Relative Price ≠ Relative Value:

Anchoring to Industry Multiples in IPO Pricing

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ABSTRACT

We develop a hypothesis where IPO offer prices are anchored to industry peer multiples and the dependence on reference price weakens through market participation. This hypothesis predicts initial compression in valuations: IPOs with multiples higher than their industry peers should experience better-than-average first-day returns. In line with the hypothesis, the subsample of IPOs priced at an EV/EBITDA multiple above their peers shows +3.0% abnormal first-day returns. IPOs with a multiple lower than industry peers should expect lower-than-average first-day returns. This subsample shows -7.6% abnormal first-day-returns. As predicted by anchoring, the effect sizes are proportional to the log of relative valuation distance. This aspect of IPO pricing does not explain long-run returns (high initial returns by this measure do not subsequently do more poorly), and is orthogonal to previous findings such as partial adjustment, prospect theory, and sentiment.

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I. Introduction

We propose a new behavioral microfoundation for initial public offering (IPO) first-day returns. Issuers and their advisors focus on industry peer multiples as a reference point in the process of deciding on the listing price. Prior to public trading, there are strong limits to arbitrage and a limited number of participants in the pricing process. Once public trading commences and a larger number of participants become involved, the effect of the initial reference point weakens. This idea leads to a three-part testable hypothesis. Companies with multiples-based valuations above their industry peers should experience higher initial market returns. Conversely, companies with multiples below their industry peers should experience lower initial market returns. Finally, companies with multiples at or close to their industry peers should experience no anchoring effect after controls.

Any claim of an additional explanation for initial IPO returns needs to be disentangled from numerous existing ones. In particular, first-day returns have been shown to correlate with price changes during the offering process, i.e. partial adjustment (Benveniste and Spindt, 1989), preceding public market returns in a manner consistent with prospect theory (Loughran and Ritter, 2002), and time-varying sentiment (Baker and Wurgler, 2007). The ideal experiment to test for anchoring would be to randomly assign informationally irrelevant reference prices to successive IPOs. If valuation multiples were influenced by these irrelevant reference multiples, one could conclude that price judgments appear "anchored." What we have, instead, are reference prices that may covary with previous explanations of overall underpricing in IPOs, or previously unexplored explanations. In our analysis, we can directly control for partial adjustment, preceding public market returns, and various forms of sentiment.

The valuation of a private company is a challenge in the best of cases. In an IPO, this challenge is exacerbated as the issuing firm is often young, rapidly growing, and has limited financial history. Moreover, given the relative rarity of IPO events for any given issuer or banker, there is little opportunity to learn through feedback from past mistakes. The IPO setting therefore provides significant reasons to observe persistent biases in valuation, including anchoring.

Pricing using comparables is an industry-standard approach to value IPOs by applying the price ratios of existing firms to the relevant measure of the listing firm to arrive at a suggested price for the new firm. The IPO valuation process typically opens with analysis of multiples of comparable IPOs, multiples of comparable traded securities, possibly multiples of comparable mergers and acquisitions, as well as projected discounted cash flows. Multiples tend to dominate this process, as typical IPO companies are young companies for which it is particularly difficult to forecast future cash flows (see Kim and Ritter (1999) for a review).[1]

Another reason for expecting anchoring towards industry multiples could be the additional defensive purposes that a valuation close to similar companies provides.[2] Overtly relying (and possibly over-relying) on comparables may provide benefit in potential litigation over fair value. In terms of communication with pre-IPO owners, comparables also provide a simple-to-explain foundation for the pricing chosen, while more idiosyncratic pricing exposes the advisors' pricing logic to multiple potential criticisms.

If valuation multiples of comparable firms play a role in determining appropriate offer prices, IPO valuations could be held back by comparable firms' multiples. Such insufficient adjustment of numerical judgments from salient reference points is widely documented as anchoring. Anchoring is said to occur when individuals overweight contextual information provided by a preceding cue value (the anchor), beyond the point of an anchor's normative relevance.

To test for anchoring to comparable multiples, we calculate the distance of the issuing firm's EV/EBITDA multiple to an average of its industry peers as our baseline explanatory variable.[3] We test and find that, consistent with anchoring, initial differences from an industry reference point predict initial market returns. In order to more thoroughly test this hypothesis, we differentiate three cases where the listing company is priced above, at, or below peer multiples.

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[1] See also standard valuation textbooks such as Rosenbaum and Pearl (2013) and lecture notes on valuation for MBAs such as Damodaran (2016). One does not have to look far to find evidence of practitioner reliance on relative value comparisons for IPO pricing. The latest IPO report from boutique IPO advisory firm Renaissance Capital's website states: "The proposed valuation is rich relative to its online education peers." Firms themselves often depend on comparables: "under the market approach, we estimated our [Business Enterprise Value] by deriving multiples of equity or invested capital to EBITDA for selected publicly traded comparable companies" (Sprouts).

[2] See Wertheimer (1998) for a discussion of how courts appraise fair value in shareholder litigation.

[3] We also use for P/E ratios and P/EBITDA ratios and find similar results.

The first type of case is the most straightforward. When the listing company is priced at multiples above its peers, under anchoring its valuation will on average have been influenced downwards from its "true" valuation by the reference price. Therefore, for this subsample, we expect a positive first day return. In addition, the farther the anchor, the stronger its pull, therefore we expect a larger valuation difference to predict a larger positive change in first-day returns, holding other things constant. In line with prior literature, we do not expect this effect to be linear, but to diminish in line with the log of distance.

In the second type of case, the listing company is priced at or close to the average of its industry peers. Under anchoring, we should observe no relationship to first-day returns. Note that as anchoring does not rule out alternative explanations of IPO underpricing, we may still observe positive first-day returns.

In the third type of case, the listing company is priced below the average multiples of its industry peers. In this case, we expect the anchor to have pulled the listing price upwards and to observe a lower-than-average first-day return. Similarly as in the first type of case, we expect a larger distance to the anchor to be associated with a larger effect size, and that this pull weakens with the log of distance.

For all of our analysis we use industry-standard, commercially available, data sources, with Thomson Reuters SDC providing the master list of IPOs. We merge this list with earnings data from Compustat for issuing firms and their industry peers, market data from CRSP, and analyst earnings estimates from I/B/E/S.

To test our predictions it becomes crucial to approximate the same forward-looking earnings multiples practitioners would have also been looking at, rather than easier-to-obtain, backwards-looking multiples. To construct forward-looking multiples, we follow a number of different approaches: using the average relationship of growth in earnings to revenues and preceding changes in earnings, or by assuming perfect foresight and using ex-post realisations of earnings. For our main specification, we simply use the most recent earnings data prior to IPO. While backwards-looking, these have the benefit of no further researcher input into their construction.[4]

[4] We are in the process of adding analysis based on observed I/B/E/S forward-looking earnings to this working paper.

In our first test exploiting the cross-section of first day returns, we define the 'distance' of an IPO from its comparables as the log ratio of the IPO's EV/EBITDA multiple to its industry average. We find a positive and significant economic relationship between this variable and an IPO's initial market return. One standard deviation in 'distance' approximately corresponds to a 6% difference in first-day returns on average.

The main relationship replicates when we move to tests with our approximations of forward-looking multiples. The relationship does not appear to be driven by outliers. Simply examining offerings below versus above comparable valuations shows that those offerings estimated to have been offered at valuations below comparables (an average of 7.6 compared to a peer average EV/EBITDA of 10.1), and hence likely to have seemed "cheap", have 5.5% lower first day returns than the average 13.5% in this sample, while those above comparables (an average EBITDA multiple of 21 compared to a peer average of 10.1) and hence seemingly "expensive", exhibit 3% greater returns than the average.

We proceed to rule out possible alternative explanations of the results, such as covariance of the valuation distance measure with a previously studied factor in IPO first-day returns. The relationship between valuation distance and first-day returns is robust to controlling for price changes during the offering process (Benveniste and Spindt, 1989), public market returns preceding the IPO (Loughran and Ritter, 2002), time-varying sentiment (Baker and Wurgler, 2007), year/month controls, and serial correlation in IPO returns. The coefficient of valuation distance remains economically large even with the introduction of these additional controls.

The rest of this paper is organized as follows. Section II describes our hypothesis and differentiates it from existing models of IPO pricing. Section III describes the dataset used, and Section IV reviews baseline results. Section V discusses a number of alternative explanations for the results, and Section VI concludes.

II. Anchoring Hypothesis of IPO Pricing

The first subsection develops a hypothesis of anchoring-based IPO pricing. The second subsection differentiates the hypothesis from existing explanations.

II.A. Anchoring Hypothesis

As the best available approximation for the unbiased true value from experimental settings, we assume that the observed price $\hat{v}_{i,j}$ of an IPO at the end of the first day of public trading for stock *i* in industry *j* is an unbiased estimate of some fundamental value v_i (this will be relaxed later):

$$\hat{v}_{ij} = v_i + \tilde{\eta}_i$$

The initial, first day market return is defined as follows with respect to the offering price v_i^O:

$$Day\ 1\ Return_{\ i} \stackrel{\text{def}}{=} \left(\frac{\hat{v}_i}{v_i^O} - 1\right)$$

Some potential models of offer price-setting follow:

<u>Efficient IPO valuation</u>[5]

$$v_i^O = v_i + \tilde{\varepsilon}_i$$

where v_i^O *is the observed offering price and* $\tilde{\varepsilon}_i$ *is white noise in the market's valuation.*

<u>IPO valuation with underpricing</u>

$$v_i^O(1+\alpha) = v_i + \tilde{\varepsilon}_i$$

where α *is the average underpricing* $(\alpha > 0)$*, initially assumed constant across issues.*

<u>IPO valuation initially anchored to industry averages</u>

$$v_{ij}^O(1+\alpha) = \overline{v}_j + \beta(v_i - \overline{v}_j) + \tilde{\varepsilon}_{ij}$$

where v_i *is the firm's price/earnings multiple and* $\overline{v}_j$ *an average of publicly traded comparables in industry j. When a() is a linear anchoring response function (Chapman Johnson 1994),* $\beta = (1 - a')$.

[5] In our empirical tests, we will adjust first day IPO returns by a market index. The results of analysis do not change.

We define compression in IPO valuations towards an industry average as follows: the greater the ratio of the offering valuation multiple to its industry average$\left(\frac{v_i^O}{\overline{v_J}}\right)$, the greater the expected ratio of the first market close to offering valuation multiple, i.e. the greater the Day 1 Return. Over the range of values where certain restrictions hold on an anchor response function *a* $(0<a'<1,\ a''=0)$, anchoring is guaranteed to imply a consistent compression in valuations.[6] We use this in the following testable hypothesis of a relationship of offering price-to-earnings multiples to Day 1 Returns:

Hypothesis 1 - If offer prices are anchored to industry averages, β is positive as defined in the model below:

$$Day\ 1\ return_{ijt} = \alpha + \beta \cdot \ln\left(\frac{v_i^O}{\overline{v_J}}\right) + \tilde{\varepsilon}_{ijt}$$

where v_i^O is the price/earnings multiple of firm i at the offer price and $\overline{v_J}$ is an average of valuation multiples from industry j (not including firm i) as of the last market close prior to the IPO.

[6] An illustrative proof of this in the non-stochastic linear anchoring case follows. Let $\hat{v}$ be the unbiased valuation, i.e. close of market price at the end of day 1. The offering price v^O is anchored to the median industry value $\overline{v}$ with the functional form $v^O = \overline{v} + \beta(\hat{v} - \overline{v})$ where $0 < \beta < 1$.

The first day return is: $\frac{\hat{v}}{v^O} - 1 = \frac{\hat{v}}{\overline{v}+\beta(\hat{v}-\overline{v})} - 1 = \frac{\hat{v}/\overline{v}}{1+\beta(\frac{\hat{v}}{\overline{v}}-1)} - 1$

Differentiating the first day return with respect to $\hat{v}/\overline{v}$:

$$\frac{d(Day\ 1\ Return)}{d\left(\hat{v}/\overline{v}\right)} = \frac{1-\beta}{\left(1+\beta\left(\hat{v}/\overline{v}-1\right)\right)^2} > 0$$

Since the ratio of the offering value to the median comparable $v^O/\overline{v} = 1 + \beta(\hat{v}/\overline{v} - 1)$, if the derivative of Day 1 Return with respect to $\hat{v}/\overline{v}$ is positive, then the derivative of the Day 1 Return with respect to $v^O/\overline{v}$ is also positive. For purposes of hypothesis testing we take a log of this ratio. As the log function is a monotonic transformation, the derivative of the first day return with respect to $\log(v^O/\overline{v})$ is also positive.

Analysis using a log of the ratio is consistent with the diminishing marginal effects of anchoring for distant ratios, allows results to be comparable with previous IPO valuation literature, and can be interpreted in the usual statistical fashion as improving analysis in the presence of outliers in the data. After winsorization, max(P/EBITDA) in the sample is still > 700, while typical ranges are under 20.

This simple framework tests whether initial market returns are consistent with anchoring. This assumes that end of day market prices are proxies for the unanchored price of a stock, and that the level of underpricing is constant across issues.

In order to relax the assumption of constant underpricing across issues, and to address existing explanations of IPO pricing, we also present results from the second model below. This second model incorporates δ_M to control for unincorporated public information (the S&P 500 return over the offering period) as in the Prospect Theory model of Loughran and Ritter (2002), δ_S as a coefficient on the Baker Wurgler (2007) time-varying sentiment index to capture sentiment as a potential time-varying common factor in first day returns, and δ_P for the percent change in price from the original filed price to eventual offering price to differentiate findings from the Partial Adjustment model of Benveniste and Spindt (1989).

Hypothesis 2 – Anchoring in offer prices is still observable (β positive), after orthogonalising day 1 returns to other models of IPO pricing in the model below

$$\begin{aligned} &Day\ 1\ return_{ijt} \\ &\qquad = \alpha + \beta \cdot \ln\left(\frac{v_i^O}{\overline{v_j}}\right) + \delta_M(offering\ period\ market\ return_{it}) \\ &\qquad + \delta_S(sentiment\ index_t) + \delta_P(\%\ offering\ period\ IPO\ price\ change_i) \\ &\qquad + \tilde{\varepsilon}_{ijt} \end{aligned}$$

The framework presented so far is not able to distinguish a subtly different alternative where industry comparables inform bad priors. “Bad Bayesian” analysts, with an incorrect white-noise prior on the distribution of potential Price/Earnings multiples, generate a (noisy) signal from their valuation process for the appropriate price of a stock. If their prior is persistently incorrect and based on the current distribution of Price/Earnings multiples in the industry rather than an accurate distribution of potential IPO valuations—with higher variance and mean owing to higher expected growth rates of IPO firms—then this alternative would also arrive at offer valuations compressed to an industry average.

II.B. Previously Documented of IPO Pricing

Established models explaining stylized facts of IPO pricing, such as historical first-day returns of approximately 12% in the US, include those employing asymmetric information such as the partial adjustment model (Benveniste and Spindt, 1989). In the partial adjustment model, investors are incentivized to truthfully reveal the information they possess during the offering process, by being rewarded with larger allocations and only partial upwards adjustment of the price, thus providing investors with more positive first day returns the more positive information they reveal. In this way, partial adjustment explains both the existence of aggregate IPO underpricing as well as the positive relationship between offering-period price changes and subsequent first day market returns (Hanley 1993).

The framework we present also predicts serial correlation in price changes during the offering period and the initial market activity. As we will show later however, the dimension of under and over-pricing with respect to valuation multiples which we document as insufficient adjustment from industry comparables, predicts returns over and above any serial correlation in price changes explained by the partial adjustment model.

In a different model of asymmetric information amongst investors, Rock (1986) generates underpricing in order for issuers to compensate less informed investors for the winner's curse in the presence of more informed investors who may or may not participate in IPOs given their information set. While some form of asymmetric information may also explain the results presented in this paper, we find the opposite of the winner's curse. With respect to industry multiples, it is those firm valuations that are far below industry averages that offer exceedingly low (even negative) initial returns and poor risk/reward ratios on average, i.e. initial market returns are related to signed distance from comparables, not the absolute magnitude of distance.

Given all the models built to explain underpricing, what are the incentives for a bank to price an IPO accurately? Dunbar (2000) finds that extreme mispricing is associated with lower market share in the IPO market and Nanda and Yun (1997) find "the market price of an underwriter's own stock does best when offerings are moderately underpriced" (Ritter and Welch 2002).

This paper is most closely related to prior work to this paper by Kim and Ritter (1999), who find that accounting multiples have a modest ability to explain the variation in pricing of IPOs even when using forward-looking earnings forecasts, and to Purnanandam and Swaminathan (2004, henceforth PS). PS find that while IPOs are underpriced on average, they are overvalued when compared to earnings multiples of the closest firm by size, sales and profit margin in the issuing company's industry. PS also find a degree of fundamental overpricing even after controlling for growth expectations. After noting that the most fundamentally overvalued firms have the highest first-day returns, PS suggest this is owing to investors' fixation on growth and inattention to profitability.

II.C. Prior Findings on Anchoring

Previous research in judgment and decision-making provides many similar reasons to expect assimilation in equity valuations towards salient reference points. The most prominent, and directly relevant finding, is anchoring, but there are also others in which context has been proven to have an influence above and beyond its informational content. These include theories of salience (Bordalo, Gennaioli and Shleifer 2012), and categorization—managing cognitive load by mapping the world's structure onto categories (Rosch 1979).

Anchoring refers to observations of judgments which are too close to a preceding salient cue or starting point. Anchoring is classically explained as insufficient adjustment from an 'anchor' value (Tversky and Kahneman, 1974, henceforth TK). An example of anchoring due to TK is as follows: subjects, when asked to multiply a long sequence of numbers under a time constraint (e.g. 5x4x3x2x1 or 1x2x3x4x5) respond with answers closer to the first digit in the sequence provided, even though the information provided in both sequences is identical.

Earlier research on anchoring in the 20^{th} century often involved assessing weights on a scale. While both the weights in a sensory experiment and the leading digit in the visual experiment from TK are informative, many authors since TK have approached anchoring under the context of "seemingly random" anchors. Danilowitz, Frederick, and Mochon (2011) recently find that even in studies of similar 'random' form to a roulette wheel, inferred informational content counts for perhaps as much as ¾ of the observed effects of anchoring.[7]

Frederick and Mochon (2012) propose a model to explain anchoring and find a theory of scale distortion best explains the evidence. Under scale distortion, subsequent judgments are altered because of the different scaling induced by the anchor, i.e. because of contrast effects (Figure 2). Translating this into the context of IPO valuations, industry valuation multiples could alter the numeric standard applied to subsequent IPO valuations. A multiple of 20 might seem high (expensive) when compared to a multiple of 18 rather than 22.

Empirically, many other papers also show that while nearby anchors have a linear assimilating effect, at some point this effect diminishes (Sherif 1958, Chapman and Johnson 1994, and outside of the lab: Choi et al 2012). These findings imply that while true values close to an anchor should be unambiguously compressed to the anchor, values farther away from the anchor may experience a decreasingly powerful effect. Wegener et al (2001) present an attitudinal change interpretation of anchoring and also find evidence of a decreasing effect the farther away a proposed anchor is from where an initial belief started. They find that if a subject is currently sleeping 8 hours per night and 7 hours is suggested as an appropriate amount of time to sleep, this suggestion is likely to have a greater effect on judgment than if the suggestion were 0 hours as this is implausibly far away.

Anchoring has been used before in a related context of valuations using comparables. Northcraft and Neale (1987) study the results of a real estate framed field experiment and show that the stated listing price of a property affects subsequent realtor appraisals of value.

In addition to anchoring, another set of relevant findings comes from categorisation. This literature finds the category an object is in influences judgments over and above object-specifics. Categorical thinking can be interpreted as a compression of beliefs about members within a category. Consequently, the framework we present can be seen as an

[7] Inferring some informational content from the value given by the experimenter, e.g. assuming the game is rigged in some way, or treating the value as a suggestion from the experimenter.

example of the "Categorical Thinking" used in Barberis and Shleifer (2003), with firm industries as the categories.

Empirically, the behavioural literature has already provided us with one existing explanation of IPO returns. Loughran and Ritter (2002) use Prospect Theory preferences and loss aversion to explain an empirical contradiction with the Partial Adjustment model. They find that issuing prices fail to fully incorporate public information of market returns over the book-building and offering period.

III. Data

We use data from Compustat to obtain earnings and other accounting data for issuing firms and their industry peers. We merge this with market data (share price, number of shares outstanding, and stock index returns) from CRSP, and with analyst earnings estimates from I/B/E/S. Thomson Reuters Datastream (formerly Securities Data Corporation, or SDC) supplies the IPO events themselves, their offering price, and any ipo-specific data (e.g. IPO date). We create the final dataset by applying the following selection criteria:

- IPOs from the time period 1980-2016 (owing to the availability of SDC and Compustat data)
- US-traded stocks only
- No ADRs, Closed-end funds, or Unit offerings
- Previous earnings (EBITDA) data populated in Compustat and positive
- Offer prices over $5, taken as a typical filter from the literature to remove 'microcap' stocks.
- No previously existing price history in CRSP, indicating that this could be a miscoded follow-on or secondary offering.

We arrive at a sample of 4,645 IPOs which satisfy the above criteria. Given the requirement to have positive earnings or EBITDA, the sample population shown in Table 1 is biased towards larger IPOs and older firms.

[INSERT TABLE 1 ABOUT HERE]

Winsorization

We refer to the change in price between the offering price and the first market close (minus an equal-weighted market return) as the "Day 1 Return." This measure, as well as the valuation multiples used, is winsorized at the 1st and 99th percentiles to ensure the results of analysis are not driven by outliers or errors in the data. The offer price is provided by Thomson Reuters SDC and the end of first day price is supplied by CRSP.

Construction of multiples

We estimate valuation multiples (specifically: EV/EBITDA, P/EBITDA, and P/E) for each issuing firm and its industry peers using the 48 industry groupings as defined by Fama and French (1997). Our main specification employs EV/EBITDA, as it is a commonly used multiple for IPOs, and we prefer EBITDA over Net Income as a Price/Earnings measure as EBITDA is more likely to be positive compared to Net Income for young IPO firms. Results turn out to be similar across all three valuation measures, and we provide the additional results in the Appendix.

We construct observable versions of the valuation multiples for IPO *i* in industry *j* and the comparable average from industry *j* as follows:

$$\widehat{v_i^O} \stackrel{\text{def}}{=} \frac{EV}{EBITDA}\,(IPO_i) = \left(\frac{Total\ Debt + \ Offer\ price\ *\ Number\ of\ shares\ outstanding\ post\ issue}{Prior\ fiscal\ year\ EBITDA}\right)_i$$

$$\overline{v_{-i,j}} = \frac{EV}{EBITDA}(Comparables\ of\ i\ in\ industry\ j) = \left(\frac{Total\ Debt + \ Market\ Price\ *\ Number\ of\ shares\ outstanding}{Prior\ fiscal\ year\ EBITDA}\right)_j$$

Share price and shares outstanding data are taken from CRSP as of the last market close prior to the issue date to construct industry average multiples. Book value of debt is taken from Compustat. All accounting data for each IPO and its industry comparables are for the most recent fiscal year filed prior to the issue date. No information available after the offering is incorporated into construction of the multiples. We apply the same positive earnings criteria to selection of same-industry comparables.

Bias and Noise in Estimates of Multiples

Our baseline results have potential sources of bias and noise in the calculations of multiples. These multiples are wrong from a theoretical and a practitioner perspective as they are backwards-, rather than forward-looking. This bias will be more prevalent in IPOs than in established firms, as IPOs have much higher expected growth rates on average, and many earnings will be close to zero or negative, skewing the price-earnings multiple relationship. For instance, the average EV/EBITDA multiple in this sample is approximately 10, whereas the mean backwards-looking EV/EBITDA of issuing firms is 41 (Table 1). Using different approaches to estimate forward-looking earnings, we arrive at averages (medians) much closer to the lower-growth firms already in the public market. We expect there to still be differences, given the variance in earnings and skew in ratios, and the higher growth of IPOs and fundamental relationship of P/E to 1/(r-g).

From a practitioner's viewpoint, we also introduce noise from two different sources into the estimates of the valuation multiples an analyst would use for relative value comparisons. First, the industry we use is an approximation of the appropriate reference industry. Fama-French 48 industries are larger than the typical set of comparables used by analysts during the offering process. Second, we present results of analysis across all industries using EV/EBITDA multiples. The more appropriate multiples, however, may vary for specific industries. For example, one industry's analysts might use Market/Book while another might use Price/(Funds From Operations).

Analyst Growth Estimates and Uncertainty

The best available forward-looking estimates of growth for equities are analyst estimates; unfortunately these are typically unavailable ex-ante (to the econometrician) as analysts only begin to follow a company and issue recommendations after an IPO. As a result the first analyst estimates are sometimes only filed months after the IPO. We use average analyst estimates of earnings from I/B/E/S and take the difference between the average forecast, made over the first year subsequent to the IPO, to the two fiscal years following the IPO, to derive an expected earnings growth rate. This is an admittedly crude proxy—we are currently in the process of incorporating in the analysis results based on actual forward-looking analyst estimates around the IPO. We also use analyst forecast dispersion as a measure of stock-specific uncertainty to control for the convexity in valuation with respect to uncertainty as pointed out by Pastor and Veronesi (2003).

IV. Baseline Results

To test if initial price changes are consistent with IPO valuations anchored to industry averages (Hypothesis 1), Table 2 estimates the following regression:

$$Day\ 1\ return_{ij} = \alpha + \beta\left(\ln\left(\frac{\widehat{v_i^O}}{\overline{v_j}}\right)\right) + \tilde{\varepsilon}_{ij}$$

Under anchoring, the coefficient will be positive as a result of the influence of the median industry multiple on an IPO's EV/EBITDA multiple. The industry multiple is constructed using the most recent data available prior to the IPO. The initial market returns are adjusted for value-weighted market returns on the first day of trading and winsorised.

[INSERT TABLE 2 ABOUT HERE]

β is positive as predicted and significant, both statistically and economically. Without controls (column 1), a one standard deviation difference in distance is associated with a 5.9% higher first day return on average, compared to average first day returns of 13.5% in this sample. Results are a similar magnitude when introducing controls for the serial correlation in IPO returns and "hot" (versus cold) IPO markets and subsequent repricing: fixed effects for time (year/month), lagged initial IPO returns, and an index of sentiment. We then orthogonalise the relationship to other previously documented factors in IPO pricing such as persistence in price changes of the IPO and the failure of IPO offer prices to incorporate previous public market returns. Prior studies have documented the fact that price changes during the offering process appear to be 'partial' and are serially correlated with subsequent first day returns. The stricter test of Hypothesis 2, which columns 2-7 of Table 3 present, provides the strongest evidence that the key result of this paper is complementary to that of partial adjustment.

While the estimated size of the coefficient of interest attenuates somewhat as additional controls are introduced, it is still of economic and statistical significance. Under the specification with the smallest estimate, a one-standard-deviation in distance is still related to a more than 4% higher day 1 return. The revision in price during the listing period appears to have the greatest explanatory power. The coefficient on the index of a reduced-form model of market sentiment enters with an unexpectedly negative estimate. Not all filings provide an estimated filing price range, have market index data available on necessary dates, or have Baker-Wurgler sentiment index data available, hence the lower number of observations as some controls are introduced.

As a further robustness check, using a smaller, hence more selected, population of IPOs with positive net income, the relationship of first day returns to P/E ratio relationships to peers is found to be similar. The relationship also replicates using P/EBITDA multiples (results in Appendix). These results are not a statistical accident of a specific choice of earnings multiple.

Additional Testable Predictions and Alternative Tests

If the estimated valuation by a firm (and its advisors) in its initial filing are also anchored and *more* biased towards industry averages than the final offering price, then we should expect to see the relative price ratios from filings predict subsequent price changes during the listing process. Table 3 tests for a relationship between price revisions over the offering period (subsequent to filing) and price multiples constructed as of the original filing. If the price originally filed by the issuing firm displays an assimilation bias more than the eventual offering price,[8] β^F is positive when estimating the following regression:

$$Offering\ period\ price\ revision_{ij} = \alpha + \beta^F \left(\ln \left(\frac{\widehat{v_i{}^F}}{\overline{v^F{}_j}} \right) \right) + \tilde{e}_{ij}$$

“Offering period price revision” is the eventual offering price divided by the original filed price estimate, minus S&P 500 returns over the same period. The IPO and industry average multiples for this analysis are constructed using only information available at the time of

[8] Filed price is taken as the middle of the estimated range provided in the filing.

filing: the most recent prices and earnings data available for the issuing firm and comparables. The issuing firm's multiple uses the filed price.

[INSERT TABLE 3 ABOUT HERE]

A one-standard-deviation in the distance of a firm's filing valuation from its industry comparables is related to a 1% revision in price from the initial filing to eventual offering. While the magnitude of the estimated coefficient is smaller, the results of Table 3 are consistent with an initial value presented by the firm to investors which is more anchored to its peers than its eventual offering price. The price could become less anchored to industry averages during the listing process as a result of investor input, and the fact that successive repricings can serve as new anchors amongst other reasons.

As an additional form of test for robustness, Table 4 repeats the main analysis of Table 2 using approximations of forward-looking multiples. The main relationship is replicated. Table 4 also conducts a simpler, binary test – did issues that likely appeared below or above industry averages perform worse or better than average? While sample sizes vary owing to the data needed to approximate forward-looking multiples, the point estimates across the different specifications of forward-looking multiples are similar. Offerings estimated to have had multiples below their Fama-French industry average suffer 0% to -2% returns compared to average, while those with estimated multiples above their industry average enjoyed +7% to +9% returns. These point estimates are relative to a base-case of offerings "at" the industry average, here defined as within +/10% of industry multiples.

V. Alternative Explanations

To gauge if distance in valuation multiples of a firm to its industry peers substitutes for relevant economic but omitted factors, we next review and present evidence to distinguish our proposed anchoring from immediate alternatives.

1. Strategic Use of Multiples by Buyers

If advisers and offering firms are somewhat uninformed as to what an appropriate price might be, one might also imagine the strategic use of multiples during the price-setting process by potential investors. Pricing IPOs too close to industry average Price/Earnings multiples is typically in the favour of investors, as IPOs tend to have greater growth prospects and should have higher P/E ratios, all else equal.

Some evidence argues against the view that anchoring could be driven by a purely strategic use of multiples by investors. If we examine offerings at the bottom and top deciles of signed distance, the lowest decile (whose distance is negative) has winsorised returns with one-day Sharpe Ratios only 40% as large as the highest decile (0.3 vs 0.74) and unwinsorised returns are negative on average. These negative distance IPOs are also almost twice as likely to suffer losses compared to the top decile of distance. These worst-return offerings are the offerings which would seem relatively cheap on a price multiple basis, but actually turn out to be systematically expensive. To provide an adequate explanation along the lines of strategic use of comparables by investors, we must provide reasons for some investors persistently accepting worse return profiles on offerings.

2. Boundedly Rational Investors and Convexity in Valuation of Growth

A subtly different alternative to our framework is one in which industry comparables inform bad priors. "Bad Bayesian" analysts, with an incorrect industry-driven, rather than IPO-driven, prior on the distribution of potential Price/Earnings multiples, generate a (noisy) signal from their valuation process for the appropriate price of an IPO. If their prior is persistently incorrect and based on the current distribution of Price/Earnings multiples in the industry rather than an accurate distribution of IPO valuations—with higher variance and mean owing to higher expected growth rates of IPO firms—then this alternative could also arrive at offer valuations compressed to an industry average.

Could 'distance' simply substitute for uncertainty around an IPO? Investors have limited time and capacity to gather information and incorporate it into bids for an IPO. Information which is more expensive to obtain should be less represented in the price of a new issue, and issues with greater uncertainty have higher information costs. We note that this type of boundedly rational approach would face a challenge from the Loughran and Ritter finding that the cheapest available information (public market returns) is only partially incorporated into offer prices. Potential proxies for uncertainty are dispersion in analyst forecasts of earnings and the Market-to-Book ratio (Pastor and Veronesi 2003). The test in Table 6 therefore serves the dual role of controlling for convexity in valuation with respect to uncertainty in growth rates.

[INSERT TABLE 5 ABOUT HERE]

The key result of this paper is robust to controls for uncertainty as shown in Table 5. Both uncertainty proxies used are imperfect, however, and we have lost many observations, owing to the fact only certain companies pick up analyst coverage following their IPO, introducing a potential selection bias.

In order to provide some illustrative evidence that the main observation of this paper is not driven purely by uncertainty around growth rates, we examine the interaction of an exhaustive list of industry fixed effects with 'distance.' Industries with the lowest estimated p-values on the interaction term of industry with distance—are: Candy and Soda; Automobiles and Trucks; Wholesale (machinery, equipment and other products); and Real Estate. On the whole, these industries do not seem to be the most opaque or the most likely valuations to suffer from uncertainty, on the contrary – they seem like industries where precision in growth estimates should be the lowest cost to deliver.

3. *Fundamentally overvalued IPOs*

If distance predicts short-term returns while having no relation to long-term returns, it is distinct from the fundamental overvaluation of IPOs discussed in Purninandam and Swaminathan (2004, henceforth PS) when matching against the closest similar firms. As a first illustration that an offering's relative 'distance' in valuation from industry averages does not predict long-term returns, Table 6 presents returns of the stock for the year subsequent to its first market closing price. These are raw returns only adjusted with a simple equal-weighted market index. We apply the sentiment index and other controls used to test hypothesis 2. Results are similarly insignificant when examining other horizons (2 weeks, 1 and 6 month returns).

[INSERT TABLE 6 ABOUT HERE]

As a more sophisticated test and to obtain better-behaved standard errors, we follow PS[9] and run Fama-French three factor and Carhart four factor regressions on the monthly returns from 6 months post-IPO to five years post-IPO. 6 months is the point in time when certain sales restrictions of participants in the IPO are lifted.[10] We take the resulting alpha - the risk-adjusted abnormal return - from these regressions as the dependent variable for analysis.

Table 8 progresses from one prior of an appropriate test in column (1) on the left, to column (5) which is close to the test PS implement and replicates their result when using P/EBITDA multiples. In column (2) we introduce the additional variables used in PS to explain returns, apart from growth. The growth variable we use is the difference in average analyst estimates of the two fiscal years' earnings subsequent to the IPO. 'Growth' is not an ex-ante measure of expectations, however, as analyst estimates of earnings typically start up to 6 months after an issue. By introducing this variable, we introduce information on developments after the IPO has taken place both as a result of sample-selection and in the information from the variable itself. Column (3) introduces the selection bias of narrowing down the universe to only those companies which subsequently pick up analyst coverage. Column (4) removes the variables representing previous models' of first day returns such as price revisions and public market returns over the offering period. The remaining material differences are introduced in column (5): use of a 3 factor model (versus 4) and a control for ex-post growth estimates.

We find no relationship between EV/EBITDA and long-run risk-adjusted returns. Neither do we find any relationship when looking at other valuation multiples: P/E and P/EBITDA. In two of the 15 specifications (5 specifications x 3 valuation multiples), the coefficient is estimated with statistical significance. This occurs when using P/EBITDA multiples (see Appendix). A negative relationship would be consistent with the view of PS that issues above their closest-matched firm's valuation multiple are *overvalued*. In the

[9] Two differences are that our distance term is based on an average, not just the closest comparable, and that we have not included a control for accruals.
[10] We find results qualitatively similar to those we present here when the return window starts immediately post IPO.

two specifications that do estimate a statistically significant relationship, it is not economically significant – one standard deviation in distance relates to less than a 0.1% alpha over 5 years. The results of Table 7 show that while the distance of an IPO from industry comparables positively predicts first day returns in-sample, it does not statistically or economically predict long-run returns.

[INSERT TABLE 7 ABOUT HERE]

We find that those offerings at the highest-seeming relative valuations are, on average, the most *undervalued.* Most importantly, we find an absence of any consistent relationship between relative valuations to an offering's subsequent long-term market returns after the first market close.

4. *Financially Inefficient, but Economically Efficient Pricing*

The most promising line of alternative explanation we envision is not one in which our key variable of interest (distance from peer valuations) represents a proxy for some omitted variable, but rather an economically-efficient equilibrium in which the errors we suggest are predictable and understood by the actors involved in issuance. Investment banks may benefit from a degree of predictability. Even issuing firms may benefit to some degree on average from a tradeoff between idiosyncratic value being fully reflected in price, and the additional time or unpredictability of mates (of price) ending up further away from actual issuing prices. Investors, in return for not upsetting the efficiency of the IPO process and diverging too far from banker-predicted valuations, could be rewarded with underpricing on average, and for reasons discussed by other authors, some limited amount of positive first day returns may not viewed by issuing firms as a bad thing (Loughran Ritter 2002).

Under this line of alternative explanation, issuers could be rewarded with a more predictable process, less prone to failure. As this mistake-free explanation would require sophisticated investors to not deviate from issues that we find offer predictably poor (negative) information ratios and returns.

VI. Conclusion

In this paper, we test for an undue influence of similar securities' valuations on the valuation of new, difficult to value, securities. We show dynamics of IPO pricing are consistent with initial valuations starting too close to industry average multiples and that the first trading day corrects for this. Based on findings in the psychology literature, such a compression in initial valuations is to be expected whenever individuals can easily compare against reference prices, as they do when using the firmly established practice of "pricing using comparables."

While we control for previous models relevant to IPO pricing—partial adjustment, prospect theory, and sentiment—distance from comparables could covary with as-yet-to-be-discovered attributes that fundamentally relate to market returns. Overall, we conclude that IPO offer prices are compressed too close to comparables, in a manner consistent with many observations over the last century of salient contextual reference points exerting an undue influence on numerical judgments.

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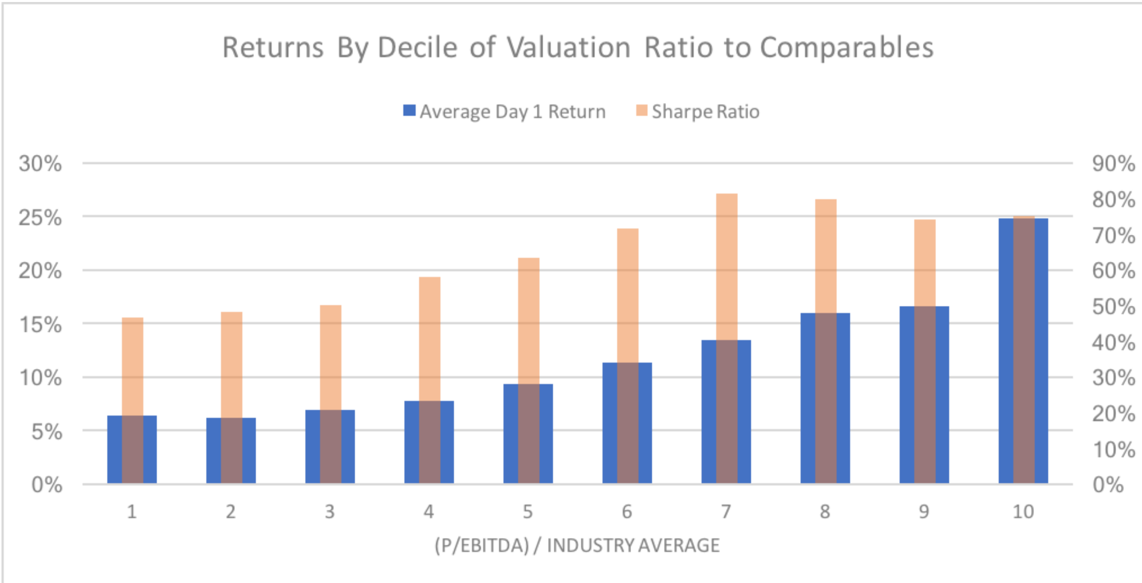
Figure 1

Average Day 1 Return by Relative Ratio of Issuer's Valuation to Industry Average



Left axis shows mean return. Right axis shows Sharpe ratio. Sharpe ratio equals the ratio of mean to standard deviation of day 1 returns for each decile. Day 1 Returns are winsorized ($1^{st}/99^{th}$ percentiles) and adjusted for equal-weighted market returns.

Table 1

Summary Statistics

Summary statistics of the sample of IPOs after minimum criteria have been applied to SDC Dataset at outlined in Section 3 (minimum Offer Price, positive EBITDA, IPO Date less than or equal to first recorded CRSP price). "Forward EV/EBITDA 1" applies a simple linear relationship of dollar changes in EBITDA to pre-offering revenues and earnings growth to estimate a forward-looking estimate of EBITDA for the issuing firm, "Forward EV/EBITDA 2" uses ex-post EBITDA realizations as if market participants had perfect foresight. "Day 1 Return" adjusts for equal-weighted market returns. * indicates winsorization at $1^{st}/99^{th}$ percentiles.

Statistic	**Obs**	**Mean**	**Median**	**Std. Dev.**	**Min**	**Max**
Proceeds ($millions)	4645	345	103	1146	3	24,072
Offer Price ($)	4645	12.9	12.0	5.6	5.0	97
Day 1 Return*	4645	0.14	0.07	0.23	-0.27	2.01
EV/EBITDA *(a)**	4645	41.1	15.3	86.7	0.58	570
Forward EV/EBITDA 1*	4645	19.15	11.51	33.82	33.82	33.82
Forward EV/EBITDA 2*	4597	11.83	9.37	38.7	-261	233
Industry median EV/EBITDA *(b)**	4645	10.85	10.20	2.88	6.25	19.83
'Distance' *(ln (a/b))*	4550	0.60	0.40	1.00	-2.80	4.32

Table 2

Relationship of Distance in Valuation Multiples to Initial Market Returns

"Day 1 Return" is the first day return of the Initial Public Offering (IPO), winsorised at the 1st/99th percentiles. "Distance" is the natural log ratio of the issuing firm's EV/EBITDA to a median of its FF48 industry EV/EBITDA multiples. Multiples are calculated using most recent filed data prior to IPO. "Lagged average first day IPO returns" are the most recent average day 1 returns for IPOs. "Sentiment" is a monthly index of sentiment (Baker Wurgler 2007). "Market Return" is the SP500 return over the offering period, from filing date to offering date. "Preceding Price Revision" is the % change from the middle of the filed price range to ultimate offering price, minus the offering period market return. Standard errors are clustered by year/month reported in parenthesis. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
				Day 1 Return			
β (Distance)	0.059*** (0.006)	0.055*** (0.005)	0.060*** (0.006)	0.047*** (0.005)	0.060*** (0.006)	0.043*** (0.005)	0.0411*** (0.005)
Lagged average first day IPO returns		0.178*** (0.03)					0.132*** (0.031)
Sentiment			-0.038*** (0.010)				-0.007 (0.007)
Market Return					0.118*** (0.032)		0.101*** (0.028)
Preceding Price Revision						0.642* (0.040)	0.607*** (0.038)
α (Constant)	0.10*** (0.004)	0.075*** (0.006)	0.116*** (0.006)		0.095*** (0.004)	0.117*** (0.004)	0.096*** (0.006)
Year/Month FEs				Y			
N	4645	44643	4626	4645	4612	4618	4570
R^2	0.065	0.098	0.072	0.246	0.071	0.202	0.225

Table 3

Distance as of Filing and Offering Period Returns

Regression of offering period return on relative valuation as of filing date

The unit of observation is a firm's listing process revision in price, from initial filing to IPO. The initial price is taken from the midpoint of range provided by firm in initial filing (where available). "Filing Distance" is the natural log ratio of issuing firm EV/EBITDA to the median of its FF48 industry, calculated as of initial filing. "Market Return" is the S&P500 return over the listing period. Standard errors clustered by month reported in parenthesis, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

	Offering Period Price Revision			
β^F (Filing distance)	0.009***	(0.003)	0.009**	(0.003)
Market Return			-0.0005	(0.025)
α (constant)	-0.018***	(0.004)	-0.018***	(0.004)
N	4309		4280	
R^2	0.005		0.005	

Table 4
Estimated Forward-Looking Valuation Multiples

Regression of first day returns on alternative forward-looking measures of relative value

Day 1 returns are winsorized at 1%/99% levels and adjusted for equal-weighted one-day market returns. Valuation multiples (EV/EBITDA) are calculated using three methods to estimate forward-looking EBITDA: 1) predicted earnings, using a simple linear model of earnings changes (estimating changes in EBITDA on previous changes and revenues), 2) actual ex-post earnings realisations. Distance is the natural log ratio of the issuing firm's multiple to a median of same FF48 industry EV/EBITDA multiples. "Below" indicates if the forward estimate was less than 90% of industry average. "Above" indicates if forward estimate was more than 110% of industry average. Standard errors are clustered by month and reported in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

4.1: *Forward EV/EBITDA 1- average growth by revenues and pre-IPO growth*

	Day 1 Return	
Distance	0.057*** (0.007)	
Below		-0.004 (0.007)
Above		0.094*** (0.009)
Constant	0.116** (0.005)	0.087*** (0.007)
N	5069	5069
R^2	0.049	0.040

4.2: *Forward EV/EBITDA 2 – perfect foresight*

	Day 1 Return			
Distance	0.051***	(0.008)		
Below			-0.018*	(0.009)
Above			0.068***	(0.011)
Constant	0.133***	(0.005)	0.118***	(0.008)
N	4624		4624	
R^2	0.033		0.031	

Table 5
Distance and Initial Market Returns with Controls for Uncertainty

"Distance" is the natural log ratio of the issuing firm's EV/EBITDA to the median multiple in the same FF48 industry. MB is the Market-to-Book ratio calculated using the offer price and most recently filed accounting data. Analyst dispersion is the standard deviation of analyst forecasts recorded by I/B/E/S for the fiscal year following the offering. Standard errors clustered by month in parenthesis. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. [Note this table is currently in process of fully updating to end of 2016 data with I/B/E/S analyst data]

	Day 1 Return			
β (Distance)	0.048***	(0.011)	0.035***	(0.009)
MB	0.007***	(0.002)	0.005**	(0.002)
Analyst Dispersion	-0.003	(0.006)	-0.009*	(0.004)
Lagged average IPO first day returns			0.177**	(0.064)
Sentiment			-0.001	(0.013)
Price Revision			[]	[]
Market return			-0.030	(0.025)
α (Constant)	0.080***	(0.006)	0.072***	(0.012)
N	1420		1404	
R^2	0.133		0.307	

Table 6

Distance and Subsequent 1 Year Returns

"1 Year Return" is the return from offering date to one year later, adjusted for the S&P500 return over same period. "Distance" is the natural log ratio of the issuing firm's EV/EBITDA to a median of its FF48 industry. "Preceding Price Revision" is the % change from the middle of the filed price range to ultimate offering price. "Market Return" is the SP500 return over the listing period. "Sentiment" is a monthly time-varying index (Baker Wurgler 2007). Standard errors clustered by month in parenthesis. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

	1 Year Return			
Distance	-0.011	(0.014)	-0.016	(0.013)
Preceding Price Revision	0.168	(0.095)	0.020	(0.099)
Market Return	-0.145	(0.095)	-0.023	(0.050)
Lagged average first day IPO returns	-0.145***	(0.055)	-0.107	(0.058)
Sentiment	-0.024	(0.027)		
Constant	0.059**	(0.022)		
Year/Month FEs			Y	
N	4249		4249	
R^2	0.005		0.173	

Table 7

Distance and Subsequent Long-term Returns

C4 = Carhart four factor model, FF3 = Fama-French three factor model. Regressions are run on returns 6-60 months post IPO. Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. [Note this table is currently in process of updating the (manual) match process for IBES data to 2016]

	(1)		(2)		(3)		(4)		(5)	
				C4 alpha						**FF3 alpha**
Distance	-0.003	(0.002)	-0.005	(0.003)	-0.001	(0.002)	-0.002	(0.002)	-0.004	(0.002)
Lagged average IPO day 1 returns	-0.001	(0.008)	-0.001	(0.007)	0.009	(0.007)				
Sentiment	0.003	(0.003)	0.003	(0.003)	0.003	(0.003)				
Preceding Price Revision	0.02	(0.021)	0.014	(0.026)	-0.015	(0.014)				
Market Return	0.005	(0.009)	0.005	(0.009)	-0.002	(0.022)				
EBITDA margin			-0.013	(0.030)	0.001	(0.010)	-0.003	(0.011)	0.001	(0.009)
ln(Sales)			0.001	(0.002)	0.002	(0.001)	0.001	(0.001)	0.001	(0.001)
ln(MB)			0.004	(0.003)	0.004^{*}	(0.001)	0.003^{*}	(0.001)	0.002	(0.002)
ln(Growth)									-0.007^{***}	(0.001)
Constant	0.003	(0.006)	-0.03	(0.041)	-0.034^{*}	(0.013)	-0.024	(0.013)	-0.021	(0.012)
N	4037		4036		1728		1728		1735	
R^2	0.000		0.002		0.006		0.004		0.036	

APPENDIX
Replication with other Valuation Multiples

P/EBITDA as Valuation Multiple
Summary of Estimated Coefficients on Distance
distance = ln((P/EBITDA of issuing firm) / (median P/EBITDA of industry comparables)), mean=0.62, stdev = 1.12

Column/Specification:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Table 2 (Day 1 returns)	0.054*** (0.005)	0.050*** (0.005)	0.055*** (0.005)	0.044*** (0.004)	0.055*** (0.005)	0.039*** (0.005)	0.037*** (0.004)
Table 3 (Listing period returns)	0.009** (0.002)	0.009** (0.002)					
Table 4 (Forward-looking multiples)	0.053*** (0.006)	0.050***(0.006)					
Table 5 (Uncertainty)	0.040*** (0.009)	0.028*** (0.007)					
Table 6 (Long-run returns)	-0.009 (0.012)	-0.011 (0.012)					
Table 7 (Long-run returns)	-0.003 (0.002)	-0.007* (0.003)	-0.003 (0.002)	-0.004 (0.002)	0.006** (0.002)		

APPENDIX
Replication with other Valuation Multiples

P/E as Valuation Multiple
Summary of Estimated Coefficients on Distance
distance = ln((P/E of issuing firm) / (median P/E of industry comparables)), mean= 0.4, stdev = 1.31

Column/Specification:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Table 2 (Day 1 returns)	0.035*** (0.004)	0.031*** (0.004)	0.034*** (0.004)	0.022*** (0.003)	0.035*** (0.004)	0.025*** (0.004)	0.023*** (0.003)
Table 3 (Listing period returns)	0.005** (0.002)	0.005** (0.002)					
Table 4 (Forward-looking multiples)	0.044*** (0.006)	0.054***(0.008)					
Table 5 (Uncertainty)	0.021*** (0.006)	0.012*** (0.005)					
Table 6 (Long-run returns)	0.009 (0.011)	-0.006 (0.012)					
Table 7 (Long-run returns)	-0.012 (0.012)	-0.013 (0.012)	0.004 (0.002)	0.003 (0.002)	0.002 (0.002)		