Shareholder Diversification and the Decision to Go Public

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We study the effects of the controlling shareholders' portfolio diversification on the initial public offering (IPO) process. Less diversified shareholders have more to gain from taking their firm public, and are more willing to accept a lower price for shares. We test these hypotheses using the data on all IPOs in Sweden between 1995 and 2001. Using detailed information on the portfolio composition of shareholders in private and public firms, we construct several proxies of their portfolio diversification and relate them to the probability of the IPO and the underpricing. We show that the less diversified individual shareholders, especially those with lower wealth, sell more of their shares at the IPO. Firms held by less diversified controlling shareholders are more likely to go public, and exhibit higher underpricing. These effects are economically and statistically significant, while the diversification of noncontrolling shareholders has no effect. Our findings suggest that diversification of controlling shareholders plays a prominent role in the IPO process. (*JEL* G120, G140, G240, G320)

". . . Richman remembered that before they entered into negotiations . . . their lawyer insisted that each of the founders sell some of their holdings in the company and each 'take down a million bucks.' This, so that they could negotiate without the dread of losing everything

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('Having to go back to your father's gas station.' Richman called that a nightmare).''—T. Kidder, *The Soul of a New Machine*.

Portfolio theory prescribes diversification as a way to reduce the overall risk of one's portfolio by removing the nonsystematic risk. It states that the utility of any risk-averse investor holding one or just a few securities is much lower than it could be if the investor held a well-diversified portfolio. This fact is evident to many successful entrepreneurs, whose wealth is closely tied to the stock of their companies. This situation not only reduces their utility directly due to excessive risk, but also may negatively affect the quality of their business decisions. Being extremely nondiversified, they are forced to use a much higher cost of capital, and seek diversification via their capital budgeting and other business decisions, which may cause them to act suboptimally. This intuition has been understood for a long time. For example, in the 1970s, lawyers of Data General Corporation (Kidder 1981) forced each founder to sell at least one million dollars, worth of shares of the rapidly growing company.[1] This was done explicitly to allow the owners to hold a more diversified portfolio, so they could conduct business from a less risk-averse position.

At some point, such a nondiversified shareholder may want to follow the path of the Data General founders by diversifying holdings to alleviate excessive risk. Among several alternatives, the shareholders will also consider taking the company public. Consequently, the benefits of diversification (the nondiversification premium) for the controlling shareholders of a private company should, in principle, affect their decision to take the company public, as well as the price at which they are willing to sell their shares at an initial public offering (IPO). The intuition is straightforward: all else equal (including the need to raise capital and other reasons for an IPO), more diversified shareholders have less to gain from an IPO, and if they choose to go public, they are less likely to agree to a large discount.

The extensive literature on IPOs largely ignores the effect of the portfolio diversification of the founding shareholders on the IPO process.[2] Hypotheses related to diversification have not been tested, because such tests require data on investors' holdings in private firms, which are unavailable in the United States and most industrialized countries. It turns out, however, that reporting requirements in Sweden—a country with a per capita income comparable to that of the United States—provide direct dataset on investors' holdings. We exploit this information to construct a of Swedish firms and create proxies for the degree of diversification of

[1] We are grateful to Matt Spiegel for suggesting this example.

[2] A notable exception is Leland and Pyle (1977), who study the decision of nondiversified shareholders to take their firm public. However, they focus on the signaling role of the share of equity offered for sale and are not concerned with the heterogeneity of diversification among the controlling shareholders.

shareholders of private firms, some of which end up going public. This enables us to study all IPOs that took place in Sweden in the period 1995–2001.[3] For each IPO, we have obtained the standard IPO control variables, as well as detailed information on the portfolio composition of the shareholders, both *before* and *after* the IPO. We have also collected data on the portfolio composition of shareholders in similar firms (in terms of size, book-to-market, and industry) that were not taken public. The information is detailed at the stock level, for both private and public firms, and is observed every six months.

We argue that the degree of diversification of the controlling shareholders determines the size of the benefits of taking the firm public. The benefits for well-diversified controlling shareholders are smaller, making them less inclined to incur the costs of an IPO.[4] We expect an increase in the degree of diversification to reduce the likelihood of an IPO in the cross section of firms. That is, less diversified shareholders are more likely to take the firm public, since they have more to gain from diversifying their portfolio.

Moreover, if a firm goes public for diversification reasons, more diversified shareholders are not likely to part with their shares at a low price, since their pre-IPO valuation is high. Thus, conditional on the IPO, we expect to observe a negative relation between the degree of diversification and the underpricing.

We test these hypotheses by constructing five proxies for portfolio diversification based on the deviation of the shareholders' portfolio from the market portfolio, on the industry concentration in the portfolio, and on the proportion of the shareholders' wealth invested in the firm and in the industry. We use these proxies first to test whether the individual owners' propensity to sell stakes at the IPO is related to their degree of diversification. The results are very strong: lower diversification leads to higher proportion of shares sold. Moreover, this effect is more pronounced for less wealthy (more risk-averse) individuals.

We then move on to the firm level and evaluate the effect of diversification on the probability of an IPO and the underpricing, while controlling for other variables used in the literature. We show that the probability of an IPO is negatively related to the degree of diversification of its controlling shareholders: firms that are held by more diversified shareholders are less likely to go public. One standard deviation increase in the shareholders' diversification accounts for up to one-third of the unconditional probability of an IPO. No such relation exists for the noncontrolling shareholders.

[3] In particular, due to data availability, the sample starts in July 1995 and ends in June 2001.

[4] We show below that if the IPO's only goal is to raise capital, then the degree of diversification has no effect.

We also show that firms controlled by more diversified shareholders exhibit significantly lower underpricing in an IPO. This holds after controlling for the endogeneity of the decision to go public and the underpricing. Again, the diversification of the noncontrolling shareholders has no effect on underpricing.

Interestingly, while the diversification of the institutional controlling shareholders has a strong effect on the decision to go public, it scarcely affects underpricing. Conversely, private shareholders' diversification has a strong effect on both. We attribute this result to the fact that many institutional investors, such as venture capital and private equity funds, are less sensitive to underpricing, for, instead of selling the shares at the IPO at a discount, they can distribute them to limited partners at post-IPO market prices. They are, however, very keen on timely exits, since these enable them to raise future rounds of financing.

Finally, we show that firms whose only goal in going public is to raise capital do not exhibit any relation between the degree of their shareholders' diversification and the underpricing. The relationship between the two is very strong in the remaining sample of firms. This indicates that when the desire to diversify the portfolio constitutes a reason to go public, the degree of diversification plays a significant role in determining the underpricing.

These findings shed light on a hitherto unexplored dimension of the IPO process. In particular, Pagano, Panetta, and Zingales (1998) argue that the main reason for IPOs is the desire of shareholders to make their holdings liquid. Kim and Weisbach (2005) argue that raising new capital for investments is the main motive for IPOs, though they concede that liquidity (or other) considerations may be important as well. They show that while some firms issue only primary shares, which raise capital, many others also offer secondary shares that were already held by the insiders. Our article shows that the desire for diversification is another important driver of the IPO process.[5]

While a survey of IPO literature is outside the scope of this article, we would like to mention a few related articles.[6] Loughran and Ritter (2002) argue that behavioral biases in general, and Prospect Theory in particular, may explain underpricing. They conjecture that shareholders are willing to suffer underpricing if their prior "reference point" is low enough to

[5] Another reason for an IPO may be the desire to exploit a temporary high valuation of shares in an industry. We control for those with annual fixed effects and industry control variables. Moreover, we see no reason why such valuations should be correlated with shareholder diversification.

[6] Additional relevant papers are: Rock (1986); Amihud and Mendelson (1988); Allen and Faulhaber (1989); Benveniste and Spindt (1989); Welch (1989); Benveniste and Wilhelm (1990); Hughes and Thakor (1992); Welch (1992); Chemmanur (1993); Chemmanur and Fulghieri (1994, 1999); Zingales (1995); Booth and Chua (1996); Black and Gilson (1998); Pagano, Panetta, and Zingales; (1998); Stoughton and Zechner (1998); Krigman, Shaw, and Womack (1999); Ellis, Michaely, and O'Hara (2000); Sherman (2000); Habib and Ljungqvist (2001); Cornelli and Goldreich (2002); Loughran and Ritter (2002); Sherman and Titman (2002); Rocholl (2004); Kim and Weisbach (2005); Pastor and Veronesi (2005) and Ellul and Pagano (2006).

make them perceive the selling price as satisfactory. The ''reference point'' can be determined in part by the shareholders' risk aversion and portfolio diversification. In this context, our findings may be interpreted as evidence that less diversified shareholders have a lower ''reference point'' to begin with.

Edelen and Kadlec (2005) offer a rational story. They show that issuers trade off the issue proceeds (the price) against the probability of a successful IPO completion. This implies that the probability of observing an IPO and the price at which it takes place are related. We show that the degree of portfolio diversification of the original controlling shareholders is one factor that directly affects both variables.

Ritter and Welch (2002, p. 1802) suggest that ''simple fundamental market mis valuation or asset pricing risk premia are unlikely to explain the average first day return'' in a typical IPO. The valuation assumption underlying this statement is from the point of view of a fully diversified investor. We conjecture that a significant part of underpricing may be explained by the idiosyncratic risk premium of the existing shareholders. Ritter and Welch also point out that there has been little research on how the surplus is split among the buyers and the sellers of new issues. Moreover, few explanations of underpricing directly focus on the characteristics of the original owners of firms being taken public. Our article contributes to this line of inquiry as well.

The article is structured as follows. In the next section, we outline the empirical hypotheses in more detail. In Section 2, we describe the data and the empirical methodology. In Section 3, we provide descriptive statistics and some preliminary evidence. In Section 4, we report the main empirical results. Section 5 deals with robustness. A brief conclusion follows in Section 6.

1. Empirical Hypotheses

The basic premise of this article is that less diversified investors value the same assets less than more diversified ones, all else equal. Consequently, given the price of the IPO, and common expectations of the future cash flows, less diversified owners are more likely to sell their shares than diversified ones.

We start by postulating a hypothesis directly related to this statement. We study the determinants of the sales of shares by the existing private shareholders at the IPO. We focus on two characteristics particularly relevant in this context: the degree of the diversification of the individual's portfolio, and the individual's wealth. The latter is generally assumed to be a proxy for the individual's risk aversion (among other things). A nondiversified shareholder cares about the nonsystematic as well as the systematic risk of a stock, as opposed to a fully diversified one, who cares

only about the systematic risk. The difference between the two valuations depends on the diversification of the controlling shareholders, and their risk aversion. We use their individual wealth as a proxy for their risk aversion. The first hypothesis is:

Hypothesis 1. *Controlling for IPO characteristics, a less diversified private shareholder is likely to sell a higher proportion of her holdings in the firm at the IPO. This effect is likely to be more pronounced for less wealthy shareholders.*

Next we move from the individual decision to the firm level. IPOs may take place for a variety of reasons; for the purposes of this study, we focus on just two: raising capital and diversification.[7] Firms that go public to raise capital should, on average, exhibit two features: they are likely to expand their operations following the IPO, and they are likely to raise primary shares. These are the newly issued shares sold by the corporation going public, and their proceeds accrue to the firm. Firms that do not experience a pressing need for capital may go public to diversify the holdings of the controlling shareholders. Such firms are not expected to expand as much on average, and, in addition to selling primary shares, the original shareholders are likely to sell some of their (secondary) shares to the public.

In the latter case, the degree of the controlling shareholders' diversification should play an important role. The IPO process enables the controlling shareholders to gain part of the nondiversification discount by letting well-diversified investors price the stock in the market. The benefit of going public for more diversified controlling shareholders is small, making them less inclined to incur the costs of an IPO. Thus, we expect that in the cross section of private firms, an increase in the degree of diversification is likely to reduce the likelihood of an IPO. That is, less diversified shareholders are more likely to initiate an IPO, since they have more to gain from diversifying their portfolio. This leads us to the second hypothesis.

Hypothesis 2. *Private firms that are held by less diversified controlling shareholders are more likely to go public, all else equal.*

If a firm goes public for diversification reasons, less diversified shareholders are more likely to allow high underpricing, as they have more to lose from an unsuccessful issue. One might consider, for example, the bargaining process between the original shareholders and the potential investors via an investment banker. For more diversified controlling

[7] We discuss liquidity and other potential reasons later on, and control for additional ones in the empirical analyses.

shareholders, the value of keeping the company private is relatively high. This implies that greater diversification is tantamount to a better outside option for the controlling shareholders; thus, the bargaining outcome should be characterized by lower underpricing. Such a view of the IPO process is consistent with Chemmanur and Fulghieri (1999), Edelen and Kadlec (2005), and a number of other theoretical papers in the IPO literature. It implies that if the IPO takes place, we should expect to observe a negative correlation between the degree of diversification of the controlling shareholders and the underpricing. This leads us to the third hypothesis:

Hypothesis 3. *If the firm does go public, a higher degree of diversification of the controlling shareholders' portfolios should on average reduce the level of underpricing.*

Finally, it is clear that if a firm goes public mainly to raise capital, the diversification of its shareholders should play a minor role in this decision and in the underpricing. Shareholders of firms that issue only primary shares do not diversify their portfolios; thus, these firms are going public to raise capital. Consequently, the underpricing of these firms should be less affected by the degree of diversification of their controlling shareholders. Our final hypothesis is:

Hypothesis 4. *The effect of the controlling shareholders' diversification on underpricing should be lower in firms that issue only primary shares at the IPO than in firms that sell secondary shares as well.*

2. Data and Methodology

2.1 IPO data

We analyze all the IPOs undertaken on the Stockholm Stock Exchange (SSE)[8] from July 1995 to June 2001: 124 in all. For each IPO, SSE provided us with offer price, first-day close price, issue size, the timing of the IPO, and the names of the underwriters. We cross-checked this information with

[8] Construction of our database required verification of many variables. We sent inquiries to the firms about their underwriters and the type of issue (IPO, private placement, or SEO). We also requested annual reports from the Swedish Royal Library, the ultimate storage facility for all printed documents in Sweden. We then confirmed the offer and first-day close prices through stock exchange registries and newspapers. We eliminated firms that were delisted because of merger, acquisition, or failure to comply with the exchange rules within a half-year period after the IPO date, or with unreliable data on the offer or the first-day close price. These were mostly very small firms with a market capitalization less than $1M USD. The elimination of these firms was mostly motivated by data availability—typically, firms delisted from the exchange leave few traces in data sources. This eliminated seven firms. Our sample is slightly smaller than that reported by Holmen and Högdfeld (2004) for two reasons. First, unlike them, we do not consider spin-offs and private placements. Second, there was considerable IPO activity at the end of 2001 and in 2002, which is beyond our sample period.

the SDC, IPO prospectuses, and Mediearkivet,[9] a registry of publications in Swedish newspapers. Percentage of cash flow and voting rights offered to outside investors are collected from IPO prospectuses.

We define *underpricing* as the difference between the first-day close price and the offer price of the issue normalized by the offer price.

After checking with the Swedish authorities, we have established that no significant changes pertaining to the minority shareholders' protection, firm reporting requirements, taxation, or other areas relevant to the decision to undertake an IPO had taken place during our sample period. For the insiders, there is a customary lockup period of six months following the IPO.

2.2 Individual stockholdings

We use the data on individual shareholders collected by Värdepapperscentralen (VPC), the Security Register Center. The data contain both the stockholding held directly and under the street name, including holdings of U.S-listed ADRs. In addition, SIS Ägarservice AB collects information on the ultimate owners of shares held via trusts, foreign holding firms, and the like (for details, see Sundin and Sundqvist 2002). We do not observe the holdings of mutual funds by individuals for the entire sample of private firms, but we collect the data for the total wealth of individuals for the restricted sample of companies that went public. These data include mutual funds, as well as cash, bonds, CDs, real estate, and even some valuables.

Our data cover the period 1995–2001. Overall, the records provide information about the owners of 98% of the market capitalization of publicly traded Swedish firms. For the median firm, we have information about 97.9% of the equity, and in the worst case, we have information on 81.6% of the market capitalization of the firm. We also possess information about equity holders of (almost) all privately held limited liability Swedish firms. For each shareholder, we have detailed information about their individual holdings of stocks (broken down at the stock level) and the type (private person or institutional investor). For private shareholders, we also have information on whether the shareholder is a member of the board of directors of a particular firm.

It is important to note that we observe stockholding data twice a year: on the last working day in June and December. The IPOs do, however, take place throughout the year. This implies that the time that passes between the calculation of the diversification of the shareholders and the time of the IPO is random. The further the IPO is from the time of the last diversification measure calculation, the less precise that measure is for predicting the IPO. Many changes may have occurred in the meantime. The post-IPO measure is also imprecise. To gauge the degree of the problem,

[9] For more information, see www.mediearkivet.se.

we also re-estimate the basic regressions in Tables 4 and 5 using dummy variables for the month of the IPO. Unreported results confirm our main findings and suggest that no bias is induced by this sampling procedure.

We focus mainly on shareholders who should have influence over firms' decisions. As in Faccio and Lang (2002), we require a private shareholder to control at least 10% of the voting rights in the IPO firm. There are 114 such private shareholders in our sample who hold 117 controlling positions in IPO firms. We also explore the broader definition of controlling shareholders, which includes directors who do not hold a significant share of the firm. Using this definition, the number of controlling private shareholders goes up to 390. For institutional shareholders, the requirement is to control at least 10% of the voting rights. There are 88 such institutional shareholders in our sample, holding 177 positions. We also study the distribution of the number of controlling shareholders in the sample of firms going public (Figure 1). Over a quarter of firms have just one controlling shareholder; 80% have four or less, suggesting that these are tightly controlled firms. In such an environment, coordination is reasonably easy. This justifies our approach of averaging the measures of diversification across the controlling shareholders to create a ''representative controlling shareholder.''

2.3 Firm-level information and other data

We use the SIX Trust Database to obtain individual security returns (including dividends), and to track the overall market index (SIX Index). We use the Market Manager Partners Databases for the firm-level

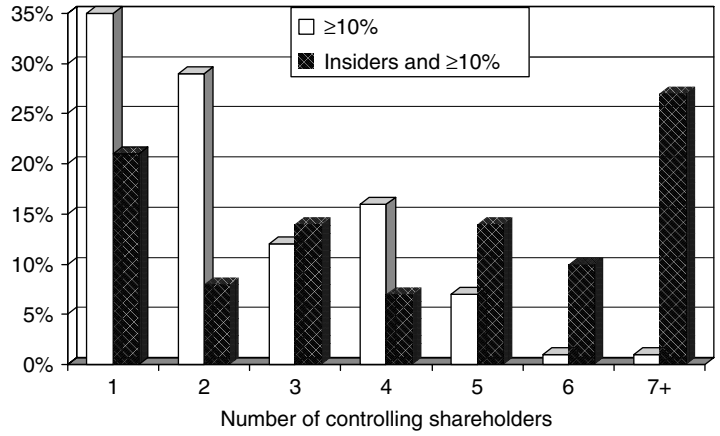

Figure 1
Frequency distribution of shareholders in control per firm. Shareholders in control are defined either as owners of blocks in excess of 10% (left bars) or as insiders and owners of blocks in excess of 10% of equity (right bars).

characteristics. These two databases are the equivalents, respectively, of CRSP and COMPUSTAT for the United States. For the analysis of private firms that did not undertake an IPO during the sample period, we require that they have reliable information on total assets, return on assets, and book value of equity for a one-year period prior to the sampling date.

2.4 Proxies of portfolio diversification

We first consider four measures of portfolio diversification. The first two measures are derived from Goetzmann and Kumar (2002); we refer the reader to their paper for a more extensive description of these proxies. The first measure of diversification, D_1, is

$$D_1 = -\sum_{i=1}^{N} (w_i - w_{mkt})^2,$$

where w_i is the weight of the stock in the portfolio of the shareholder and w_{mkt} is the weight that the same stock would have in the market portfolio. This measure expresses diversification in terms of the divergence of the financial portfolio of the shareholder from the market portfolio.

The second measure, D_2, is the average correlation of the return of the industry to which the IPO firm belongs with the shareholder's total portfolio returns, multiplied by -1.[10] We define the industry return as the weighted average of returns of all publicly traded firms that fall under the same industrial category (SNI92[11]), weighted by their market capitalization. There are 12 industries. D_2 proxies for the degree of industry diversification of the shareholder. Diversification increases when the shareholder includes stocks in the portfolio from industries whose returns are not highly correlated with each other.

We also consider two additional proxies that capture the relative importance of the firm being taken public in the shareholders' portfolio. D_3 is the negative of the fraction of the portfolio of the shareholder allocated to the firm being taken public and D_4 is the negative of the fraction of the portfolio allocated to the firms that belong to the same industry. The proxy $D_3(D_4)$ captures the sensitivity of the shareholder's equity portfolio to the exposure to the specific firm (the industry). As the fraction of the portfolio allocated to a particular asset or industry goes down, its diversification increases. All these measures are therefore constructed in such a way that they increase in the degree of diversification.

To construct the proxies, we use information on all the holdings in both public and private equity. Public equity is evaluated at the market close

[10] We also tried an alternative definition based on correlation with the non-IPO part of the investor's portfolio. The results are not qualitatively different from those reported.

[11] For more information, see www.scb.se.

on the date of the IPO. The value of private equity is estimated as the most recent pre-IPO book value of the shareholder's holdings multiplied by the corresponding average industry market-to-book ratio. We present the exact definitions of the proxies in Appendix A.

One possible objection is that our measures of diversification are based just on direct equity holdings and do not account for the rest of the wealth of the shareholder (e.g., cash, mutual funds, bonds, and real estate). We therefore construct a fifth measure (D_5) to deal with this issue for the specification on underpricing. It is defined as the negative of the ratio of the shareholder's holdings in the IPO firm over the total estimated wealth of the shareholder. We estimate the total wealth of the shareholder by using tax records and wealth tax declarations (residents of Sweden are required to pay a 1.5% tax on wealth in excess of 800-K SEK). Data were collected manually in the Swedish Tax Office; for this reason, we had to limit these data to firms that went public; thus, they apply it applies only to the underpricing tests. Moreover, we also consider a set of specifications in which the simple diversification measures (D_1 to D_4) interact with $-D_5$. That is, the degree of diversification of the shareholders is scaled up by the fraction of the shareholders' wealth in the company. Higher D_5 should make the degree of diversification more relevant.

All the proxies, D_1 to D_5, are constructed first at the shareholder level and then aggregated at the firm level by averaging the degree of diversification of each shareholder in the firm. We use the value-weighted average, where the weights are given by the percentage of firm cash-flow rights held by each shareholder. We aggregate the individual measures for subsets of shareholders; two partitions are particularly relevant: institutional versus private shareholders, and controlling versus noncontrolling ones. These partitions yield four mutually exclusive shareholder groups. We use the superscript "*ip*" ("*inp*") to denote the institutional shareholders who have a controlling (minority) stake, and the superscript "*pp*" ("*pnp*") to denote the private shareholders who have a controlling (minority) stake. A shareholder is assumed to have a controlling stake if they are a member of the board or hold at least 10% of the votes in the firm.

2.5 Selection bias

To properly estimate the determinants of underpricing, we have to account for the potential selection bias: it is possible that the variables that determine the probability of the IPO also determine the underpricing. To address this issue, we use the following econometric specification. Let us assume that

$$l_i^* = \alpha_1 + \beta_1 D_i + \gamma_1 C_{1i} + \varepsilon_{1i}, \tag{1}$$

where for the *ith* firm, l_i^* is a latent variable that represents the decision to list the firm, D_i is one of our measures of portfolio diversification for the

controlling shareholders, and $C_{1,i}$ is the vector of control variables defined above. In practice, we observe l_i, a dummy that takes the value of 1 if the firm is listed and zero otherwise:

$$l_i = 1 \text{ if } l_i^* > 0 \text{ and } l_i = 0 \text{ if } l_i^* \leqslant 0 \,.$$

The equation that defines the underpricing ("u") for the *ith* firm being taken public is

$$u_i^* = \alpha_2 + \beta_2 D_i + \gamma_2 C_{2i} + \varepsilon_{2i}, \tag{2}$$

where the observed underpricing of the firms is $u_i = u_i^*$ and is observed only if $l_i^* > 0$ ($l_i = 1$). In case the firm is not listed (i.e., $l_i^* \leqslant 0$), u_i is not observed and $l_i = 0$. $C_{2,i}$ is a vector of control variables and D_i is one of our measures of portfolio diversification for the controlling shareholders. However, the decision to go public is itself endogenous with respect to the explanatory variables. This may generate selection bias and the standard OLS estimates of Equation (2) would be biased (Maddala 1983). To address this issue, we adopt the Heckman (1979) two-stage procedure. We first estimate the equation

$$l_i = \alpha_1 + \beta_1 D_i + \gamma_1 C_{1i} + \varepsilon_{1i}, \tag{3}$$

using a standard probit model. This is the regression that estimates the effect of diversification on the probability of going public. Then, we estimate

$$u_i = \alpha_2 + \beta_2 D_i + \gamma_2 C_{2i} + \delta\lambda_i + \varepsilon_{2i}, \tag{4}$$

where λ_i is the Heckman's Lambda and is estimated from the results of the first stage. We assume the following correlation structure:

$$\begin{pmatrix} \varepsilon_{1i} \\ \varepsilon_{2i} \end{pmatrix} \sim NID\left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{matrix} \sigma_1^2 & \sigma_{12} \\ \sigma_{12} & \sigma_2^2 \end{matrix} \right). \tag{5}$$

In Equation (3), the standard errors are corrected for heteroskedasticity and selection bias (Greene 1981). The value and significance of δ provide a test of the null that there is no sample selection bias. The set of control variables at the two stages (i.e., $C_{1,i}C_{2,i}$) is different and this provides the identification restriction.

In particular, we exploit the fact that in general the literature agrees that the value of the firm's assets is not a direct determinant of the underpricing. Moreover, the degree of concentration of the industry (represented by the Herfindahl Index) and its changes are not related to underpricing. Corwin and Schulz (2005) explicitly use the Herfindahl Index and do not find any statistically significant correlation. Also, the return on assets, though a determinant of the decision to go public (Pagano, Panetta, and Zingales

1998), has not been found to affect underpricing. Accordingly, we use these variables to identify the first stage of the Heckman procedure. There is an additional set of variables identified in the literature as affecting the degree of underpricing: the fraction of the cash-flow rights offered to the outside investors at the IPO (''fraction of outside rights''), the degree to which issuers partially adjust the offer price (''the partial adjustment''), and the presence of venture capital funds. We use these only in Equation (2), and they provide additional identifying restrictions. The estimates are based on a robust variance–covariance matrix.

3. Descriptive Statistics and Preliminary Results

We start by providing descriptive statistics of our measures of portfolio diversification, as well as some preliminary evidence relating to our hypotheses.

3.1 Descriptive statistics

We start by providing some evidence of the difference between the rate of return required by the shareholders—depending on their degree of portfolio diversification—and the rate of return required by fully diversified shareholders—constructed according to the market portfolio. We use a methodology based on the Fama–French three-factor pricing model, similar to the one adopted by the ADR literature (e.g., Karolyi 1998).[12] The undiversified shareholders' required rate of return depends on the degree of diversification of their portfolios. For each firm, the diversified required risk premium is constructed as the product between the Fama and French factor risk premium and the loading of the firm return on that factor. The firm stock return in the years before the IPO is proxied by the return of a listed firm with analogous characteristics (in terms of size and book-to-market). The undiversified required rate of returns is constructed as follows. For each investor, we calculate the loading (''beta'') between the return on the stock and the return on the investor portfolio. This is then multiplied by the excess return of the investor portfolio over the 30-day Treasury bill rate. The procedure is described in detail in Appendix B.

We report the results in Table A2.1. The difference between diversified and undiversified required rates of return for all groups of investors is always strongly statistically significant, both in terms of mean and median tests. The discount is roughly 25% of the diversified investor's value of an average firm in our sample. Sarin, Koeplin, and Shapiro (2000) show that privately held firms are sold at a discount of 20–30% relative to the market price of similar public firms; our findings indicate a similar magnitude.

[12] The results based on a one-factor model are similar and are omitted for brevity. We did not use a four-factor model, since the momentum effect in Sweden is negligible, as shown by Rouwenhorst (1998).

Table 1
Descriptive statistics for firms going public

Panel A: Underpricing, underperformance, main financial, and accounting variables

Variable	Mean	Median	StdDev	Interquartile range	Minimum	Maximum
Underpricing	0.142	0.075	0.324	0.204	−0.467	2.435
Size (Mln. SEK)	1915	512	4814	1431	20	32995
Mktlb k	4.73	3.76	3.29	3.07	0.57	18.47
Total assets (Mln. SEK)	753	114	3649	249	15	38232
ROA	0.012	0.015	0.315	0.184	−2.646	0.713
Own equity	0.655	0.689	0.242	0.354	0.076	0.999

Panel B: Distribution of IPO's by industry

Industry	Number	%
Mining and heavy machinery manufacturing	11	9%
Other manufacturing	7	6%
Trade	12	10%
Transport	5	4%
Financials	3	2%
Business services	51	41%
High tech	32	26%
News and entertainment	3	2%
Total	124	100%

Panel C: Distribution of institutional shareholders by type

Type of institution	Number of IPO	Percentage in the sample	Percentage of the IPO value
Foreign nonfinancial	16	9.04%	12.23%
Foreign financial	16	9.04%	9.64%
Swedish nonfinancial	82	46.32%	46.13%
Swedish financial	59	33.33%	30.71%
Others	4	2.26%	1.28%

We then move on to the main descriptive statistics about our sample, which are reported in Table 1. In Panel A, we describe the level of underpricing and the main financial and accounting variables of the firms being taken public. The mean underpricing is a little over 14%, which is consistent with many studies around the world, and suggests that our sample is representative. Industry distribution of the IPO firms is in Panel B: Business Services and High Tech constitute the majority. Panel C presents the distributions of the types of institutional investors in the sample: Swedish nonfinancial institutions dominate. These include corporations, VCs, and private equity funds. Panel D reports the descriptive statistics for the main control variables. The descriptive statistics show the substantial variation in firm characteristics. Averages are very different from medians. The average age of the firm taken public in our sample is only 15 years (median of 11), which is close to the U.S. average of 18 (median of 8), as reported by Field and Karpoff (2002).

Table 1
(Continued)

Panel D: Control variables

Variable	Mean	Median	StdDev	Interquartile range	Minimum	Maximum
Age	15.089	11.000	16.088	9.500	1.000	96.000
Outside rights	0.351	0.297	0.177	0.226	0.045	0.855
Telecom dummy	0.250	0.000	0.435	0.500	0.000	1.000
Carve-out dummy	0.194	0.000	0.397	0.000	0.000	1.000
Market underpricing	0.160	0.127	0.123	0.158	0.014	0.657
Number of IPOs	11.815	12.000	5.537	8.000	1.000	24.000
Momentum	0.132	0.179	0.166	0.198	−0.299	0.525
Volatility	0.013	0.011	0.004	0.007	0.007	0.022
Underwriter reputation	15.468	12.000	8.513	15.500	2.000	27.000
Venture capital	0.419	0.000	0.495	1.000	0.000	1.000
Partial adjustment	0.002	0.000	0.060	0.000	−0.283	0.244
Leverage	0.366	0.317	0.263	0.388	0.001	0.890
Primary/Total capital	0.679	0.750	0.382	0.502	0.000	1.649
α	0.152	0.106	0.188	0.177	0.000	0.817
γ	0.292	0.237	0.294	0.180	0.000	2.329
InvAge	48.838	48.263	8.946	12.355	30.118	78.778
HHI	0.057	0.029	0.084	0.035	0.004	0.588
ΔHHI	−0.004	0.000	0.044	0.010	−0.698	0.198
Ind Growth Sales	0.028	0.037	0.156	0.132	−0.219	0.291
Comp Growth Sales	0.306	0.097	0.902	0.720	−0.778	1.891

Panel A reports descriptive statistics for underpricing and main financial and accounting variables of firms taken public. The data are obtained from the SIX Trust Database and the Market Manager Partners Databases. Underpricing is defined as the difference between the first-day close and offer price normalized by the offer price. Size is defined as the market capitalization of the firm (in millions of SEK) on the first trading day (during the period of our sample the exchange rate varied between 7 and 10 SEK per USD). Mkt/bk is market-to-book value of the firm at the closest end of January/June date after the IPO. Total assets and ROA are, respectively, the total accounting value of the firm assets and the return on total assets at the closest available date before the IPO. Own equity is defined as a ratio of the firm's own equity to the firm's total assets.

Panel D displays the descriptive statistics for the control variables we use in our regressions: *Age*—years from the registration of the IPO firm to its IPO date; *Outside Rights*—fraction of the cash-flow rights offered to the outside investors at the IPO; *Telecom* and *Carve-Out Dummies*—telecom industry dummy and carve-out dummy; *Market Underpricing* and *Number of IPOs*—average underpricing and number of IPOs over the previous six-month period; *Momentum* and *Volatility*—total return and average daily standard deviation on the market portfolio in the previous six months; *Underwriter Reputation*—the number of deals conducted by the leading manager over the observed period. *Venture Capital* equals 1 if the firm has venture capitalists among its major shareholders, and 0 otherwise. *Partial Adjustment* is defined as the difference between the final offer price and the offer price at the announcement of IPO scaled down by the offer price at the announcement. Offer price at the announcement is taken from IPO prospectuses. In case only a price interval is indicated, offer price at the announcement is defined as the mean value of the price interval. *Leverage* is a ratio of long-term debt to the total assets of the firm. *Primary Capital* is defined as IPO proceeds that result from sale of new equity. *Total Capital* is defined as IPO proceeds that result from sale of both new and seasoned (existing) equity. α is defined as the ratio of secondary equity sold at IPO to total equity existed before IPO. γ is defined as the ratio of primary capital sold at IPO to existing equity before IPO. *InvAge* is the average age of the controlling shareholders in the company. *HHI* is the Herfindahl Index of three-digit SNI industry concentration. ΔHHI is change in the Herfindahl Index over the previous year. *Ind Growth Sales* is growth in sales of corresponding industry over previous year. *Company Growth Sales* is growth in company sales over the previous year.

Table 2 focuses on our diversification measures. In Panel A, we report the descriptive statistics of shareholders' diversification, partitioned into four shareholder groups. As expected, the diversification of the private controlling shareholders is usually the lowest, followed by the private

Table 2
Descriptive statistics on diversification proxies

Panel A: Diversification proxies

Variable	Mean	Median	StdDev	Interquartile range	Minimum	Maximum
D_1^{ip}	−0.723	−0.858	0.316	0.580	−1.000	−0.053
D_1^{inp}	−0.757	−0.999	0.306	0.531	−1.000	−0.048
D_1^{pp}	−0.935	−0.992	0.082	0.074	−1.000	−0.205
D_1^{pnp}	−0.883	−0.998	0.183	0.225	−1.000	−0.208
D_2^{ip}	−0.625	−0.924	0.429	0.864	−1.000	0.006
D_2^{inp}	−0.470	−0.270	0.438	0.756	−1.000	0.123
D_2^{pp}	−0.721	−0.941	0.336	0.593	−1.000	−0.001
D_2^{pnp}	−0.721	−0.858	0.328	0.561	−1.000	0.081
D_3^{ip}	−0.636	−0.776	0.390	0.677	−1.000	−0.001
D_3^{inp}	−0.655	−0.995	0.407	0.767	−1.000	−0.001
D_3^{pp}	−0.926	−0.995	0.109	0.065	−1.000	−0.179
D_3^{pnp}	−0.839	−0.994	0.256	0.225	−1.000	−0.006
D_4^{ip}	−0.713	−0.845	0.329	0.472	−1.000	−0.002
D_4^{inp}	−0.741	−1.000	0.343	0.480	−1.000	−0.015
D_4^{pp}	−0.948	−0.997	0.099	0.046	−1.000	−0.231
D_4^{pnp}	−0.879	−0.999	0.209	0.180	−1.000	−0.074
D_5^{ip}	−0.636	−0.776	0.390	0.677	−1.000	−0.001
D_5^{pp}	−0.815	−0.835	0.130	0.191	−0.999	−0.034

Panel B: Correlations among the diversification proxies

Variable	D_1^{ip}	D_1^{pp}	D_2^{ip}	D_2^{pp}	D_3^{ip}	D_3^{pp}	D_4^{ip}	D_4^{pp}	D_5^{ip}
D_1^{ip}	1.000								
D_1^{pp}	0.074	1.000							
D_2^{ip}	0.740	−0.051	1.000						
D_2^{pp}	0.198	0.582	0.071	1.000					
D_3^{ip}	0.824	0.064	0.822	0.022	1.000				
D_3^{pp}	0.094	0.778	0.168	0.582	0.051	1.000			
D_4^{ip}	0.756	0.031	0.764	−0.060	0.924	0.008	1.000		
D_4^{pp}	0.055	0.899	0.142	0.539	0.021	0.845	0.028	1.000	
D_5^{ip}	0.824	0.064	0.822	0.123	1.000	0.051	0.924	0.021	1.000
D_5^{pp}	0.142	0.522	0.168	0.281	0.122	0.722	0.111	0.637	0.228

noncontrolling shareholders. In all categories, there is a significant variation in the degree of diversification across firms.

Panel B of Table 2 shows the correlation matrix between various diversification measures for the controlling shareholders. The four measures are highly correlated within each shareholder group, never dropping below a 70% correlation. However, the correlation is far from

Table 2
(Continued)

Panel C: Diversification of shareholders of IPO firms versus shareholders of other firms

Measures of diversification	Degree of diversification	% of IPO	% of NON-IPO	Wilcoxon test	
				Z	Pr < Z
D_1	Low	58.06%	49.35%	1.85	0.03
	High	41.94%	50.65%		
D_2	Low	58.06%	49.35%	1.83	0.03
	High	41.94%	50.65%		
D_3	Low	61.29%	49.05%	2.61	0.005
	High	38.71%	50.95%		
D_4	Low	58.87%	49.27%	2.04	0.02
	High	41.13%	50.73%		

Panel D: Changes in diversification around the IPO for private and institutional shareholders

	Private		Institutional	
	Wilcoxon's Z	p-Value	Wilcoxon's Z	p-Value
D_1	−1.570	0.058	−0.466	0.320
D_2	−1.821	0.035	0.215	0.822
D_3	−1.800	0.036	−1.403	0.080
D_4	−1.675	0.047	0.038	0.485

perfect, suggesting that the different proxies are not redundant. The correlation of the same proxy between the institutional and private shareholders is very low, never exceeding 20%, which suggests that both of them could potentially affect the IPO process.

Panel C of Table 2 presents a test of differences between firms that go public and those that stay private. We first partition all firms into high and low groups on the basis of whether their diversification proxy is above or below the median of the entire sample. We then show that firms that stay private are only slightly more likely to be of the ''high'' type. Firms that end up going public are disproportionately (by at least 15%) located in the ''low'' diversification category. The degree of diversification seems to be related to the decision to go public, as we conjectured.

Panel D of Table 2 shows similar results, but from a different angle. It presents the comparison of diversification proxies before and after the IPO for firms that end up going public. Given that we observe the individual holdings every six months, ''before'' means the last semiannual observation before the IPO, and ''after'' means the first semiannual observation after the IPO. It is clear that private shareholders significantly increase their portfolio diversification. Panel D shows that following the IPO the controlling shareholders reduced their exposure to the firm that is being taken public.

The IPOs in our sample are subject to the lockup period, during which time there are restrictions on open market sales of shares by the original

Table 2
(Continued)

Panel E: Age of controlling shareholder and decision to go public

Age of controlling shareholders	Variable	*N*	Mean	Median	Wilcoxon *Z*	*p*-Value
Under 45	p (going public)	301	0.123	0.000		
	company age	301	6.196	5.000		
	underpricing	26	0.253	0.150		
45–52	p (going public)	328	0.085	0.000	−1.54	0.061
	company age	328	8.003	8.500	4.69	0.000
	underpricing	26	0.281	0.154	0.05	0.481
53–57	p (going public)	295	0.034	0.000	−4.03	0.000
	company age	295	8.261	8.000	4.95	0.000
	underpricing	34	0.103	0.052	−1.29	0.099
58 or older	p (going public)	309	0.019	0.000	−4.99	0.000
	company age	309	8.204	8.000	5.68	0.000
	underpricing	31	0.128	0.091	−0.10	0.333

Panel A reports the descriptive statistics for the average levels of diversification of the shareholders of the firms being taken public, broken down into institutional and private shareholders and controlling and minority shareholders. The measures of diversification are defined in Appendix A. We consider the institutional and private shareholders, as well as the controlling shareholders (for all measures) and the minority ones (for D_1—D_4). We use the superscript "*ip*" ("*inp*") to denote the institutional shareholders who have a controlling (minority) stake and the superscript "*pp*" ("*pnp*") to denote the private shareholders who have a controlling (minority) stake. A shareholder is assumed to have a controlling stake if the individual is a member of the board or has at least 10% of the votes in the firm.
Panel C reports the percentages of the IPOed and non-IPOed private firms in the lower and upper halves of the sample based on diversification measures D_1–D_4. We also report the result of the Wilcoxon test of equality between the diversification proxies distribution of the two samples.
Panel E reports the probability of going public, company age, and underpricing at IPO for different age groups of noncontrolling shareholders. We use individual controlling shareholders as the unit of analysis. For age and probability of going public we use the sample of shareholders in all "eligible" privately held companies, while for underpricing we use only shareholders of companies that went public. We report mean, median, and the Wilcoxon statistics for difference with the youngest group.

shareholders.[13] This may lead to an underestimation of the change in the controlling shareholders' diversification prior to the end of the lockup period. We reproduce Table 2, Panel D, focusing on the difference between the post-IPO diversification of controlling shareholders before and after the customary six-month lockup period expires. The results (not reported) show that there is no further difference in the degree of diversification, which suggests that our earlier findings are not affected by the lockup restriction.

Finally, it may be that the controlling private shareholders want to take the firm public to retire or sell the family firm they inherited.[14] We investigate this possibility in Panel E of Table 2 by looking at the

[13] These restrictions are much more binding on individuals than on institutions, and some nonmarket transactions (e.g., transfers are exempt).

[14] It is worth noting that during our sample period, an IPO was an inferior tool for estate planning. Wealth held in privately held companies was not taxed, while wealth held in publicly traded companies was taxed as long as the company was traded on the A-list of the SSE.

company's age, the probability of going public, and the underpricing (conditional on going public) for shareholders of different age groups. The younger owners seem more eager to go public and suffer higher underpricing. Moreover, companies controlled by these shareholders are significantly younger and unlikely to be an inheritance. In the next section, we look at this issue in multivariate regression framework.

The above evidence suggests that a change in diversification may indeed translate into a significant change in both the propensity to undergo an IPO and the degree of underpricing, which we may be able to capture in the data.

3.2 Private versus institutional controlling shareholders

Out of 117 private controlling shareholders, positions, 15 (13% of the sample) sold their entire holdings at the IPO, while a further 53 (45% of the sample) reduced them by 12%, on average.[15] This suggests that private shareholders do use IPOs to reduce their risk exposure. We also report that out of the 177 institutional investors' positions, 111 (67% of the sample) sold their entire holdings at the IPO, while an additional 25 (15%) reduced theirs.

It seems that the institutional shareholders sell more than the private ones at the IPO; however, the institutional sales numbers are misleading and cannot be compared directly. It must be noted that in our data, ''sale'' is defined as a reduction in holdings over a six-month period (between our two observation points). Thus institutions that transfer their shares shortly after the IPO would be classified as selling their shares. For example, there are many venture capital and private equity funds among the controlling institutional shareholders. These may not even sell at the IPO, yet they become fully diversified by distributing their shares to the limited partners in the fund at the post-IPO market prices (see Gompers and Lerner 1998). Such VCs do not really suffer from the underpricing, and so they should not care about it. On the other hand, they are more concerned with making the company public so that they can distribute their shares at the higher post-IPO price.

We can show that in general, institutions sell very little of their holdings at the IPO. Consider the sample of IPOs with some controlling institutional shareholders: on average, 32% of such a firm is sold at or around the IPO as primary and secondary shares, out of which the new shares constitute almost 22% (all are post-IPO valuation). This means that secondary shares sold by the private and institutional owners constitute roughly 10% of the firm's post-IPO value. Sales of the private controlling shareholders at the IPO, which are specifically indicated in the IPO prospectus, add up

[15] If we use the extended definition of insiders (both members of the board of directors and 10% stakeholders), we observe that 13% exit at IPO, while 26% reduce their holdings.

to about 11% of the firm. This implies that very little, if anything, is left for the secondary share sales by institutions.[16] Yet, over the six-month observation window around the IPO, these institutions are reported to reduce their position by about 30% of the post-IPO value, on average. This suggests that institutional shareholders, sales take place not at the IPO but shortly thereafter (e.g., in the form of distributions or private transactions).

To illustrate this, consider Kungsleden AB. The company went public on April 4, 1999, offering outside investors 31% of the equity in the new company, all in primary shares. Comparing the holdings of this company's shareholders before and after the IPO (December 1998 and June 1999), we observe that 48% of the company belonged to the new shareholders after the IPO. A large part of the difference is due to the partial liquidation of the stakes of the four largest institutional shareholders, which controlled 62% of the pre-IPO company. These four sold 11% of the post-IPO firm to three large institutional investors. One of them was a bank affiliated with one of the four original shareholders. These would be recorded in our data as IPO sales, but in fact they were not.

VCs and PE funds that do sell part of their holdings at the IPO realize that they play a repeated game vis-à-vis the market, and are willing to forego some of the current gains to increase the probability of the next successful exit.[17] Private shareholders are much more likely to sell some of their shares at the IPO, and usually view it as a one-shot game, which makes them less willing to make price concessions. This again implies that institutions press for a quicker exit, while not insisting too much on the underpricing, relative to the private shareholders.

These considerations suggest that the degree of portfolio diversification of the institutions should have a less pronounced effect on underpricing than the diversification of private owners.

4. Empirical Results

4.1 Private shareholders' decisions and diversification

To test the first prediction that lower diversification translates into a higher proportion of holdings sold, we first focus on the decisions by

[16] Some of these numbers refer to transactions at the IPO, while others are calculated over the six-month period. Moreover, some of the original shareholders buy shares at the IPO. This explains the discrepancies.

[17] It is well known that general partners at VCs are very sensitive to timely exits, one reason being that they have to sell their shares (usually at a discount) in firms that did not get an exit at the time the fund was liquidated. In some cases they have to forego their shares in such firms entirely (Kandel et al. 2006). General partners, who make all the decisions in the VC funds, are very much interested in raising their next fund, which is dependent on their success rate (exits) and less so on the exact return they delivered. Gompers (1996) shows that younger VCs, for whom establishing reputation is more important, push for earlier IPOs and are willing to tolerate higher underpricing than their more established peers. Lin and Smith (1998) hypothesize that VCs would like to establish a reputation for not selling overpriced shares and are willing to tolerate underpricing. They find evidence consistent with this hypothesis. In both cases, VCs are worried about reputation. This consideration should not affect most private investors, which also supports our conjecture above.

private shareholders to sell shares at the IPO. We have the semiannual data on the holdings of 2322 individuals associated with the 86 IPOs that resulted in at least some sales by private shareholders. From these data we can calculate how much these shareholders sell (buy) around the IPO.

Although we would like to estimate the nondiversification discount directly, we cannot, and so we take an indirect approach. We conjecture that the propensity of the original shareholders to sell their shares at the IPO increases in the nondiversification discount. And since this discount declines in the degree of diversification, the observable proportion sold is expected to decline in the degree of individual diversification.

The nondiversification discount also increases in the shareholder's risk aversion. Our only observable proxy for risk tolerance is individual wealth (e.g., if these individuals maximize a CRRA utility function). Alternatively, wealthier shareholders can make business decisions "without the dread of losing everything" (Kidder 1981), which would also make them less sensitive to being less diversified. We conjecture that since less wealthy individuals are more risk averse, the nondiversification discount and their propensity to sell their shares to diversify should be more pronounced.

We regress the proportion of the individual shareholdings of the *jth* shareholder sold at the IPO of the *ith* firm on individual characteristics that include the diversification measure. We control for shareholder's gender (*Male*), age and squared age (*InvAge* and $InvAge^2$), wealth, and distance from the headquarters of the company to capture possible private information or home bias (*dist_hq*). We also have an indicator for whether the shareholder is an insider (*Insider*), or a controlling shareholder ($control_{10}$ equals 1 if a person holds at least 10% of the voting rights). We use firm fixed effects to control for IPO-specific characteristics. The results are reported in Table 3, in the first column for each diversification measure. As predicted, less diversified shareholders sell significantly higher proportions of their stakes, and this result holds for all our diversification measures.[18]

Next we run the same regression, while interacting the diversification measure with a dummy that indicates individual wealth above the median in the sample (*High Wealth*) and another one that indicates individual wealth below the median (*Low Wealth*). Since relative wealth proxies for the degree of risk aversion, we expect less wealthy shareholders to be more sensitive to diversification in their decisions.

The second column of estimates for each diversification measure in Table 3 indicates that the effect is indeed more pronounced for the less wealthy shareholders. The wealthier shareholders, while selling a higher

[18] To illustrate the magnitude we calculate that a one-standard-deviation increase in the diversification measure decreases the percentage of shares sold from 12.1 to 6.8%, 5.6, 8.6, 2.7, and 7.9% for D_1–D_5, respectively. We also analyzed a model with IPO-specific characteristics instead of the IPO fixed effects, and obtained similar results.

Table 3
Sales of shares by the original individual shareholders at the IPO

	Diversification measure									
	D_1		D_2		D_3		D_4		D_5	
Diversification	−0.145		−0.153		−0.096		−0.341		−0.123	
	(−5.54)		(−4.77)		(−3.14)		(−6.77)		(−3.73)	
Diversification Low W*		−0.250		−0.253		−0.117		−0.351		−0.172
		(−4.51)		(−6.25)		(−3.38)		(−6.87)		(−4.58)
Diversification High W*		0.075		−0.098		−0.074		−0.252		−0.076
		(0.25)		(−2.80)		(−2.09)		(−2.76)		(−2.06)
$control_{10}$	−0.029	−0.022	−0.078	−0.079	−0.046	−0.040	−0.086	−0.086	−0.055	−0.044
	(−0.37)	(−0.28)	(−0.99)	(−1.02)	(−0.59)	(−0.51)	(−1.10)	(−1.11)	(−0.70)	(−0.56)
Insider	0.010	0.006	−0.022	−0.045	−0.004	−0.007	−0.060	−0.062	−0.003	−0.009
	(0.25)	(0.15)	(−0.57)	(−1.15)	(−0.10)	(−0.18)	(−1.54)	(−1.59)	(−0.09)	(−0.25)
Male	−0.020	−0.020	−0.014	−0.017	−0.015	−0.016	−0.018	−0.019	−0.018	−0.020
	(−0.91)	(−0.93)	(−0.65)	(−0.78)	(−0.71)	(−0.74)	(−0.84)	(−0.90)	(−0.85)	(−0.93)
InvAge	−0.002	−0.003	−0.002	−0.004	−0.002	−0.003	−0.004	−0.004	−0.002	−0.003
	(−0.78)	(−0.91)	(−0.82)	(−1.22)	(−0.77)	(−0.86)	(−1.43)	(−1.46)	(−0.82)	(−1.04)
*InvAge** 2*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.54)	(0.67)	(0.67)	(1.08)	(0.57)	(0.65)	(1.30)	(1.32)	(0.66)	(0.88)
log_wealth	0.019	0.014	0.037	0.025	0.025	0.019	0.017	0.015	0.028	0.016
	(3.43)	(2.07)	(5.65)	(3.48)	(4.45)	(2.64)	(3.32)	(2.55)	(4.79)	(2.12)
dist_hq	−0.012	−0.012	−0.009	−0.008	−0.011	−0.011	−0.007	−0.008	−0.012	−0.012
	(−1.33)	(−1.31)	(−0.96)	(−0.85)	(−1.18)	(−1.18)	(−0.78)	(−0.82)	(−1.24)	(−1.25)
Intercept	0.164	0.170	3.359	2.194	0.310	0.292	−0.511	−0.502	3.281	3.736
	(0.33)	(0.05)	(6.55)	(4.91)	(0.63)	(0.68)	(−1.04)	(−0.98)	(6.69)	(5.91)
Adj. R2	0.238	0.239	0.243	0.246	0.240	0.242	0.248	0.248	0.241	0.243
F-statitic for LowW=HighW		2.73		16.36		1.64		1.36		7.44
(*p-Value*)		(0.10)		(0.00)		(0.20)		(0.24)		(0.01)

This table presents the results of the regression of the percentage change in the number of shares held by an individual before and after the IPO, sales=1−*N*(After)/*N*(Before) in the firm being taken public, on the individual degree of diversification (*Dij*), as well as individual and company characteristics. The diversification variables are defined as before. Control variables are dummies that are equal to 1 if a person holds at least 10% of the voting rights (*control_10*) or is a company insider (*Insider*), a male dummy (*Male*), the age of the shareholder (*InvAge* and *InvAge** 2*), the logarithm of his wealth, and the distance between the residence of the shareholder and the firm headquarters (*dist_hq*). We use IPO fixed effects to control for firm-specific characteristics. We report two sets of results. In the first, we use just the diversification measure; in the second, we interact diversification measures with low wealth and high wealth dummies (above and below the median wealth). All *t*-statistics (in parentheses) are adjusted for heteroskedasticity and clustering over individuals. Total number of observations is 2322.

proportion of their portfolio,[19] are less affected by their nondiversification. The difference is significant at the 10% level for three out of the five diversification measures.

It is interesting to note that over 10% of the private shareholders in these companies actually bought more shares at the IPO. We had performed a *t*-test and a Wilcoxon test on the differences in individual diversification measures and *log_wealth* before an IPO between the group of shareholders that increase their position in the company around the IPO and the group that does not. The results (not reported) show that the shareholders that further increased their positions were more diversified and wealthier than the others. These results are statistically significant and robust across all the specifications.

4.2 Probability of an IPO and portfolio diversification

Next we move to the firm-level data and explore the effect of diversification on the probability of going public. Insofar as the availability of data allows, we adopt the same specification as Pagano, Panetta, and Zingales (1998), and add thereto our measures of portfolio diversification and additional controls. In particular, to estimate Equation (3), we use an expanded dataset that contains all the nonlisted firms that satisfy listing requirements on either the SSE or the Nordic Growth Market for the year of the IPO. This dataset includes a total of 1309 firms/observations for private firms.

We control for the IPO market conditions by using annual fixed effects. Additional control variables are the logarithm of total assets (*total assets*), the return on assets of the firm (*ROA*), and a proxy for the financial stability of the firm (*own equity*), which is the ratio of equity to the firm's total assets.

We also control for new growth opportunities using both industry and company sales growth in the previous year (*Industry Sales Growth, Company Sale Growth*). These variables proxy for whether the demand for new investments is behind the decision to list. We also add a dummy (*Telecom*), which takes the value of 1 if the IPO is a telecom firm and 0 otherwise.

The controlling shareholders may want to obtain liquidity toward their retirement. Alternatively, younger shareholders may want to sell their inheritance. We control for age effect by including the age of the main shareholders of the firm (*InvAge*).

Increased competition may make it more desirable to take the company public, since it may reduce the expected private benefits of control. We include the Herfindahl Index of concentration of the industry in which the firm operates as a control for the degree of competition. We also

[19] Notice that sales somewhat increase in the level of wealth. We have no explanation for this effect, other than the possibility that wealth also proxies for other individual features that may affect the sale decision.

include the change in the index from the previous year to control for the change in competition and its potential impact on the required capital investment.

Our working hypothesis predicts that firms controlled by more diversified shareholders should be less prone to go public (in Equation 3, $\beta_1 < 0$). The results are reported in Table 4. We report three different specifications, and four measures of portfolio diversification.

In Panel A of Table 4, we report the results for the entire sample using value-weighted measures of portfolio diversification averaged among shareholders with controlling rights in excess of 10%, where the weights are the fractions of the firm capital held by the shareholders. For robustness, we also consider a smaller sample of larger firms with assets exceeding 50M SEK; the results are reported in Panel B. Panel C reports the results for the controlling shareholders, who either hold in excess of 10% of the shares or sit on the board of directors. We also consider specifications based on industry fixed effects and using a simple average of individuals' measures of portfolio diversification (not reported). The results are qualitatively similar to those reported.

The results show a strong and negative relation between the degree of the controlling shareholders' portfolio diversification, $D_1 - D_4$, and the probability of going public. As predicted, more diversified shareholders are less likely to initiate an IPO. These results are consistent across our diversification measures, and the effect is quite strong. In Panel A of Table 4, for private shareholders, a one-standard-deviation increase in the diversification measure above its mean results in a 2.28% reduction in the IPO probability for D_1 (3.44, 3.31, and 3.08%, respectively, for D_2–D_4). The corresponding marginal effects for institutional shareholders are somewhat smaller: about 1.20% if we consider D_1 and 2.28, 2.16, and 1.67% for $D_2 - D_4$, respectively. The unconditional probability of going public in our sample is 8.65%, which makes diversification an economically as well as statistically significant feature of the IPO process. The results in Panel C are significant, but less strong. The degree of diversification of the directors without significant holdings in the firm introduces additional noise, because it should not affect their decisions.

Only the shareholders with significant control make the IPO decisions. Thus the diversification of the noncontrolling shareholders should have no effect. We repeat the estimation procedure on the sample of the noncontrolling shareholders in the same firms. The results (not reported) show no relation between their degree of diversification and the propensity of their firms to go public.

Table 4
Probability of an IPO and portfolio diversification

Panel A: Value-weighted diversification measures—all firms; controlling shareholders are those with at least 10% of the voting rights)

Variable	Estimate	*t*-Stat	Estimate	*t*-Stat	Estimate	*t*-Stat	Estimate	*t*-Stat
Intercept	−3.395	(−4.74)	−2.061	(−5.07)	−3.658	(−5.99)	−3.730	(−5.64)
D_1^{ip}	−0.259	(−1.71)						
D_1^{pp}	−1.931	(−3.10)						
D_2^{ip}			−0.307	(−2.16)				
D_2^{pp}			−0.748	(−4.41)				
D_3^{ip}					−0.385	(−2.85)		
D_3^{pp}					−2.276	(−4.66)		
D_4^{ip}							−0.357	(−2.26)
D_4^{pp}							−2.302	(−4.18)
Log(Assets)	−0.089	(−2.44)	−0.089	(−2.44)	−0.093	(−2.50)	−0.100	(−2.68)
ROA	0.138	(0.72)	0.122	(0.63)	0.103	(0.52)	0.153	(0.78)
Own equity	0.385	(1.87)	0.468	(2.25)	0.453	(2.11)	0.414	(2.63)
InvAge	−0.003	(−0.47)	−0.003	(−0.52)	−0.003	(−0.48)	−0.003	(−0.42)
HHI	1.591	(2.66)	1.671	(2.78)	1.453	(2.37)	1.487	(2.44)
ΔHHI	1.189	(0.64)	1.011	(0.57)	1.013	(0.54)	1.561	(0.81)
Ind Growth Sales	0.019	(0.44)	0.020	(0.48)	0.016	(0.37)	0.018	(0.42)
Comp Growth Sales	0.024	(0.40)	0.002	(0.28)	0.007	(0.10)	0.007	(0.11)
Telecom Dummy	0.936	(5.34)	1.034	(5.78)	0.921	(5.14)	0.943	(5.26)
Time Dummies	Yes		Yes		Yes		Yes	
Log likelihood	−362.580		−347.262		−347.912		−355.584	
Pseudo R^2	0.151		0.192		0.191		0.172	

Panel B: Value-weighted diversification measures—firms with assets exceeding 50M SEK; controlling shareholders with at least 10% of the voting rights

Variable	Estimate	*t*-Stat	Estimate	*t*-Stat	Estimate	*t*-Stat	Estimate	*t*-Stat
Intercept	−2.237	(−2.90)	−0.786	(−1.67)	−2.414	(−3.63)	−2.420	(−3.39)
D_1^{ip}	−0.213	(−1.18)						
D_1^{pp}	−0.939	(−2.95)						
D_2^{ip}			−0.367	(−2.44)				
D_2^{pp}			−0.797	(−4.37)				
D_3^{ip}					−0.331	(−2.23)		
D_3^{pp}					−2.058	(−4.11)		
D_4^{ip}							−0.308	(−1.77)
D_4^{pp}							−2.093	(−3.61)
Log(Assets)	−0.303	(−6.28)	−0.312	(−6.36)	−0.304	(−6.18)	−0.308	(−6.32)
ROA	−0.310	(−1.23)	−0.266	(−1.03)	−0.270	(−1.06)	−0.238	(−0.93)
Own equity	0.372	(1.65)	0.404	(1.78)	0.421	(1.77)	0.396	(1.70)
InvAge	0.002	(0.30)	0.002	(0.25)	0.004	(0.60)	0.002	(0.17)
HHI	1.467	(2.28)	1.683	(2.60)	1.421	(2.15)	1.470	(2.25)
ΔHHI	2.313	(0.98)	1.754	(0.77)	2.127	(0.90)	2.426	(1.04)
Ind Growth Sales	0.005	(0.14)	0.005	(0.14)	0.030	(0.01)	0.007	(0.17)
Comp Growth Sales	0.114	(1.66)	0.002	(1.25)	0.007	(1.50)	0.106	(1.48)
Telecom Dummy	1.297	(6.04)	1.034	(6.46)	0.921	(5.80)	1.321	(6.03)
Time Dummies	Yes		Yes		Yes		Yes	
Log likelihood	−302.705		−304.847		−297.047		−298.440	
Pseudo R^2	0.208		0.206		0.229		0.225	

(continued overleaf)

Table 4
(Continued)

Panel C: Value-weighted diversification measures—all firms

Variable	Estimate	t-Stat	Estimate	t-Stat	Estimate	t-Stat	Estimate	t-Stat
Intercept	−1.564	(−3.00)	−1.751	(−4.21)	−2.315	(−4.79)	−2.554	(−4.75)
D_1^{ip}	−0.318	(−1.92)						
D_1^{pp}	0.011	(0.07)						
D_2^{ip}			−0.270	(−1.93)				
D_2^{pp}			−0.266	(−1.69)				
D_3^{ip}					−0.468	(−3.56)		
D_3^{pp}					−0.750	(−2.57)		
D_4^{ip}							−0.434	(−2.81)
D_4^{pp}							−1.012	(−2.71)
Log(Assets)	−0.096	(−2.67)	−0.088	(−2.45)	−0.092	(−2.53)	−0.100	(−2.75)
ROA	0.102	(0.53)	0.117	(0.62)	0.076	(0.39)	0.137	(0.70)
Own equity	0.408	(2.00)	0.428	(2.09)	0.436	(2.08)	0.397	(1.92)
InvAge	−0.003	(−0.44)	−0.002	(−0.36)	−0.002	(−0.29)	−0.002	(−0.36)
HHI	1.611	(2.69)	1.533	(2.57)	1.443	(2.40)	1.466	(2.44)
ΔHHI	1.381	(0.73)	1.350	(0.73)	1.197	(0.64)	1.744	(0.91)
Ind Growth Sales	0.015	(0.36)	0.016	(0.39)	0.016	(0.37)	0.016	(0.37)
Comp Growth Sales	0.087	(1.45)	0.081	(1.34)	0.007	(1.48)	0.088	(2.08)
Telecom Dummy	0.961	(5.43)	0.956	(5.44)	0.921	(5.17)	0.956	(28.34)
Time Dummies	Yes		Yes		Yes		Yes	
Log likelihood	−370.450		−365.438		−359.241		−362.340	
Pseudo R^2	0.106		0.116		0.135		0.122	

This table reports results of the probit regression of the decision to go public on our proxies of shareholders' diversification and a set of control variables. We report the results for firms with at least 20M SEK (roughly 2M USD) in total assets (Panels A and C). We also report a robustness check for firms with assets above 50M SEK in Panel B. In Panel A, we report the results for the measures of portfolio diversification based on value-weighted average for all shareholders with a controlling stake at least equal to 10% of the voting rights (weights are the fraction of the firm capital held by the shareholders); in Panel B we reproduce Panel A for 50M SEK in total assets cutoff; in Panel C, the results are for the value-weighted measures of portfolio diversification based on the average of all the controlling shareholders. The sample includes 124 firms taken public during the sample period and 277 firms which remain private. The dependent variable is a dummy that takes the value 1 if the firm was listed in the observed six-month period and 0 otherwise. The total number of observations is 1433 in Panels A and C, and 1122 in Panel B. Diversification measures and control variables are defined in the text and in Tables 1 and 2. All t-statistics are adjusted for heteroskedasticity and the errors are clustered at the industry level.

Finally, we tested whether the probability of an IPO depends on whether the firm was a part of a conglomerate, but the conglomerate dummy was not significant (t-statistics on the order of 0.01).

4.3 Underpricing and portfolio diversification

Next we relate the degree of underpricing to portfolio diversification and estimate Equation (2). We control for the uncertainty of the IPO firm valuation by including the following set of variables: the logarithm of age of the firm being taken public (*Age*), a dummy that shows if the issue was backed by a venture capitalist (*Venture Capital*). We control for new growth opportunities using industry sales growth in the previous year (*Industry Sales Growth*). We also include two dummies: *Telecom firms* and

Carve-outs. If age affects the shareholders' desire to go public, it may be the case that age also affects their willingness to compromise on price and accept a higher underpricing. We therefore add the age of the main shareholders of the firm (*InvAge*) as a control.[20]

We control for IPO market conditions by including the average underpricing (*Market Underpricing*) and the number of IPOs in the previous six months (*Number of IPOs*). We also include the return on the market portfolio in the previous six months (*Momentum*) and its average daily standard deviation in the analogous period (*Volatility*) to control for market momentum and the riskiness of the investment environment, respectively. As a response to market conditions, issuers can partially adjust the offer price (Hanley 1993). We therefore follow the literature and include a variable that controls for this partial adjustment. This is constructed as the difference between the final offer price and the offer price at the announcement of the IPO scaled down by the offer price at the announcement.[21]

Finally, the reputation of the underwriter explains part of the underpricing. The proxy variable used (*Underwriter Reputation*) represents the number of deals conducted by the leading manager over the observed period. This is similar to Balvers, McDonald, and Miller (1988) and Beatty, Bunsis, and Hand (1998), who partition underwriters into "prestigious" and "non-prestigious" groups based on their appearance in the Top 25 annual ranking by the *Institutional Investor*. In Sweden, firms that appear at the top of the rankings receive most of the deals.

Equation (2) is estimated using a heteroskedasticity-consistent estimator; the estimates are robust, and the errors have been clustered at the industry level.[22] We consider the five measures of diversification, $(D_1 - D_5)$, and the interaction between the simple measures of diversification $(D_1 - D_4)$ and $-D_5$. As mentioned before, this allows us to control for the weight of the firm being taken public in the portfolio of the shareholder. Recall that our working hypothesis predicts $\beta_2 < 0$.

The results are reported in Table 5. We consider two alternative specifications, based on the different measures of portfolio diversification described in Section 2.4. In Panel A, we report results for the value-weighted measures of portfolio diversification, calculated among the shareholders with a controlling stake of at least 10%, where the weights are the fraction of the firm capital held by the shareholders. In Panel B, the results are

[20] We also tried a few other control variables, including size, but none were significant.

[21] Our results are invariant to the omission of this variable.

[22] We report the clustered results. The nonclustered ones are significant and available upon request.

Table 5
Underpricing and portfolio diversification

Panel A: Value-weighted diversification measures (controlling stake of more than 10% of the voting rights)

	Simple diversification measures									Simple diversification measures interacted with $(-D_5)$								
Variable	Estimate	*t*-Stat	Estimate	*t*-Stat	Estimate	*t*-Stat	Estimate	*t*-Stat	Estimate	*t*-Stat	Estimate	*t*-Stat	Estimate	*t*-Stat	Estimate	*t*-Stat	Estimate	*t*-Stat
Intercept	−0.892	(−2.19)	−0.488	(−1.43)	−0.838	(−1.69)	−0.843	(−1.79)	−0.309	(−0.67)	−0.135	(−0.37)	−0.284	(−0.73)	−0.101	(−0.29)	−0.084	(−0.23)
D_1^{ip}	0.017	(0.53)									0.031	(1.69)						
D_1^{pp}	−0.880	(−10.15)									−0.281	(−10.67)						
D_2^{ip}			−0.027	(−1.45)									−0.002	(−0.09)				
D_2^{pp}			−0.206	(−5.81)									−0.286	(−5.59)				
D_3^{ip}					−0.017	(−0.87)									0.014	(0.86)		
D_3^{pp}					−0.780	(−4.35)									−0.273	(−10.34)		
D_4^{ip}							−0.005	(−0.19)									0.022	(1.23)
D_4^{pp}							−0.824	(−5.61)									−0.273	(−9.95)
D_5^{ip}									0.034	(1.72)								
D_5^{pp}									−0.487	(−3.21)								
Log(Age)	−0.001	(−0.03)	0.010	(0.45)	0.001	(0.08)	−0.001	(−0.05)	0.001	(0.05)	0.001	(0.06)	0.009	(0.45)	0.002	(0.11)	0.002	(0.11)
Telecom Dummy	0.232	(11.79)	0.251	(10.39)	0.222	(9.57)	0.221	(6.74)	0.182	(6.38)	0.199	(9.42)	0.228	(9.75)	0.193	(7.31)	0.191	(6.76)
Carve-Out Dummy	−0.052	(−0.97)	−0.119	(−2.00)	−0.065	(−1.19)	−0.056	(−0.97)	−0.016	(−0.32)	−0.019	(−0.33)	−0.063	(−1.10)	−0.024	(−0.41)	−0.023	(−0.39)
Market Underpricing	−0.158	(−1.48)	−0.155	(−1.50)	−0.164	(−1.75)	−0.170	(−1.79)	−0.140	(−1.58)	−0.174	(−1.70)	−0.171	(−1.62)	−0.158	(−1.72)	−0.161	(−1.71)

Table 5
(Continued)

Panel A: Value-weighted diversification measures (controlling stake of more than 10% of the voting rights)

	Simple diversification measures										Simple diversification measures interacted with $(-D_5)$							
Variable	Estimate	*t*-Stat	Estimate	*t*-Stat	Estimate	*t*-Stat	Estimate	*t*-Stat	Estimate	*t*-Stat	Estimate	*t*-Stat	Estimate	*t*-Stat	Estimate	*t*-Stat	Estimate	*t*-Stat
Number of IPOs	−0.005	(−2.75)	−0.003	(−2.00)	−0.005	(−2.73)	−0.005	(−2.73)	−0.007	(−3.50)	−0.007	(−5.22)	−0.005	(−2.54)	−0.008	(−6.87)	−0.008	(−5.59)
Momentum	0.246	(1.34)	0.345	(1.66)	0.258	(1.54)	0.257	(1.46)	0.225	(1.13)	0.242	(1.17)	0.301	(1.37)	0.226	(1.15)	0.226	(1.11)
Volatility	−9.303	(−1.69)	−8.041	(−1.24)	−9.609	(−1.73)	−9.135	(−1.67)	−7.721	(−1.37)	−7.901	(−1.35)	−7.448	(−1.26)	−7.875	(−1.33)	−7.734	(−1.33)
Underwriter Reputation	0.001	(1.01)	0.002	(1.25)	0.001	(0.92)	0.001	(0.94)	0.002	(1.23)	0.002	(1.79)	0.002	(2.08)	0.002	(1.82)	0.002	(1.82)
Venture Capital	−0.059	(−1.25)	−0.074	(−1.11)	−0.055	(−1.01)	−0.059	(−1.13)	−0.060	(−1.13)	−0.059	(−1.10)	−0.060	(−0.94)	−0.058	(−1.03)	−0.059	(−1.06)
Partial Adjustment	0.964	(3.08)	1.038	(2.51)	0.970	(3.28)	0.992	(3.27)	1.145	(4.97)	1.063	(4.15)	1.024	(2.88)	1.073	(4.12)	1.078	(4.09)
Leverage	0.036	(1.06)	0.094	(1.74)	0.049	(1.35)	0.044	(1.39)	0.097	(3.20)	0.067	(2.31)	0.059	(1.58)	0.080	(2.77)	0.081	(2.58)
InvAge	0.002	(0.49)	0.001	(0.19)	0.002	(0.52)	0.002	(0.47)	0.000	(0.12)	0.001	(0.27)	0.002	(0.45)	0.001	(0.26)	0.001	(0.24)
Ind Sales Growth	0.104	(1.10)	0.126	(1.39)	0.085	(1.13)	0.094	(1.13)	0.059	(0.67)	0.058	(0.65)	0.094	(0.96)	0.053	(0.64)	0.055	(0.62)
Heckman's Lambda	0.135	(4.05)	0.171	(4.11)	0.146	(5.66)	0.135	(4.82)	0.083	(2.57)	0.079	(1.92)	0.122	(2.91)	0.061	(2.05)	0.054	(1.78)
R2	0.324		0.314		0.312		0.316		0.299		0.312		0.337		0.307		0.307	
Adj R2	0.211		0.200		0.198		0.202		0.185		0.198		0.226		0.192		0.192	

Table 5
(Continued)

Panel B: Value-weighted diversification measures

	Simple diversification measures									Simple diversification measures interacted with $(-D_5)$								
Variable	Estimate	*t*-Stat	Estimate	*t*-Stat	Estimate	*t*-Stat	Estimate	*t*-Stat	Estimate	*t*-Stat	Estimate	*t*-Stat	Estimate	*t*-Stat	Estimate	*t*-Stat	Estimate	*t*-Stat
Intercept	−0.251	(−0.65)	−0.147	(−0.37)	−0.170	(−0.39)	−0.255	(−0.70)	0.015	(0.04)	−0.016	(−0.05)	−0.090	(−0.23)	−0.002	(−0.01)	−0.003	(−0.01)
D_1^{ip}	0.036	(1.23)									0.030	(1.50)						
D_1^{pp}	−0.460	(−2.57)									−0.220	(−6.13)						
D_2^{ip}			0.006	(0.27)									0.012	(0.72)				
D_2^{pp}			−0.165	(−4.32)									−0.225	(−10.34)				
D_3^{ip}					0.012	(0.68)									0.017	(0.89)		
D_3^{pp}					−0.368	(−2.12)									−0.209	(−4.64)		
D_4^{ip}							0.020	(0.66)									0.017	(0.90)
D_4^{pp}							−0.482	(−2.80)									−0.214	(−5.18)
D_5^{ip}									0.029	(1.30)								
D_5^{pp}									−0.274	(−2.57)								
Log(Age)	0.001	(0.08)	0.014	(0.63)	0.006	(0.34)	0.002	(0.14)	0.005	(0.28)	0.000	(0.03)	0.010	(0.51)	0.002	(0.13)	0.002	(0.11)
Telecom Dummy	0.187	(10.37)	0.192	(11.31)	0.172	(11.18)	0.178	(12.84)	0.175	(12.05)	0.187	(8.23)	0.195	(10.42)	0.182	(8.00)	0.184	(7.93)
Carve-Out Dummy	−0.086	(−1.16)	−0.147	(−1.93)	−0.093	(−1.17)	−0.082	(−1.09)	−0.052	(−0.80)	−0.047	(−0.80)	−0.093	(−1.52)	−0.049	(−0.82)	−0.045	(−0.74)
Market Underpricing	−0.055	(−0.94)	−0.060	(−0.71)	−0.075	(−1.10)	−0.045	(−0.78)	−0.055	(−0.70)	−0.084	(−1.43)	−0.071	(−0.98)	−0.085	(−1.42)	−0.077	(−1.36)

Table 5
(Continued)

Panel B: Value-weighted diversification measures

	Simple diversification measures										Simple diversification measures interacted with $(-D_5)$							
Variable	Estimate	*t*-Stat	Estimate	*t*-Stat	Estimate	*t*-Stat	Estimate	*t*-Stat	Estimate	*t*-Stat	Estimate	*t*-Stat	Estimate	*t*-Stat	Estimate	*t*-Stat	Estimate	*t*-Stat
Number of IPOs	−0.007	(−3.36)	−0.007	(−2.66)	−0.008	(−3.72)	−0.007	(−3.40)	−0.008	(−3.32)	−0.008	(−3.81)	−0.007	(−2.78)	−0.008	(−4.05)	−0.008	(−3.62)
Momentum	0.212	(1.07)	0.306	(1.39)	0.206	(1.13)	0.195	(1.00)	0.155	(0.84)	0.170	(0.92)	0.227	(1.13)	0.160	(0.89)	0.161	(0.88)
Volatility	−8.345	(−1.43)	−4.997	(−0.81)	−7.334	(−1.34)	−8.489	(−1.48)	−8.719	(−1.58)	−8.638	(−1.58)	−6.809	(−1.18)	−8.641	(−1.60)	−8.777	(−1.61)
Underwriter Reputation	0.002	(1.39)	0.002	(1.73)	0.002	(1.43)	0.001	(1.24)	0.001	(0.82)	0.001	(1.21)	0.002	(1.58)	0.002	(1.25)	0.002	(1.24)
Venture Capital	−0.078	(−1.55)	−0.063	(−0.99)	−0.066	(−1.21)	−0.075	(−1.42)	−0.062	(−1.05)	−0.064	(−1.13)	−0.054	(−0.86)	−0.060	(−1.04)	−0.061	(−1.06)
Partial Adjustment	1.146	(3.85)	0.985	(2.44)	1.110	(3.95)	1.109	(4.01)	1.112	(4.73)	1.056	(4.20)	0.943	(2.77)	1.053	(4.20)	1.058	(4.20)
Leverage	0.119	(5.19)	0.139	(3.14)	0.139	(4.37)	0.124	(5.13)	0.141	(5.00)	0.107	(4.56)	0.103	(3.97)	0.113	(4.65)	0.112	(4.39)
InvAge	0.001	(0.40)	0.001	(0.23)	0.001	(0.25)	0.001	(0.23)	0.000	(0.08)	0.002	(0.60)	0.003	(0.72)	0.002	(0.57)	0.002	(0.54)
Ind Sales Growth	0.050	(0.55)	0.110	(1.16)	0.042	(0.53)	0.055	(0.60)	0.036	(0.45)	0.039	(0.45)	0.086	(0.83)	0.041	(0.49)	0.041	(0.48)
Heckman's Lambda	0.010	(2.99)	0.073	(2.14)	0.158	(2.88)	0.052	(2.97)	0.043	(1.98)	0.053	(1.92)	0.057	(2.51)	0.059	(2.36)	0.049	(1.99)
R2	0.285		0.296		0.278		0.286		0.276		0.299		0.319		0.294		0.296	
Adj R2	0.166		0.179		0.158		0.167		0.157		0.182		0.205		0.177		0.178	

Table 5
(Continued)

Panel C: Value-weighted diversification measures for noncontrolling shareholders

Variable	Estimate	*t*-Stat	Estimate	*t*-Stat	Estimate	*t*-Stat	Estimate	*t*-Stat
Intercept	0.233	(0.59)	0.428	(0.96)	0.287	(0.80)	0.281	(0.73)
D_1^{inp}	−0.024	(−0.26)						
D_1^{pnp}	−0.010	(−0.22)						
D_2^{inp}			0.053	(1.09)				
D_2^{pnp}			0.041	(1.22)				
D_3^{inp}					0.019	(0.30)		
D_3^{pnp}					−0.023	(−0.38)		
D_4^{inp}							−0.076	(−0.87)
D_4^{pnp}							0.063	(1.04)
Log(Age)	0.004	(0.18)	0.011	(0.43)	0.006	(0.24)	0.007	(0.27)
Telecom Dummy	0.190	(12.07)	0.193	(13.08)	0.192	(10.23)	0.182	(9.00)
Carve-Out Dummy	−0.079	(−1.20)	−0.044	(−0.63)	−0.078	(−1.16)	−0.061	(−0.88)
Market Underpricing	−0.117	(−0.94)	−0.142	(−0.92)	−0.115	(−1.03)	−0.131	(−0.95)
Number of IPOs	−0.008	(−4.88)	−0.010	(−7.06)	−0.009	(−6.21)	−0.009	(−5.73)
Momentum	0.253	(1.03)	0.239	(0.94)	0.246	(1.06)	0.253	(1.10)
Volatility	−7.285	(−1.07)	−5.973	(−0.91)	−7.064	(−1.03)	−6.482	(−0.94)
Underwriter Reputation	0.002	(1.58)	0.002	(1.89)	0.002	(1.65)	0.002	(1.59)
Venture Capital	−0.069	(−1.14)	−0.068	(−1.17)	−0.068	(−1.05)	−0.069	(−1.16)
Partial Adjustment	1.203	(4.14)	1.166	(4.28)	1.218	(3.88)	1.135	(3.74)
Leverage	0.176	(2.24)	0.186	(2.78)	0.181	(2.56)	0.172	(2.49)
InvAge	−0.002	(−0.42)	−0.002	(−0.34)	−0.002	(−0.39)	−0.002	(−0.42)
Ind Sales Growth	0.028	(0.35)	0.045	(0.51)	0.033	(0.39)	0.035	(0.40)
Heckman's Lambda	0.020	(0.27)	−0.063	(−1.34)	0.000	(0.00)	−0.012	(−0.22)
R2	0.243		0.249		0.243		0.245	
Adj R2	0.117		0.124		0.115		0.119	

This table presents the results on the effect of shareholder diversification on underpricing, controlling for self-selection bias. Heckman's Lambda is estimated from probit regressions in Table 3. Diversification measures and control variables are defined in Tables 1 and 2. In Panel A, we report the results for the measures of portfolio diversification based on the value-weighted average, considering only the shareholders with a controlling stake of at least 10% of the voting rights, where the weights are the fractions of the firm capital held by the shareholders. In Panel B, the results for the measures of portfolio diversification are based on the value-weighted average for all controlling shareholders. Panel C reports the results for value-weighted diversification measures for noncontrolling shareholders. All *t*-statistics are adjusted for heteroskedasticity and the errors are clustered at the industry level.

calculated on all the controlling shareholders. Panel C reports similar results for the noncontrolling shareholders.[23]

First, selection bias seems to be important, since the coefficient of Heckman's Lambda is almost always significant. While the ownership variables are significant, employment of the Heckman procedure increases point estimates (absolute values) by 15–40%. Underpricing is negatively related to the degree of diversification of the shareholders before the IPO. This holds across specifications of the diversification proxies and control variables.

The results show that underpricing declines in the degree of diversification, as predicted. That is, more diversified controlling shareholders require a higher price (lower underpricing), while less diversified shareholders are willing to settle for a lower one (higher underpricing). This is true for all our measures of diversification for the private controlling shareholders; in all cases, the relationship is significant at the 1% level. To illustrate the magnitude, note that a one-standard-deviation increase in the degree of portfolio diversification of the private controlling shareholders reduces underpricing from its unconditional mean of 14.2–7.0% for D_1 (to 7.3, 5.8, 6.5, and 7.8% for $D_2 - D_5$, respectively). Diversification measures also contribute significantly to the R^2 of the underpricing regression −5.3, 4.2, 4.0, 4.4, and 3.7% for $D_1 - D_5$, respectively. Analogous results hold if simple measures of diversification are interacted with $-D_5$. As in the previous section, our results are strongest for the narrow definition of insiders and weaken (but remain statistically and economically significant) for the broader definition, which introduces additional noise.

We then repeat the same estimation with the noncontrolling shareholders (using the definition in Panel A of Table 5) and find no relation between their diversification and the degree of underpricing (the results are reported in Panel C of Table 5). The comparison clearly indicates that the diversification of the controlling shareholders matters, since it is they who determine whether to take the firm public and its offer price.

Interestingly, the negative relationship is entirely due to private controlling shareholders. The diversification of institutions with a controlling stake, while strongly affecting the decision to go public (Table 4), does not seem to affect the issue price. These findings are consistent across specifications. They also fit with our previous discussion about the presence of many venture capital funds among the shareholders. As we pointed out, these do not really suffer from the underpricing, while

[23] As a robustness check, we also estimate a specification in which we restrict the sample to the IPO firms that have at least 50M SEK in assets (roughly 5M USD). The results (not reported) are consistent with those in Table 6.

the underpricing is more likely to be set by the degree of diversification of the private shareholders.

It is worth noting that these findings are consistent with our working hypothesis that less diversified shareholders are more likely to push for an IPO than more diversified shareholders. The above statement simply argues that the tradeoffs between the quicker exit (an IPO) and a higher price, conditional on exit, differ between institutions (especially VCs) and private shareholders.

Finally, we also included a dummy for *Media* firms and the ratio of voting rights retained by old owners at IPO to their cash-flow rights. Neither the *Media* dummy, nor the vote-to-capital ratio, is significant.

4.4 Underpricing, portfolio diversification, and IPO objectives

We have shown that diversification affects the decision to take the company public, as well as the degree of underpricing. We argued that this is due to the fact that more diversified shareholders are less willing to incur the cost of an IPO, and are less inclined to allow high underpricing, since their own valuation of the private firm is closer to the post-IPO price. Our last hypothesis states that the effect of the controlling shareholders' diversification on underpricing in firms whose sole IPO motive is to raise new capital for investment should be marginal. The effects of diversification should be much more pronounced in firms whose shareholders appear to care about it.

How can we identify such firms? We use the fact that selling secondary shares at the IPO contributes to diversification, but does not raise capital for the firm (see also Kim and Weisbach 2005). Thus shareholders of firms that do not sell any secondary shares at the IPO are clearly not interested in diversification; thus, we should not expect to find a significant effect of diversification on their underpricing.

Accordingly, we partition the sample into firms that issue only primary shares (34 firms) and those that sell at least some secondary shares (86 firms). Then we re-estimate the underpricing regression from Panel A of Table 5 in these two samples. The results comparing the effects of shareholder diversification between the two samples are in Table 6. As predicted, the effect of diversification on pricing is very strong in firms that sold some secondary shares. At the same time, the result completely disappears in firms that did not sell any secondary shares; the coefficient becomes insignificant, and in most cases even changes sign. These findings are consistent with the prediction that the effect of diversification on underpricing should manifest itself in firms whose shareholders exhibit some desire to diversify. The remaining firms, which go public to raise capital, exhibit no effect of diversification on underpricing. Despite the

Table 6
Underpricing and diversification

Sample		D_1^{pp}	D_2^{pp}	D_3^{pp}	D_4^{pp}	D_5^{pp}	$-D_5^{pp} \times D_1^{pp}$	$-D_5^{pp} \times D_2^{pp}$	$-D_5^{pp} \times D_3^{pp}$	$-_5^{pp} \times D_4^{pp}$
All companies	Coeff	−0.880	−0.206	−0.780	−0.824	−0.487	−0.281	−0.286	−0.273	−0.273
	t-Stat	(−10.15)	(−5.81)	(−4.35)	(−5.61)	(−3.21)	(−10.67)	(−5.59)	(−10.34)	(−9.95)
	Adj R^2	0.211	0.200	0.198	0.202	0.185	0.198	0.226	0.192	0.192
Companies that sell some secondary shares ($N = 86$)	Coeff	−1.014	−0.223	−0.975	−0.983	−0.517	−0.327	−0.317	−0.315	−0.314
	t-stat	(−11.30)	(−6.76)	(−11.98)	(−11.87)	(−7.55)	(−4.84)	(−5.00)	(−5.48)	(−5.67)
	Adj R^2	0.266	0.233	0.262	0.263	0.265	0.252	0.268	0.243	0.243
Companies that do not sell secondary shares ($N = 34$)	Coeff	0.201	−0.079	0.075	−0.812	0.139	0.133	−0.213	0.129	0.151
	t-Stat	(0.39)	(−1.77)	(0.32)	(−0.43)	(1.33)	(0.59)	(−1.25)	(0.52)	(0.93)
	Adj R^2	0.434	0.395	0.376	0.364	0.375	0.416	0.382	0.392	0.389

We report the regression of underpricing on a set of control variables as in Table 5 (Panel A), using subsamples of firms that sell some secondary shares and of those that do not. All t-statistics are adjusted for heteroskedasticity and the errors are clustered at the industry level. To conserve space, we report only the coefficients of diversification variables for private individuals (along with t-statistics and overall regression R^2).

small sample size, this is strong evidence in support of the diversification hypothesis.

One may conjecture that our results do not capture the direct effect of diversification on underpricing; indeed, it may be that diversification directly affects the fraction of secondary shares sold (as we have shown), and the latter determines the underpricing. To test this hypothesis, we replaced the diversification measures in the underpricing regressions with the fraction of secondary shares sold at the IPO. We find that the fraction of secondary shares has no effect on underpricing. It appears that diversification directly affects both the underpricing and the proportion of shares sold by the existing shareholders.

5. Robustness and Extensions

In this section, we discuss the robustness of our results and consider alternative hypotheses.[24]

5.1 Sales of secondary shares and diversification

In Section 4.1, we tested the relation between the private shareholders' diversification and their decision to sell shares. Here we test the same relationship at the aggregate IPO level. First, we partition the IPOs into high (above the median) and low (below the median) for each private diversification measure. Then we compute the fraction of secondary shares as the ratio of secondary shares sold at the IPO to the total number of shares outstanding before the IPO, and then compare the averages of these ratios for high and low diversification samples. The results in Panel A of Table 7 show that firms with less diversified owners sell significantly more secondary shares of their holdings for all five measures of diversification. This is consistent with the predictions and with the results at the individual level in Section 4.1.

Then, we regress the proportion of secondary capital on our measures of diversification and a set of control variables. The results for shareholders with a controlling stake of at least 10% of the voting rights are reported in Table 7, Panel B.[25] The fraction of secondary shares declines in their degree of diversification; that is, firms with more-diversified shareholders sell lower proportions of secondary shares. This is true for most measures of diversification for the private controlling shareholders. We also performed analogous estimations by using the ratio of primary shares issued at the IPO to shares outstanding as a dependent variable. The results

[24] To check whether changes in the industry competitive environment had an effect, we explicitly control for the level and the changes in Herfindahl indices by industry. We found no such effect.

[25] The results (not reported) for the sample of all the controlling shareholders are very similar.

Table 7
Diversification and secondary shares at the IPO level

Panel A: Proportion of the number of shares sold by the existing shareholders at the IPO to the total number of shares outstanding and diversification measures

	Diversification measure									
	D_1		D_2		D_3		D_4		D_5	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median
High diversification	0.25	0.16	0.26	0.20	0.25	0.16	0.24	0.15	0.20	0.15
Low diversification	0.40	0.36	0.39	0.36	0.40	0.40	0.41	0.40	0.40	0.31
	Stat.	*p*-Value	Stat.	*p*-Value	Stat.	*p*-Value	Stat.	*p*-Value	Stat.	*p*-Value
t-Statistics	2.05	0.04	1.86	0.07	2.16	0.03	2.30	0.02	3.02	0.003
Wilcoxon Z-Statistics	1.88	0.03	1.54	0.06	1.95	0.03	2.13	0.02	2.57	0.005

Table 7
(Continued)

Panel B: Determinants of the sales of secondary shares in an IPO. Value-weighted diversification measures (controlling stake > = 10% of voting rights).

	Simple diversification measures									Simple diversification measures interacted with (-d5)								
	Est.	$t-$Stat	Est.	t-Stat	Est.	t-Stat	Est.	t-Stat	Est.	$t-$Stat	Est.	t-Stat	Est.	t-Stat	Est.	t-Stat	Est.	t-Stat
D_1^{ip}	0.189	(1.45)									0.131	(1.36)						
D_1^{pp}	−0.580	(−5.21)									−0.404	(−4.36)						
D_2^{ip}			0.049	(0.54)									0.044	(0.59)				
D_2^{pp}			−0.173	(−3.81)									−0.302	(−4.08)				
D_3^{ip}					0.136	(1.26)									0.124	(1.36)		
D_3^{pp}					−0.449	(−4.20)									−0.393	(−4.56)		
D_4^{ip}							0.312	(2.98)									0.132	(1.36)
D_4^{pp}							−0.569	(−5.10)									−0.393	(−4.22)
D_5^{ip}									0.157	(1.63)								
D_5^{pp}									−0.455	(−5.17)								
Log(Age)	−0.040	(−1.20)	−0.042	(−1.52)	−0.051	(−1.67)	−0.049	(−1.69)	−0.040	(−1.46)	−0.035	(−1.13)	−0.039	(−1.53)	−0.039	(−1.24)	−0.037	(−1.25)
Telecom Dummy	−0.013	(−0.22)	−0.007	(−0.12)	−0.025	(−0.42)	−0.046	(−0.82)	−0.010	(−0.19)	0.000	(0.00)	−0.002	(−0.04)	−0.006	(−0.10)	−0.009	(−0.16)
Carve-Out Dummy	0.224	(2.73)	0.199	(2.21)	0.223	(2.75)	0.281	(3.63)	0.251	(3.18)	0.234	(2.87)	0.194	(2.29)	0.231	(2.74)	0.238	(2.90)
Market Underpricing	−0.884	(−2.86)	−0.937	(−2.35)	−0.906	(−2.74)	−1.041	(−2.57)	−0.972	(−2.90)	−0.960	(−3.00)	−0.954	(−2.54)	−0.954	(−3.08)	−0.958	(−2.84)

Table 7
(Continued)

Panel B: Determinants of the sales of secondary shares in an IPO. Value-weighted diversification measures (controlling stake > = 10% of voting rights).

	Simple diversification measures									Simple diversification measures interacted with (-d5)								
	Est.	*t*−Stat	Est.	*t*-Stat	Est.	*t*-Stat	Est.	*t*-Stat	Est.	*t*−Stat	Est.	*t*-Stat	Est.	*t*-Stat	Est.	*t*-Stat	Est.	*t*-Stat
Number of IPOs	−0.012	(−2.17)	−0.011	(−2.06)	−0.013	(−2.86)	−0.014	(−2.62)	−0.014	(−3.06)	−0.014	(−2.61)	−0.012	(−2.38)	−0.014	(−3.18)	−0.013	(−2.91)
Momentum	0.385	(4.82)	0.463	(5.99)	0.379	(4.65)	0.489	(7.40)	0.403	(4.44)	0.390	(3.84)	0.417	(4.79)	0.392	(3.85)	0.423	(4.25)
Volatility	−7.395	(−1.11)	−6.760	(−1.04)	−6.808	(−1.04)	−4.575	(−0.69)	−9.139	(−1.39)	−8.869	(−1.33)	−8.735	(−1.33)	−8.382	(−1.35)	−8.316	(−1.31)
Underwriter Reputation	0.004	(0.93)	0.004	(0.99)	0.003	(0.84)	0.003	(0.59)	0.002	(0.42)	0.003	(0.61)	0.003	(0.79)	0.003	(0.64)	0.002	(0.52)
Venture Capital	−0.018	(−0.41)	−0.016	(−0.31)	−0.040	(−0.88)	−0.035	(−0.73)	−0.046	(−1.07)	−0.031	(−0.69)	−0.022	(−0.45)	−0.042	(−0.94)	−0.041	(−0.90)
Partial Adjustment	−0.006	(−0.01)	0.087	(0.15)	0.112	(0.16)	−0.096	(−0.16)	0.159	(0.27)	0.115	(0.18)	0.133	(0.23)	0.179	(0.29)	0.144	(0.23)
Leverage	−0.201	(−1.61)	−0.237	(−1.84)	−0.177	(−1.41)	−0.205	(−1.84)	−0.150	(−1.32)	−0.166	(−1.38)	−0.212	(−1.66)	−0.152	(−1.30)	−0.149	(−1.28)
Industry Sales growth	−0.386	(−4.44)	−0.358	(−5.68)	−0.357	(−4.78)	−0.378	(−5.02)	−0.357	(−4.36)	−0.362	(−4.43)	−0.341	(−5.21)	−0.338	(−4.25)	−0.362	(−4.58)
Heckman's Lambda	0.087	(0.70)	0.214	(1.72)	0.104	(1.21)	0.101	(1.10)	0.123	(1.44)	0.096	(0.83)	0.202	(1.71)	0.095	(1.06)	0.127	(1.39)
Intercept	0.238	(0.89)	0.229	(1.08)	0.344	(2.01)	0.366	(1.55)	0.435	(2.45)	0.468	(2.17)	0.323	(1.89)	0.487	(2.90)	0.425	(2.34)
R2	0.24		0.24		0.25		0.26		0.26		0.25		0.25		0.25		0.25	
Adj R2	0.11		0.11		0.12		0.13		0.13		0.12		0.12		0.12		0.12	

In Panel B we report the regression of the fraction of secondary capital on a set of diversification measures and control variables as defined in Table 5, Panel A.
We report the results on the effect of diversification on the proportion of the number of shares sold by the existing shareholders at the IPO to the total number of shares outstanding before the IPO. We partition the IPO in two equal groups based on diversification measures of the lead shareholder and calculate the ratio of secondary shares to shares outstanding prior to the IPO. High (Low) diversification firms are the ones in which the average degree of diversification of the controlling shareholders is above (below) the median value across all the IPO firms. We report the mean and the median ratios and tests of the difference in this variable between the two groups.

(not reported) show that diversification has no effect on the proportion of the primary capital raised. Both findings are consistent with the predictions.

5.2 Time to IPO

As an additional robustness check, we estimated the relation between the time it takes a firm to be taken public, and how long it waited from the time when it fulfilled all the exchange prerequisites to be listed. The assumption is that the less diversified shareholders will take the company public sooner. We compute the waiting time for the 54 firms for which the accounting data were available for three years or more prior to IPO, and regress it on the diversifications measures and annual dummies. The results (not reported) support our hypothesis: firms held by more diversified shareholders tend to wait longer until the IPO.

5.3 Growth opportunities

Kim and Weisbach (2005) argue that firms are taken public mainly to raise funds to finance new growth opportunities. They show that the post-IPO growth of a firm's assets can be explained by a set of pre-IPO variables. As a robustness check for our interpretation, we re-estimate their equation in our sample, and add thereto our measures of pre-IPO diversification as explanatory variables.

The intuition is that when a firm whose shareholders are diversified goes public, it is more likely to raise capital, and so its growth in the years following the IPO should be higher on average. This is indeed the case in the data. On the basis of these results (not reported) we have included the three-year post-IPO growth of assets into our underpricing regressions in Table 5. In this specification, the future realized growth proxies for the planned expansion. We show that future growth is positively related to underpricing as it captures the need for capital, but our measures of diversification do not lose significance (results are available upon request). Moreover, the economic effect of asset growth on underpricing is significantly smaller than the effect of diversification.

Finally, we also considered alternative measures of investment needs in the underpricing regressions: ratio of R&D expenses over sales, change in ratio of total assets to sales, and ratio of intangible assets to sales, ratio of R&D expenses to sales. The diversification results are invariant to the omission of these alternative measures.

5.4 Liquidity

Listing the stock on an exchange makes it more liquid, thus creating the potential for diversification, while selling the secondary shares at the IPO utilizes this potential. These concepts are related, even though the former does not require the latter. Amihud and Mendelson (1988) and Pagano, Panetta, and Zingales (1998) argue that one of the most important features

of an IPO is that it dramatically increases the liquidity of the firm's shares, thus increasing its value. This argument is similar to ours: in both cases the post-IPO value of the liquid stock is higher than its pre-IPO value to the insider. The difference is that the post-IPO valuation no longer depends on the post-IPO holdings of the original shareholders. We cannot rule out that the demand for liquidity may be partly responsible for the desire to go public, along with the demand for diversification. However, demand for liquidity does not explain the effect of shareholder diversification on underpricing.

Although we would like to test the liquidity hypothesis separately, we unfortunately do not observe the holdings of cash and bonds of all shareholders, but only the holdings of shareholders of firms that went public. Collecting data on all the shareholders is prohibitively costly; thus, we cannot estimate the liquidity of their portfolios. The effects of diversification are much less sensitive to these omissions. Not surprisingly, the liquidity of the portfolio for shareholders in our IPO sample increases significantly following the IPO.

6. Conclusion

We study IPOs by focusing on the degree of the portfolio diversification of the controlling shareholders taking the firm public. We argue that less diversified shareholders are more eager to take their company public, and are willing to accept a lower price for the sale of shares than a more diversified shareholder. We test these hypotheses on a sample of private firms in Sweden that includes all the IPOs in the period 1995–2001. We construct measures of the portfolio diversification of the controlling shareholders before the IPO, and then we relate them to the probability of the IPO and the underpricing of the IPO.

We first show that the existing private shareholders sell more of their own shares at the IPO, if they are less diversified. This effect is strong for less wealthy (more risk-averse) individuals. This indicates that diversification is indeed an important driver of individual decisions. Then, we show that the probability of an IPO is negatively related to the degree of diversification of its controlling shareholders, private and institutional alike; firms that are held by more diversified shareholders are less likely to go public.

We also document a negative and significant relation between the degree of diversification and the underpricing. Firms controlled by more diversified shareholders exhibit a significantly lower underpricing in an IPO, even after controlling for the endogeneity of the decision to go public. Interestingly, while the diversification of the institutional controlling shareholders has a strong effect on the decision to go public, it scarcely affects underpricing. Conversely, private shareholders' diversification has a strong effect on both. We attribute this result to the fact that VCs are

less sensitive to underpricing, but they are keen on timely exits, since these enable them to raise future rounds of financing. These results are robust across alternative specifications and different measures of the degree of shareholder portfolio diversification. Also, the use of a Heckman two-stage procedure allows us to control for the selection bias induced by the IPO itself.

These findings relate the IPO process to a very basic concept in finance: portfolio diversification. Our findings suggest that this relation deserves closer attention.

Appendix A:

We summarize here the definitions of our proxies for the degree of diversification.

D_1 is defined as follows: let w_i denote the weight of the stock in the portfolio and w_{mkt} be the weight of the same stock in the market portfolio:

$$D_1 = -\sum_{i=1}^{N} (w_i - w_{mkt})^2.$$

D_2 is the correlation of the return of the industry portfolio to which the IPO firm belongs (R_{indipo}), with the return of the total shareholder's portfolio, multiplied by -1. We construct the industry return as a weighted average of the returns of all the publicly traded firms in the same SNI92 (see www.scb.se for details) industrial category, weighted by their market capitalization. This classification contains 12 industries:

$$D_2 = -corr\left(R_{indipo}, \sum_{i=1, i\neq ipo}^{N} w_i R_i\right).$$

D_3 is the negative of the share of the firm taken public in the shareholder's equity portfolio:

$$D_3 = -w_{i=ipo}.$$

D_4 is the negative of the percentage of the portfolio of the shareholder allocated to the industry to which the firm in question belongs:

$$\mathrm{D}_4 = -\sum_{i=1}^{N} \delta(industry_i = industry_{ipo}) w_i.$$

D_5 is the negative of the ratio of IPO firm market capitalization to the total estimated wealth of the shareholder. We estimate the nonequity wealth of the shareholder in the fiscal year prior to IPO, $W(t-1)$, using tax records and the fact that individual shareholders in Sweden are required to pay 1.5% tax on wealth in excess of 800K SEK. We made adjustments to the specifics of tax legislation. In practice, $W(t-1)$ contains real estate, valuables, boats, bond holdings, and bank account balances:

$$D_5 = -\frac{N_{IPOshares} P_{ipo,t0}}{W(t-1) + \sum_{i=1}^{N} N_{shares,i} P_{i,t0}}.$$

Table A2.1
Excess required rate of return for different classes of shareholders

	Noncontrolling institutions (inp)	Controlling institutions (ip)	Noncontrolling private (pnp)	Controlling private (pp)
Excess required rate of returns with loadings constructed over 36 months				
Mean (%)	0.51	0.57	0.67	0.70
t-Value	2.45	2.50	2.87	2.85
p-Value	0.015	0.013	0.004	0.005
Wilcoxon z	2.20	2.47	2.44	2.36
p-Value	0.014	0.007	0.007	0.009
Excess required rate of returns with loadings constructed over 60 months				
Mean (%)	0.56	0.59	0.68	0.71
t-Value	3.29	3.26	3.68	3.69
p-Value	0.001	0.001	0.001	0.001
Wilcoxon z	2.44	2.51	2.62	2.66
p-Value	0.007	0.006	0.004	0.004

This table presents estimates of monthly differences between the required rate of returns for different groups of shareholders and the ones required by diversified shareholders. For each firm, the diversified required risk premium is constructed as the product between the Fama and French (1993) factor risk premium and the loading of the firm return on that factor. The firm stock return in the years before the IPO is proxied by the return of a listed firm with analogous characteristics (in terms of size and book-to-market). The undiversified required rate of returns is constructed as follows. For each shareholder, we calculate the loading (''beta'') between the return on the stock and the return on the shareholder portfolio. This is then multiplied by the excess return of the shareholder portfolio over the riskless (30-day Treasury bill) rate. Then, for each firm being taken public, we calculate the required rate of returns (undiversified as well as diversified), aggregated across all the shareholders of the firm. As before, we report a breakdown for institutional and private shareholders, as well as for controlling and minority shareholders. We use the superscript ''*ip*'' (''*inp*'') to denote the institutional shareholders who have a controlling (minority) stake and the superscript ''*pp*'' (''*pnp*'') to denote the private shareholders who have a controlling (minority) stake. We present the results for three-factor (Fama–French) models using factor loadings estimated over 36 and 60 months prior to the IPO date. We use the following matching mechanism to identify listed firms most similar to the IPO firms in our sample: (i) we select firms with a market capitalization within 30% of the market capitalization of the firm at the date of its IPO; (ii) among firms satisfying condition (i), we select the ones that have the book-to-market ratio closest to the book-to-market ratio of the firm going public. The notations on the types of shareholders are as in Table 1. The number of observations is 124 and the number of degrees of freedom for the mean and the median test is 246.

Appendix B:

In this appendix, we focus on the shareholders' required rate of return, as a function of their degree of diversification. We report the required rate of return of the firm's shareholders and compare it to the required rate of return for a well-diversified shareholder before the IPO. We calculate the diversified required rate of return using the Fama and French (1993) three-factor pricing model. We construct the undiversified required rate in the following way. For each shareholder, we calculate the ''beta'' between the return on the stock and the average return on the shareholder portfolio. This is then multiplied by the excess return of the shareholder portfolio over the riskless rate (three-month Swedish Treasury bill). Then, the required rate of return for each shareholder is aggregated across all the shareholders of each firm taken public. We consider a breakdown for institutional and private shareholders, as well as for controlling and minority shareholders. We estimate the parameters using either 36 or 60 months. For example, consider the required rate of return of the controlling institutions. This is determined as follows.

First, we identify the institutions with controlling power. Then, for each institution we calculate the required rate of return on the basis of their portfolio holdings. Finally, we construct the aggregate required rate of return for the institutions with controlling power

by averaging the required rate of return individually constructed for all the controlling institutions. In all cases, the return on the firm stock before the IPO, as well as the returns of all nonlisted stocks held in the portfolios, are proxied by the return on "similar" (in terms of size and book-to-market) listed stocks. We use two criteria to select such firms: first, we select firms with similar market capitalization (within 30% range) at the date of the IPO. Among them we pick those with the closest book-to-market ratio to the firm going public.[26] We test whether the required rate of return of a particular group of less-diversified shareholders is larger than the required rate of return by diversified shareholders. Table A2.1 reports the mean values of the estimates of the required rates of return, the t-stat, the significance levels for the one-sided mean test, the Wilcoxon z-score, and the significance level for the one-sided median test.

References

Allen, F., and G. Faulhaber. 1989. Signaling by Underpricing in the IPO Market. *Journal of Financial Economics* 23:303–23.

Amihud, Y., and H. Mendelson. 1988. Liquidity and Asset Prices: Financial Management Implications. *Financial Management* 17:5–15.

Balvers, R. J., B. McDonald, and R. E. Miller. 1988. Underpricing New Issues and the Choice of Auditor as a Signal of Investment Banker Reputation. *Accounting Review* 63:605–22.

Beatty, R. P., H. Bunsis, and J. R. M. Hand. 1998. The Indirect Economic Penalties in SEC Investigations of Underwriters. *Journal of Financial Economics* 50:151–86.

Benveniste, L., and P. Spindt. 1989. How Investment Bankers Determine the Offer Price and Allocation of New Issues. *Journal of Financial Economics* 24:343–61.

Benveniste, L., and W. Wilhelm. 1990. A Comparative Analysis of IPO Proceeds under Alternative Regulatory Environments. *Journal of Financial Economics* 28:173–207.

Black, B. S., and R. J. Gilson. 1998. Venture Capital and the Structure of Capital Markets: Banks versus Stock Markets. *Journal of Financial Economics* 47:243–77.

Booth, J. R., and L. Chua. 1996. Ownership Dispersion, Costly Information, and IPO Underpricing. *Journal of Financial Economics* 41:291–310.

Chemmanur, T. J. 1993. The Pricing of Initial Public Offerings: A Dynamic Model with Information Production. *Journal of Finance* 48:285–304.

Chemmanur, T. J., and P. Fulghieri. 1994. Investment Banker Reputation, Information Production, and Financial Intermediation. *Journal of Finance* 49:57–79.

Chemmanur, T. J., and P. Fulghieri. 1999. A Theory of the Going-Public Decision. *Review of Financial Studies* 12:57–79.

Cornelli, F., and D. Goldreich. 2002. Bookbuilding: How Informative Is the Order Book? *Journal of Finance* 58:1415–44.

Corwin, S. A., and P. Schultz. 2005. The Role of IPO Underwriting Syndicates: Pricing, Information Production, and Underwriter Competition. *Journal of Finance* 60:443–86.

Edelen, R. M., and G. B. Kadlec. 2005. Issuer Surplus and the Partial Adjustment of IPO Prices to Public Information. *Journal of Financial Economics* 77:347–73.

Ellis, K., R. Michaely, and M. O'Hara. 2000. The Accuracy of Trade Classification Rules: Evidence from NASDAQ. *Journal of Financial and Quantitative Analysis* 35:529–51.

[26] The average (median) control firm is 3.98% (5.07%) smaller in terms of market capitalization and has a 0.057 (0.042) lower book-to-market ratio.

Ellul, A., and M. Pagano. 2006. IPO Underpricing and After-Market Liquidity. *Review of Financial Studies* 19:381–421.

Faccio, M., and L. Lang. 2002. The Ultimate Ownership of Western European Corporations. *Journal of Financial Economics* 65:365–95.

Fama, E., and K. French. 1993. Common Risk Factors in the Returns on Stocks and Bonds. *Journal of Financial Economics* 33:3–56.

Field, L. C., and J. M. Karpoff. 2002. Takeover Defenses at IPO Firms. *Journal of Finance* 57:1857–89.

Goetzmann, W., and A. Kumar. 2002. Equity Portfolio Diversification. NBER Working Paper No. 8686.

Gompers, P. 1996. Grandstanding in the Venture Capital Industry. *Journal of Financial Economics* 43:133–56.

Gompers, P., and J. Lerner. 1998. Venture Capital Distributions: Short-Run and Long-Run Reactions. *Journal of Finance* 53:2161–83.

Greene, W. H. 1981. On the Asymptotic Bias of the Ordinary Least Squares Estimator of the Tobit Model. *Econometrica* 49:505–13.

Habib, M., and A. Ljungqvist. 2001. Underpricing and Entrepreneurial Wealth Losses in IPOs: Theory and Evidence. *Review of Financial Studies* 14:433–58.

Hanley, K. 1993. Underpricing of Initial Public Offerings and the Partial Adjustment Phenomenon. *Journal of Financial Economics* 34:231–50.

Heckman, J. 1979. Sample Selection Bias as a Specification Error. *Econometrica* 47:153–61.

Holmén, M., and P. Högfeldt. 2004. Law and Finance Analysis of Initial Public Offerings. *Journal of Financial Intermediation* 13:324–58.

Hughes, P., and A. Thakor. 1992. Litigation Risk, Intermediation, and the Underpricing of Initial Public Offerings. *Review of Financial Studies* 5:709–42.

Kandel, E., D. Leschinskii, and H. Yuklea. 2006. Aging Brings Myopia: VC Fund's Limited Horizon as a Source of Inefficiency. Working Paper, Hebrew University of Jerusalem.

Karolyi, G. A. 1998. Why Do Firms List Shares Abroad? A Survey of the Evidence and Its Managerial Implications. *Financial Markets, Institutions, and Instruments* 7:3–12.

Kidder, T. 1981. *The Soul of a New Machine*. Little, Brown & Co. Inc.: Boston, MA.

Kim, W., and M. S. Weisbach. 2005. Do Firms Go Public to Raise Capital? NBER Working Paper No. 11197.

Krigman, L., W. Shaw, and K. Womack. 1999. The Persistence of IPO Mispricing and the Predictive Power of Flipping. *Journal of Finance* 54:1015–44.

Leland, H. E., and D. H. Pyle. 1977. Informational Asymmetries, Financial Structure, and Financial Intermediation. *Journal of Finance* 32:371–88.

Lin, T., and R. L. Smith. 1998. The Unwinding of Venture Capital Investments: Insider Selling During Equity IPOs. *Journal of Corporate Finance* 4:241–63.

Loughran, T., and J. R. Ritter. 2002. Why Don't Issuers Get Upset about Leaving Money on the Table in the IPOs? *Review of Financial Studies* 15:413–43.

Maddala, G. S. 1983. *Limited-Dependent and Qualitative Variables in Econometrics*. Cambridge University Press: Cambridge, MA.

Pagano, M., F. Panetta, and L. Zingales. 1998. Why Do Firms Go Public? An Empirical Analysis. *Journal of Finance* 53:27–65.

Pastor, L., and P. Veronesi. 2005. Rational IPO Waves. *Journal of Finance* 60:1713–57.

Ritter, J. R., and I. Welch. 2002. A Review of IPO Activity, Pricing, and Allocations. *Journal of Finance* 57:1795–828.

Rocholl, J. 2004. The Private Benefits of Listing. Working Paper, Kenan-Flagler Business School, University of North Carolina at Chapel Hill.

Rock, K. 1986. Why New Issues Are Underpriced. *Journal of Financial Economics* 15:187–212.

Rouwenhorst, K. G. 1998. International Momentum Strategies. *Journal of Finance* 53:267–84.

Sarin, A., J. Koeplin, and A. C. Shapiro. 2000. The Private Company Discount. *Journal of Applied Corporate Finance* 12:94–101.

Sherman, A. E. 2000. IPO and Long-Term Relationships: An Advantage of Book Building. *Review of Financial Studies* 13:697–714.

Sherman, A. E., and S. Titman. 2002. Building the IPO Order Book: Underpricing and Participation Limits with Costly Information. *Journal of Financial Economics* 65:3–29.

Stoughton, N., and J. Zechner. 1998. IPO-Mechanisms, Monitoring, and Ownership Structure. *Journal of Financial Economics* 49:45–77.

Sundin, A., and S. I. Sundqvist. 2002. *Ägarna och Makten i Sveriges Börsföretag (Owners and Power in Sweden's Listed Firms)*. SIS Ägarservice, Dagens nyheters Bokförlag: Stockholm, Sweden.

Welch, I. 1989. Seasoned Offerings, Imitation Costs, and the Underpricing of the Initial Public Offerings. *Journal of Finance* 44:421–49.

Welch, I. 1992. Sequential Sales, Learning, and Cascades. *Journal of Finance* 47:695–732.

Zingales, L. 1995. Insider Ownership and the Decision to Go Public. *Review of Economic Studies* 62:425–48.