the offer price (P_{offer},from SDC) and the first-day closing price (P_{close}, from CRSP):

$$UP_{i,j,t_i} = \frac{P_{i,j,t_i,close} - P_{i,j,t_i,offer}}{P_{i,j,t_i,offer}} \tag{1}$$

Table II shows summary statistics of underpricing. It contains the annual number of IPOs, the annual mean and median underpricing, and the annual standard deviation of underpricing. The number of IPOs fluctuates strongly over time, peaking in the mid-nineties and hitting the bottom in 2008. The mean level of underpricing also fluctuates strongly over time, peaking in the years 1999 and 2000 and hitting the bottom in 2008. This large variation is illustrated in Figure 1; this figure

[3] https://site.warrington.ufl.edu/ritter/ipo-data/. This website also contains corrections to the SDC data, which I apply.

shows the monthly average underpricing of all IPOs for the period from 1990 until 2014; a value of '1', implies a 100% increase in the stock price on the first day of trading. The 'dot-com' years immediately catch the attention by the huge average underpricing that exceeded 100% in multiple months. In comparison, the fluctuation in underpricing in other years may seem small, though this is a bit misleading. For instance, in the year 1994 underpricing was modest with underpricing only slightly above 0%, while in the year 1995 underpricing approached 40%.

There is also substantial time variation in cross-industry dispersion in underpricing. This can be seen in Figure 2. The figure shows the difference in average underpricing between the five Fama-French industries (Manufacturing, Consumer, High-Tech, Health and Other) for the years 1990 until 2014. Depending on the year, the dispersion varies greatly. In the dot-com years 1999 and 2000, tech IPOs had an average underpricing of 82% while health related IPOs had an average underpricing of 'only' 24%. In the year 1992, health related IPOs had an average underpricing of 13% while manufacturing related IPOs had a not so different average underpricing of 5%. In sum, there is much variation to explain.

B. Stereotypes

Stereotypical industry underpricing is formed based on underpricing in the industry j relative to underpricing in other industries $-j$. At each particular IPO i in j at time t_i, the first-day returns of all individual IPOs in j in the prior year are grouped together and form a distribution. The same holds for the first-day returns of all individual IPOs not in j in the prior year, which form the distribution of the contrast group. Similar to the example of Table I, the distribution of underpricing is cut up into three quantiles based on the distribution of the contrast group; this yields a 'low','medium', and 'high' return.

The choice for three quantiles is partly dictated by the data. To be able to calculate representativeness of the quantiles of the distribution reliably, a sufficient number of observations per quantile is required. So while more quantiles may make a stereotype more sophisticated, it also leaves fewer observations per quantile, making the estimates of the representativeness of the quantiles more noisy. This in turn would make stereotypes with more severe limits to recall more noisy relative to stereotypes with less severe limits to recall, and would bias against finding evidence in favor of stereotypes. Another reason for the choice of three quantiles is that it is simple and intuitive and

may better fit real world stereotyping.

For each quantile q, its representativeness for the IPOs in industry j is calculated as:

$$REP(q, j, t_i) = \frac{P(UP_{i,j,t} \in q | j = j_i, t = t_i - 250 : t_i - 1)}{P(UP_{i,j,t} \in q | j \neq j_i, t = t_i - 250 : t_i - 1)} \tag{2}$$

Due to limits to recall, only the d most representative quantiles are recalled when an investor forms expectations about industry underpricing; these d quantiles end up in the stereotype about industry j. In case $d = 1$ this can be more formally written as:

$$ST_{j,t_i} = \begin{cases} \overline{UP}_{i \in 1,j,t_i} & \text{if } argmax_q(REP(q, j, t_i)) == 1 \\ \overline{UP}_{i \in 2,j,t_i} & \text{if } argmax_q(REP(q, j, t_i)) == 2 \\ \overline{UP}_{i \in 3,j,t_i} & \text{if } argmax_q(REP(q, j, t_i)) == 3 \end{cases} \tag{3}$$

Here, $\overline{UP}_{i \in 1,j,t_i}$ equals the average over all underpricing within the most representative quantile. So, if for example the right tail of the underpricing distribution of industry j is most representative, q will equal 3, ST_{j,t_i} will be equal to the average underpricing in tercile 3, and underpricing will stereotypically be high. This stereotype creates time-varying cross-industry dispersion in expectations about underpricing and with that in demand for IPOs. It has the potential to contribute to explaining why underpricing at a certain time is much higher in IPOs in some industries rather than in IPOs in others.

How stereotypes may change over time is illustrated by looking at the distributions of tech IPOs versus non-tech IPOs, and how the resulting representativeness of the terciles changes over time. The 'dot-com' years 1999 and 2000 may be particularly interesting to look at; as can be seen in Figure 2 the average underpricing per industry diverged pronouncedly during that episode. Figure 3a shows the distribution of Tech IPOs (top, in red) and the distribution of IPOs in other industries (bottom, in blue) at the end of 1997. The blue lines indicate the percentiles that cut up the underpricing distributions into terciles, based on the distribution of underpricing of IPOs in the non-tech industries. For each tercile, the representativeness for recent IPOs of each underpricing quantile is calculated; the results are on the right in the top histogram. This figure shows that at the end of 1997, the high and the low returns are most representative for tech IPOs; in other

words, tech IPOs are stereotypically risky.

When progressing through time, the stereotype shifts. Figure 3b shows that by the end of 1998 the right tail of the distribution of underpricing in tech IPOs is still most representative, and that the middle of the road return has become more representative than the low return. Now, tech IPOs are stereotypically less risky and on top of that still have high returns. The new stereotype for tech IPOs becomes even more pronounced by the end of 1999 (Figure 3c), before the stereotype changes again in 2000 (Figure 3d): while the extreme right tail is still most representative at the end of 2000, the low return has become more representative than the middle of the road return. Tech IPOs are stereotypically risky again.

This example illustrates how stereotypes about underpricing change over time. Investors who suffer from limits to recall, may form their expectations about industry underpricing using these stereotypes and set their demand for future IPOs accordingly.

C. Long-run performance

Long-run performance for IPO i and industry j is calculated (similar to e.g., Ritter, 1991) as the annualized buy and hold return from the IPO date t_i up until time $t_i + h$, where h refers to the horizon over which long-run performance is evaluated:

$$LRP_{i,j,t_i} = \frac{\prod_{s=t_i}^{t_i+h}(1 + r_{i,j,s})}{h+1} \times 250 \tag{4}$$

Here $r_{i,j,s}$ is the return of firm i in industry j at time s. In case a firm delists in the horizon over which long-run performance is calculated, I include the delisting return in my calculations. When a delisting is related to performance and the delisting return is missing, I set the delisting return to -55% as is advised by Shumway and Warther (1999). I use raw returns rather than log-returns and correspondingly the product rather than the sum, as IPO (first-day) returns may sometimes be too large to let the approximate equality $log(1 + r) = r$ hold. I divide the returns by the horizon over which they are calculated, to allow for easy comparison across horizons. I multiply these average daily returns by 250 to allow them to be interpreted as annualized returns.

To correct for general market movements, I create measures of long-run performance in excess of the CRSP equal weighted market returns. I use the equal weighted market portfolio rather than

the value weighted market portfolio as it gives more weight to small stocks. The excess long-run performance for IPO i in industry j at time t_i with respect to benchmark the equal weighted market portfolio is calculated as:

$$LRP_{i,j,t_i,EW} = LRP_{i,j,t_i} - \frac{\prod_{s=t_i}^{t_i+h}(1+r_{EW,s})}{h+1} \times 250 \tag{5}$$

D. Turnover, price revision and controls

Following Krigman, Shaw, and Womack (1999), I calculate share turnover of IPO i in industry j on its first trading day t_i as the volume of shares traded (VOL_{i,j,t_i}) divided by the number of shares issued ($ShIss_{i,j,t_i}$):

$$Turnover_{i,j,t_i} = \frac{VOL_{i,j,t_i}}{ShIss_{i,j,t_i}} \tag{6}$$

I use the number of shares issued rather than the number of shares outstanding after the offering, as done in Krigman et al. (1999). The issued shares are traded at least once on the first day, and can be traded without problem, whereas the other shares are not necessarily available for trade, for example due to a lock-up agreement, or out of control considerations. As the fraction of shares that are retained by original owners for these purposes varies from IPO to IPO, the number of shares outstanding is not a great scaling factor. The turnover variable can be interpreted as the average number of times an issued share is traded on the first trading day.

Following e.g., Loughran and McDonald (2013), I calculate price revision of an IPO as the relative change from the original middle of the filing price range ($MFile_{i,j,t_i}$) to the eventual offer price ($P_{i,j,t_i,offer}$):

$$PrcRev_{i,j,t_i} = \frac{P_{i,j,t_i,offer} - MFile_{i,j,t_i}}{MFile_{i,j,t_i}} \tag{7}$$

This variable can be interpreted as the increase in the offer price during the bookbuilding process.

The rich literature on underpricing has identified multiple variables that may affect underpricing. One important class of control variables is the class of ex-ante risk factors, which play a role in asymmetric information models, principal-agent models, and signaling models. More risky firms

tend to require higher underpricing. There are multiple characteristics that may proxy for ex-ante risk; I use firm age (Loughran and Ritter, 2004; Ljungqvist and Wilhelm, 2003) from the Field-Ritter dataset of company founding dates, and firm size (Ritter, 1984), industry (e.g. Benveniste, Ljungqvist, Wilhelm, and Yu, 2003), the price-to-book ratio and the offer size from SDC.

Following Ljungqvist and Wilhelm (2003), I construct a dummy for the primary use of proceeds being operating expenses from data on use of proceeds from SDC; firms burning cash at a high rate may be riskier, requiring higher underpricing. I construct a dummy for high underwriter reputation (Carter and Manaster, 1990) from data on underwriters from SDC that equals one for IPOs in which the underwriter is in the top 20 of underwriters in terms of the number of IPOs underwritten. The involvement of high reputation underwriters may be an indication of quality and reduce underpricing, or it may indicate increased placement power and boost demand, increasing underpricing. Similarly, I include a dummy for venture capital involvement which may signal quality and reduce risk, potentially also reducing underpricing (Megginson and Weiss, 1991; Barry, Muscarella, Peavy, and Vetsuypens, 1990). Finally I include a dummy that indicates the presence of a syndicate managing the offer rather than a single underwriter, which may improve information production and reduce underpricing (Corwin and Schultz, 2005).

I control for the change in insider holdings (Spiess and Pettway, 1997), the participation ratio (the fraction of secondary shares offered relative to the pre-IPO shares outstanding) and the dilution factor (the fraction of primary shares offered relative to the pre-IPO shares outstanding), which all play a role in principal-agent models. I expect them to reduce underpricing, as more insider selling and more potential dilution will increase incentives to monitor pricing, reducing underpricing (Habib and Ljungqvist, 2001).

To proxy for supply side effects on pricing, I include the logarithm of the number of IPOs over the last year up to the date of the IPO; a large supply of IPOs may absorb demand and reduce underpricing. I control for average recent underpricing to account for the evidence that IPOs come in waves (Helwege and Liang (2004), Pastor and Veronesi (2005)) and that these waves have a dominant effect on underpricing, to account for any potential confounder that co-varies with the average level of underpricing, and to allow the stereotype variable to explain why underpricing is higher in some industries at certain times than in others. Finally, I include industry dummies as there may be differences in average underpricing between industries. These differences may arise

because some industries have riskier future cash flows than others, or because some industries are more prone to informational frictions.

E. Methods

I estimate the relation between stereotypes and underpricing using a set-up with controls and industry dummies:

$$UP_{i,j,t_i} = ST_{j,t_i,d} + C_{i,t_i} + UP_{\mu,t_i} + \log(N_{IPOs}) + D_j + \epsilon_{i,t_i} \tag{8}$$

Here UP_{i,j,t_i} is the observed underpricing of IPO i in industry j that takes place at time t_i; $ST_{j,t_i,d}$ is the stereotypical underpricing of industry j at time t_i with recall parameter d; C_{i,t_i} is the set of firm specific control variables; $\log(N_{IPOs})$ is the logarithm of the number of IPOs over the year prior to time t_i; UP_{μ,t_i} is the average level of underpricing over the year prior to time t_i; and D_j are industry dummies. I cluster the errors by industry, as error terms may be correlated within industries because of industry specific trends or developments.

To investigate to what extent the stereotypes formed on past underpricing suffer from limited recall, I estimate the above regression with stereotypes allowing for different values for the limits-to-recall parameter d. If $d \neq 3$, I test whether it is significantly different from $d = 3$ using a likelihood ratio test.

F. Remarks on endogeneity

The theory of stereotypes imposes substantial structure on how investors form expectations based on recent underpricing. In the IPO context, the theory allows for little room to mitigate potential endogeneity concerns by exploiting an exogenous shock. However, there are strong arguments why stereotypical industry underpricing is not endogenous to current firm underpricing. First, simultaneity as a source of endogeneity is unlikely to be an issue here. Stereotypical industry underpricing and current firm underpricing are not determined in equilibrium; stereotypical industry underpricing is a function of recent underpricing and is known *before* firm underpricing of the upcoming IPO is realized.

Second, any measurement error is likely to either be absorbed by the controls or to bias re-

gressions against finding a result. Stereotypical industry underpricing is a function of recent underpricing. If there is some structural time-varying measurement error in underpricing that might cause a spurious relation between stereotypical industry underpricing, it would be absorbed by the variable concerning the average level of recent underpricing that is included in each regression. In case there is random measurement error, this may bias against finding a positive relation rather than the opposite.

Third, omitted variable bias is unlikely to be a source of endogeneity. The industry dummies take care of any omitted industry specific effect, the average level of recent underpricing absorbs any time-varying omitted variables that affect overall underpricing, and the host of control variables proxy for the most prominent alternative explanations from the literature. Moreover, stereotypical industry underpricing changes non-linearly when representativeness has shifted enough for a different part of the underpricing distribution to enter the stereotype. These changes are particular to stereotypes and are arguably unlikely to be correlated to any omitted variable.

III. Results

A. Underpricing

To investigate the effect of stereotypical industry underpricing on firm underpricing, I run regressions of firm underpricing on stereotypes, controls, and general market conditions with errors clustered by industry. The results are in table III. Specification (1) shows that stereotypical industry underpricing is significantly positively related to firm underpricing when controlling for firm characteristics and general market conditions. The economic effect is large: a 1% increase in stereotypical industry underpricing is associated with an increase in underpricing of 0.32%; alternatively, a 1 standard deviation increase in stereotypical industry underpricing is accompanied by an increase in underpricing of 0.21 standard deviations. The limit to recall parameter d equals 2; the likelihood-ratio test indicates that d is significantly different from the null hypothesis of d equal to 3.

These results indicate that stereotypical industry underpricing is strongly associated with underpricing of IPOs within that industry. The test on the limits to recall parameter indicates that these stereotypes are significantly different from rational expectations formed on recent industry

underpricing. Both findings combined support the idea that investors use stereotypes in forming their expectations about industry underpricing and that they only focus on the most representative parts of the underpricing distribution within the industry, rather than the whole distribution.

The firm characteristics show that younger firms tend to suffer significantly more underpricing than older firms, and is in line with findings by Loughran and Ritter (2004) and Ljungqvist and Wilhelm (2003), while firm size and the price to book value per share do not seem to affect underpricing.

In specification (2) and (3), offer characteristics are included as controls. These specifications show that a reputable underwriter increases underpricing, in line with findings by Loughran and Ritter (2004), and support the idea that IPOs with a reputable underwriter have a larger investor pool to tap from and reach more potential demand. Gross proceeds are also positively related to underpricing in line with findings by Loughran and Ritter (2004), as raising larger sums of money from investors may require steeper discounts to get the marginal investors across the line. The primary use of proceeds being operating expenditures does not have a significant effect, contrary to the idea put forward by Ljungqvist and Wilhelm (2003) that these firms are ex-ante more risky. Venture backing of an IPO seems to positively affect IPO underpricing, which goes against the idea that venture capital involvement signals quality and reduces risk (Megginson and Weiss, 1991; Barry et al., 1990). Finally, syndication seems to negatively affect underpricing in line with the idea that it improves information production and thus lowers underpricing, as found by Corwin and Schultz (2005).

In specification (4), insider selling variables are included as controls. The participation ratio negatively affects underpricing, in line with the idea that pre-IPO shareholders with a larger stake in the game will bargain harder about pricing and thus reduce underpricing, as predicted by Habib and Ljungqvist (2001). The change in insider holdings and the dilution factor do not seem to affect underpricing, which goes against previous findings in Ljungqvist and Wilhelm (2003) and Spiess and Pettway (1997) obtained on specific sub-samples.

General market conditions are included in each of the specifications (1-4). The logarithm of the number of IPOs in the past year is indeed strongly negatively related to underpricing, in line with the idea that a large supply of IPOs implies that less investor demand remains unfulfilled, decreasing underpricing. The average underpricing over the recent year is strongly positively related to current

underpricing, in line with the findings that there is persistence in underpricing (e.g., Helwege and Liang, 2004; Pastor and Veronesi, 2005).

In specification (5), all controls are included without stereotypical industry underpricing. Firm size is now negatively related to firm underpricing, in line with the idea that larger firms are less opaque and easier to price, reducing ex-ante risk. The participation ratio is not significant anymore; the dilution factor seems to be positively and significantly related to underpricing, contrary to expectations, but this effect disappears again in specification (6). Interesting to note in specification (5) is the strong reduction in the effect of the number of IPOs when stereotypical industry underpricing is not included. This may occur in a situation in which demand is not adequately proxied for; it points at the demand side channel through which stereotypical industry underpricing has its effect.

Finally, in specification (6) all controls are included. In each of the above specifications, the effect of stereotypical industry underpricing remains stable; the limits-to-recall parameter d consistently and significantly indicates the presence of limits to recall. All in all, stereotypical industry underpricing seems to offer an explanation for firm underpricing that is complementary to existing explanations in the literature.

Summing up, stereotypical industry underpricing is significantly positively related to IPO underpricing, both economically as well as statistically, and is significantly different from rational expectations about industry underpricing. This effect is unchanged when controlling for other explanations from the literature. These findings confirm hypothesis H1 and suggest that underpricing is partly explained by boundedly rational demand side factors.

B. Turnover

To test hypothesis H2 that stereotypical industry underpricing indeed affects underpricing via an increase in demand, I run regressions with turnover on the first trading day as dependent variable; each of these regressions again includes various controls, and has errors clustered by industry. Specification (1) of table IV shows that stereotypical industry underpricing is significantly positively related to turnover when controlling for firm characteristics and general market conditions. The limits-to-recall parameter d equals 2, which implies that again limits to recall are present. The economic effect of stereotypical industry underpricing is substantial: a 1 standard deviation increase

results in a 0.12 standard deviations increase in turnover. These findings support the idea that demand is positively related to industry stereotypes.

To account for potentially confounding factors, I add the offer characteristics and insider selling variables to the regressions in the specifications (2-4) and (6). None of the controls significantly affect the relation between stereotypical industry underpricing and turnover. Interestingly, specification (6) shows that most of the variables that are significant in the underpricing regressions are also significant and have the same sign in the turnover regressions. The determinants of firm underpricing are similar to the determinants of turnover, suggesting that firm underpricing and demand are intimately linked. All in all, these results are in line with hypothesis H2 and show that demand is strongly positively related to stereotypical industry underpricing.

C. Price Revision

My results so far suggest that stereotypical industry underpricing affects firm underpricing through demand, and that the stereotypes differ significantly from rational expectations formed on recent industry underpricing. According to Ljungqvist, Nanda, and Singh (2006), issuers partly exploit any potential excess demand by raising offer prices. I expect any deficit demand either to be incorporated into offer prices or to result in canceled IPOs. Hence, I expect stereotypical industry underpricing to be positively related to offer prices.

To test this, I run regressions with price revision on the left hand side. The results are shown in table V. Specification (1) shows that stereotypical industry underpricing indeed significantly and positively affects price revisions when controlling for firm characteristics and general market conditions. The economic magnitude is non-negligible: a 1% increase results in a 0.07% increase in the offer price; equivalently a 1 standard deviation increase results in a 0.14 standard deviation increase in the offer price. The estimated limits-to-recall parameter d equals 2, implying that the stereotypes are again not fully rational. These findings support the idea that issuers indeed partly incorporate demand generated by stereotypes by adjusting offer prices.

To account for potentially confounding factors, I add the offer characteristics and insider selling variables to the regressions in the specifications (2-4) and (6). None of the controls significantly affect the relation between stereotypical industry underpricing and turnover. Looking at specification (6), the effects of the controls are of similar sign and significance as those in the regressions

with underpricing as dependent variable with the exceptions of: the dummy indicating the use of proceeds being operating expenses, the dummy indicating the presence of a high reputation underwriter, the dummy indicating whether a syndicate underwrites the IPO, and average past underpricing. The use of proceeds being operating expenses is significantly associated with lower price revisions; neither the involvement of a high reputation underwriter, venture capital backing, nor the average past underpricing are related to price revisions.

In each of specifications (1-4) and (6), the limits to recall parameter equals either 1 or 2 and is significantly different from full recall. Overall, these results provide evidence that hypothesis H3 holds and supports the idea that higher stereotypical underpricing affects demand that is partly incorporated by issuers through adjusting offer prices.

D. Institutional ownership

The model of Ljungqvist, Nanda, and Singh (2006) predicts that IPOs with a large share of non-institutional investors post-IPO should be more affected by stereotypes than IPOs with a small share of non-institutional investors. To test this prediction, I construct post-IPO institutional ownership from 13-F fillings and split up the sample of IPOs with 13-F information around the median of post-IPO institutional ownership. Mean (median) institutional ownership is 0.22 (0.19). I run regressions of firm underpricing on stereotypical industry underpricing, controls, and general market conditions with clustering on industries. Specifications (1-4) and (6) of panel A of table VI show the results of those regressions for the sample with high institutional ownership post-IPO. They show that only occasionally there is a significant effect of stereotypical industry underpricing on firm underpricing; moreover, the limits-to-recall parameter d is only sometimes equal to 2 and never significantly different from 3, the situation with full recall. These results show that there is no consistent effect of stereotypical industry underpricing on firm underpricing.

Specifications (1-4) and (6) of panel B show results of the same regressions for the sample with low institutional ownership post-IPO. Stereotypical industry underpricing is positively and significantly related to firm underpricing in each specification. The economic magnitude of the effect is larger than in the full sample regressions: a 1% increase in stereotypical industry underpricing is associated with an increase in firm underpricing between 0.40% and 0.51%. The limits-to-recall parameter equals 2 consistently and full recall is rejected systematically. These results provide

support for hypohtesis H4 and are in line with the idea that stereotypes are held more by non-institutional investors than by more sophisticated institutional investors.

E. Long-run performance

The results so far provide support for the story that stereotypical industry underpricing affects demand, and that this is incorporated partly in the offer price and for the rest in underpricing on the first trading day. However, while stereotypical industry underpricing may positively affect stock prices in the short run, stock prices should revert back to their fundamental values in the long-run according to Ljungqvist, Nanda, and Singh (2006).

To test this prediction, I run two-stage least squares regressions of IPO long-run performance on underpricing and on price revisions, both instrumented by stereotypical industry underpricing. I calculate long-run performance as annualized buy-and-hold returns in excess of the equal weighted CRSP universe over periods varying in length from 1 to 3 years. For the regressions with underpricing, I calculate long-run performance starting from the *closing* price on the first trading day. For the regressions with price revision, I calculate long-run performance starting from the *offer* price. Table VII show the result of these regressions.

Specification (1) of panel A shows that long-run performance measured over one year is significantly positively related to the part of underpricing that is explained by stereotypical industry underpricing. The economic magnitude is large: an increase in fitted underpricing of 1% results in an increase in stock price performance of 0.54%. It indicates that over a relatively short horizon of 1 year, stereotypical industry underpricing positively affects stock prices through underpricing. Specification (2) shows that the sign flips when long-run performance is measured over a period of two years. Now fitted underpricing is significantly negatively related to long-run performance. An increase of 1% in fitted underpricing results in a decrease in annualized stock price performance of 0.48%. Specification (3) shows a similar story where long-run performance is measured over 3 years; an increase of 1% in fitted underpricing results in a decrease in annualized stock price performance of 0.52%.

In specification (4-6) of panel A similar regressions are run, but now with firm underpricing added to the set of explanatory variables. The results from specifications (1-3) are qualitatively unchanged: the part of underpricing explained by stereotypical industry underpricing still has the

same effect as in specifications (1-3) both statistically and economically. [4]

Panel B contains the results of two-stage least squares regressions of long-run performance on the part of price revision explained by stereotypical industry underpricing. Specification (1) shows that the coefficient of fitted price revision has a positive sign, but is not significant. Specification (2) shows that the sign flips as expected, but still fitted price revision is not significant. However, in specification (3) fitted price revision is significantly negatively related to long-run performance, as expected. The economic magnitude is large: an increase in fitted price revision of 1% results in a decrease in average annualized stock performance of 2.8%.

Specifications (4-6) of panel B have price revision added to the set of explanatory variables. The results from specifications (1-3) are qualitatively unchanged: the part of underpricing explained by stereotypical industry underpricing still has the same effect as in specifications (1-3) both statistically and economically. Interestingly, the effect of price revision, i.e. the part that is *not* explained by stereotypical industry underpricing, is consistently positive and significant.[5] This would be in line with the idea that in a world stripped of non-rational behavior with risk-averse investment banks, a noisy positive signal on firm quality would result in a positive price revision as well as a positive return after the stock is trading.

Overall, the coefficients show signs that are in line with expectations. Moreover, the parts of underpricing and price revision that are explained by stereotypical industry underpricing both have a significant negative effect on long-run stock performance with large economic magnitude. It supports hypothesis H5 that stereotypical industry underpricing affects stock performance negatively on the long-run.

[4] In panel A, it is hard to cleanly separate the effect of stereotypical industry underpricing that runs via underpricing, from the effect that runs via price revisions. The coefficient of fitted underpricing may also reflect part of the effect of stereotypical industry underpricing that is incorporated in price revisions. The regressions are interesting nonetheless, as the absence of any result would be informative.

[5] In panel B, the effect of stereotypical industry underpricing that runs via price revisions is more cleanly identified. Long-run performance is measured from the offer price rather than the closing price. If the coefficient reflects any effect of stereotypical industry underpricing that runs via underpricing, the effect likely biases the coefficient towards zero rather than in the opposite direction.

F. Robustness checks

F.1. Overfitting

As the structure imposed by the theory of stereotypes is quite specific, there is little reason to believe that the results are driven by overfitting; particularly as the hypothesized effects of stereotypical industry underpricing on the other dependent variables are similarly confirmed. On the other hand, there may be concerns that stereotypical industry underpricing may just be picking up persistence in industry underpricing, even though the null of $d == 3$ is rejected in-sample, and that the in-sample rejection of $d == 3$ is due to sample selection bias and is a characteristic of the current sample.

To test this, I perform an out-of-sample forecasting analysis and compare a simple model for underpricing, that consists of stereotypical industry underpricing and general market conditions, to the same model with the restriction that the limits-to-recall parameter d equals 3. In the restricted model there are no limits-to-recall, the stereotype variable equals average industry underpricing, and underpricing is solely explained by persistence in underpricing.

I use an expanding estimation-sample with start sizes varying from 30% to 70% of the full sample size. Iteratively, I estimate both models in-sample on the data within the estimation-sample, make for each model a one-step-ahead out-of-sample forecast, and expand the estimation-sample with one observation. If the effect of stereotypical industry underpricing presented in tabel III were a result of overfitting, the out-of-sample forecasts of the stereotype model would be further off from the corresponding true underpricing values than the out-of-sample forecasts of the more basic persistence model. If the effect of stereotypical industry underpricing were not a result of overfitting, the forecasts of the stereotype model would be closer to the true underpricing values than the forecasts of the more basic persistence model.

Table VIII shows mean squared prediction errors (MSPEs) of the forecasts of both models. For each estimation-sample start size, the MSPE of the stereotype model is lower than the MSPE of the more basic persistence model. It indicates that the forecasts of the stereotype model are closer to the true underpricing values, and that the additional restriction on the limits to recall in the persistence model is hurting forecasting performance. The Diebold-Mariano (Diebold and Mariano, 1995) test statistics confirm this and show that the out-of sample forecasting performance

of the unrestricted model is significantly better than that of the restricted model, for all estimation-sample start sizes with the exception of the 70% sample start sizes. Overall, these findings imply that overfitting does not drive the results.

G. Hot markets, cold markets, dot-com years and non-dot-com years

In the IPO market there are periods with high volume and high underpricing, characterized as hot markets, and periods with low volume and low underpricing, characterized as cold markets (Helwege and Liang (2004)). When underpricing is high, the differences in the underpricing distribution between industries may become more pronounced; when underpricing is lower on average, the differences may become smaller. Accordingly, stereotypes about industry underpricing may be stronger in hot markets and weaker in cold markets.

To investigate this, I determine whether months are hot or cold by calculating a centered moving average of IPO volume per month, with a window of 3 months. I do so by first calculating the number of IPOs per month. For each month, I subsequently calculate the average over the number of IPOs in the months prior, concurrent, and after. I divide the resulting centered moving average of IPO volume into terciles, discarding the middle tercile and labeling the high volume months 'hot' and the low volume months 'cold'. Terciles are calculated separately for the periods 1990-2000 and 2001-2014, as there is a sharp drop in overall IPO volume around the split.

Specification (1) and (2) of table IX show the results of regressions of underpricing on stereotypical industry underpricing in hot and cold markets, respectively. Specification (1) shows that stereotypical industry underpricing is significantly positively related to underpricing in hot markets. The limits to recall parameter equals 2 and is significantly different from 3, indicating the presence of limits to recall. In cold markets, the coefficient in front of stereotypical industry underpricing is small, negative and insignificant. These findings support the idea that the effect of stereotypes is weaker in cold markets and stronger in hot markets.

Another interesting issue is whether the effect of stereotypical industry underpricing on firm underpricing is particular to the dot-com years 1999 and 2000. In these years underpricing reached record highs and for these years there is ample anecdotal evidence of boundedly rational behavior. To investigate this, I split up the sample into dot-com-years and non-dot-com years. Specification (3) and (4) of table IX show the results of regressions of underpricing on stereotypical industry

underpricing for these subsamples. Specification (3) shows that the effect of stereotypical industry underpricing is positive and significant. The limits to recall parameter d equals 2, but it is not significantly different from 3; this may be due to the relatively small number of observations in the regression. Specification (4) shows that the effect of stereotypical industry underpricing is also positive and significant. The limits to recall parameter d equals again to 1 and is now significantly different from 3. Overall, I find no evidence that the effect of stereotypical industry underpricing is particular to the dot-com years; based on these results it seems even that the effect is stronger outside of the dot-com years.

H. Industries

Some industries may be more sensitive to stereotypes than others, for instance due to being more opaque. Along those lines, I would expect consumer and manufacturing industries to be less affected by stereotypes, and high-tech and health to be more affected by stereotypes. IPOs in the 'Other' category may either be less sensitive to stereotypes as they belong to a less coherent industry group, or more sensitive to stereotypes as they may be more opaque due to belonging to a more mixed industry group.

Table X shows the result of regressions of underpricing on stereotypical industry underpricing and controls, for sub-samples based on industry. Specifications (1) and (2) contain the results for consumer and manufacturing industries; in neither of the specifications the coefficient of stereotypical industry underpricing is significant. Specifications (3) and (4) contain the results for high-tech and health IPOs; in both specifications the effect of stereotypical industry underpricing is positive and significant. The limits to recall parameter d equals 2 and 1 respectively, and is significantly different 3. Specification (5) contains the results for other IPOs; the coefficient of stereotypical industry underpricing is positive and significant. The limits to recall parameter d equals 2, but is not significantly different from 3.

These results show that the effect of stereotypical industry underpricing is mainly concentrated in high-tech and health IPOs, and perhaps to some extent in other IPOs. The effect is not present in the less opaque consumer and manufacturing industries.

IV. Conclusion

In this paper, I show that firm underpricing is strongly related to stereotypical industry underpricing. I further show that demand, as proxied for by first-day turnover, is also positively related to stereotypical underpricing and that the effect of stereotypical underpricing seems to mainly originate from non-institutional investors. The increased demand from stereotypical underpricing is partly taken advantage of by issuers through raising offer prices. The parts of offer price changes and first-day returns that are due to stereotypical industry underpricing are negatively related to post-IPO stock performance measured over horizons of 2 and 3 years. These results are in line with predictions of the model of Ljungqvist, Nanda, and Singh (2006).

These findings are supportive of a demand side explanation of IPO underpricing. They support a view in which investors use stereotypes as a heuristic to determine their expectations about underpricing in future IPOs, and with that, their demand for stocks in future IPOs. They challenge a view in which underpricing is solely a result of rational deliberations regarding e.g. information asymmetries or risk. The implications of these results are that there are inefficiencies in the way capital gets allocated during IPOs.

The effects of stereotypical industry underpricing on firm underpricing and price revision may comprise only a part of the potential effect of stereotypes. It is possible that the original offer price set by the investment bank is already taking into account demand generated by stereotypes, even before it is further adjusted during the book building process. In the current set-up, that is difficult to measure.

There are two ways in which the effect of stereotypes on pricing may be mitigated. Firstly, better information provision to potential investors may reduce limits-to-recall, which may allow investors to form better expectations about future underpricing and set demand accordingly. Secondly, fewer restrictions on short selling stock may allow traders that suffer less from limits-to-recall to counter any excess demand generated by traders holding stereotypes, and may deter issuers from exploiting any excess demand in the first place.

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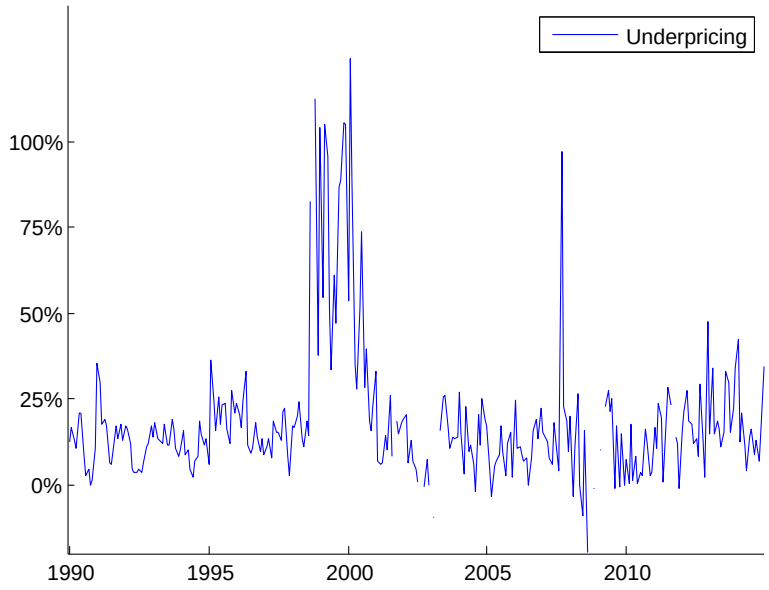


Figure 1. Average underpricing per month over the period 1990-2014.

This figure shows the average underpricing per month in the U.S. over the period 1990-2014. The y-axis shows the levels of underpricing, where a value of 100% implies a first-day return of 100%; the x-axis shows the time. Underpricing is calculated as the return from the IPO offer price to the closing price on the first day of trading. Data on IPOs is obtained from SDC; first day closing prices are obtained from CRSP.

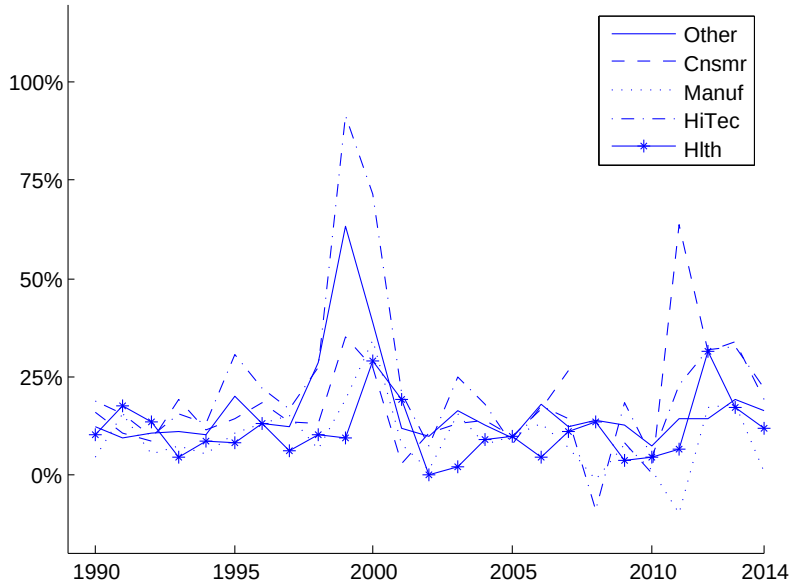
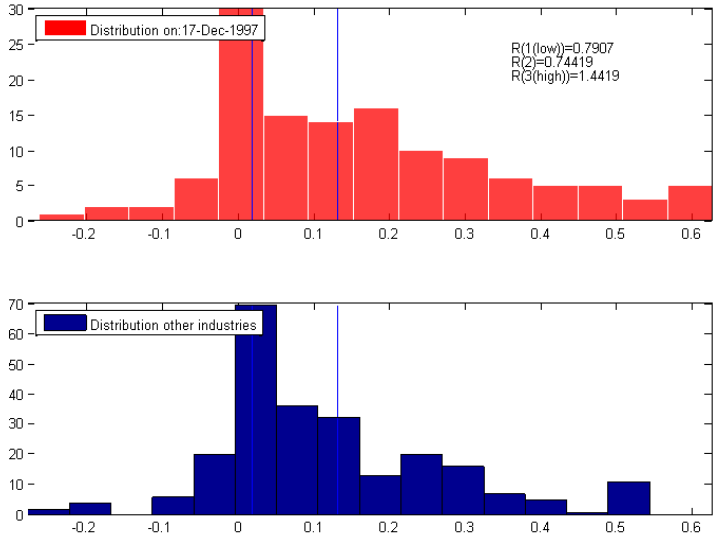
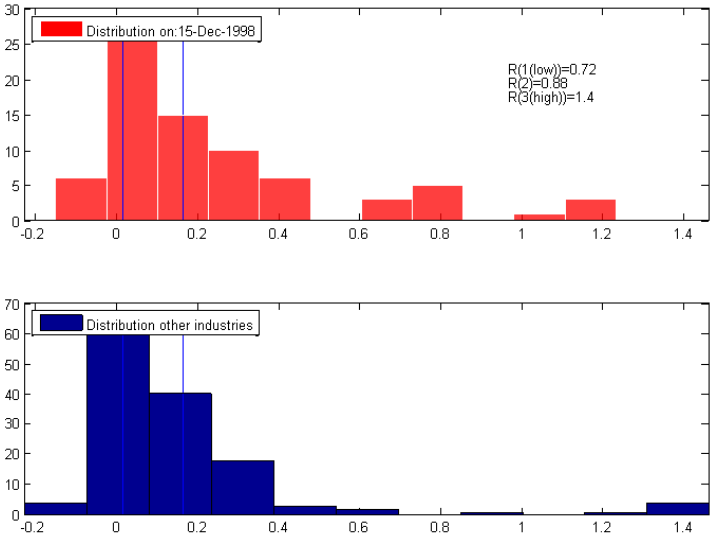


Figure 2. Average underpricing per industry per year over the period 1990-2014.

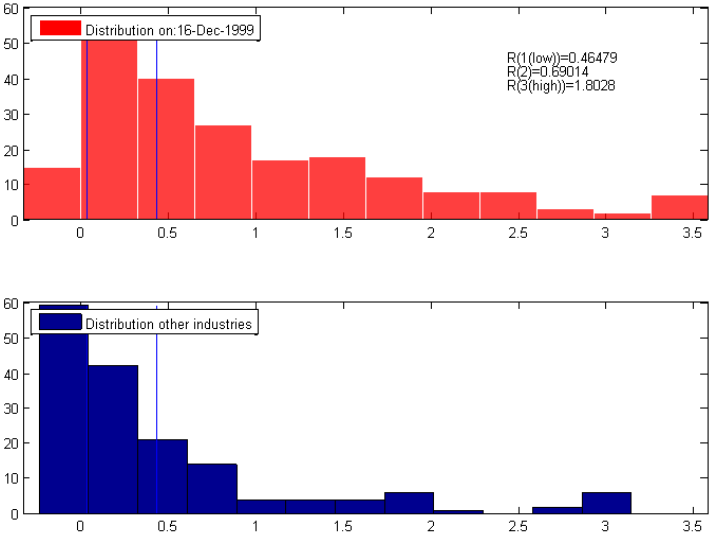
This figure shows the average underpricing per industry per year in the U.S. over the period 1990-2014. The 5 Fama-French industries are used to categorize IPOs. The y-axis shows the levels of underpricing; the x-axis shows the years. Underpricing is calculated as the return from the IPO offer price to the closing price on the first day of trading. Data on IPOs is obtained from SDC; first day closing prices are obtained from CRSP.



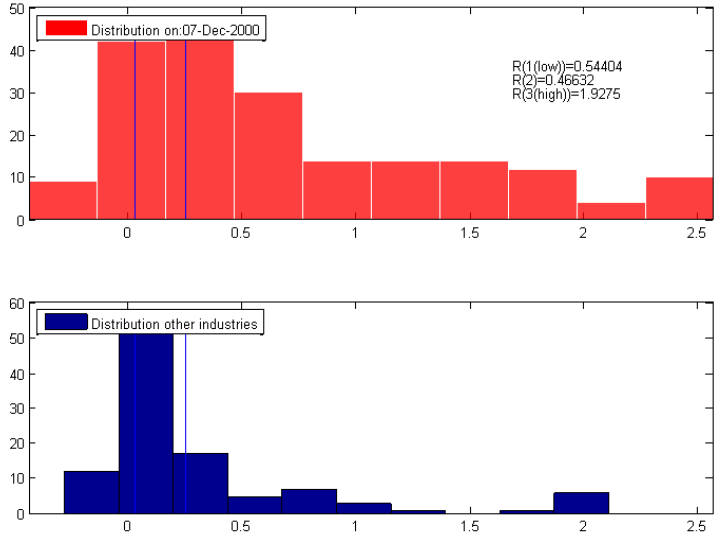
(a) Histograms at the end of 1997



(b) Histograms at the end of 1998



(c) Histograms at the end of 1999



(d) Histograms at the end of 2000

Figure 3. Histograms of underpricing in the tech industry versus histograms of underpricing in other industries, at different points in time.

This figure contains 4 panels that each show the histogram of IPO underpricing in the tech industry (at the top of each panel in red) and the histogram of IPO underpricing in other industries (at the bottom of each panel in blue) at a specific moment in time. Within each panel, the y-axis shows the number of IPOs; the x-axis shows the level of underpricing where a level of 0.1 implies an underpricing of 10%. The vertical lines denote terciles, calculated on the bottom histogram of each panel, that divide the top histogram into a low, medium and high return. The numbers in the top right corner of each panel denote the representativeness of each return for IPOs in the tech industry. The 5 Fama-French industries are used to categorize IPOs into industries. Underpricing is calculated as the return from the IPO offer price to the closing price on the first day of trading. Data on IPOs is obtained from SDC; first day closing prices are obtained from CRSP.

Table II: Summary statistics of underpricing

This table reports the number of IPOs, the average underpricing , the median underpricing and the standard deviation of underpricing by year of U.S. IPOs in the period from 1990 until 2014. Underpricing is calculated as the return from the IPO offer price to the closing price on the first day of trading. Data on IPOs are obtained from SDC; first day closing prices are obtained from CRSP.

Year	N_{IPOs}	mean(%)	median(%)	st.dev.(%)
1990	124	12.3	6.7	17.3
1991	290	13.5	8.3	18.7
1992	414	9.7	3.6	18.9
1993	521	13.3	6.3	22.0
1994	404	10.2	5.0	18.7
1995	425	21.2	12.5	28.0
1996	601	17.1	10.6	25.2
1997	378	13.6	9.3	20.1
1998	216	22.5	10.7	53.2
1999	382	73.4	42.6	95.2
2000	290	58.1	28.7	79.3
2001	51	14.2	13.5	15.9
2002	49	7.3	2.7	17.1
2003	52	14.9	13.9	15.0
2004	136	12.4	7.4	17.7
2005	124	9.1	5.5	14.3
2006	121	13.7	9.1	21.7
2007	119	13.5	7.6	23.1
2008	16	6.5	-2.1	21.2
2009	32	11.0	5.7	17.0
2010	75	6.6	2.0	14.3
2011	62	14.2	15.0	18.6
2012	85	17.7	10.9	23.9
2013	112	21.1	13.1	29.2
2014	133	15.9	7.2	30.5

Table III: Regressions of underpricing on stereotypical industry underpricing.

This table contains the results of non-linear least squares regressions of IPO underpricing on stereotypical industry underpricing. Underpricing of IPO i in industry j at time t_i, UP_{i,j,t_i}, is calculated as the return from the IPO offer price (from SDC) to the closing price on the first day of trading (from CRSP). Stereotypical industry underpricing of industry j at time t_i is the average of the d most representative terciles of the distribution of recent underpricing of industry j. The parameter d is the limits-to-recall parameter that determines how much of the full underpricing distribution of industry j is incorporated into the stereotype about industry underpricing. Other independent variables cover firm characteristics, offer characteristics, insider selling and general conditions. Variable defintions are in the appendix. Each regression includes 2-digit SIC code dummies. The last row contains the results of likelihood-ratio tests of the null-hypothesis that d equals 3. Significance at the 10%, 5% and 1% is indicated by *,**, and *** respectively, based on standard errors clustered by 2-digit SIC codes.

Dependent variable	UP_{i,j,t_i}					
	(1)	(2)	(3)	(4)	(5)	(6)
$ST_{j,t_i,d}$	0.315***	0.370***	0.336***	0.359***		0.383***
Firm Characteristics						
Age	-0.002***				-0.001***	-0.001***
log(Total Assets)	0.005				-0.027**	-0.027***
Price/Book Value Per Share	0.000				0.000	0.000
Offer Characteristics						
$D_{High\ Rep\ Underwriter}$		0.052**			0.037*	0.041*
$D_{Use\ Of\ Proceeds=OPEX}$		-0.105			-0.044	-0.061
Gross Proceeds		0.032*			0.065**	0.077***
$D_{Venture\ Backed}$			0.096***		0.042***	0.040**
$D_{Syndicated}$			-0.050**		-0.072***	-0.088***
Insider Selling						
Change Insider Stake				0.001	0.000	0.000
Dilution Factor				-0.003	0.000***	0.000
Participation Ratio				-0.063*	-0.004	-0.002
General Conditions						
$\log(N_{IPOs})$	-0.140***	-0.105***	-0.125***	-0.130***	-0.034***	-0.149***
UP_{μ,t_i}	0.461***	0.404***	0.478***	0.207***	0.480***	-0.003
Industry Controls	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit
N_{obs}	2,372	3,652	3,718	2,252	2,068	1,860
R^2	0.15	0.16	0.15	0.11	0.12	0.17
d	2	2	2	2	NA	2
LR-test (H0: d equals 3)	5.06**	13.02***	9.40***	4.99**	NA	8.48***

Table IV: Regressions of turnover on stereotypical industry underpricing.

This table contains the results of non-linear least squares regressions of share turnover on the first trading day on stereotypical industry underpricing. First-day share turnover of IPO i in industry j at time t_i, $\text{Turnover}_{i,j,t_i}$, is calculated by dividing the volume of shares traded on the first trading day (from CRSP) by the number of shares issued at the IPO (from SDC). Stereotypical industry underpricing of industry j at time t_i is the average of the d most representative terciles of the distribution of recent underpricing of industry j. The parameter d is the limits-to-recall parameter that determines how much of the full underpricing distribution of industry j is incorporated into the stereotype about industry underpricing. Other independent variables cover firm characteristics, offer characteristics, insider selling and general conditions. Variable defintions are in the appendix. Each regression includes 2-digit SIC code dummies. The last row contains the results of likelihood-ratio tests of the null-hypothesis that d equals 3. Significance at the 10%, 5% and 1% is indicated by *,**, and *** respectively, based on standard errors clustered by 2-digit SIC codes.

Dependent variable	$Turnover_{i,j,t_i}$					
	(1)	(2)	(3)	(4)	(5)	(6)
$ST_{j,t_i,d}$	0.272***	0.331***	0.284***	0.320**		0.286***
Firm Characteristics						
Age	-0.004***				-0.001	-0.002***
log(Total Assets)	0.043***				-0.040*	-0.054***
Price/Book Value Per Share	0.000				0.000	0.000
Offer Characteristics						
$D_{High\ Rep\ Underwriter}$		0.184***			0.134***	0.127***
$D_{Use\ Of\ Proceeds=OPEX}$		0.009			-0.023	0.011
Gross Proceeds		0.088***			0.161***	0.205***
$D_{Venture\ Backed}$			0.203***		0.092***	0.098***
$D_{Syndicated}$			0.187***		0.072	0.046
Insider Selling						
Change Insider Stake				0.001	0.000	0.000
Dilution Factor				-0.022*	0.000***	0.000
Participation Ratio				0.255***	-0.015	-0.018
General Conditions						
$\log(N_{IPOs})$	-0.309***	-0.217***	-0.262***	-0.325***	-0.082**	-0.305***
UP_{μ,t_i}	1.176***	0.992***	1.122***	1.081***	1.196***	0.720***
Industry Controls	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit
N_{obs}	2,371	3,652	3,652	2,252	2,068	1,860
R^2	0.26	0.27	0.26	0.19	0.25	0.30
d	2	2	2	2	NA	2
LR-test (H0: d equals 3)	7.96***	15.13***	11.82***	4.84**	NA	3.57*

Table V: Regressions of price revision on stereotypical industry underpricing.

This table contains the results of non-linear least squares regressions of offer price revision on stereotypical industry underpricing. Offer price revision of IPO i in industry j at time t_i, Price Revision$_{i,j,t_i}$, is calculated as the percentage change from the mid point of the filing range to the IPO offer price (both from SDC). Stereotypical industry underpricing of industry j at time t_i is the average of the d most representative terciles of the distribution of recent underpricing of industry j. The parameter d is the limits-to-recall parameter that determines how much of the full underpricing distribution of industry j is incorporated into the stereotype about industry underpricing. Other independent variables cover firm characteristics, offer characteristics, insider selling and general conditions. Variable defintions are in the appendix. Each regression includes 2-digit SIC code dummies. The last row contains the results of likelihood-ratio tests of the null-hypothesis that d equals 3. Significance at the 10%, 5% and 1% is indicated by *,**, and *** respectively, based on standard errors clustered by 2-digit SIC codes.

Dependent variable	$PrcRev_{i,j,t_i}$					
	(1)	(2)	(3)	(4)	(5)	(6)
$ST_{j,t_i,d}$	0.073**	0.067*	0.107*	0.105**		0.151***
Firm Characteristics						
Age	-0.001				-0.001**	-0.001**
log(Total Assets)	0.003				-0.039***	-0.040***
Price/Book Value Per Share	0.000				0.000	0.000
Offer Characteristics						
$D_{High\ Rep\ Underwriter}$		0.015			0.013	0.009
$D_{Use\ Of\ Proceeds=OPEX}$		-0.056			-0.054*	-0.064*
Gross Proceeds		0.045***			0.112***	0.119***
$D_{Venture\ Backed}$			0.034**		-0.007	-0.005
$D_{Syndicated}$			-0.005		-0.071***	-0.071***
Insider Selling						
Change Insider Stake				0.000	0.000	0.000
Dilution Factor				-0.004	-0.003	-0.004
Participation Ratio				0.071*	0.005	0.010
General Conditions						
log(N_{IPOs})	-0.129***	-0.116***	-0.116***	-0.147***	-0.132***	-0.143***
UP_{μ,t_i}	0.068	-0.028	0.009	-0.059	-0.085*	-0.252***
Industry Controls	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit
N_{obs}	1,870	2,801	2,801	1,797	1,622	1,564
R^2	0.04	0.08	0.04	0.04	0.15	0.17
d	1	1	2	1	NA	2
LR-test (H0: d equals 3)	3.48*	4.18**	3.40*	5.30**	NA	3.66*

Table VI: Regressions of underpricing on stereotypical industry underpricing, given institutional ownership.

This table consists of two panels that contain results of non-linear least squares regressions of IPO underpricing on stereotypical industry underpricing for different sub-subsamples. Panel A contains results for the sub-sample of IPOs with above median institutional ownership; panel B contains results for the sub-sample of IPOs with below median institutional ownership. Institutional ownership is calculated from 13F-filings obtained from Thomson Reuters. Underpricing of IPO i in industry j at time t_i, UP_{i,j,t_i}, is calculated as the return from the IPO offer price (from SDC) to the closing price on the first day of trading (from CRSP). Stereotypical industry underpricing of industry j at time t_i is the average of the d most representative terciles of the distribution of recent underpricing of industry j. The parameter d is the limits-to-recall parameter that determines how much of the full underpricing distribution of industry j is incorporated into the stereotype about industry underpricing. Other independent variables cover firm characteristics, offer characteristics, and general conditions. Variable defintions are in the appendix. Each regression includes 2-digit SIC code dummies. The last row contains the results of likelihood-ratio tests of the null-hypothesis that d equals 3. Significance at the 10%, 5% and 1% is indicated by *,**, and *** respectively, based on standard errors clustered by 2-digit SIC codes.

Panel A: High institutional investor ownership

Dependent variable	UP_{i,j,t_i}					
	(1)	(2)	(3)	(4)	(5)	(6)
$ST_{j,t_i,d}$	0.406	0.232**	0.246***	0.406		0.599**
Firm Characteristics						
Age		-0.002**			-0.001***	-0.001***
log(Total Assets)		-0.019***			-0.038**	-0.056***
Offer Characteristics						
$D_{High\ Rep\ Underwriter}$			-0.005		-0.001	-0.011
Gross Proceeds			0.028**		0.106***	0.138***
$D_{Venture\ Backed}$				0.078***	0.066***	0.078***
$D_{Syndicated}$				-0.163***	-0.039	-0.050
General Conditions						
$\log(N_{IPOs})$	-0.036*	-0.046**	-0.022	-0.048**	0.011	-0.006
UP_{μ,t_i}	0.325	0.513*	0.437*	0.302	0.582***	0.007
Industry Controls	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit
N_{obs}	951	765	946	951	1,382	763
R^2	0.12	0.14	0.13	0.13	0.15	0.17
d	3	2	2	3	NA	3
LR-test (H0: d equals 3)	-	0.37	0.72	-	NA	-

Panel B: Low institutional investor ownership

Dependent variable	UP_{i,j,t_i}					
	(1)	(2)	(3)	(4)	(5)	(6)
$ST_{j,t_i,d}$	0.511***	0.455***	0.480***	0.488***		0.514***
Firm Characteristics						
Age	-0.005***				-0.003**	-0.004***
log(Total Assets)	0.033*				-0.035**	-0.036**
Offer Characteristics						
$D_{High\ Rep\ Underwriter}$		0.070			0.046	0.074*
Gross Proceeds		0.094**			0.152***	0.207***
$D_{Venture\ Backed}$			0.148***		0.102***	0.108***
$D_{Syndicated}$			-0.061		-0.156**	-0.243***
General Conditions						
$\log(N_{IPOs})$	-0.223***	-0.157***	-0.200***	-0.205***	0.031	-0.167***
UP_{μ,t_i}	0.228***	0.211**	0.284***	0.340***	0.689***	-0.006
Industry Controls	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit
N_{obs}	975	1,241	1,244	1,244	1,330	975
R^2	0.14	0.16	0.15	0.14	0.15	0.20
d	2	2	2	2	NA	2
LR-test (H0: d equals 3)	4.98**	5.45**	5.09**	5.90**	NA	5.47**

Table VII: Regressions of long-run performance on stereotypical industry underpricing.

This table contains two panels with the results of regressions of long-run performance on fitted underpricing $\widehat{UP}_{i,j,t_i}$ and fitted price revision $\widehat{PrcRev}_{i,j,t_i}$. In panel A long-run performance, $LRP_{i,j,t_i+1,EW}$, is calculated as the annualized buy and hold return in excess of the equal weighted CRSP universe from the *closing price* at the end of the first trading day until one, two or three years later; in panel B long-run performance,$LRP_{i,j,t_i,EW}$, is calculated as the annualized buy and hold return in excess of the equal weighted CRSP universe from the *offering price* at the end of the first trading day until one, two or three years later. The regressions are estimated using two-stage least squares with stereotypical industry underpricing as instrument for underpricing (panel A) and price revision (panel B). In the first stage regression the variable to be fitted is excluded from the independent variables. Independent variables include underpricing, price revision, firm characteristics, offer characteristics and general conditions. Variable definitions are in the appendix. Each regression includes 2-digit SIC code dummies. Significance at the 10%, 5% and 1% is indicated by *,**, and *** respectively, based on standard errors clustered by 2-digit SIC codes and corrected for first-stage estimation uncertainty in the fitted variables $\widehat{UP}_{i,j,t_i}$ and $\widehat{PrcRev}_{i,j,t_i}$.

Panel A: Underpricing and long-run performance excluding first-day returns

Dependent variable	$LRP_{i,j,t_i+1,EW}$					
	(1): one year	(2): two years	(3): three years	(4): one year	(5): two years	(6): three years
$\widehat{UP}_{i,j,t_i}$	0.536**	-0.479**	-0.517**	0.558**	-0.443*	-0.482**
UP_{i,j,t_i}				-0.023	-0.037*	-0.035**
Firm Characteristics						
Age	0.001	-0.001	-0.001	0.001	-0.001	-0.001
log(Total Assets)	0.026**	0.035***	0.033***	0.025**	0.034***	0.032***
Offer Characteristics						
$D_{High\ Rep\ Underwriter}$	0.178***	0.095***	0.039	0.179***	0.097***	0.041
Gross Proceeds	0.021	0.023	0.019	0.023	0.027*	0.022
$D_{Venture\ Backed}$	0.079	0.106**	0.066***	0.081	0.109**	0.069***
$D_{Syndicated}$	0.059	0.069	0.101**	0.057	0.065	0.097**
General Conditions						
$\log(N_{IPOs})$	-0.048	0.211**	0.187**	-0.050	0.207**	0.183*
UP_{μ,t_i}	-1.032***	-0.553***	-0.144	-1.025***	-0.542***	-0.134
Industry Controls	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit
N_{obs}	2,783	2,783	2,783	2,783	2,783	2,783
R^2	0.04	0.03	0.03	0.04	0.03	0.03

Panel B: Price Revision and long-run performance including first-day returns

Dependent variable	$LRP_{i,j,t_i,EW}$					
	(1): one year	(2): two years	(3): three years	(4): one year	(5): two years	(6): three years
$\widehat{PrcRev}_{i,j,t_i}$	0.403	-3.077	-2.790*	0.120	-3.351	-2.979*
$PrcRev_{i,j,t_i}$				0.284**	0.274	0.189*
Firm Characteristics						
Age	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
log(Total Assets)	0.019	0.025*	0.019	0.030*	0.035**	0.026*
Offer Characteristics						
$D_{High\ Rep\ Underwriter}$	0.258***	0.256**	0.092	0.251***	0.249**	0.087
Gross Proceeds	0.045**	0.001	0.023	0.016	-0.027	0.003
$D_{Venture\ Backed}$	0.095*	0.113***	0.125***	0.094*	0.111***	0.124***
$D_{Syndicated}$	0.016	0.082	0.122*	0.030	0.096	0.132*
General Conditions						
$\log(N_{IPOs})$	0.167**	0.405***	0.380***	0.201***	0.438***	0.403***
UP_{μ,t_i}	-0.421*	0.088	0.438***	-0.382	0.125	0.464***
Industry Controls	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit
N_{obs}	2,025	2,025	2,025	2,240	2,236	2,230
R^2	0.03	0.04	0.03	0.04	0.03	0.02

Table VIII: Out-of-sample mean squared prediction errors.

This table shows mean squared prediction errors for IPO underpricing of an out-of-sample forecasting analysis. The base model consists of general market conditions (2-digit SIC code fixed effects, the average level of underpricing in the year up to the IPO, the logarithm of the number of IPOs in the year up to the IPO) and stereotypical industry undepricing. Underpricing of IPO i in industry j at time t_i, UP_{i,j,t_i}, is calculated as the return from the IPO offer price (from SDC) to the closing price on the first day of trading (from CRSP). Stereotypical industry underpricing of industry j at time t_i is the average of the d most representative terciles of the distribution of recent underpricing of industry j. The parameter d is the limits-to-recall parameter that determines how much of the full underpricing distribution of industry j is incorporated into the stereotype about industry underpricing. Variable definitions are in the appendix. The base model is estimated both with varying d and with d fixed to equal 3. An expanding window approach is used with varying estimation-sample start sizes. Diebold-Mariano tests are presented that test the null hypothesis of equal forecasting performance.

Dependent Variable:	UP_{i,j,t_i}	
Estimation-sample start size	Model	
30%	MSPE: d estimated	0.637
	MSPE: d equals 3	0.653
	DM-test statistic	7.11***
40%	MSPE: d estimated	0.714
	MSPE: d equals 3	0.736
	DM-test statistic	8.20***
50%	MSPE: d estimated	0.891
	MSPE: d equals 3	0.915
	DM-test statistic	6.94***
60%	MSPE: d estimated	1.234
	MSPE: d equals 3	1.269
	DM-test statistic	6.58***
70%	MSPE: d estimated	1.238
	MSPE: d equals 3	1.246
	DM-test statistic	1.05

Table IX: Regressions of underpricing on stereotypical industry underpricing in hot markets, cold markets, dot-com years, and non-dot-com years.

This table contains the results of non-linear least squares regressions of IPO underpricing on stereotypical industry underpricing for IPOs taking place in hot markets, cold markets, dot-com years or non-dot-com years. Hot and cold markets are determined by dividing a series of centered 3 month moving averages of IPO volume into terciles, discarding the middle tercile and labelling the high volume months 'hot' and the low volume months 'cold'. Terciles are calculated separately for the periods 1990-2000 and 2001-2014. Dot-com years are defined to be the years 1999 and 2000, non-dot-com years the rest. Underpricing of IPO i in industry j at time t_i, UP_{i,j,t_i}, is calculated as the return from the IPO offer price (from SDC) to the closing price on the first day of trading (from CRSP). Stereotypical industry underpricing of industry j at time t_i is the average of the d most representative terciles of the distribution of recent underpricing of industry j. The parameter d is the limits-to-recall parameter that determines how much of the full underpricing distribution of industry j is incorporated into the stereotype about industry underpricing. Other independent variables cover firm characteristics, offer characteristics, and general conditions. Variable defintions are in the appendix. Each regression includes 2-digit SIC code dummies. The last row contains the results of likelihood-ratio tests of the null-hypothesis that d equals 3. Significance at the 10%, 5% and 1% is indicated by *,**, and *** respectively, based on standard errors clustered by 2-digit SIC codes.

Dependent variable	UP_{i,j,t_i}			
	(1): Hot	(2): Cold	(3): Dot-com	(4): Non-Dot-com
$ST_{j,t_i,d}$	0.390***	-0.091	0.128***	0.117***
Firm Characteristics				
Age	-0.002***	-0.006*	-0.011***	-0.001***
log(Total Assets)	-0.016	-0.033	-0.038**	-0.025**
Offer Characteristics				
$D_{High\ Rep\ Underwriter}$	0.048**	0.275***	0.058*	0.070**
Gross Proceeds	0.069***	0.103**	0.408***	0.041***
$D_{Venture\ Backed}$	0.081***	0.095**	0.344***	0.013
$D_{Syndicated}$	-0.094***	-0.097	-0.313	-0.056**
General Conditions				
$\log(N_{IPOs})$	0.017	-0.356	1.375**	-0.072***
UP_{μ,t_i}	0.656***	0.427	-3.032***	0.204
Industry Controls	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit
N_{obs}	1,481	385	565	2,254
R^2	0.21	0.14	0.18	0.06
d	2	1	2	1
LR-test (H0: d equals 3)	6.58**	0.45	0.59	5.35**

Table X: Regressions of underpricing on stereotypical industry underpricing for different industries.

This table contains the results of non-linear least squares regressions of IPO underpricing on stereotypical industry underpricing for different industries, defined using the Fama-French 5 industry definitions. Underpricing of IPO i in industry j at time t_i, UP_{i,j,t_i}, is calculated as the return from the IPO offer price (from SDC) to the closing price on the first day of trading (from CRSP). Stereotypical industry underpricing of industry j at time t_i is the average of the d most representative terciles of the distribution of recent underpricing of industry j. The parameter d is the limits-to-recall parameter that determines how much of the full underpricing distribution of industry j is incorporated into the stereotype about industry underpricing. Other independent variables cover firm characteristics, offer characteristics and general conditions. Variable defintions are in the appendix. Each regression includes 2-digit SIC code dummies. The last row contains the results of likelihood-ratio tests of the null-hypothesis that d equals 3. Significance at the 10%, 5% and 1% is indicated by *,**, and *** respectively, based on standard errors clustered by 2-digit SIC codes.

Dependent variable	UP_{i,j,t_i}				
	(1): Cnsmr	(2): Manuf	(3): HiTec	(4): Hlth	(5): Other
$ST_{j,t_i,d}$	0.199	0.538	2.527***	0.217**	0.339*
Firm Characteristics					
Age	-0.001***	-0.001***	-0.009***	0.000	-0.002**
log(Total Assets)	-0.024*	-0.025*	-0.041**	-0.004	-0.019
Offer Characteristics					
$D_{High\ Rep\ Underwriter}$	0.064	-0.044***	0.077***	-0.011	0.060
Gross Proceeds	0.053*	0.050*	0.194***	0.048**	0.051
$D_{Venture\ Backed}$	0.018	0.017	0.127***	-0.014	0.149***
$D_{Syndicated}$	-0.058***	0.014	-0.191*	-0.120*	-0.085*
General Conditions					
$\log(N_{IPOs})$	-0.161	-0.185***	-0.054	-0.035**	-0.092**
UP_{μ,t_i}	0.188	0.061	-2.823***	0.297	0.278***
Industry Controls	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit	SIC 2 digit
N_{obs}	549	167	1,108	273	722
R^2	0.10	0.14	0.26	0.10	0.10
d	1	3	2	1	2
LR-test (H0: d equals 3)	4.59**	-	11.32***	3.95**	1.26

Appendix: Variable definitions and data sources

Variable	Description	Source
Dependent variables		
UP_{i,j,t_i}	The return from the offer price to closing price at the end of the first day of trading. I remove all non-main tranches, companies with more than one IPO in the sample, companies with SIC codes 49 and 60 (financial and utility firms), and companies that did not offer primary shares.	SDC, CRSP, own computations
$Turnover_{i,j,t_i}$	The volume of shares traded on the first trading day divided by the number of shares issued at the IPO. I remove all non-main tranches, companies with more than one IPO in the sample, companies with SIC codes 49 and 60 (financial and utility firms), and companies that did not offer primary shares.	SDC, CRSP, own computations
$PrcRev_{i,j,t_i}$	The percentage change from the original middle of the filing price range to the final offer price. I remove all non-main tranches, companies with more than one IPO in the sample, companies with SIC codes 49 and 60 (financial and utility firms), and companies that did not offer primary shares.	SDC, CRSP, own computations
$LRP_{i,j,t_i,EW}$	The annualized buy-and-hold return from the IPO until 1-5 years after the offering in excess of the CRSP equal weighted market portfolio. I follow the advise by (Shumway and Warther, 1999) in dealing with delistings. I use raw returns rather than log-returns and correspondingly the product rather than the sum, as IPO (first-day) returns may sometimes be too large to let the approximate equality $log(1+r) = r$ hold.	SDC, CRSP, own computations

Variable	Description	Source
Independent variables		
$ST_{j,t_i,d}$	Stereotypical industry underpricing that is equal to the average underpricing of the d most representative parts of the industry underpricing distribution. The underpricing distributions of a particular industry at a specific time consists of underpricing of all IPOs within that industry that took place over the last year.	SDC, CRSP, own computations
Age	The age of the firm at the time of its IPO.	Field-Ritter dataset
log(Total Assets)	The logarithm of the book value of total assets in the year prior to the IPO.	SDC, own computations
Price/Book Value Per Share	The offer price divided by the book value per share prior to the IPO	SDC
log(Gross Proceeds)	The logarithm of the total dollar amount of proceeds of the IPO.	SDC, own computations
$D_{Venture\ Backed}$	A dummy that equals one if the IPO is backed by venture capital	SDC
$D_{Syndicated}$	A dymmy that equals one if the IPO is managed by a syndicate of underwriters	SDC
$D_{Use\ of\ Proceeds==OPEX}$	A dummy that equals one if the use of proceeds equals operating expenses, and zero otherwise.	SDC, own computations
$D_{High\ Rep\ Underwriter}$	A dummy that equals one if the underwriter is a high reputation underwriter, and zero otherwise. An underwriter that is in the top 20 of underwriters in terms of the number of IPOs underwritten is deemed a high reputation underwriter.	SDC, own computations
Change Insider Stake	The change in insider holdings at the IPO, calculated as the difference between post IPO insider holdings and pre-IPO insider holdings	SDC, own computations
Dilution Factor	The fraction of primary shares issued with respect to shares outstanding before the IPO	SDC, own computations
Participation Ratio	The fraction of secondary shares issued with respect to shares outstanding before the IPO	SDC, own computations
$log(N_{IPOs})$	The logarithm of the number of IPOs over last year up to the date of the IPO.	SDC, own computations
UP_{μ,t_i}	The average level of underpricing in the last year up to the date of the IPO.	SDC, CRSP, own computations