Liquidity risk, leverage and long-run IPO returns

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Abstract

We examine the risk-return characteristics of a rolling portfolio investment strategy where more than 6,300 Nasdaq IPO stocks are bought and held for up to five years over the 1973-2000 period. The puzzling low average long-run (raw) return to IPO stocks first reported by Ritter (1991) manifests itself in this much larger sample as well. As Brav and Gompers (1997) and Brav, Geczy, and Gompers (2000), we challenge the claim that the returns are too low to be explained within standard, rational asset pricing paradigms. However, our risk explanation goes beyond the earlier papers' reference to a general—but poorly understood—book-to-market effect in the average return to small growth stocks. We show that the typical IPO firm exhibits relatively low leverage and high liquidity. There is theoretical basis for arguing that each of these two characteristics lower the systematic risk exposure of equity returns. Our factor model estimation, which includes a new liquidity risk factor, produces estimates consistent with this explanation. We cannot reject the hypothesis that the low average IPO returns are commensurable with their risk exposures, as defined here.

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1 Introduction

Following the early work of Ritter (1991), it is now well known that IPO stocks generate low returns over holding periods of two–to–five years following the IPO date. On the one hand, these holding-period returns appear so low as to challenge the fundamental notion of rational and efficient capital market pricing, providing a motivation for the development of behavioral asset pricing models where the marginal investor is slow to assimilate publicly available information.[1] On the other hand, surprisingly little is known about the true long-run risk-return characteristics of IPO stocks. Brav and Gompers (1997) and Brav, Geczy, and Gompers (2000) present systematic evidence that the low post-IPO return pattern is concentrated in small growth stocks. Thus, the low post-IPO returns may be a manifestation of the more general finding of Fama and French (1993) that small growth stocks generally have low returns during the post-1963 period. While this finding is important, it does not explain the economic fundamentals of the low IPO returns. In this paper, we provide new, large-sample evidence on links between firm-specific characteristics such as leverage and liquidity and risk-return tradeoffs for IPO stocks. In addition to advancing our understanding of the return-generating process of IPO shares, this evidence also points to broader pricing issues related to leverage and liquidity.

With a sample exceeding 6,300 Nasdaq IPOs over the 1972-1998 period, we show that IPO stocks are both significantly less leveraged and exhibit significantly greater liquidity (stock turnover) than non-IPO firms matched on stock exchange, equity size and book-to-market ratio.[2] The discovery of greater liquidity is important as it suggests a potential liquidity-based explanation for lower *expected* returns to IPO stocks. Our finding of lower leverage is consistent with the fact that IPO firms tend to have fewer assets in place and lower current earnings to support extensive borrowing as compared to more seasoned companies. We explore these findings by estimating parameters in empirical factor models where the risk factors have links to leverage and stock liquidity. The basic hypothesis to be tested concern whether IPO stocks have lower expected return due to these characteristics.

[1] See, e.g., Daniel, Hirshleifer, and Subrahmanyam (1998), Barberis, Shleifer, and Vishny (1998), and Hong and Stein (1999)].

[2] As explained below, over the sample period, more than 90% of all IPOs took place on Nasdaq. Adding back the 432 IPOs on NYSE/Amex over the sample period does not materially affect any of the paper's conclusions. At the same time, the Nasdaq restriction helps comparing "apples with apples" which is useful when selecting non-IPO matched firms.

For the leverage analysis, we draw on the multifactor models of Merton (1973) and Ross (1976) and include macroeconomic risk factors such as the changes in the term spread, the default spread, and unexpected inflation.[3] Following the argument in Galai and Masulis (1976), factor loadings (betas) estimated using equity returns depend on the firm's leverage ratio. The leverage effect enters through the product of the firm-value beta and the elasticity of equity price with respect to firm value. Since this elasticity increase with leverage, systematic risk is generally increasing in leverage (and time varying as leverage changes over time). Our test strategy involves comparing factor loadings of IPO stocks with those of non-IPO matched firms, to see if these differ in the direction predicted by the "turbo charging" effect of leverage.[4]

Turning to our analysis of liquidity, a growing body of empirical research suggests that greater stock liquidity reduces risk.[5] To examine this possibility in the context of our IPO stocks, we expand the Fama and French (1993) model with a new liquidity risk factor generated in the same way as the original Fama-French factors themselves. Sorting first on equity size, this new factor is a portfolio long in low-liquidity stocks and short in high-liquidity stocks. Interestingly, we find that our liquidity factor performs well when applied to the 25 Fama-French size- and book-to-market sorted stock portfolios. We also find that this factor reduces the expected return to IPO stocks relative to the non-IPO matched firms. The overall conclusion from our factor model estimation is that, with holding periods up to five years, IPO excess returns are positive and reflect risk exposures attenuated by both lower leverage and greater liquidity. The resulting estimates of abnormal returns are not reliably different from zero.

The rest of the paper is organized as follows. Section 2 contains a description of the data and key sample characteristics, including leverage, liquidity, and frequency plots of extreme events and returns. This section also presents average long-run buy-and-hold returns as well as the return to 5-year rolling portfolios of IPO stocks. The factor model with macroeconomic risk factors is presented in Section 3. The factor model estimation is also performed on portfolios of matched firms (matching on size as well as on size and book-to-market ratios), and on a "zero-investment" portfolio long

[3] In the absence of a universally accepted empirical asset pricing model, our approach to model selection is agnostic. We choose risk factors based on the works of, e.g., Chen, Roll, and Ross (1986), Ferson and Harvey (1991), Shanken (1992) Evans (1994), Ferson and Korajczyk (1995), and Ferson and Schadt (1996).

[4] Alternatively, as in Hecht (2000) and Charoenrook (2001), one could examine the leverage effect on factor loadings using estimates of *firm* (not equity) returns. We do not, however, have access to firm returns.

[5] See, e.g., Brennan and Subrahmanyam (1996), Brennan, Chordia, and Subrahmanyam (1998), Datar, Naik, and Radcliffe (1998)], Pastor and Stambaugh (2002), Eckbo and Norli (2002) and Easley, Hvidkjaer, and O'Hara (2002).

in the IPO stocks and short in matched firms. Since the zero-investment portfolio represents the difference between IPOs and their matches, results based on this portfolio are relatively robust with respect to omitted factor bias. Section 4 presents the general liquidity risk factor and applies it to our IPO portfolio, while Section 5 concludes the paper.

2 Sample Characteristics

2.1 Selection of IPOs and control firms

The primary data source for our sample of IPOs is Securities Data Corporation's (SDC's) New Issues database over the 1972 to 1998 period. The sample also includes IPOs from the dataset compiled by Ritter (1991), covering the period 1975–1984, that is not present in the SDC database.[6] These sources generate a total sample of 6,379 IPOs satisfying the following sample restrictions: The issuer is domiciled in the U.S., the IPO is on the Nasdaq Stock Exchange and it involves common stocks only (excludes unit offerings), and the issuer must appear on the CRSP tapes within two years of the offering.

Our sample selection criteria differ somewhat from those used by Loughran and Ritter (1995) and Brav, Geczy, and Gompers (2000). The primary difference is our longer sample period: Loughran and Ritter (1995) draw their sample of 4,753 IPOs from the period 1970–1990, while the total sample of 4,622 IPOs in Brav, Geczy, and Gompers (2000) is from the 1975–1992 period. Moreover, these other studies do not restrict their samples to Nasdaq IPOs. The Nasdaq-only restriction excludes a total of 432 NYSE/AMEX IPOs that satisfy our remaining selection criteria. This reflects the fact that more than 90% of the IPOs over the 28-year period took place on Nasdaq.

Figure 1 shows the annual distribution of the 6,379 IPOs in our total sample. Compustat provides book-to-market data for 5,350 of the sample IPOs, with the missing information for the most part occurring prior to the 1990s. Figure 1 also reveals a clustering of IPOs ("hot issue" period) in the early to mid 1980s. Moreover, the figure shows a steady growth in the number of IPOs from a low in 1990 through a high in 1996, with a subsequent decline towards the end of the sample period.

Figure 2 (A) shows a frequency distribution of the equity size of the IPO firms relative to size-

[6] The IPOs compiled by Ritter (1991) is publicly available on the IPO resource page http://www.iporesources.org.

deciles of NYSE and Nasdaq firms. When using NYSE size-breakpoints, it is clear that the IPO stocks are relatively small as they tend to cluster in decile 1 (smallest) and 2. However, when using Nasdaq breakpoints, the IPO sample is concentrated around deciles 6-8. Thus, the typical IPO firm is *not* small relative to seasoned Nasdaq firms. Turning to Figure 2 (B), we see that the IPO sample is concentrated around the lowest book-to-market-ratio deciles whether one uses NYSE or Nasdaq breakpoints. Thus, the typical IPO exhibits low book-to-market regardless of the stock exchange universe.

In order to provide a link to earlier studies, in particular Ritter (1991) and Loughran and Ritter (1995), we systematically compare the returns on IPO stocks to a set of control firms matched on both size and book-to-market ratio. Size-matched firms are selected from all companies listed on the Nasdaq stock exchange at the end of the year prior to the IPO and that are not in our sample of IPOs for a period of five years prior to the offer date. The size-matched firm is the firm closest in market capitalization to the issuer, where the issuer's market capitalization is the first available market capitalization on the CRSP monthly tapes after the offering date.

When matching on size and book-to-market ratios, we use the same set of Nasdaq firms as above, and select the subset of firms that have equity market values within 30% of the equity market value of the issuer. This subset are ranked according to book-to-market ratios. The size and book-to-market matched firm is the firm with the book-to-market ratio, measured at the end of the year prior to the issue year, that is closest to the issuer's ratio. Matched firms are included for the full five-year holding period or until they are delisted, whichever occurs sooner. If a match delists, a new match is drawn from the *original* list of candidates described above.

If available on COMPUSTAT, the issuer book value of equity is also measured at the end of the year prior to the issue year. If this book value is not available, we use the first available book value on Compustat starting with the issue year and ending with the year following the issue year.[7] Following Fama and French (1993) book value is defined as "the COMPUSTAT book value of stockholders equity, plus balance sheet deferred taxes and investment tax credits (if available), minus the book value of preferred stock. Depending on availability, we use the redemption, liquidation, or par value (in that order) to estimate the value of preferred stock." (Fama and French, 1993, p.8).

[7] On average, the first available book value is found 6.1 months after the offer date. Brav and Gompers (1997) look a maximum of 12 months ahead for book values while Brav, Geczy, and Gompers (2000) look a maximum of 18 months ahead.

Panel A of Table 1 shows several characteristics of the sample IPO firms and the control firms matched on size and book-to-market. The average issuer has a total equity value of $76 mill. with issue proceeds equaling 39% of its equity size. The average book-to-market ratio is 0.38. Matched firms, whether matching on size only or size and book-to-market ratio, have greater leverage and lower monthly turnover rates than issuer firms. We return to this observation below.

2.2 Buy-and-hold returns

It is common in the long-run performance literature to report the cross-sectional average of compounded (holding period) returns, also referred to as "average buy-and-hold return" ($\overline{\text{BHR}}$). Let R_{it} denote the return to stock i over month t, and let ω_i denote stock i's weight in forming the average holding-period return. The holding period for stock i is T_i which is either five years or the time until delisting, whichever comes first.[8] For a sample of N stocks, $\overline{\text{BHR}}$ is given by

$$\overline{\text{BHR}} \equiv \sum_{i=1}^{N} \omega_i \left[\prod_{t=\tau_i}^{T_i} (1 + R_{it}) - 1 \right] \times 100. \tag{1}$$

Furthermore, several event studies use the difference in $\overline{\text{BHR}}$ for the event firms and their matched firms as a definition of event-induced "abnormal" return, $\overline{\text{BHAR}}$. In our context, this is given by

$$\overline{\text{BHAR}}_{\text{IPOs}} \equiv \overline{\text{BHR}}_{\text{IPOs}} - \overline{\text{BHR}}_{\text{Matches}}. \tag{2}$$

Table 2 shows the values of $\overline{\text{BHR}}$ and $\overline{\text{BHAR}}$ using control firms matched on size and both size and book-to-market ratio. Notice first that when using value-weighting, there is no evidence of IPO underperformance. Thus, in the following, we focus on the results for equal-weighted returns.

Panel (A) shows that for the full sample of 6,379 IPOs the equally weighted $\overline{\text{BHR}}$ for issuers is 40.4%. This average buy-and-hold return is very close to the average return reported by Brav, Geczy, and Gompers (2000), but about twice as high as the return reported by Loughran and Ritter (1995). The discrepancy between our result and the result of Loughran and Ritter (1995) is due to the extremely low returns earned by companies that went public during the period 1970–1972. The equal-weighted $\overline{\text{BHR}}$ for size-matched firms is 69.1%, resulting in a relative IPO underperformance

[8] In an earlier draft, we showed that using shorter holding periods (1-year, 2-year, .. 4-year) does not alter the main conclusions of this paper. These additional results are available upon request.

of $\overline{\text{BHAR}} = -28.8\%$, which compares to the $\overline{\text{BHAR}}$ of -50.7% reported for the IPO sample in Loughran and Ritter (1995).

As shown in the right half of Table 2, the underperformance resulting from size matching disappears when matched firms are selected using both size and book-to-market ratio. The difference in $\overline{\text{BHR}}$ between issuers and the size and book-to-market matched firms is now an insignificant 3%. Interestingly, this result is sensitive to the selection of Compustat information on book values. The insignificant 3% underperformance results when missing Compustat book value information is replaced by bringing back the first future book value observation (maximum of two years out). While this is the standard procedure in the extant literature, it carries with it a survivorship bias. The second part of Panel (B) Table 2 computes $\overline{\text{BHR}}$ and $\overline{\text{BHAR}}$ free of this survivorship bias. That is, a firm is included only as of the date the book value information is available on Compustat. The value of $\overline{\text{BHAR}}$ is now -12.1%, which is statistically significant on a 7% level.[9]

2.3 Post-IPO portfolio returns

The primary object of analysis in this paper is a 5-year running portfolio of IPO stocks. An IPO stock is first included in this "issuer portfolio" in the month following the IPO date and held for five years or until it delists from the exchange, whichever comes first. The first month of the portfolio is January 1973 and the last month is December 2000. Thus, there are a total of 336 monthly portfolio return observations over the 28-year period.

Returning to Table 1, Panel (B) shows the average monthly compounded return to the issuer and matching firm portfolios using either equal-weights or value-weights. For the full sample of 6,379 IPOs, the average monthly return is 1.14% given equal-weighted portfolio returns. However, a more interesting number is the monthly growth rate R implied by a \$1 initial investment in January 1973 growing to become \$X=16.88 by December 2000. This growth rate is given by

$$R = e^{\ln(X)/T} - 1 \tag{3}$$

where "ln" denotes the natural logarithm and T is the number of months in the estimation ($T =$

[9]For analyses of the statistical properties of test statistics based on long-run return metrics such as $\overline{\text{BHAR}}$ see, e.g., Kothari and Warner (1997), Barber and Lyon (1997), Lyon, Barber, and Tsai (1999), and Mitchell and Stafford (2000). With the exeption of the descriptive analysis above, we do not focus on estimates of $\overline{\text{BHAR}}$ in this paper.

336). As shown in Panel (B), R equals 0.84% per month for the equal-weighted issuer portfolio, 1.16% for the portfolio of size-matched firms, and an intermediate 1.05% for the portfolio of firms matched on both size and book-to-market ratio. R is generally lower when portfolios are value-weighted.

The growth rates of the issuer and matched firm portfolios are shown in Figure 3 for the case of equal-weighted (EW) portfolios. The right side legend indicates the identity of the portfolio, and inside the brackets are the terminal value of the initial $1 investment and the implied growth rate R. Figure 3 also highlights the market-wide poor performance of the early years 1972-74. While not shown here, if the starting point for the portfolio strategy is moved up to January 1975, the implied growth rates increases substantially for all portfolios. Also, as noted by previous authors as well, the effect of value-weighting is to reduce the difference between the average monthly compounded returns of issuers and non-issuer stocks. Throughout the factor model estimation below, we show parameter estimates for both value-weighted and equal-weighted portfolios.

Several conclusions emerge. First, regardless of the weighting scheme, the issuer portfolio performs better than the risk-free asset but substantially worse than the Nasdaq market index. As shown below, this underperformance is not driven by a low exposure to market risk: the portfolio market beta is close to one. In Figure 3, the issuer portfolio underperforms the market index by 0.26% per month, or by 16.9% over the five-year holding period. Over the same period, the issuer portfolio underperformed the portfolio of size-matched firms by 19.7% and the size and book-to-market matched firms by 13.4%. These percentages compare to the underperformance of 26.6% and the overperformance of 3% discussed earlier in Panel (B) of Table 2. Thus, while our portfolio metric attenuates the magnitude of the underperformance (perhaps because it gives equal weight to each of the 336 months in the total sample period, while $\overline{\text{BHR}}$ gives equal weight to each IPO *event*), there is nevertheless evidence of significantly lower long-run returns to IPOs than to control firms matched on size and book-to-market ratio.[10]

[10] As shown in an earlier draft, the effect of value-weighting is to nearly eliminate this underperformance This is not surprising as value-weights favors larger, more successful stocks.

2.4 Delistings and extreme returns

The return to the issuer portfolio is affected by delistings over the five-year holding period. Delistings due to bankruptcy and liquidations reduce the realized return to the portfolio while delistings due to premium takeovers increases portfolio return. Thus, the low return realization for the issuer portfolio may reflect a greater probability of negative delisting events than the case is for the portfolio of non-IPO control firms.

Figures 4 and 5 address this possibility. Figure 4 (A) shows the annual frequency of delistings due to liquidations over the sample period for both IPO and non-IPO firms. In each year, the front column shows the percent of the total number of recent IPO firms (i.e., firms that undertook an IPO within the past five years) that delisted that year. The rear column shows the same frequency for non-IPO firms. The frequency is very similar for the two categories of firms and thus provide no basis for arguing that IPO stocks have a greater risk of liquidations. Thus, the liquidation rate is not an explanation for the low IPO return realizations.

Figure 4 (B) plots the frequency of delistings due to merger, takeover, exchange offer or other events where common stockholders were bought out. If IPO stocks provide a better-than-average bet on a future takeover, then it ought to be apparent from this figure. However, the figure provides no basis for such an inference: if anything, in most years, the frequency of these takeover events appear somewhat *lower* than for non-IPO stocks.

Figure 5 further indicates the nature of IPO stocks as "longshots." Figure 5 (A) shows the left tail of the frequency distribution of returns, i.e., returns below 500%. The plots are for the IPO stocks as well as for firms matched on size and book-to-market ratio. Inspection of the left boundary (at -100%) shows that IPO stocks do not exhibit an abnormal chance of this extreme negative value. This finding is generally consistent with the evidence in Figure 4.

On the other hand, there is some evidence in Figure 5 (B) that IPO stocks have a greater probability than non-IPO stocks of experiencing extreme return realizations of 1,000% of higher. The right tail of the return distribution is somewhat higher for IPO stocks. Given the evidence on takeover frequencies in Figure 4 (B), the extra probability mass under the 1,000% return outcome is not driven by acquisitions. Rather, it may reflect the probability of the firm "growing into another Microsoft" on its own. Regardless, given the low average return realization of the IPO portfolio, this extra "longshot" probability does not appear to represent priced risk.

2.5 Post-IPO leverage and liquidity

Table 3 shows average leverage ratios and measures of stock liquidity for the issue year and each of the five years following the issue. Panel (A) documents that IPO stocks have significantly lower leverage than either the size-matched or size/BM-matched firms in year 0 (the year of the IPO) as well as in the two following years. This is true whether we measure leverage as the ratio of long-term debt to total assets, long-term debt to market value of equity, or total debt (current liabilities plus long-term debt) to total assets. We do not have data on actual leverage changes (i.e., equity issues and/or debt repurchases) other than the IPO itself. Of course, the IPO-proceeds itself cause a substantial reduction in leverage. Moreover, since IPO-companies are younger than the matched firms, they tend to have less collateral and may therefore have lower optimal leverage ratios. The lower debt policy may also be reinforced by the significant growth opportunities often found in private companies selecting to go public. As these growth opportunities are exercised and the firm builds collateral, the leverage ratios of IPO firms and the matched companies tend to converge, much as shown in Panel (A) over the five-year post-IPO period.

Panel (B) of Table 3 shows the average annual values of our measure of liquidity: monthly turnover computed as trading volume divided by the number of shares outstanding. With this measure, IPO stocks are significantly more liquid than either size-matched or size/BM-matched firms in each of the five years starting in year 1. Also, IPO stock liquidity tends to be greatest in the year of the issue.

3 Leverage and expected returns

In this section we report abnormal returns to portfolios of issuing and matched firms defined using a factor model with leverage-related risk factors. The regression results help answer the question of whether the relatively low returns to IPO stocks shown earlier is consistent with standard risk arguments. The most powerful answer to this questions comes from examining the abnormal return to a zero-investment portfolio strategy where one goes long in the IPO stock and short the matched firm, with a holding period of five years.

3.1 Model specification and factor mimicking

Let r_{pt} denote the return on portfolio p in excess of the risk-free rate, and assume that expected excess returns are generated by a K-factor model,

$$E(r_{pt}) = \beta_p' \lambda, \tag{4}$$

where β_p is a K-vector of risk factor sensitivities (systematic risks) and λ is a K-vector of expected risk premiums. This model is consistent with the APT model of Ross (1976) and Chamberlain (1988) as well as with the intertemporal (multifactor) asset pricing model of Merton (1973).[11] The excess-return generating process can be written as

$$r_{pt} = E(r_{pt}) + \beta_p' f_t + e_{pt}, \tag{5}$$

where f_t is a K-vector of risk factor shocks and e_{pt} is the portfolio's idiosyncratic risk with expectation zero. The factor shocks are deviations of the factor realizations from their expected values, i.e., $f_t \equiv F_t - E(F_t)$, where F_t is a K-vector of factor realizations and $E(F_t)$ is a K-vector of factor expected returns.

Regression equation (5) requires specification of $E(F_t)$, which is generally unobservable. However, consider the excess return r_{kt} on a "factor-mimicking" portfolio that has unit factor sensitivity to the kth factor and zero sensitivity to the remaining $K - 1$ factors. Since this portfolio must also satisfy equation (4), it follows that $E(r_{kt}) = \lambda_k$. Thus, when substituting a K-vector r_{Ft} of the returns on factor-mimicking portfolios for the raw factors F, equations (4) and (5) imply the following regression equation in terms of observables:

$$r_{pt} = \beta_p' r_{Ft} + e_{pt}. \tag{6}$$

Equation (6) generates stock p's returns. Thus, inserting a constant term α_p into a regression estimate of equation (6) yields an unbiased estimate of abnormal return. We employ monthly returns, so this "Jensen's alpha," first introduced by Jensen (1968), measures the average monthly abnormal return to a portfolio over the estimation period.

[11] Connor and Korajczyk (1995) provide a review of APT models.

As listed in Panel (A) of Table 4, the model contains a total of six factors: the value-weighted CRSP market index (RM), the seasonally adjusted percent change in real per capita consumption of nondurable goods (RPC), the difference in the monthly yield change on BAA-rated and AAA-rated corporate bonds (BAA−AAA), unexpected inflation (UI), the return spread between Treasury bonds with 20-year and one-year maturities (20y−1y), and the return spread between 90-day and 30-day Treasury bills (TBILLspr). These are the same factors that are used in Eckbo, Masulis, and Norli (2000) in their study of the performance after seasoned security offerings, and similar factors also appear in, Ferson and Harvey (1991), Evans (1994), Ferson and Korajczyk (1995), and Ferson and Schadt (1996).[12]

Of the six factors, three are themselves security returns, and we create factor-mimicking portfolios for the remaining three, RPC, BAA−AAA, and UI. Factor-mimicking portfolio are constructed by first regressing the return of each of the 25 size and book-to-market sorted portfolios of Fama and French on the set of six factors. These 25 time-series regressions produce a (25×6) matrix B of slope coefficients against the six factors. If V is the (25×25) covariance matrix of error terms for these regressions (assumed to be diagonal), then the weights used to construct mimicking portfolios from the 25 Fama-French portfolios are formed as

$$w = (B'V^{-1}B)^{-1}B'V^{-1}. \tag{7}$$

For each factor k, the return in month t on the corresponding mimicking portfolio is determined by multiplying the kth row of factor weights with the vector of month t returns for the 25 Fama-French portfolios. Mimicking portfolios are distinguished from the underlying macro factors ΔRPC, BAA−AAA, and UI using the notation $\widehat{\Delta\text{RPC}}$, $\text{BA}\widehat{\text{A} - \text{A}}\text{AA}$, and $\widehat{\text{UI}}$.

As shown in Panel (B) of Table 4, the factor-mimicking portfolios are reasonable: they have significant pairwise correlation with the raw factors they mimic, and they are uncorrelated with the other mimicking portfolios and the other raw factors. Moreover, Panel (C) of Table 4 shows that when we regress the mimicking portfolios on the set of six raw factors, it is only the own-factor slope

[12] The returns on T-bills, and T-bonds as well as the consumer price index used to compute unexpected inflation are from the CRSP bond file. Consumption data are from the U.S. Department of Commerce, Bureau of Economic Analysis (FRED database). Corporate bond yields are from Moody's Bond Record. Expected inflation is modeled by running a regression of real T-bill returns (returns on 30-day Treasury bills less inflation) on a constant and 12 of its lagged values.

coefficient that is significant.[13] Turning to Panel (D) of Table 4, the pairwise correlation coefficient between the six macroeconomic factors ranges from a minimum of -0.298 between ΔRPC and UI, and a maximum of 0.395 between TBILLspr and 20y$-$1y.

We now turn to the estimation of this macro-factor model using portfolios of IPO stocks and their control firms.

3.2 Parameter estimates

We estimate the parameters in the following macro-factor model:

$$r_{pt} = \alpha_p + \beta_1 \text{RM}_t + \beta_2 \widehat{\Delta\text{RPC}}_t + \beta_3 (\widehat{\text{BAA} - \text{AAA}})_t + \beta_4 \widehat{\text{UI}}_t + \beta_5 (20\text{y} - 1\text{y})_t + \beta_6 \text{TBILLspr}_t + e_t, \quad (8)$$

where e_t is a mean zero error term in month t, and the constant term (Jensen's alpha) is the average monthly abnormal return to portfolio p. The model is estimated using OLS with standard errors computed using the heteroscedasticity-consistent estimator of White (1980).

Table 5 reports total sample estimates of Jensen's alpha and factor loadings for six portfolios: equal-weighted (EW) and value-weighted (VW) portfolios consisting of IPO-stocks only ("Issuer"), size-matched firms only ("Match"), and the zero investment portfolio long in IPO stocks and short in the matched firms ("Zero"). Thus, for IPO stocks to underperform the matched firms (which would be consistent with the evidence presented earlier), the estimate of alpha for the zero investment portfolio must be negative.

Notice first that nine of the twelve alpha estimates in Table 5 are negative and all are insignificant. The overall conclusion is that the monthly abnormal performance of IPO stocks is statistically indistinguishable from the average monthly abnormal performance of the corresponding portfolio of matched firms. In other words, the apparent underperformance of IPO stocks generated by the matched firm technique is eliminated once we take into account the differential exposures (factor loadings) of IPO stocks and matched firms to the macroeconomic risk factors in our regression model.

[13] Let b_k be the kth row of B. The weighted least squares estimators in (7) are equivalent to choosing the 25 portfolio weights w_k for the kth mimicked factor in w so that they minimize $w_k' V w_k$ subject to $w_k b_i = 0$, $\forall k \neq i$, and $w_k' b_k = 1$, and then normalizing the weights so that they sum to one. Lehmann and Modest (1988) review alternative factor mimicking procedures. As they point out, the normalization of the weights will generally produce own-factor loadings, as those listed in Panel (C) of Table 4, that differ from one.

Turning to the individual factor loadings reported in Table 5, IPO stocks have a significantly greater exposure than matched firms to the market factor (RM). Panel (A) and (B) show that the market beta for IPO stocks is 1.38 and 1.44 for the equal-weighted portfolios and 1.58 and 1.62 for the value weighted portfolios.[14] The corresponding betas are 0.97 and 1.27 for the equal-weighted portfolios of matched firms and 1.07 and 1.33 for value-weighted matched firms. In other words, the market risk factor *increases* the expected return to our zero-investment portfolio (since this portfolio is long in issuer stocks). The significantly greater market beta for the issuer portfolio occurs despite the "turbo-charging" effect of leverage on equity returns explained in Galai and Masulis (1976).[15] Thus, the contribution of the market risk factor itself is to make the evidence of low IPO long-run returns even more puzzling.

For the low IPO returns to be explained in terms of risk exposure, there must exist non-market risk factors that reduces the expected return to IPO stocks relative to matched firms. Table 5 shows that, of the non-market risk factors, the percent change in real per capita consumption of non-durable goods (ΔRPC) is statistically significant and positive for each of the issuer- and match portfolios. Thus, expected portfolio returns are increasing in this factor. However, focusing on the equal-weighted portfolio in Panel A, the product of the factor beta of 0.06 and the mean factor return implies that this factor on average contributes only 0.013% per month to expected portfolio return. Also, since the factor loadings are almost identical across the issuer and matched firm portfolios (with a value of 0.06 for EW-Issuer and 0.05 for EW-Match), the zero-investment portfolio does not have a statistically significant exposure to this factor. Thus, this particular risk factor also does not contribute much to our understanding of the *differential* risk exposure of IPO stocks versus size-matched firms.

The third risk factor in Table 5, the credit spread (BAA–AAA) is statistically significant for each of the issuer and matching firm portfolios. Moreover, this factor significantly reduces the expected return to the zero-investment portfolio. However, again the total factor contribution to

[14]The greater market beta for value-weighted than for equal-weighted portfolios reflects the fact that the average IPO firm size is close to the population mean (Figure 2).

[15]Galai and Masulis (1976) illustrate this effect using the standard Capital Asset Pricing Model (CAPM) and the Black-Scholes option pricing model. Let $\eta_s = (\partial s/\partial v)/(s/v)$ denote the elasticity of the stock price s with respect to total firm value v, The market beta estimated using equity returns can be written as $\beta_s = N(d_1)(v/s)\beta_v = \eta_s\beta_v$ where $N(d_1)$ is the cumulative Normal probability at d_1 as defined in the Black-Scholes model, and β_v is the market beta estimated using total firm returns. As mentioned in the introduction, in a multifactor setting, this "turbo-charging" effect of leverage appears in the factor loading of *each* risk factor.

expected return is small (approximately one basis point per month). Thus, at appears that this factor also does not help explain the differential return on the issuer- and matched-firm stocks. A similar conclusion holds for unexpected inflation (UI).

The final two risk factors are the long-term bond spread (20y–1y) and the short T-bill spread (TBILLspr). Both factors produce relatively large factor loadings and they tend to reduce the expected return to issuer firms. Equal-weighted portfolios have significant loadings on the term spread factor, while the factor loadings on the T-bill-spread factor are insignificant. The long-term bond spread reduces the expected return to the EW-issuer portfolio by a significant five basis points per month while the effect of the T-bill spread is to further reduce this expected return by (a statistically insignificant) 6 basis points per month.

Overall, the evidence in Table 5 shows that the market risk factor by far is the dominant factor impacting portfolio expected returns. While some of the non-market factors have statistically significant betas, their overall contribution to expected return (factor loading times average factor risk premium) is small. While the direction of the impact of these non-market factors is consistent with the lower leverage of IPO stocks relative to matched firms, the magnitude of this effect is too small to provide much confidence in this explanation alone.

Having said that, it remains true that the factor model "prices" the portfolios in the sense of producing constant terms (alphas) that are not significantly different from zero. Moreover, the magnitudes of these constant terms (e.g., 17 basis points for EW issuer portfolio) is small by the standards of the general asset pricing literature as well as extant papers on equity offerings. Thus, we cannot rule out the hypothesis that the lower leverage of IPO firms implies lower exposure to factors such as unexpected inflation and term premium and therefore lower expected returns relative to matched firms. We now turn to a risk analysis of the second unique characteristic of IPO stocks; their greater liquidity.[16]

[16] The above estimation of model (8) assumes that the factor loadings (β) are constant through time. Following Ferson and Schadt (1996), we re-estimated Jensen's alpha in a conditional factor model framework assuming that the factor loadings are linearly related to a set of L known information variables Z_{t-1}:

$$\beta_{1pt-1} = b_{p0} + B_{p1} Z_{t-1}.$$

Here, b_{p0} is a K-vector of "average" factor loadings that are time-invariant, B_{p1} is a $(K \times L)$ coefficient matrix, and Z_{t-1} is an L-vector of information variables (observables) at time $t-1$. The product $B_{p1}Z_{t-1}$ captures the predictable time variation in the factor loadings. After substituting this equation back into Eq. (6), the return-generating process becomes

$$r_{pt} = b_{p0}' r_{Ft} + b_{p1}'(Z_{t-1} \otimes r_{Ft}) + e_{pt},$$

4 Liquidity risk and expected returns

Brennan and Subrahmanyam (1996), Datar, Naik, and Radcliffe (1998), and Brennan, Chordia, and Subrahmanyam (1998) find that stock expected returns are cross-sectionally related to stock liquidity measures. In particular, share turnover appears to be a priced asset characteristic that lowers a stock's expected return. This suggests that, since IPO firms have significantly higher liquidity than matched firms (Table 3), they are also less risky and should command lower expected returns than the matched firms over the post-issue period.

We examine this proposition using a factor model that includes liquidity as a risk factor. This serves to link our IPO performance analysis to the asset pricing literature more generally, and it provides new information on the role of liquidity as a determinant of expected returns. Absent a theoretically "best" definition of liquidity, our approach is agnostic, and we use monthly turnover, defined as the number of shares traded over the month divided by number of shares outstanding, to construct the liquidity factor.[17]

4.1 Liquidity factor construction

We construct the liquidity factor, named TO, using an algorithm similar to the one used by Fama and French (1993) when constructing their size (SMB) and book-to-market ratio (HML) factors. To construct TO, we start in 1972 and form two portfolios based on a ranking of the end-of-year market value of equity for all NYSE/AMEX stocks and three portfolios formed using NYSE/AMEX stocks ranked on TO. Next, six portfolios are constructed from the intersection of the two market value and the three turnover portfolios. Monthly value-weighted returns on these six portfolios are calculated starting in January 1973. Portfolios are reformed in January every year using firm rankings from December the previous year. The return on the TO portfolio is the difference between

where the KL-vector b_{p1} is $\text{vec}(B_{p1})$ and the symbol $\otimes$ denotes the Kronecker product. (The operator $\text{vec}(\cdot)$ vectorizes the matrix argument by stacking each column starting with the first column of the matrix.) As information variables, Z_{t-1}, we used the lagged dividend yield on the CRSP value-weighted market index, the lagged 30-day Treasury bill rate, and the lagged values of the credit and yield curve spreads, BAA−AAA and TBILLspr, respectively. The resulting estimates of Jensen's alpha support the overall conclusion of zero abnormal IPO stock performance. The estimates are available upon request.

[17] Eckbo and Norli (2002) construct liquidity factors from several stock specific liquidity measures and confirm that the turnover factor used here, as well a factor based on bid-ask spreads, are significant determinants of expected stock returns, in the presence of the Fama and French (1993) factors and the Carhart (1997) momentum factor. See also Table 7, below. Pastor and Stambaugh (2002) also show that trading volume impacts expected stock returns for large portfolios.

the equal-weighted average return on the two portfolios with low turnover and the equal-weighted average return on the two portfolios with high turnover.

Comparing this procedure with the one used by Fama and French to create SMB and HML, TO "plays the role" of the book-to-market factor. When Fama and French constructed their SMB and HML factors, the idea was to "mimic the underlying risk factors in returns related to size and book-to-market equity." Their procedure tries to accomplish this goal by making sure that the average size for the firms in the three book-to-market portfolios is the same, while also maintaining the same average book-to-market ratio for the two size portfolios. The idea behind TO is similar, but we try to capture the risk factor in return related to liquidity.

Having constructed the liquidity factor, we place this factor in a five-factor model that in addition includes the three Fama-French factors (the market index RM, SMB, and HML), as well as a momentum mimicking portfolio labeled UMD.[18] The momentum factor is constructed in a slightly different way than the momentum factor used by Carhart (1997). In particular, six value-weighted portfolios are constructed as the intersections of two portfolios formed on market value of equity (size) and three portfolios formed on prior twelve month return. Portfolios are formed monthly using the median NYSE value for the size portfolios and the 30th and 70th NYSE percentiles for the prior twelve month returns. The momentum factor, UMD, is the average return on the two high prior return portfolios minus the average return on the two low prior return portfolios.

Table 6 shows the mean, standard deviation and pairwise correlations for the five risk factors. In Panel (A), notice that the mean return the liquidity factor is positive. Recall that the factor is a portfolio long in low-liquidity stocks and short in high-liquidity stocks. Thus, to the extent that illiquid stocks are more "risky" than liquid stocks, they have higher average returns and thus the factor portfolios have positive returns on average. Panel (B) of Table 6 shows that the HML portfolio is positively related to TO. This is likely a reflection of the fact that it is constructed in the same way as HML relative to size sorted portfolios. The momentum mimicking portfolio (UMD) does not show any strong correlation with the other characteristic-based mimicking factors, suggesting that these portfolios mimic underlying risk factors not captured by the other factor portfolios.

[18]We thank Ken French for providing us with the return series on these factors.

4.2 Parameter estimates

Table 7 shows estimates of the five-factor model for each of the Fama-French 25 size and book-to-market sorted portfolios. The table shows that adding the UMD factor and the TO factor to the three-factor model of Fama and French (1993) improves the general model fit for most portfolios. Interestingly, the liquidity risk factor TO appears to add at least as much explanatory power as the momentum factor UMD.

Next, we apply the new factor model to the portfolio returns of IPOs and matched firms. The results are shown in Table 8. Starting with a four factor model that amends the UMD factor to the original Fama-French model, there is little evidence of significant IPO underpricing in the top half of panel (A). Jensen's alpha for the equal-weighted zero-investment portfolio is an insignificant -0.15% per month (p-value of 0.205), while value-weighting produces a Jensen's alpha of 0.06%, also statistically insignificant.[19] Moreover, moving to the expanded model in the second half of panel (A), the alphas of the zero-investment portfolios are again uniformly insignificantly different from zero. A very similar conclusion holds for Panel (B) where the control firms are matched on size and book-to-market ratio.

As seen in Table 8, adding the liquidity factor only slightly improves the fit of the four factor regression. For example, for the equal-weighted, zero-investment portfolio in Panel (A), the R^2 increases from 0.530 in the four factor model to 0.549 in our expanded model. With value-weighted portfolios, the increase in R^2 is from 0.502 to 0.550. The momentum factor UMD is insignificant across all the zero-investment portfolios. In contrast, the liquidity factors receives a significant factor loading in several of the portfolios, including all of the zero-investment portfolios. The factor loading on TO is generally negative, as expected. Greater liquidity lowers expected return, and the reduction is greater for issuer stocks than for the matched firms in Table 8.[20]

Table 9 summarizes the factor contribution of the two asset pricing models used in this section

[19] Brav, Geczy, and Gompers (2000) use a similar model (where the momentum factor is generated as in Carhart (1997)) and find somewhat larger estimates of alpha, ranging from -37 basis points to -11 basis points for their equal-weighted and value-weighted portfolios, respectively. The larger alphas is due to their somewhat shorter sample period (1975-95 versus our 1972-98 period) and smaller sample size (4,622 versus 5,350 in Panel B). Also, of their total sample, 3,869 are Nasdaq IPOs, while we focus exclusively on Nasdaq issues.

[20] Eckbo, Masulis, and Norli (2000) find that also SEO firms have higher liquidity than matched firms. However, they do not test for the risk reducing effects of liquidity. When applying the above factor model to their sample of 3,315 SEOs from the period 1964–1997, we find that the liquidity factor is again statistically significant and contributes to a greater extent than the momentum factor to the expected returns of issuers. It appears that the net effect of the liquidity factor is to reduce the expected return to SEO stocks as well.

and the previous. Again, the factor contribution is computed as the product of the mean monthly factor returns over the sample period and the portfolio factor loadings reported above.[21] In addition, Table 9 lists the average monthly portfolio excess return (first column) and the average monthly model return (i.e., the portfolio expected return given by the model). Since the main purpose of Table 9 is expository, the earlier information on significance levels is left out.

Several summary conclusions emerge from Table 9. First, regardless of the model specification, the excess return on the market factor RM alone generates almost all of the average portfolio return. Second, in Panel (B), the four non-market factors compete almost on an "equal footing" in terms of factor contribution, perhaps with a slight edge to the SMB factor. Third, of the five non-market factors in Panel (A), the term spread (20y - 1y) and TBILLspr appears to have factor contributions of a similar magnitude to the factors HML, UMB and TO in the extended Fama-French model. Fourth, the leverage-related risk factors 20y–1y, and TBILLspr reduces the expected return to the issuer portfolio relative to the portfolio of matched firms. A similar conclusion holds for the liquidity factor in Panel (B): the contribution of TO is to reduce expected return to the issuer portfolio by a greater amount than for the matched portfolio. The latter is consistent with the hypothesis that IPO stocks have lower expected return due to their generally greater liquidity than the control firms matched on size and equity book-to-market ratio.

5 Conclusion

Using a multifactor, empirical asset pricing framework, we investigate the risk-return characteristics of an unprecedented large sample of IPO stocks over the 1973-2000 period. The factors are motivated by our finding that IPO stocks have significantly lower leverage ratios and exhibit greater liquidity than other small growth stocks. Since leverage "turbo charges" equity returns by increasing factor loadings, reducing leverage also reduces the stock's exposure to leverage-related risk factors. This argument notwithstanding, the market beta of IPO stocks is, if anything, greater than for matched firms. On the other hand, using a factor model with macroeconomic risks, we find that IPO stocks have somewhat lower exposures than matched firms to leverage-related factors such as the default spread, the term spread and unexpected inflation. While the contribution of

[21] This, of course, is just a restatement of Eq. (6). The sample factor means are given in Table 4 and Table 6 and are not repeated here.

the non-market risk factors to overall portfolio expected return is small, the evidence does indicate that the attenuating effect on average returns of the non-market risk factors help offset the greater market risk exposure of IPO stocks. Overall, we cannot reject the hypothesis that the model with macroeconomic risk factors prices the IPO portfolio in the sense of producing a statistically insignificant intercept term (Jensen's alpha).

Moreover, we examine the risk-reducing effects of greater liquidity through the lens of a factor model based on the Fama and French (1993) three-factor model augmented with a momentum factor and a new liquidity risk factor introduced here. The liquidity factor is constructed as the return differential between a portfolio of low-liquidity stocks and a portfolio of high-liquidity stocks. There is theoretical reason to suspect that such a factor is priced, and we show that the factor indeed produces factor loadings of a magnitude and significance comparable to that produced by the momentum factor. When applied to the IPO portfolio, the liquidity factor reduces expected portfolio return, as predicted.

We also investigate the nature of the return distribution of IPO stocks by quantifying the frequency of extreme events, including delistings due to liquidations and takeovers, as well as extreme return observations. Interestingly, there is no evidence that IPO firms exhibit a chance of delisting that differs from the typical non-IPO Nasdaq-listed company. Moreover, the frequency of -100% return realizations is no greater for IPO stocks than for non-IPO firms matched on either size and size and book-to-market ratio. However, there is a somewhat greater chance that an IPO stock will experience a return realization of 1,000% or more. The low expected return to IPO stocks suggests that this extra probability mass represents non-priced risk, perhaps confirming the popular notion of IPO stocks as "longshot" bets on large, future returns.

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Figure 1
Annual Distribution of 6,379 Nasdaq IPOs with offer dates between 1972–1998.

The column heights represent the number of Nasdaq IPOs in the sample for a given year.

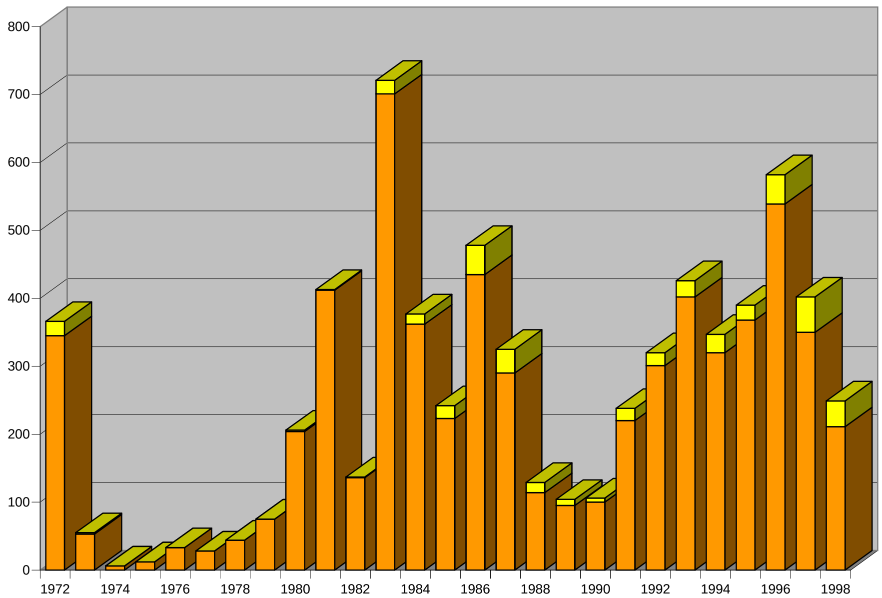
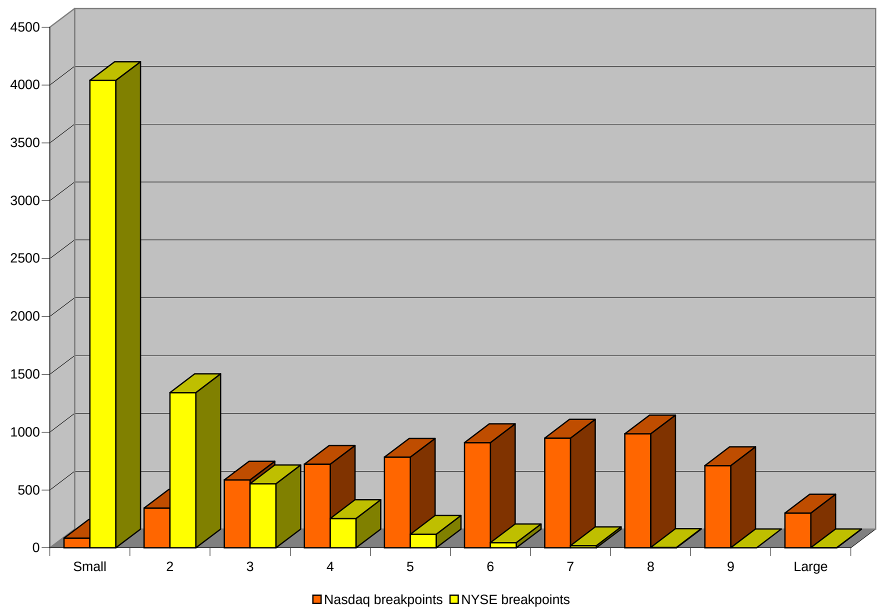


Figure 2
IPO size and book-to-market ratio distributions, for the total sample of 6,379 Nasdaq IPOs, 1973-2000.

In Panel A, each IPO are placed in a size decile using either NYSE size breakpoints or Nasdaq size breakpoints. In panel B, each IPO are placed in a book-to-market ratio decile using either NYSE book-to-market breakpoints or Nasdaq book-to-market breakpoints. The column heights represent the number of IPOs in each decile.

(A) IPO size distribution



(B) IPO book-to-market ratio distribution

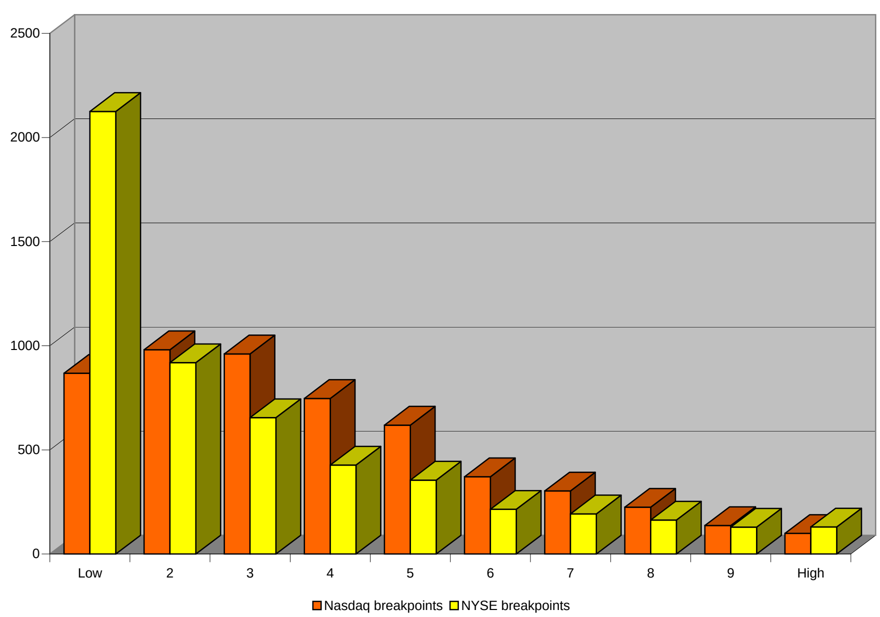


Figure 3
Compounded returns on the EW CRSP Nasdaq index, an EW portfolio of Nasdaq-IPOs, an EW portfolio of matching firms, and 30-day Treasury bills, Total sample of 6,379 IPOs, 1973–2000.

The graphs depicts how the value of a $1 investment evolves over the sample period January 1973 to December 2000.

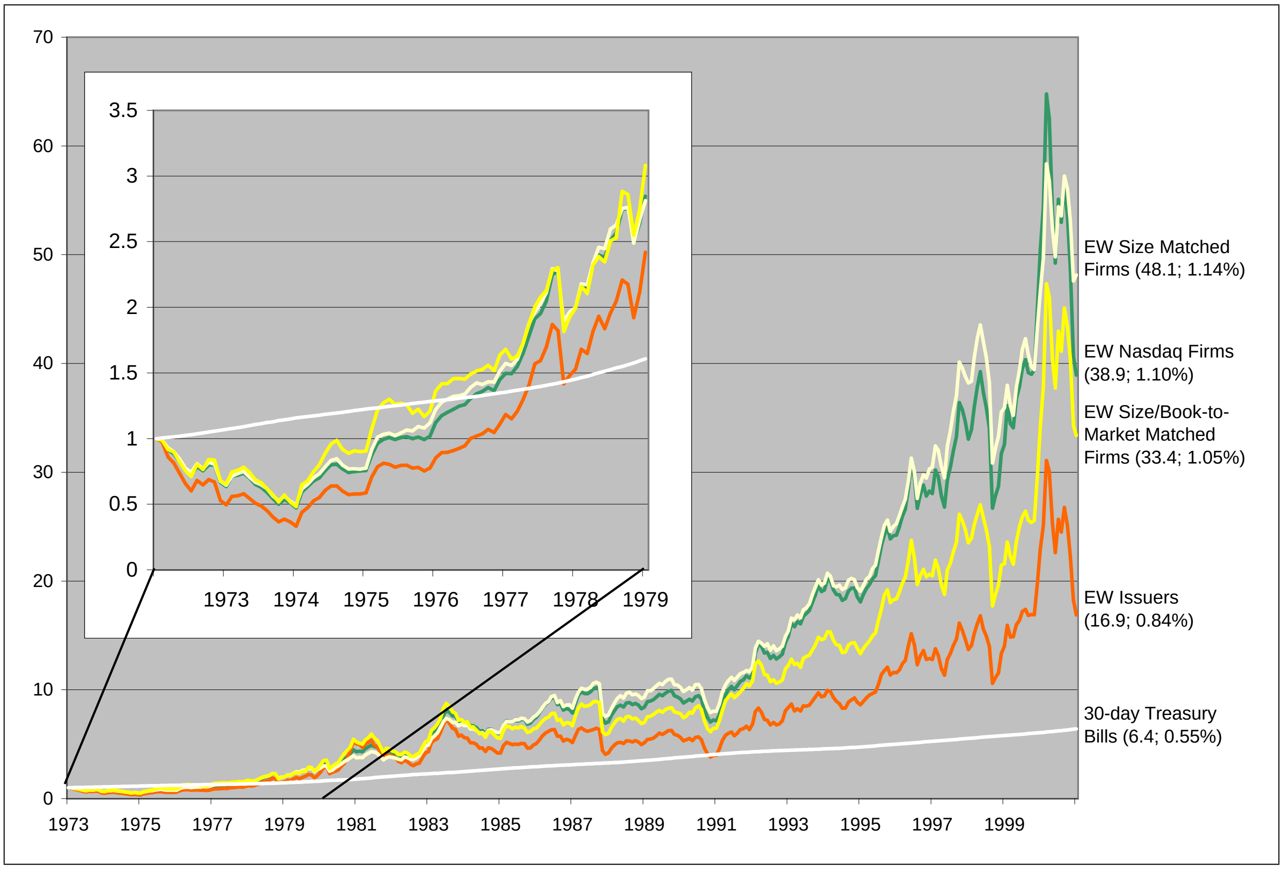
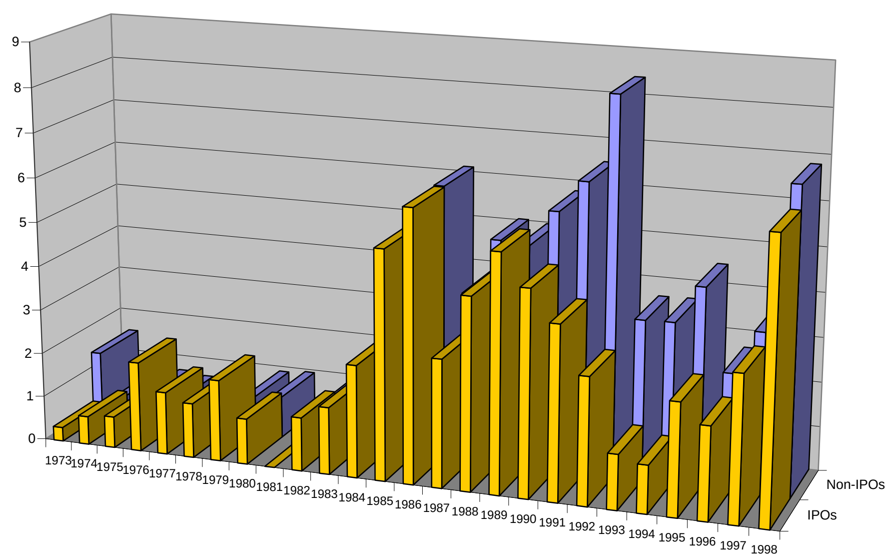


Figure 4
Delistings due to liquidation, mergers or takeovers.

Panel A covers delistings due to liquidations. Panel B covers number of delistings due to merger, takeover, exchange offers, or other events where common shareholders are bought out. In both panels, front columns are delistings by recent IPO firms (IPO less than five years before delisting date) divided by number of recent IPO firms. Back columns are delistings by Non-IPO firms (IPO more than five years ago) divided by number of non-IPO firms. Total sample of 6,379 IPOs from 1972-1998.

(A) Delistings due to liquidation



(B) Delistings due to merger or takover

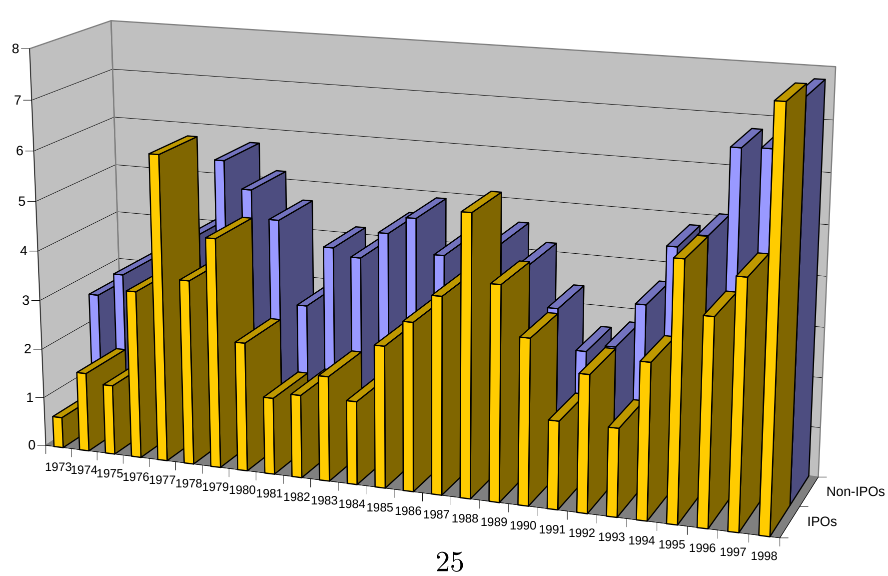
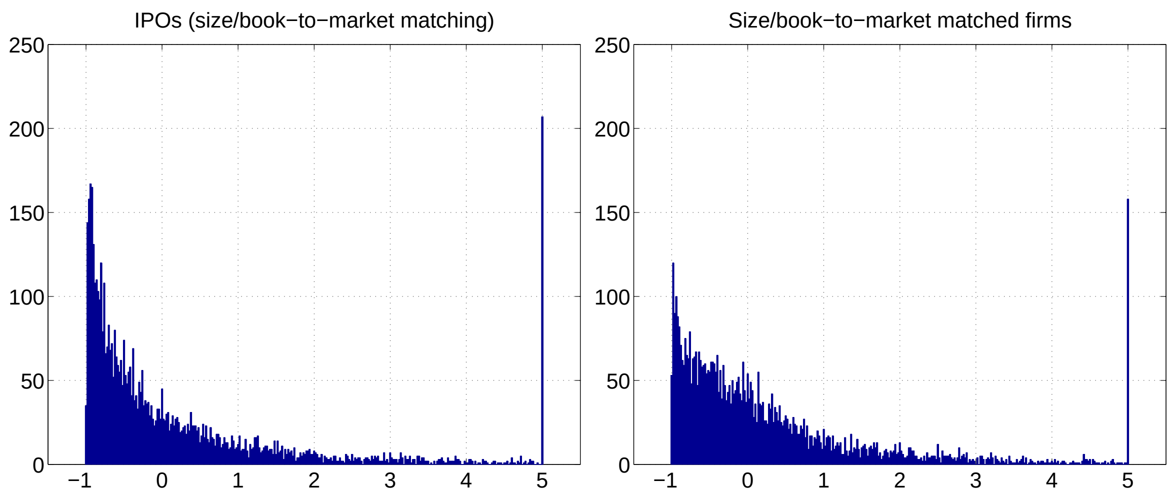


Figure 5
Histogram of five-year holding period returns between −100% and 1000% for issuers and size/book-to-market matched control firms.

Each bar in the histogram represent a 2 percentage point interval, and the height of the bar shows how many firms had a five-year holding period return within this 2 percentage point interval.

(A) Histogram of five-year holding period returns between −100% and 500%



(B) Histogram of five-year holding period returns between 100% and 1000%

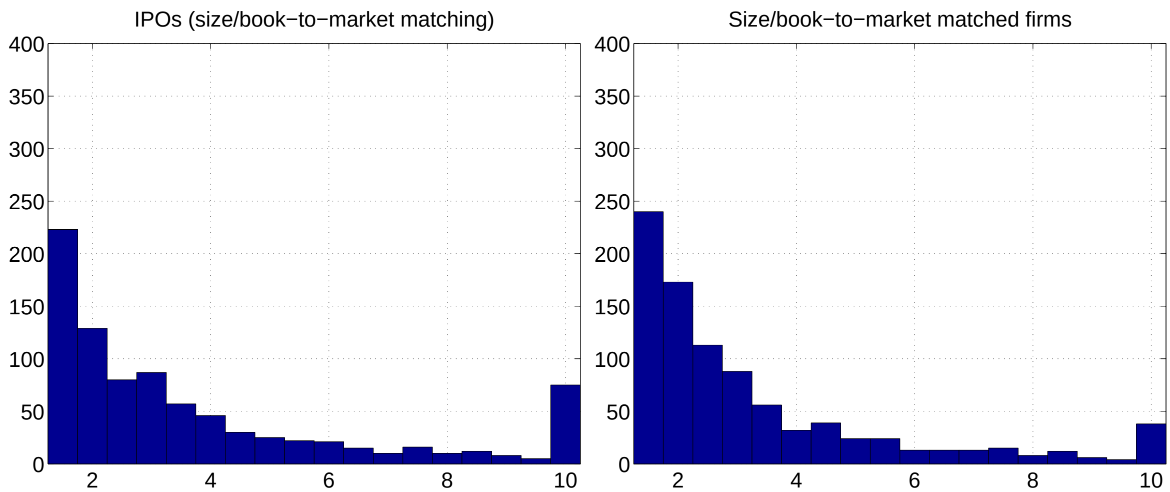


Table 1
Firm characteristics and portfolio characteristics for 6,379 firms going public between 1972 and 1998, and their non-issuing control firms matched on size and size/book-to-market ratio. All issuers and matching firms are listed on Nasdaq.

The number of observations used to compute the numbers in panel A vary by the variables. The number of observations range between 4,832 and 6,379. The equal weighted and value weighted issuer and match portfolios are constructed using monthly returns between January 1973 and December 2000, which gives 336 monthly returns for each portfolio.

	Size matching		Size/Book-to-market matching	
	Issuer	Match	Issuer	Match
(A) Average issuers and matching firms characteristics				
Size (market capitalization)	76.41	76.37	84.12	84.41
Book value of equity	—	—	26.54	26.85
Book-to-market ratio	—	—	0.377	0.378
Issue proceeds/size	0.391	—	0.322	—
Long-term debt/Total assets	0.102	0.150	0.102	0.147
Total debt/Total assets	0.155	0.211	0.154	0.208
Long-term debt/Market value	0.148	0.457	0.147	0.249
Average monthly turnover	0.121	0.071	0.120	0.102
(B) Monthly issuer and matching firm portfolio returns				
Equal weighted portfolios				
Mean percent return	1.14	1.31	1.20	1.29
Median percent return	1.54	1.54	1.48	1.36
Standard deviation of returns	7.70	5.38	7.94	7.03
End-value of a $1 investment	16.88	48.14	19.27	32.68
Implied average return to compound	0.84	1.16	0.88	1.04
Value weighted portfolios				
Mean percent return	1.12	1.19	1.24	1.11
Median percent return	1.21	1.76	1.28	1.51
Standard deviation of returns	8.45	5.59	8.64	7.02
End-value of a $1 investment	12.80	31.31	18.03	18.12
Implied average return to compound	0.76	1.03	0.86	0.87
Equal and value weighted portfolios				
Number of issuers and matches	6,379	6,379	5,350	5,350
Minimum number of firms in portfolios	86	86	71	71
Maximum number of firms in portfolios	1,722	1,722	1,676	1,676
Average number of firms in portfolios	888	888	776	776

Table 2

Five-year buy-and-hold stock percent returns ($\overline{\text{BHR}}$) for a total of 6,379 firms going public between 1972 and 1998, and their matched control firms, classified by type of matching procedure (size/size-and-book-to-market), sample period, and portfolio weights (equal-/value-weighted). All issuers and matching firms are listed on Nasdaq.

Buy-and-hold percent returns are defined as:

$$\overline{\text{BHR}} \equiv \omega_i \sum_{i=1}^{N} \left[\prod_{t=\tau_i}^{T_i} (1 + R_{it}) - 1 \right] \times 100.$$

When equal-weighting (EW), $\omega_i \equiv 1/N$, and when value-weighting (VW), $\omega_i = MV_i/MV$, where MV_i is the issuer's common stock market value (in 1999 dollars) at the start of the holding period and $MV = \sum_i MV_i$. The abnormal buy-and-hold returns shown in the column marked "Diff" represent the difference between the $\overline{\text{BHR}}$ in the "Issuer" and "Match" columns. The rows marked "N" contain number of issues. The p-values for equal-weighted abnormal returns are p-values of the t-statistic using a two-sided test of no difference in average five-year buy-and-hold returns for issuer and matching firms. The p-values for the value-weighted abnormal returns are computed using $U \equiv \omega' x/(\sigma\sqrt{\omega'\omega})$, where ω is a vector of value weights and x is the corresponding vector of differences in buy-and-hold returns for issuer and match. Assuming that x is distributed normal $N(\mu, \sigma^2)$ and that σ^2 can be consistently estimated using $\sum_i \omega_i(x_i - \bar{x})^2$, where $\bar{x} = \sum_i \omega_i x_i$, U is distributed $N(0, 1)$.

	Size matching					Size/book-to-market matching				
	N	Issuer	Match	Diff	$p(t)$	N	Issuer	Match	Diff	$p(t)$
(A) Total sample										
EW	6379	40.4	69.1	−28.8	0.000					
VW	6379	68.7	78.6	−10.0	0.302					
(B) Require sample firms to have book values on Compustat										
Holding period starts the month after the IPO date (looking ahead for the first book value on Compustat)										
EW	5350	46.3	72.5	−26.2	0.000	5350	46.3	43.3	3.0	0.627
VW	5350	74.8	82.2	−7.4	0.507	5350	74.8	59.1	15.7	0.130
Holding period starts the month after first post-IPO book value on Compustat										
EW	5225	47.3	73.3	−25.9	0.000	5225	47.3	59.4	−12.1	0.066
VW	5225	125.9	82.8	43.0	0.047	5225	125.9	89.6	36.2	0.102

Table 3

Average annual leverage ratios and liquidity for firms going public between 1972 and 1998, and their non-issuing control firms matched on size and size/book-to-market ratio. All issuers and matching firms are listed on Nasdaq.

The leverage variables are computed using long-term debt, total debt (long-term debt plus debt in current liabilities), and total assets at the end of the fiscal year (as reported by COMPUSTAT). Market values are measured at the end of the calendar year. Observations with negative book equity value and observations with a long-term debt to market value ratio that exceeds 10,000 are excluded. Turnover is volume divided by number of shares outstanding. The reported turnovers are average monthly turnover for each year zero to five in the holding period.

(A) Leverage

		Long-term debt divided by total assets			Long-term debt divided by market value of equity			Total debt divided by total assets		
Year	N	Issuer	Match	p-diff	Issuer	Match	p-diff	Issuer	Match	p-diff
Issuers and size matched firms										
0	4042	0.100	0.145	0.000	0.153	0.438	0.000	0.152	0.202	0.000
1	3959	0.124	0.149	0.000	0.290	0.483	0.000	0.184	0.205	0.000
2	3444	0.139	0.147	0.057	0.372	0.459	0.001	0.199	0.203	0.337
3	2849	0.151	0.149	0.771	0.433	0.509	0.025	0.212	0.206	0.231
4	2170	0.150	0.146	0.465	0.572	0.488	0.202	0.213	0.206	0.278
5	1869	0.153	0.152	0.802	0.659	0.511	0.042	0.213	0.213	0.952
Issuers and size/book-to-market matched firms										
0	4649	0.102	0.144	0.000	0.161	0.255	0.000	0.154	0.203	0.000
1	4407	0.125	0.150	0.000	0.291	0.337	0.012	0.185	0.211	0.000
2	3710	0.139	0.150	0.010	0.379	0.350	0.248	0.199	0.209	0.031
3	3043	0.147	0.153	0.206	0.448	0.409	0.297	0.209	0.213	0.496
4	2319	0.146	0.152	0.246	0.524	0.417	0.062	0.209	0.216	0.270
5	1941	0.156	0.158	0.692	0.608	0.483	0.031	0.217	0.225	0.229

(B) Liquidity measured as monthly average turnover

		Issuers and size matched firms			Issuers and size-book-to-market matched firms		
Year	N	Issuer	Match	p-diff	Issuer	Match	p-diff
0	4486	0.126	0.074	0.000	0.125	0.105	0.000
1	4801	0.111	0.074	0.000	0.114	0.098	0.000
2	4641	0.120	0.077	0.000	0.126	0.097	0.000
3	4022	0.120	0.079	0.000	0.125	0.100	0.000
4	3330	0.119	0.077	0.000	0.124	0.102	0.000
5	2736	0.106	0.071	0.000	0.113	0.090	0.000

Table 4
Factor mimicking portfolios and macroeconomic variables used as risk factors, January 1973 to December 2000.

A factor mimicking portfolio is constructed by first regressing the returns on each of the 25 size and book-to-market sorted portfolios of Fama and French (1993) on the total set of six factors, i.e., 25 time-series regressions producing a (25×6) matrix B of slope coefficients against the factors. If V is the (25×25) covariance matrix of the error terms in these regressions (assumed to be diagonal), then the weights on the mimicking portfolios are: $w = (B'V^{-1}B)^{-1}B'V^{-1}$ (see Lehmann and Modest (1988)). For each factor k, the return in month t for the corresponding mimicking portfolio is calculated from the cross-product of row k in w and the vector of month t returns on the 25 Fama-French portfolios.

(A) Raw macroeconomic variables

	N	Mean	Std Dev
Excess return on the market index (RM)	336	0.539	4.649
Change in real per capita consumption of nondurable goods (ΔRPC)[a]	336	0.053	0.686
Difference in BAA and AAA yield change (BAA−AAA)	336	-0.012	1.138
Unanticipated inflation (UI)[b]	336	-0.024	0.253
Return difference on Treasury bonds (20y−1y)[c]	336	0.109	2.649
Return difference on Treasury bills (TBILLspr)[d]	336	0.052	0.115

(B) Correlation between raw macroeconomic factor and the factor mimicking portfolio

Mimicking factor	ΔRPC	BAA−AAA	UI
$\widehat{\Delta RPC}$	0.265 (0.000)	0.011 (0.836)	−0.046 (0.401)
$\widehat{BAA-AAA}$	0.004 (0.935)	0.265 (0.000)	−0.026 (0.631)
$\widehat{UI}$	0.001 (0.991)	−0.031 (0.575)	0.287 (0.000)

(C) Correlation between macroeconomic factors

	RM	$\widehat{\Delta RPC}$	$\widehat{BAA-AAA}$	$\widehat{UI}$	20y−1y	TBILLspr
RM	1.000					
$\widehat{\Delta RPC}$	-0.008	1.000				
$\widehat{BAA-AAA}$	0.013	-0.099	1.000			
$\widehat{UI}$	0.020	-0.298	0.266	1.000		
20y−1y	0.314	-0.004	0.080	-0.067	1.000	
TBILLspr	0.115	0.028	0.066	-0.062	0.395	1.000

[a] Seasonally adjusted real per capita consumption of nondurable goods are from the FRED database.
[b] Unanticipated inflation (UI) is generated using a model for expected inflation that involves running a regression of real returns (returns on 30-day Treasury bills less inflation) on a constant and 12 of it's lagged values.
[c] This is the return spread between Treasury bonds with 20-year and 1-year maturities.
[d] The short end of the term structure (TBILLspr) is measured as the return difference between 90-day and 30-day Treasury bills.

Table 5

Jensen's alphas and constant factor loadings for stock portfolios of a total of 6,379 firms going public on Nasdaq and non-issuing Nasdaq firms matched on size and size/book-to-market ratio, classified by portfolio weights. Portfolios are first formed in January 1973 and held until December 2000.

The model is:

$$r_{pt} = \alpha_p + \beta_1 \text{RM}_t + \beta_2 \widehat{\Delta\text{RPC}}_t + \beta_3 (\widehat{\text{BAA} - \text{AAA}})_t + \beta_4 \widehat{\text{UI}}_t + \beta_5 (20\text{y} - 1\text{y})_t + \beta_6 \text{TBILLspr}_t + e_t$$

where r_{pt} is either a portfolio excess return or a return on a zero investment portfolio that is long issuers and short in mathcing firms, RM is the excess return on the market index, RPC is the percent change in the real per capita consumption of nondurable goods, BAA−AAA is the difference in the monthly yield changes on bonds rated BAA and AAA by Moody's, UI is unanticipated inflation, 20y−1y is the return difference between Treasury bonds with 20 years to maturity and 1 year to maturity, and TBILLspr is the return difference between 90-day and 30-day Treasury bills. The factors $\widehat{\Delta\text{RPC}}$, $\widehat{\text{BAA} - \text{AAA}}$, and $\widehat{\text{UI}}$ are mimicking portfolios for the corresponding raw factors. T is the number of months in the time series regression, N is the average number of firms in the portfolio, and I is the number of issues used to construct the portfolio. The coefficients are estimated using OLS. Standard errors are computed using the heteroscedasticity consistent estimator of White (1980). The numbers in parentheses are p-values.

		Factor betas (T=336, N=888)						
Portfolio	$\hat{\alpha}$	RM	$\widehat{\Delta\text{RPC}}$	$\widehat{\text{BAA} - \text{AAA}}$	$\widehat{\text{UI}}$	20y−1y	TBILLspr	Rsq
(A) Issuers and size matched control firms (I=6,379)								
EW-issuer	−0.17 (.510)	1.38 (.000)	0.06 (.000)	−0.03 (.000)	0.05 (.000)	−0.42 (.000)	−0.46 (.845)	0.704
EW-match	0.10 (.566)	0.97 (.000)	0.05 (.000)	−0.01 (.000)	0.04 (.000)	−0.26 (.000)	1.76 (.218)	0.736
EW-zero	−0.27 (.102)	0.41 (.000)	0.01 (.104)	−0.01 (.000)	0.01 (.212)	−0.16 (.027)	−2.22 (.178)	0.364
VW-issuer	−0.12 (.651)	1.58 (.000)	0.03 (.023)	−0.02 (.016)	−0.02 (.360)	−0.29 (.012)	−2.37 (.305)	0.731
VW-match	−0.02 (.903)	1.07 (.000)	0.03 (.012)	−0.01 (.095)	0.00 (.691)	−0.14 (.023)	1.54 (.316)	0.780
VW-zero	−0.10 (.635)	0.51 (.000)	0.00 (.583)	−0.01 (.117)	−0.02 (.093)	−0.14 (.129)	−3.92 (.034)	0.309
(B) Issuers and size/book-to-market matched control firms (I=5,350)								
EW-issuer	−0.10 (.709)	1.44 (.000)	0.06 (.000)	−0.03 (.000)	0.05 (.001)	−0.47 (.000)	−1.21 (.614)	0.715
EW-match	−0.02 (.913)	1.27 (.000)	0.06 (.000)	−0.02 (.000)	0.05 (.000)	−0.39 (.000)	0.80 (.703)	0.729
EW-zero	−0.07 (.581)	0.18 (.000)	−0.00 (.220)	−0.00 (.159)	0.00 (.687)	−0.08 (.105)	−2.01 (.117)	0.135
VW-issuer	0.02 (.940)	1.62 (.000)	0.03 (.025)	−0.02 (.018)	−0.02 (.283)	−0.32 (.006)	−2.99 (.224)	0.728
VW-match	−0.15 (.474)	1.33 (.000)	0.04 (.010)	−0.01 (.034)	0.00 (.936)	−0.20 (.010)	−0.01 (.993)	0.764
VW-zero	0.17 (.372)	0.29 (.000)	−0.01 (.246)	−0.00 (.345)	−0.02 (.052)	−0.12 (.138)	−2.97 (.104)	0.160

Table 6
Descriptive statistics for characteristic based risk factors, January 1973 to December 2000 sample period.

The size factor (SMB) is the return on a portfolio of small firms minus the return on a portfolio of large firms (See Fama and French, 1993). The momentum factor (UMD) is constructed using a procedure similar to Carhart (1997): It is the return on a portfolio of the one-third of the CRSP stocks with the highest buy-and-hold return over the previous 12 months minus the return on a portfolio of the one-third of the CRSP stocks with the lowest buy-and-hold return over the previous 12 months. The SMB, HML, and UMD factors are constructed by Ken French and are downloaded from his web-page. The liquidity factor TO is constructed using an algorithm similar to the one used by Fama and French (1993) when constructing the SMB and HML factors. To construct TO, we start in 1972 and form two portfolios based on a ranking of the end-of-year market value of equity for all NYSE/AMEX stocks and three portfolios formed using NYSE/AMEX stocks ranked on TO. Next, six portfolios are constructed from the intersection of the two market value and the three turnover portfolios. Monthly value-weighted returns on these six portfolios are calculated starting in January 1973. Portfolios are reformed in January every year using firm rankings from December the previous year. The return on the TO portfolio is the difference between the equal-weighted average return on the two portfolios with low turnover and the equal-weighted average return on the two portfolios with high turnover.

(A) Characteristic based factors

	N	Mean	Std Dev
Difference in returns between small firms and big firms (SMB)	336	0.099	3.346
Difference in return between firms with high and low book-to-market (HML)	336	0.453	3.120
Difference in return between winners and losers (UMD)	336	1.010	3.814
Difference in return between firms with high and low turnover (TO)	336	0.115	2.727

(B) Correlation between characteristic based factors

	RM	SMB	HML	UMD	TO
RM	1.000				
SMB	0.257	1.000			
HML	-0.473	-0.312	1.000		
UMD	0.093	0.101	-0.314	1.000	
TO	-0.673	-0.544	0.522	-0.098	1.000

Table 7
Factor-betas and t-values for the extended Fama-French model using 25 size and book-to-market sorted portfolios as test assets

The model is:

$$r_{pt} = \alpha_p + \beta_1 \text{RM}_t + \beta_2 \text{SMB}_t + \beta_3 \text{HML}_t + \beta_4 \text{UMD}_t + \beta_5 \text{TO}_t + e_t$$

where r_{pt} is excess return on the 25 Fama and French (1993) size and book-to-market ratio sorted portfolios. RM is the excess return on a value weighted market index, SMB and HML are the Fama and French (1993) size and book-to-market factors, UMD is a momentum factor and is constructed as the return difference between the one-third highest and one-third lowest CRSP performers over the past 12 months. The SMB, HML, and UMD factors are constructed by Ken French and are downloaded from his web-page. The liquidity factor TO is constructed using an algorithm similar to the one used by Fama and French (1993) when constructing the SMB and HML factors. To construct TO, we start in 1972 and form two portfolios based on a ranking of the end-of-year market value of equity for all NYSE/AMEX stocks and three portfolios formed using NYSE/AMEX stocks ranked on TO. Next, six portfolios are constructed from the intersection of the two market value and the three turnover portfolios. Monthly value-weighted returns on these six portfolios are calculated starting in January 1973. Portfolios are reformed in January every year using firm rankings from December the previous year. The return on the TO portfolio is the difference between the equal-weighted average return on the two portfolios with low turnover and the equal-weighted average return on the two portfolios with high turnover. The coefficients are estimated using OLS. Standard errors are computed using the heteroscedasticity consistent estimator of White (1980). The model is estimated using monthly data over the sample period April 1963 through December 2000, giving 453 observations. The numbers in parentheses are t-values.

	Intercept	RM	SMB	HML	UMD	TO	ARsq
P11	−0.38 (−3.75)	0.97 (33.46)	1.32 (26.44)	−0.27 (−5.23)	0.04 (1.21)	−0.21 (−3.25)	0.93
P12	−0.01 (−0.07)	0.95 (34.54)	1.33 (27.15)	0.07 (1.67)	0.03 (0.99)	−0.01 (−0.15)	0.94
P13	0.04 (0.56)	0.94 (48.52)	1.11 (37.83)	0.28 (9.03)	−0.03 (−1.27)	−0.01 (−0.30)	0.96
P14	0.18 (2.77)	0.91 (46.15)	1.04 (25.40)	0.44 (14.01)	−0.02 (−1.05)	−0.00 (−0.03)	0.95
P15	0.14 (2.02)	0.99 (46.53)	1.09 (26.32)	0.67 (18.08)	−0.03 (−1.25)	0.02 (0.36)	0.95
P21	−0.05 (−0.63)	1.00 (45.89)	0.88 (21.51)	−0.39 (−10.77)	−0.04 (−1.38)	−0.30 (−5.86)	0.96
P22	0.03 (0.37)	1.02 (44.29)	0.84 (25.61)	0.13 (3.68)	−0.11 (−4.40)	−0.05 (−1.22)	0.95
P23	0.17 (2.61)	0.97 (44.34)	0.72 (19.69)	0.39 (9.79)	−0.07 (−2.72)	−0.06 (−1.40)	0.94
P24	0.10 (1.55)	1.00 (53.39)	0.69 (27.07)	0.56 (17.41)	−0.03 (−1.15)	0.03 (0.76)	0.94
P25	0.03 (0.38)	1.06 (48.86)	0.78 (29.55)	0.77 (25.45)	−0.00 (−0.22)	−0.06 (−1.70)	0.95
P31	0.02 (0.18)	1.03 (41.10)	0.65 (13.01)	−0.40 (−10.64)	−0.05 (−1.97)	−0.21 (−4.15)	0.95
P32	0.17 (1.95)	1.00 (35.43)	0.44 (8.90)	0.19 (4.11)	−0.08 (−2.52)	−0.18 (−3.10)	0.91
P33	0.07 (0.88)	0.98 (41.19)	0.38 (7.64)	0.47 (10.76)	−0.10 (−3.96)	−0.13 (−2.32)	0.90
P34	0.10 (1.24)	0.99 (44.67)	0.35 (9.54)	0.64 (14.78)	−0.07 (−2.22)	−0.05 (−0.99)	0.90
P35	0.11 (1.33)	1.06 (43.08)	0.47 (9.86)	0.82 (21.11)	−0.05 (−1.88)	−0.12 (−2.32)	0.90
P41	0.18 (2.26)	0.98 (37.56)	0.29 (6.21)	−0.43 (−11.36)	0.02 (0.62)	−0.19 (−4.42)	0.94
P42	−0.00 (−0.05)	1.05 (33.96)	0.13 (2.58)	0.19 (3.91)	−0.13 (−4.05)	−0.16 (−2.73)	0.89
P43	0.11 (1.34)	1.03 (43.13)	0.08 (1.38)	0.47 (10.11)	−0.09 (−3.00)	−0.19 (−3.08)	0.89
P44	0.17 (2.12)	1.00 (35.42)	0.17 (4.09)	0.59 (14.27)	−0.05 (−1.58)	−0.10 (−2.04)	0.88
P45	0.11 (1.10)	1.06 (34.91)	0.12 (2.61)	0.86 (20.20)	−0.06 (−1.88)	−0.34 (−6.01)	0.86
P51	0.25 (3.60)	0.97 (46.35)	−0.24 (−8.39)	−0.40 (−12.68)	−0.03 (−1.31)	0.04 (1.01)	0.93
P52	−0.00 (−0.03)	1.04 (42.80)	−0.26 (−6.79)	0.09 (2.12)	−0.05 (−1.59)	0.00 (0.06)	0.90
P53	−0.07 (−0.83)	0.99 (37.93)	−0.29 (−7.05)	0.26 (7.06)	0.02 (0.52)	−0.01 (−0.25)	0.84
P54	−0.02 (−0.29)	0.98 (39.89)	−0.27 (−8.95)	0.60 (20.14)	−0.06 (−2.90)	−0.12 (−2.83)	0.89
P55	−0.07 (−0.70)	0.94 (27.91)	−0.14 (−2.26)	0.83 (15.26)	−0.03 (−0.77)	−0.23 (−3.54)	0.80

Table 8

Jensen's alphas, Fama and French (1993) factor loadings, and factor loadings for momentum and liquidity factors for stock portfolios of a total of 6,379 firms going public on Nasdaq and non-issuing Nasdaq firms matched on size and size/book-to-market, classified by portfolio weights. Portfolios are first formed in January 1973 and held until December 2000.

The model is:

$$r_{pt} = \alpha_p + \beta_1 \mathrm{RM}_t + \beta_2 \mathrm{SMB}_t + \beta_3 \mathrm{HML}_t + \beta_4 \mathrm{UMD}_t + \beta_5 \mathrm{TO}_t + e_t$$

where r_{pt} is either a portfolio excess return or a return on a zero investment portfolio that is long issuers and short in mathcing firms, RM is the excess return on a value weighted market index, SMB and HML are the Fama and French (1993) size and book-to-market factors, UMD is a momentum factor and is constructed as the return difference between the one-third highest and one-third lowest CRSP performers over the past 12 months. The SMB, HML, and UMD factors are constructed by Ken French and are downloaded from his web-page. The liquidity factor TO is constructed using an algorithm similar to the one used by Fama and French (1993) when constructing the SMB and HML factors. To construct TO, we start in 1972 and form two portfolios based on a ranking of the end-of-year market value of equity for all NYSE/AMEX stocks and three portfolios formed using NYSE/AMEX stocks ranked on TO. Next, six portfolios are constructed from the intersection of the two market value and the three turnover portfolios. Monthly value-weighted returns on these six portfolios are calculated starting in January 1973. Portfolios are reformed in January every year using firm rankings from December the previous year. The return on the TO portfolio is the difference between the equal-weighted average return on the two portfolios with low turnover and the equal-weighted average return on the two portfolios with high turnover. In the panel headings, T is the number of months in the time series regression, N is the average number of firms in the portfolio, and I is the number of issues used to construct the portfolio. The coefficients are estimated using OLS. Standard errors are computed using the heteroscedasticity consistent estimator of White (1980). The numbers in parentheses are p-values.

		Factor betas (T=336, N=888)					
Portfolio	$\hat{\alpha}$	RM	SMB	HML	UMD	TO	A-Rsq
(A) Issuers and size matched control firms (I=6,379)							
EW-issuer	−0.01 (0.958)	1.05 (0.000)	1.18 (0.000)	−0.10 (0.214)	−0.04 (0.508)		0.860
EW-match	0.14 (0.126)	0.85 (0.000)	0.91 (0.000)	0.27 (0.000)	−0.06 (0.024)		0.917
EW-zero	−0.15 (0.205)	0.20 (0.000)	0.27 (0.000)	−0.37 (0.000)	0.02 (0.666)		0.530
VW-issuer	0.07 (0.651)	1.13 (0.000)	0.90 (0.000)	−0.68 (0.000)	0.11 (0.047)		0.903
VW-match	0.01 (0.892)	0.90 (0.000)	0.70 (0.000)	−0.03 (0.558)	0.08 (0.035)		0.919
VW-zero	0.06 (0.749)	0.23 (0.000)	0.20 (0.020)	−0.65 (0.000)	0.03 (0.668)		0.502
EW-issuer	0.05 (0.780)	0.97 (0.000)	1.10 (0.000)	−0.06 (0.525)	−0.03 (0.607)	−0.28 (0.039)	0.864
EW-match	0.14 (0.127)	0.85 (0.000)	0.90 (0.000)	0.27 (0.000)	−0.06 (0.023)	−0.01 (0.848)	0.917
EW-zero	−0.10 (0.387)	0.12 (0.005)	0.20 (0.002)	−0.33 (0.000)	0.03 (0.557)	−0.26 (0.003)	0.549
VW-issuer	0.18 (0.216)	0.97 (0.000)	0.73 (0.000)	−0.59 (0.000)	0.12 (0.011)	−0.56 (0.000)	0.915
VW-match	0.01 (0.895)	0.90 (0.000)	0.70 (0.000)	−0.03 (0.556)	0.08 (0.036)	−0.00 (0.991)	0.919
VW-zero	0.16 (0.308)	0.07 (0.198)	0.03 (0.689)	−0.55 (0.000)	0.04 (0.454)	−0.56 (0.000)	0.550
(B) Issuers and size/book-to-market matched control firms (I=5,350)							
EW-issuer	0.06 (0.718)	1.09 (0.000)	1.19 (0.000)	−0.15 (0.091)	−0.05 (0.465)		0.862
EW-match	0.13 (0.313)	1.01 (0.000)	1.14 (0.000)	0.06 (0.366)	−0.08 (0.086)		0.881
EW-zero	−0.08 (0.487)	0.08 (0.007)	0.05 (0.214)	−0.20 (0.000)	0.03 (0.378)		0.192
VW-issuer	0.19 (0.225)	1.15 (0.000)	0.90 (0.000)	−0.72 (0.000)	0.11 (0.056)		0.897
VW-match	−0.06 (0.599)	1.02 (0.000)	0.90 (0.000)	−0.31 (0.000)	0.12 (0.005)		0.934
VW-zero	0.25 (0.125)	0.13 (0.010)	−0.00 (0.988)	−0.41 (0.000)	−0.01 (0.935)		0.234
EW-issuer	0.12 (0.448)	1.00 (0.000)	1.10 (0.000)	−0.09 (0.317)	−0.04 (0.569)	−0.32 (0.018)	0.866
EW-match	0.16 (0.226)	0.97 (0.000)	1.09 (0.000)	0.08 (0.219)	−0.08 (0.111)	−0.15 (0.193)	0.882
EW-zero	−0.04 (0.692)	0.03 (0.426)	0.00 (0.963)	−0.17 (0.001)	0.04 (0.301)	−0.18 (0.009)	0.208
VW-issuer	0.32 (0.026)	0.96 (0.000)	0.71 (0.000)	−0.61 (0.000)	0.13 (0.008)	−0.65 (0.000)	0.912
VW-match	−0.03 (0.781)	0.98 (0.000)	0.86 (0.000)	−0.28 (0.000)	0.12 (0.003)	−0.14 (0.054)	0.935
VW-zero	0.35 (0.024)	−0.02 (0.801)	−0.15 (0.122)	−0.33 (0.000)	0.01 (0.870)	−0.51 (0.000)	0.296

Table 9

Average portfolio return, and individual factor contribution to portfolio expected return, for stock portfolios of firms going public on Nasdaq and non-issuing Nasdaq firms matched on size and book-to-market ratio. Portfolios are first formed in January 1973 and held until December 2000.

The returns on the issuer and match portfolios are reported in excess of the one month Treasury bill. For the model in panel (A), RM is the excess return on the market index, RPC is the percent change in the real per capita consumption of nondurable goods, BAA−AAA is the difference in the monthly yield changes on bonds rated BAA and AAA by Moody's, UI is unanticipated inflation, 20y−1y is the return difference between Treasury bonds with 20 years to maturity and 1 year to maturity, and TBILLspr is the return difference between 90-day and 30-day Treasury bills. For the model in panel (B) RM is the excess return on a value weighted market index, SMB and HML are the Fama and French (1993) size and book-to-market factors, UMD is a momentum factor and is constructed as the return difference between the one-third highest and one-third lowest CRSP performers over the past 12 months. The factor is constructed by Ken French and is downloaded from his web-page. TO (monthly volume divided by number of shares outstanding) is a liquidity factor. To construct TO, we start in 1972 and form two portfolios based on a ranking of the end-of-year market value of equity for all NYSE/AMEX stocks and three portfolios formed using NYSE/AMEX stocks ranked on TO. Next, six portfolios are constructed from the intersection of the two market value and the three turnover portfolios. Monthly value-weighted returns on these six portfolios are calculated starting in January 1973. Portfolios are reformed in January every year using firm rankings from December the previous year. The return on the TO portfolio is the difference between the equal-weighted average return on the two portfolios with low turnover and the equal-weighted average return on the two portfolios with high turnover.

Portfolio	Average portfolio excess return	Average model return	Factor contribution to expected return (Mean return on factor mimicking portfolio times factor-beta)					
(A) Macro-factor model								
			RM	$\widehat{\Delta RPC}$	$\widehat{BAA - AAA}$	$\widehat{UI}$	20y−1y	TBILLspr
EW-Issuer	0.65	0.75	0.777	0.013	-0.002	0.070	-0.052	-0.062
EW-Match	0.74	0.76	0.682	0.014	-0.001	0.066	-0.043	0.041
VW-Issuer	0.69	0.67	0.874	0.008	-0.001	-0.025	-0.035	-0.154
VW-Match	0.55	0.70	0.715	0.010	-0.001	0.002	-0.022	-0.001
(B) Extended Fama-French Model								
			RM	SMB	HML	UMD	TO	
EW-Issuer	0.65	0.53	0.536	0.109	-0.042	-0.038	-0.037	
EW-Match	0.74	0.58	0.521	0.109	0.036	-0.076	-0.017	
VW-Issuer	0.69	0.37	0.518	0.070	-0.276	0.131	-0.074	
VW-Match	0.55	0.58	0.526	0.085	-0.128	0.121	-0.016	