Executive Stock Options, Managerial Characteristics and Idiosyncratic Volatility

by

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Abstract

This paper examines idiosyncratic volatility determinants. We extend the existing literature in two directions. First, we empirically test if CEO stock options have any impact on idiosyncratic volatility. Second, we put forward and test new hypotheses which relate some easily identifiable managerial characteristics, such as the CEO's age, founder-CEO status and managers' professional background, to idiosyncratic volatility. Using a sample of 182 IPO firms from the biotech industry, we find that the CEO stock options and managerial characteristics can help predict idiosyncratic volatility. Our empirical results are robust to various measures of idiosyncratic volatility, different sample periods and various model specifications. These findings have direct implications to idiosyncratic volatility sensitive investors and researchers with interest in idiosyncratic volatility determination.

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I. Introduction

Idiosyncratic volatility of individual stocks is of interest and importance for at least three reasons. First, as pointed out by Campbell, Lettau, Malkiel and Xu (CLMX) (2001), a majority of individual investors are either unable or unwilling to hold a diversified portfolio. CLMX document that idiosyncratic volatility has increased over the decades, so that 50 stocks were required in the 1987-97 period to achieve the diversification benefits attained by a 20 stock portfolio in the 1963-85 period. Statman (2004) reports that today's optimal level of diversification, measured by the rules of the mean-variance portfolio theory, exceeds 300 stocks, but the average investor holds only 3.4 stocks. Barber and Odean (2000) document that an average individual investor holds only 4.3 stocks in their portfolio. When non-tradable equity (Angeletos, 2003) and human capital (Baxter and Jermann, 1997) are considered, the diversification benefits are even more difficult to achieve. On the other hand, many active fund managers have chosen to under-diversify in order to beat the market (Ankrim and Ding, 2002). If a majority of investors are under-diversified, idiosyncratic risk affects stock returns and should be priced (see Goetzmann and Kummr, 2004; Malkiel and Xu, 2002; and Goyal and Santa-Clara, 2003). Idiosyncratic volatility is also important to arbitrageurs and option traders, whose profit depend on total rather than market volatility.

Second, idiosyncratic volatility may reflect the information content of stock prices and serve as a gauge of the efficiency of capital allocation in a country. Morck, Yeung and Yu (2000) observe that stocks in developed markets tend to have a higher ratio of idiosyncratic risk to total risk when compared to emerging markets. They argue that the higher ratio indicates that more firm-specific information is incorporated into stock prices. Subsequent empirical work by Durnev, Morck and Yeung (2003) supports the notion that a higher ratio of idiosyncratic risk to total risk reflects a higher informational efficiency in the stock market. They further document that capital is more likely to be allocated to firms in industries in which idiosyncratic volatility is larger in the sense that these firms utilize more external financing. In his study across 65 countries, Wurgler (2000) finds that the efficiency of capital allocation is positively correlated with the degree of firm-specific movement in domestic stock returns. Hamao, Mei and Xu (2003) reaffirm that idiosyncratic volatility affects capital allocation.

Third, the study of idiosyncratic volatility can potentially serve as a linkage between microeconomics and macroeconomics. Recent research suggests that idiosyncratic volatility (CLMX, 2001), especially idiosyncratic volatility of large firms (Gabaix, 2003), might be a predictor of GDP volatility and that idiosyncratic volatility itself is affected by outsourcing and competition (Thesmar and Thoenig, 2003).

Since idiosyncratic volatility is of importance both in theory and in practice, it is natural to study the factors that can help to predict idiosyncratic volatility. Using a sample of biotech IPO firms, we examine whether managerial characteristics and the executive stock options affect idiosyncratic volatility. Although there are studies relating firm specific factors to idiosyncratic volatility, no study has yet examined the relationship between managerial characteristics and idiosyncratic volatility.[1] We fill this void by examining whether managerial characteristics such as the age of senior managers, founder-CEO status or the professional backgrounds of directors can help to predict idiosyncratic volatility. These easily identifiable managerial characteristics are important because they may have direct implications to a firm's management style, risk averseness and corporate behavior. Previous studies have found that managerial characteristics are related to organizational outcomes.[2] It is very likely that they are also associated with idiosyncratic volatility. We formally develop and test hypotheses relating these managerial characteristics to idiosyncratic volatility. Specifically, using upper echelon theory, we contribute to the literature by putting forward the resource dependency hypothesis that the proportion of corporate elites with legal and regulatory background should be negatively associated with idiosyncratic volatility in a nationally regulated industry.

We also examine the relationship between stock options and idiosyncratic volatility because there are different predictions in the literature, but no empirical work has been done on these predictions. CLMX (2001) suggest that idiosyncratic volatility should be positively associated with executive stock options because stock options encourage managers to take risks. On the other hand, it has been argued that executive stock options would not be effective given that executives' human capital is already tied up with the firm. The higher the idiosyncratic

[1] For example, Cao, Simin and Zhao (2004) find that the investment decisions of senior managers have an impact on idiosyncratic volatility. Wei and Zhang (2003) document that earnings and the variance of earnings are associated with idiosyncratic volatility. Johnson and Marietta-Westberg (2003) show that news citations (the number of times a firm is reported in leading news wire services) are associated with idiosyncratic volatility of IPO firms. Spiegel and Wang (2005) further document that idiosyncratic volatility is positively correlated with the illiquidity.

[2] See Pfeffer, 1972, Grimm and Smith, 1991; Wiersema and Bantel, 1992; May, 1995; Eisenhardt and Schoohoven, 1996; Golden and Zajac, 2001; Certo, Covin, Daily and Dalton, 2001; Falenbrach, 2003; Gulati and Higgins, 2003.

volatility, the less effective are the stock option plans. Our empirical tests on the relationship between stock options and idiosyncratic volatility can shed light on these predictions.

Our sample of IPO firms in the biotech industry offers a unique information environment which facilitates the study. Firms at different development stages may exhibit different idiosyncratic volatility (See Pastor and Veronesi, 2003). By focusing on IPO, we can control the possible life cycle effect on idiosyncratic volatility. In addition, although many investors are interested in IPOs, relatively less information is available for these firms, since IPO firms tend to be small and with little publicly available information before listing (DuCharme, Malatesta and Sefcik (2001) and Teoh, Welch and Wong (1998)). Therefore, our easily identifiable managerial characteristics may be particularly helpful to predict idiosyncratic volatility for IPO firms. Furthermore, an IPO firm is less likely to have CEO or board member changes within one year after the IPO, greatly reducing problems associated with our data collection.

On the other hand, prior research suggests that idiosyncratic volatility is positively associated with high-tech firms, especially after their IPOs (See CLMX (2001), Pastor and Veronesi (2002), Wei and Zhang (2003)). By examining IPO firms in the biotech industry, one of the high-tech industries, it would in general be easier to detect the possible factors that have an impact on idiosyncratic volatility. Also, a high percentage of these biotech firms have stock option plans. This would help us to test the possible relationship between stock options and idiosyncratic volatility. Without exception, the newly listed biotech firms in our sample do not issue dividends, which can reduce the confounding effect in the tests. More important, the biotech industry is nationally regulated. As will be discussed in the next section, this can help us to test the resource dependency hypothesis. Finally, biotech firms have attracted a lot of attentions in the market (See Robbins-Roth (2000) and Wolff (2001)).

Our major results indicate that, even after control for various factors, managerial characteristics, such as the proportion of corporate elites with legal and regulatory background and the average age of board members (or the CEO age), can help predict idiosyncratic volatility. In addition, stock options are positively related to idiosyncratic volatility. These findings have important implications to both researchers and practitioners.

The rest of the paper is organized as follows. The next section develops our testing hypotheses. Section III describes data and methodology, while empirical results and the robustness check are presented in section IV. Section V concludes.

II. Hypothesis Development

Stock Options Hypothesis

Cohen, Hall and Viceira (2000) find a positive association between stock return volatility and executive stock options. CLMX (2001) interpret this finding as evidence that stock options might encourage senior managers to align themselves with shareholders' interests and take more risks. Thus, they suggest that executive stock options should be positively associated with idiosyncratic volatility.

Alternatively, it may also be argued that executive stock options can be negatively associated with idiosyncratic volatility. Due to the fact that a CEO's non-diversifiable human capital is tied up with the firm he serves, a further granting of stock options to him/her for that firm will make his/her personal portfolio even less diversified and thus less effective. The higher the idiosyncratic volatility of the firm, the less effective are the stock options. Therefore, we have the following hypothesis:

H1: CEO stock options are positively associated with idiosyncratic volatility.

Our alternative hypothesis is:

H1a: CEO stock options are negatively associated with idiosyncratic volatility.

Managerial Characteristics Hypotheses

As mentioned earlier, we want to examine the relationship between idiosyncratic volatility and managerial characteristics. The rationale is that the characteristics of corporate elites could proxy for certain managerial decisions, activities or behaviors (Hambrick and Mason, 1984). There is no doubt that managerial decisions, activities or behaviors can affect idiosyncratic volatility. It is well-documented that managerial investment decisions (Hamao et al, (2003) and Cao, Simin and Zhao, (2004)), disclosure decisions (Johnson and Marietta-Westberg, 2003) and more focused business strategies (CLMX, 2001) can all affect idiosyncratic volatility.

According to the upper echelon theory, demographic variables of top managers can predict their strategic choices because the organization is a reflection of its top managers. The logic is that the manager's cognitive base and values shape managerial perceptions, and thus influence strategic decision making.[3] The demographic variables, such as the age of senior managers, founder-CEO status or the professional backgrounds of directors, have been identified by the previous authors to have an impact on organizational outcomes. We develop our hypotheses based on these variables.

Prior research suggests that the age of the top management team could be negatively related to risk taking. For example, Vroom and Pahl (1971) find a negative relationship between age and risk taking by managers, while Hitt and Tyler (1991) document similar results for top executives. There is also cognitive evidence that older managers are more cautious as they seek more information and take more time before making decisions (Taylor, 1975). In a discussion of top managers, upper echelon theorists also theorized that younger managers prefer growth strategies (Hambrick and Mason, 1984). Indeed, two studies find that the age of top management team members is negatively associated with strategic change (Grimm and Smith, 1991; Wiersema and Bantel, 1992). Thus, it is likely that the CEO's age may proxy for risk aversion. However, Golden and Zajac (2001) find that average age of the board members is positively related to strategic change. Thus, they concluded that to impel strategic change, board members must have sufficient capabilities, experiences and confidence and added that these characteristics are most likely to be present among boards with more senior members. As such, it is likely that as a CEO's age (the average age of board members) increases, his (their) risk aversion may decrease. That is, only experienced leaders dare to take big risks. The two proxies we used in this study are the CEO's age and the average age of board members. Our basic hypothesis regarding CEO age is:

H2: The CEO's age (the average age of board members) is negatively associated with idiosyncratic volatility.

Our alternative hypothesis is

H2a: The CEO's age (the average age of board members) is positively associated with idiosyncratic volatility.

[3] See Hambrick and Mason, 1984, and Finkelstein and Hambrick, 1996

Founder management style may involve more risky decisions and lower levels of information disclosures. Existing research finds that founder-CEOs make more non-diversifying acquisitions and less diversifying acquisitions than non-founder-CEOs (Falenbrach, 2003). It has been argued that this is because founder-CEOs are specialists, who acquire firms that correspond to their specific skill set (May, 1995). Falenbrach (2003) documents in a recent study that a founder-CEO invests more in R&D and have higher capital expenditures. Specifically, he reports that the average founder-CEO invests about 1% more of total assets in R&D each year and has 0.75% higher capital expenditures than the median firm in its industry. Thus, we can hypothesize that:

H3: Founder management style (Founder-CEO status) is positively associated with idiosyncratic volatility

On the other hand, it is possible that founder-CEOs might be less likely to disclose information, given that they do not behave like the employee-fiduciary agent. In a recent study, Schrand and Verrecchia (2004) find that underpricing is negatively associated with information disclosures. That is, they find evidence that underpricing is a cost of capital directly attributed to managerial choices on information disclosures. Parallel to this, Certo, Covin, Daily and Dalton (2001) report that existence of founder-CEOs in young entrepreneurial firms is positively related to underpricing. Thus, there appear to be prima facie evidence that founder-managers prefer to disclose less information. Given that higher idiosyncratic volatility implies more information is impounded into stock prices (Durnev, Morck, Yeung and Zarowin, 2003), we have the alternative hypothesis:

H3a: Founder management style (Founder-CEO status) is negatively associated with idiosyncratic volatility.

We finally put forward our resource dependence hypothesis, which is based on social theory and is particularly relevant to the biotech industry because it is nationally regulated. It has been argued that for an organization to survive, it must be able to acquire resources from the environment (Pfeffer and Salancik, 1978). To acquire resources, an organization is expected to follow a strategy of cooptation (Pfeffer and Salancik, 1978). For example, when the University of California appropriate resources from the US government by embracing certain White House's educational objectives, it is following a strategy of cooptation (Pfeffer and Salancik, 2003). This came to be known as the resource dependency theory.

In an influential study of corporate boards, Pfeffer (1972) hypothesized that the percentage of lawyers on a corporate board will be higher when the firm's industry is nationally regulated. This is because the regulatory influence emanates from Washington and tends to be more legalistic and formal, which therefore necessitates the services of lawyers. Pfeffer also hypothesized that the percentage of lawyers on a corporate board will be positively related to the firm's needs to access external capital markets because the use of outside financing requires legal knowledge. Therefore, Pfeffer sees the appointment of lawyers to the board as a mechanism to extract resources from the environment, particularly if the firm is nationally regulated and going public.

Biotech firms are nationally regulated. They face many regulatory and resources problems that are often decided in Washington D.C. For example, the level of the National Institute of Health's (NIH) funding to various research institutes in different geographic areas could affect the quality of technology transfers to biotech companies. Another example is the landmark decisions reached by the Federal Judiciary, particularly the Court of Appeals for the Federal Circuit and the United States Supreme Court. These rulings may bring clarity to contentious patent issues and could change the fortunes of many biotech companies.

Indeed, due to this national regulation characteristic, many biotech companies are inclined to join their sector's respective nation-wide lobbying organizations that could conceivably represent their interests. Examples of such organizations include Pharmaceutical Research and Manufacturers of America (PhRMA), Biotechnology Industry Organization (BIO), The Medical Device Manufacturers Association (MDMA), American Hospital Association (AHA) and National Venture Capital Association (NVAC). Some of the activities undertaken by these organizations include lobbying for more NIH funding and lobbying to cap product and professional liability claims.

Hence, it is likely that the percentage of lawyers on a biotech firm's corporate board is likely to be high. More importantly, the resource dependence perspective suggests that the extraction of resources from the environment or a strategy of cooptation is subtle and is probably not required to be filed in SEC documents. In fact, it is probably a low risk corporate strategy that allows an organization to stabilize cash flow resources via informal alliances with key players in Washington without informational impact on the stock prices. Therefore, we hypothesize that:

H4: Resource dependencies (the number of corporate elites trained in regulatory and/or legal affairs as a proportion of the number of corporate elites) are negatively associated with idiosyncratic volatility.

III. Data and Methodology

Data for our study are collected from SDC, CRSP and the IPO prospectuses. IPO prospectuses are available from Edgar since May 1996 (Ljungqvist and Wilhelm, 2003). Thus, for ease of data collection, our sample period is defined as 1st May 1996 to 31st Dec 2001. To be included in our sample, a firm must be recorded as a biotech company in SDC, its IPO prospectus must be available on Edgar and it must have stock return information in CRSP for more than 240 trading days (roughly one year) from the IPO date. These three criteria resulted in 182 companies.

Compute the Dependent Variable: Idiosyncratic Volatility

We follow the direct decomposition method in Xu and Malkiel (2003) to obtain idiosyncratic volatility simply by using residuals from a factor model. Other than simplicity, we prefer the direct decomposition method because Xu and Malkiel (2003) find it yields more conservative estimates relative to the indirect decomposition method used in CLMX (2001).

Prior research also suggests that it is necessary to use a GARCH approach to calculate idiosyncratic volatility (Xu and Malkiel, 2003; Wagner, 2003; Spiegel and Wang, 2005; and Fu, 2005). We choose the GARCH (1,1) model and run it for each firm separately to ensure that the GARCH conditional variances of each firm will not be contaminated by cross-sectional firm effects.

To ensure robustness, we also compute the idiosyncratic volatility using the asset pricing model in Durnev, Morck, Yeung and Zarowin (2003) and the Fama-French three factors. The SIC code used to calculate the industry return is the same SIC code we used to construct our biotech industry sample. Further, to ensure that our results will not be affected by the NASDAQ volatility documented in prior research (Schwert, 2002; Xu and Malkiel, 2003), we also calculate the industry return based only on NASDAQ stocks. As such, we have a total of five measures of idiosyncratic volatility.

In the first step, we regress industry returns against market returns in equation 1, where the industry return is denoted as R_{it}, the market return is denoted as R_{mt} and the residuals of industry returns are denoted as ε_{it}.

$$R_{it} = \alpha_i + \beta_{im} R_{mt} + \varepsilon_{it} \tag{1}$$

We construct the equal-weighted measure of R_{it}. We also construct a "NASDAQ only" version of the equal-weighted R_{it}. Consequently, we have two measures of the industry return residual, ε_{it}. In the second step, we use ε_{it} as an independent variable and run the following GARCH regressions:

$$R_{jit} = \alpha_{ji} + \beta_{im} R_{mt} + \beta_{ji} \varepsilon_{it} + e_{jit} \tag{2}$$

$$h_{jit} = C_{ji} + e^2_{jit-1} + h_{jit-1} \tag{3}$$

where R_{jit} denote firm j's return in industry i for time t, while GARCH conditional variance is denoted as h_{jjt}. We calculate the average of h_{jjt} for the two versions of ε_{it}. These form our first measure (using the overall industry return) and second measure (using NASDAQ industry return only) of idiosyncratic volatility.[4] Our next two measures of idiosyncratic volatility are constructed based on the asset pricing model in Durnev, Morck, Yeung and Zarowin (2003) as delineated in equation (2a) and (3a).

$$R_{jit} = \alpha_{ji} + \beta_{im} R_{mt} + \beta_{ji} R_{it} + e_{jit} \tag{2a}$$

$$h_{jit} = C_{ji} + e^2_{jit-1} + h_{jit-1} \tag{3a}$$

[4] In unreported OLS regressions, we use the variance of the residuals and the firm-level cross-sectional patterns of the values appear to be qualitatively unchanged.

The only thing different between equations (2) and (2a) is the industry return. Instead of using the industry return residual, ε_{it}, industry return R_{it} is used in equation 2a. Again, we calculate the average of h_{jit} based on the two versions of R_{it} (the overall industry return and the NASDAQ only industry return) and use them to form our third and fourth measures of idiosyncratic volatility. Since we run the GARCH model for each firm separately, we do not need to scale the risk measure as Durnev, Morck, Yeung and Zarowin (2003) do. Instead, our version of h_{jit} represents an absolute measure of idiosyncratic volatility.

Finally, using the Fama-French three factor model as shown in equations (4) and (5), we compute the average of h_{jit} as our fifth measure of idiosyncratic volatility

$$R_{jit} = C_{ji} + \beta_{im} R_{mt} + \beta_{smb} R_{smb} + \beta_{hml} R_{hml} + e_{jit} \tag{4}$$

$$h_{jit} = C_{ji} + e^2_{jit-1} + h_{jit-1} \tag{5}$$

The Fama-French factors (market return minus risk free rate; small-firm portfolios return minus large-firm portfolio returns; and high book-to-market ratio portfolio return minus low book-to-market ratio portfolio return) are downloaded from "Kenneth R. French - Data Library."

Independent Variables

Xu and Malkiel (2003) document a negative correlation between idiosyncratic volatility and firm size. Since market capitalization is likely a function of firm size, we control for firm size. Our proxy for firm size is the log of the number of employees upon listing. Data on the number of employees are downloaded from the SDC database. However, the information on the number of employees is substantially missing in the SDC. Hence, we check the IPO prospectuses and hand collect data on the number of employees for many firms. Our alternative proxy for firm size is the log of average market capitalization. The market capitalization values are downloaded from CRSP for 240 trading days (roughly a year) and the average value is computed as average market capitalization. We do not use total assets before listing as a proxy because quite a few firms have missing values even in the prospectus.

We also control for growth prospects since Xu and Malkiel (2003) find that idiosyncratic volatility is positively associated with the analyst earnings growth estimates. However, we cannot use analyst earnings growth estimates as a proxy for growth prospects because many firms in our sample are not covered by analysts. But prior research supports the use of firm age as a reverse proxy for growth prospects (Evans, 1987; Jovanovic, 1982; Megginson and Weiss, 1991). Hence, we use the log of firm age as a reverse proxy for growth prospects, i.e., the older the firm upon listing, the lower the growth prospects. Firm age is calculated as the difference between the founding date as documented in the IPO prospectuses and the listing date (converted into years). We download listing dates and founding dates from the SDC. Since the data on the founding dates are incomplete, we hand collect part of the data from IPO prospectuses.

We further control for momentum because Jog and Wang (2002) find that underpricing and idiosyncratic volatility in the IPO aftermarket are positively correlated in their univariate WLS analysis. Our proxy for momentum is the mid-file price change. The mid-file price change is the percentage change in the IPO offer price during the book building phase. Prior research in IPO book building theories has documented that underpricing is positively associated with the mid-file price change (Hanley, 1993). Hence, the mid-file price change is probably the earliest indicator of momentum. We also have two alternative proxies for the robustness check: the first day underpricing,

$$\text{Underpricing}_{\text{1st\_day}} = \left(\frac{Closing\_price_{1st\_day} - Offer\_price_{0th\_day}}{Offer\_price_{0th\_day}} \right) \tag{6}$$

and the first month abnormal return,

$$\text{Abnormal\_Return}_{\text{1st\_month}} = \left(\frac{Closing\_price_{end-of-the-month} - Offer\_price_{0th\_day}}{Offer\_price_{0th\_day}} \right) - \left(\frac{Nasdaq\_index_{mth\_t} - Nasdaq\_index_{mth\_t-1}}{Nasdaq\_index_{mth\_t-1}} \right) \tag{7}$$

where $Nasdaq\_index_{mth\_t}$ is the NASDAQ index on the month that the firm go public and $Nasdaq\_index_{mth\_t-1}$ is the month prior to the firm going public. The decision to use the NASDAQ index rather than the market index in computing the abnormal return is attributed to the fact that biotech IPOs are more likely to be compared to other technology companies.

In addition, we control for profitability and earnings variance. Paster and Veronesi (2003) find that profitability is associated with idiosyncratic volatility, while Wei and Zhang (2003) suggest that the variance of earnings is associated with idiosyncratic volatility. Since it is quite normal for high-tech firms to have negative net profits before their listings, we use the three-year average of prelisting gross-profit on sales (GPOS) as a proxy for a firm's profitability and the variance of prelisting gross-profit on sales as a proxy for earnings variance.

More recently, Speigel and Wang (2005) document that idiosyncratic volatility and illiquidity are strongly positively correlated. Hence, we also control for illiquidity. The Amihud measure

$$\left(\left[\frac{1}{240}\sum\frac{daily\_absolute\_return}{daily\_trading\_volume}\right]x10^{6}\right) \tag{8}$$

is used as a proxy for illiquidity.

Hypotheses testing or experimental variables

As mentioned before, the CEO's risk aversion is proxied by the CEO's age. An alternative measure is the average age of board members. Both the CEO and board member ages are available in the IPO prospectuses as a result of Regulation S-K, item 401.

To test the hypothesis regarding stock options, we collect data on the CEO salary, the value of the CEO stock options, and the value of the CEO's bonus. The information are available on the CEO's salary from the IPO prospectuses because SEC [Regulation S-K, section 229, item 402 (a)(3)(i)] mandates that firms are required to report the CEO's compensation. Such information allows us to compute our measure of the CEO's stock based compensation, Option, which is the value of stock options divided by the CEO's total compensation (the sum of stock options, salary, and bonus). However, it may be argued that the CEO's total compensation is a mix of forward and backward looking items.[5] In addition, the option value provided in IPO prospectus is based on SEC regulation S-K which requires that the value of the stock options awarded in the previous year be reported, assuming both 5% and 10% price appreciation. Although we use the more conservative 5% assumption, this assumption is still over-optimistic. At the end of the first year after the IPO, only 37% of our sample firms had annualized price

[5] We do not standardize the option value by the post-IPO market capitalization because the measure would produce significant bias against firms with large market capitalization. Given that the stock option value is computed based on the fixed 5% price appreciation assumption, the larger the market capitalization (due to the higher stock price), the lower would be the option proxy value standardized by the market capitalization, which is counter-intuitive.

appreciation exceeding 5%. The corresponding percentage of firms with annualized growth rate exceeding 5% at the end of years 2, 3, 4, and 5 are, respectively, 31%, 14%, 24%, and 21%. In fact, the median annual growth rate is negative throughout from year 1 to year 5 after the IPO. To avoid possible problems caused by standardize the option value by the CEO's total compensation and by the unrealistic 5% annual growth rate assumption, we create an alternative proxy, Option Dummy, which takes the value of 1 if a firm has CEO stock options and zero otherwise.

We construct two resource dependence proxies. RDep1 is the number of corporate elites trained in legal and regulatory affairs as a proportion of the total number of corporate elites. RDep2 is more specific and is defined as the number of regulatory elites in patents and clinical trials management as a proportion of the total number of corporate elites. Dunford (1987) finds that firms can engage in several legal tactics, many of which are related to patents and licensing, to manage the firms' external dependence on resources. Since most biotech firms depends on patents and FDA product approvals (Robbins-Roth, 2001; Wolff, 2001), it can be argued that a subset of the regulatory elites, namely regulatory elites who have experience in patents and clinical trials management, can use their expertise to reduce the firm's risk in this specific aspect. The finer measure (RDep2) does not, in anyway, invalidate the broader measure (RDep1). Rather, it just serves as an alternative proxy.

Our management style variable is proxied by the founder-CEO dummy. The data are available because Regulation S-K, item 401 mandates that the names, age, qualifications, including educational background and the last five years of experience, for all executive officers and directors (corporate elites) must be disclosed in IPO prospectuses. We review the career histories of corporate elites covered in the IPO prospectuses and count the total number of corporate elites (directors and executive officers) to compute our measure of the number of corporate elites. We code the founder-CEO as 1 when the career history indicates that the CEO is also the founder and zero otherwise. We also count the number of founders who are appointed as senior executives or directors.

Model Specification

With above discussion, we specify our baseline cross-sectional regression model as follow:

$$\text{Volatlity} = \beta_0 + \beta_1\text{Illiquidity} + \beta_2\text{Momentum} + \beta_3\text{lnFirmage} + \beta_4\text{Profitability} + \beta_5(\text{Earnings Variance}) + \beta_6\text{Size} + \beta_7\text{FounderCEO} + \beta_8\text{lnCEOage} + \beta_9\text{Rdep} + \beta_4\text{Option} + \text{Listing Year Dummies} + \varepsilon \quad (9)$$

where

Volatility = Idiosyncratic volatility 240 trading days (one year) after the IPO

RDep = The number of corporate elites trained in legal and regulatory affairs as a proportion of the number of corporate elites (RDep1) or the number of regulatory elites in patents and clinical trials management as a proportion of the total number of corporate elites (Rdep2).

ln(CEOAge) = The natural log of CEO age which is our proxy for management risk aversion

ln(Boardage) = The natural log of average age of board members which is used as an alternative proxy for management risk aversion

FounderCEO = Dummy variable for the founder-CEO which is our proxy for founder management style and takes the value of 1 if the CEO is also the founder of the firm, and zero otherwise.

Option = Value of CEO stock options divided by the CEO's total compensation.

Option Dummy = Takes the value of 1 if a firm has CEO stock options and zero otherwise.

Momentum = Mid-file price change. Two other alternative proxies are those as expressed in equations (6) and (7).

ln(Firmage) = The natural log of firm age, which is an reverse proxy for growth prospects.

Size = The natural log of the number of employees, Ln(Employee) or the natural log of a firm's after-listing market capitalization, Ln(Mktcap).

Profitability = Three-year pre-listing average gross-profit on sales (GPOS).

Earnings Variance = The standard deviation of annual GPOS in the prelisting years (three years).

Illiquidity = The Amihud illiquidity measure as expressed in equation (8).

Four Listing Year Dummies for 1997, 1998, 1999, and 2000 are used to control for possible year specific effects.

Following Jog and Wang (2002), we use WLS instead of OLS because we have heteroscedasticity problem as they do when using OLS. Since some firms have 180-day lock-up period after the IPO and this lock-up may impact the volatility of the stocks, we also repeat our regressions by excluding the first 120 trading days (roughly half a year).

[Insert Table 1 here]

Table 1 presents the summary statistics of all the relevant variables. The idiosyncratic volatility presented is based on the first measure derived from equations (1) – (3), where the industry return includes all firms in the industry, not just the NASDAQ firms. Several observations are worth mentioning. First, the mean and median of the total volatility are just a bit larger than the corresponding mean and median of idiosyncratic volatility both for the whole year period and the second half year period. According to Morck, Yeung and Yu (2000), the high ratio of idiosyncratic risk to total risk indicates that more information is incorporated into stock prices. The fact that our sample has a high ratio of idiosyncratic risk to total risk indicates that IPO firms in the biotech industry have more firm specific information. Second, the mean and median of the whole year volatility (both total and idiosyncratic) are larger than those excluding the lockup period. This means that, on average, the volatility does not increase after the lock-up period. Third, 52% of our sample firms issued CEO stock options. On average, the option value is about 37% of CEO's total compensation in the previous year. The maximum of 1 indicates that the CEO's compensation only consists of options. Fourth, the mean and median three-year average GPOS are -241 and -93, respectively. The range of the three-year average GPOS is from -52313 to 356607. These indicate that the prelisting sales for our sample firms are small and more than half of the firms incur loss even in terms of gross profit. Since we cannot take log for negative numbers, we scale the three-year average GPOS by 10000 and use the scaled numbers in our regression analyses. Since the range of GPOS is large, the standard deviation of the GPOS is also very large. We take the natural log of GPOS_SD to bring the numbers to the comparable range of other variables used in the regressions.

For other variables, the average number of employees in the sample firms is about 560 and the average one-year market capitalization after the IPO is about $188 million; the mean Amihud measure of illiquidity is 0.59; the average firm age is 7 years; the average CEO and board ages are 49 and 48, respectively. The average number of corporate elites trained in legal and regulatory affairs as a proportion of the number of corporate elites (senior managers and directors) in the firm is about 7 percent. All variables have reasonably wide range across sample firms.

[Insert Table 2 here]

Table 2 further presents the Pearson correlation coefficient matrix between all the independent variables used in equation (9). The correlation coefficients are generally below 0.4 and insignificantly different from zero. The only exception is the correlation coefficient of 0.68 between RDep1 and RDep2, which is significant at the 5% level. However, RDep1 and RDep2 are not included in the same regression. Therefore, multicollinearity is not a serious problem in our regression analyses.[6]

IV. Empirical Results

Table 3 presents the whole sample period (240 days) regression results of equation (9) using our first measure of idiosyncratic volatility. Panel A contains 8 models using alternative proxies for Size, Rdep, and Options. For managerial characteristic variables, it is clear that both Rdep1 and Rdep2 are negatively associated with idiosyncratic volatility in all different model specifications and their t-values are all significant at the 5% level. These results strongly support our resource dependency hypothesis (H4) that that a high proportion of corporate elites with a legal and regulatory affairs background lead to lower idiosyncratic volatility. Ln(BoardAge) is positive and highly significant in all 8 models, implying that the more experienced the leadership of a firm, the more confident it is to impel strategic changes. This is consistent with H2a, but not with H2 which says that the older the managers, the more risk averse they are. However, the Founder-CEO dummy is insignificant in all 8 models, suggesting founder-CEO status does not have any impact on idiosyncratic volatility. This is neither consistent with H2 nor with H2a.

[Insert Table 3 here]

[6] We do not include the two dummy variables, Option Dummy and Founde-rCEO, in the correlation matrix to save space. However, their correlations with other variables are all below 0.25 and mostly insignificant.

For CEO stock options, our evidence is consistent with H1, the stock option value as a percentage of the CEO's total compensation is positively associated with idiosyncratic volatility. The Option enters the regression models 1, 3, 5 and 7 positively and is significant at the 5% level in all these models. Our alternative measure, Option Dummy, enters positively in models 2, 4, 6 and 8. For models 2, 4 and 6, the Option Dummy is significant at the 10% level. In model 8, the t-value associated with Option Dummy is 1.591 which is marginally insignificant. The mostly positive and significant Option Dummy in our regressions lends strong support to the hypothesis that CEO stock options tend to increase idiosyncratic volatility because Option Dummy does not require any option value estimation and standardization which may cause various biases as mentioned earlier.

For control variables, Amihud, Momentum, and GPOS have no impact on idiosyncratic volatility in all 8 models. These results are inconsistent with (1) Spiegel and Wang's (2005) finding that idiosyncratic volatility is positively correlated with illiquidity; (2) Jog and Wang's (2002) finding that idiosyncratic volatility is positively affected by momentum; and (3) Paster and Veronesi's (2003) finding that profitability is associated with idiosyncratic volatility.[7] On the other hand, Ln(GPOS_SD) is positive and highly significant in all 8 models, which is consistent with Wei and Zhang's (2006) predication that earnings variance should be positively associated with idiosyncratic volatility. Consistent with Xu and Malkiel (2003), the size of the firm is negatively associated with idiosyncratic volatility no matter the size is proxied by Ln(Employee) or Ln(Makcap), and the t-value is significant at the 5% level in all 8 models. However, it is unexpected that Ln(Firmage) is positive and mostly significant in all 8 models. Xu and Malkiel (2003) find that idiosyncratic volatility is positively associated with the growth prospects. Since Ln(Firmage) is a reverse proxy for growth prospects, it should be negatively associated with idiosyncratic volatility. One possible explanation is that the firm age is a noisy proxy for growth prospects, especially for IPO firms. The firm age may also be a proxy for the availability of firm specific information. The older the firm age, the more firm specific information might be available to the public. Given that higher idiosyncratic volatility implies more information is impounded into stock prices (Durnev, Morck, Yeung and Zarowin, 2003), it is possible to find a positive relation between idiosyncratic volatility and Ln(Firmage).

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[7] The results are qualitatively the same when we use Amivest measure (See Hasbrouk, 2005) as the proxy for liquidity, first day underpricing and first month abnormal return (see equations (6) and (7)) as proxies for momentum, and EBIT over sales as the proxy for profitability. They are not reported to save space.

The adjusted R^2 is around 0.2 and the Durbin Watson statistic is close to 2 (indicating no serial correlation) for all 8 models in Panel A. To save space, we do not report the listing year dummies although they are included in all the regression models.

Using Ln(CEOAge) to replace Ln(Boardage) does not produce significant changes in results as shown in Panel B of Table 3. Like Ln(BoardAge), Ln(CEOAge) is positively associated with idiosyncratic volatility and are mostly significant. The only major difference is that Option Dummy becomes insignificant in all models, which lends less support to the hypothesis that CEO stock options are positively related to idiosyncratic volatility.

Since many firms have a lock-up period of six months after their IPO, managers and board members are not allowed to sell their shares during this period. It is possible that the lock-up may have an impact on the idiosyncratic volatility. As shown in Table 1, although the mean and median of 2nd half idiosyncratic volatility is lower than those of the 1st year, the range is wider. In order to eliminate the possible impact of the lock-up, we repeat the regressions with idiosyncratic volatility computed from the second half of the year, which excludes the first six months. The results are reported in Table 4.

[Insert Table 4 here]

The results in Panel A of Table 4 are very much similar to those in Panel A of Table 3. However, Option Dummy now enters positively and the statistical significance level is at the 5% for all four models and this is true even in Panel B of Table 4. In contrast, Option Dummy is only significant at the 10% level for three models in Panel A of Table 3 and is totally insignificant in all four models in Panel B of Table 3. This finding suggests that CEO stock options are strongly associated with idiosyncratic volatility when lock-up period is excluded. A major difference between Panel B of Table 4 and Panel B of Table 3 is that Ln(CEOAge) becomes insignificant in all models in Table 4 while in Table 3 it is mostly significant. In addition, Ln(Mktcap) is only significant in two out of four models in Panel B of Table 4 while it is significant for all four models in Panel B of Table 3. On the whole, the adjusted R^2 for regressions in Table 4 is higher, mostly above 0.25, while it is around 0.2 in Table 3. The Durbin Watson statistic is still close to 2 in Table 4.

To further check if our results are sensitive to the alternative idiosyncratic volatility measures, we repeat the regressions with the rest of the four measures described in Section III. Measure 2 is obtained by using NASDAQ firms as industry proxy in equation (1). Measures 3 and 4 are obtained by using the normal industry return and the NAQDAQ industry return, respectively, in equation (2a). Measure 5 is obtained from Fama-French three-factor model (equations (4) and (5)). To save space, we only report specifications with Ln(Mktcap), Ln(BoardAge), RDep1 in Table 5. However, the results using Ln(Employee), Ln(CEOAge), and RDep2 are qualitatively the same.

[Insert Table 5 here]

Panel A of Table 5 presents the results using the 1st year idiosyncratic volatility. Our results are quite robust across different volatility measures. Similar to the findings in Panel A of Tables 3 and 4, Amihud, Momentum, and GPOS do not have any significant impact on idiosyncratic volatility, Ln(GPOS_SD) has significantly positive impact on idiosyncratic volatility, and Ln(Mktcap) has significantly negative impact on idiosyncratic volatility. More important, our findings for experimental variables, Founder-CEO, Ln(BoardAge), RDep1, and Option, are consistent with those reported in the corresponding panel of Tables 3 and 4. That is, the Founder-CEO is insignificant, Ln(BoardAge) and Option are positive and significant, and RDep1 is negative and significant. Option Dummy is also positive and significant for measures 2 and 4. The only thing different is that Ln(Firmage) is mostly insignificant although still positive.

Panel B of Table 5 further presents the results using the 2nd half-year idiosyncratic volatility. The results are not as robust as those reported in Panel A but still largely consistent with those reported in the corresponding panel of Tables 3 and 4.

On the whole, our results presented in Tables 3, 4, and 5 provide quite strong and robust evidences that CEO stock options and certain managerial characteristics, especially, the management age and professional background, can help predict idiosyncratic volatility.

V. Conclusion

Since idiosyncratic volatility is important in asset pricing, capital allocation and providing linkage between macro and micro economics, many authors have investigated the possible determinants of idiosyncratic volatility. Building on these studies and the upper echelon theory, we further study if some easily identifiable managerial characteristics, such as CEO age, Founder-CEO status and the proportion of corporate elites with legal and regulatory background can help predict idiosyncratic volatility using a sample of IPO firms in the biotech industry. In addition, we also empirically test if CEO stock options have any impact on idiosyncratic volatility.

Our findings (after controlling for various possible determinants of idiosyncratic volatility) are: first, stock options are positively related to idiosyncratic volatility, which is consistent with CLMX's (2001) prediction; second, resource dependency has a strong negative impact on idiosyncratic volatility, as we predicted for the biotech industry, which is nationally regulated; third, the age of board members and the CEO tend to affect idiosyncratic volatility positively, in opposition to the common belief that young managers are more aggressive. But this is consistent with the prediction by Golden and Zajac (2001) that experienced managers dare to take bigger risk and impel strategic changes in the company; and finally, the founder-CEO status does not have much impact on idiosyncratic volatility. These findings are robust across different idiosyncratic volatility measures, sample periods with and without excluding the lock-up period, and a few alternative proxies for control and experimental variables.

Overall, the easily identifiable managerial characteristics we put forward can help, to a certain extent, predict a firm's idiosyncratic volatility. Our findings may have direct implications to idiosyncratic sensitive investors, fund managers as well as researchers, who are interested in idiosyncratic volatility determinants.

However, one caveat should be noted. Our study is based only on IPO firms in the biotech industry. A more comprehensive study on IPO firms in all high-tech or all industries is necessary before our conclusion on managerial characteristics and stock options can be generalized. We leave this for the future study.

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