Determinants of Idiosyncratic Volatility for Internet Companies: Evidence from China

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Abstract/Summary:

Internet companies are developing rapidly and are harder to value due to a greater uncertainty regarding their future growth. This study is using a group of listed Chinese internet companies to investigate whether the idiosyncratic volatility ("IV" hereafter) of Chinese internet companies is significantly higher than that of the control firms, and, if so, whether such a higher IV is driven by measures of greater uncertainty regarding their future growth. I compare the internet companies to three control groups, including (1) all other A-shares firms, (2) firms that are most identical in accounting figures but from other industries, and (3) high-tech firms. There are three main findings. Firstly, I find that the IV of Chinese internet companies is significantly higher than the first and second control groups. Secondly, IV has shown a more significant effect on the stock returns of the Chinese internet companies than all control groups. Thirdly, I find that the book-to-market ratio of internet firms has a more significantly negative effect on IV than that of all control firms. In sum, my results imply that internet companies have more firm-specific risk due to the uncertainty of their future growth. I believe that my study can contribute to a better knowledge on how to value an internet company.

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Attestation of Authorship

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.

Signature:

Date:

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Introduction

Internet companies are developing rapidly and playing an important role in both social life and the economic world. It is one industry, yet relates to many: manufacturing, health, education, e-commerce, etc. From the early dot coms to today's more varied subsections, different business models are being developed and adopted, such as b2b, b2c and c2c. Internet companies grow and expand on a scale that is unprecedented. However, investing in internet companies is a complex and difficult task nowadays. The prior literature has attributed such companies' uncertainties to many factors, such as customer needs and investment pay-offs (e.g. Eisenmann, 2006). The nature of these companies differentiates themselves in term of the risks and challenges they are facing and growth pattern they will experience. One important task of being an investor is to discover a valuable firm with potentials, and equally important is to avoid investing in the firms that are overvalued.

Therefore, the objective of this study is to discover and categorise the determinants of IV, using a group of Chinese internet companies. More specifically, I aim to investigate whether the IV of these companies is significantly higher than that of the control firms, and, if so, whether such a higher IV is driven by measures of a greater uncertainty regarding their future growth. Findings may be helpful for an analyst to identify the early signs and forecast how these companies are likely to perform in the future.

To address the above research questions, I am planning to run regressions of IV on some potential dominating variables like company returns, market capitalisation, etc. Then, I will examine whether the findings from my study are in line with findings done in other studies. By doing so, I aim to provide a reliable reference for researchers to conduct studies in related areas. From a practical viewpoint, the findings could be helpful for investors to set up strategy, to avoid picking unworthy firms, as well as to increase the possibility of making successful investments.

There are two reasons for this paper to use a group of Chinese internet companies. Firstly, most recent studies focus on the developed markets such as the United States. However, to date, the emerging markets have yet to receive much attention from researchers. Therefore, my study aims to fill this gap by focusing on the internet companies in China. The primary reason is that China, being a large economic entity, is still a developing country. It is in

transition from a planned economy system to a market economy system, and the government is highly influential and still intervening in the operation of the economy.

Secondly, during the recent years, financial markets in China have attracted more and more attention among financial researchers. The Shanghai Stock Exchange (SSE) is one of the two stock exchanges in China. It was established on 26th November 1990. As of today, the SSE has a total market capitalisation of 30.84 trillion Chinese yuan, in which A-shares form 99.7% of its value. Of the total market capitalisation, the circulation market value is 26.15 trillion Chinese yuan. In total, there are 1,435 companies listed on the SSE and they have an average price-earning ratio of 14.42. It was the fifth largest stock exchange in the world by the end of 2016. Shenzhen Stock Exchange (SZSE) first started on 1st December 1990. As of today, the SZSE has a total market capitalisation of 20.7 trillion Chinese yuan, in which the circulation market value is 15 trillion Chinese yuan. The SZSE has 2,115 listed companies as of today and their average price-earning ratio is 25.45 among all. The SZSE was the eighth largest stock exchange in the world by the end of 2016. The trading of these two stock exchanges is generally only available to Chinese citizens, and foreign investors can only trade through certain institutions.

It is normal for Chinese companies to choose to list their shares elsewhere, like Hong Kong and the US. The first major reason is that the waiting time to IPO in the SSE and the SZSE is too long. Thus, the SSE and the SZSE are not obvious options if a company wants to raise funds in limited amount of time. The second major reason is that certain investors from other parts of the financial world value companies differently. Therefore, there is always a trend for a certain industry to choose to go public in a certain market, which allows them to raise more funds for the same number of shares offered. In my study, I am going to focus solely on the Chinese internet firms listed in mainland China (SSE and SZSE).

This study focuses solely on Chinese internet companies, especially those popular and large ones either owned or controlled by local investors. The main reason to do so is because of the market circumstances around Chinese internet firms. Even though the business model may have started in western countries, it is unlikely for foreign businesses to enter the Chinese market. Harwit and Clark (2001) suggest, "Conservative members of the government leadership believe that the actual tools of communication should remain in state hands." On the other hand, Chinese companies are not likely to expand business outside of China, because

their users or customers are always primarily Chinese. Some internet companies could be valued at a very high figure but remain private in nature. One possible reason is due to the difficulty for companies to go public in China. For example, there is an average waiting time of nearly two years after an already lengthy examination by the securities regulatory commission. Even though there are a lot of private companies worth investigating, I will be examining only the public Chinese companies in this study, due to the availability and reliability of the information.

The sample I am using includes 50 listed internet firms from both the SSE and the SZSE. There will be three control groups for comparison. The first control group is all other A-shares firms excluding the internet firms. The second control group will be 50 listed firms with the most similarity in certain accounting figures to those sample firms. The third control group will be 50 listed high-tech firms from the business areas of augmented reality and wearable smart devices as they are experiencing similar growth patterns and perception from investors. The reason to form three control groups is in order to analyse internet firms from different aspects and, therefore, more comprehensively. Based on the logic discussed earlier, the first hypothesis in this study is whether the idiosyncratic volatility of Chinese internet firms is significantly higher than that of other firms from other industries. Then I am planning to test whether the idiosyncratic volatility has a more significant effect on the returns of Chinese internet firms than other firms. Lastly, I will test variables like book-to-market ratio to see if they are having a more significant effect on the IV of Chinese internet firms than others. To compute idiosyncratic volatility of individual Chinese internet firms, I used the following approach: firstly, the Fama-French (1992) 3-factor model is implemented to estimate the factor betas of market, SMB (size), and HML (value); the second step is to compute the daily excess returns of individual Chinese internet stocks. Thirdly, the sample standard deviation of the excess returns within the prior 30 days is used to proxy the daily idiosyncratic return volatility. For the first hypothesis, I will use a two-group t-test for comparison. For the second and third hypotheses, I will first estimate two regressions, and then I will apply a Chow test to compare the results. I will present the details of these processes in the data and methodology section.

The findings of the empirical testing are in support of my three hypotheses. For the first one, the idiosyncratic volatility of Chinese internet companies is in fact significantly higher than all the other A-shares group and the second control group. The testing of the second hypothesis shows that IV has a more significant effect on the returns of Chinese internet firms than all

three control groups. The third and last empirical testing is also in support of my hypothesis: the variable book-to-market ratio measuring future growth has a more significant effect on the idiosyncratic volatility of the Chinese internet companies than all three control groups. The detailed discussion will be in the empirical findings paragraph.

The rest of this dissertation proceeds as follows. Section 2 provides an overview of related literature. Section 3 describes the research design and sample selection procedures. Section 4 provides the main results from empirical analysis. Section 5 concludes the study.

Literature review

The prior literature has well documented that internet companies can distinguish themselves from other firms, in terms of their future growth, marketing strategies, among others. Consequently, it is harder for investors to value an internet company due to its greater uncertainty from future growth. I summarise the literature on the factors regarding the valuation of internet firms as follows.

Capital is the fuel for a company's growth and daily operations, regardless of whether it is a public or private company. The channels for private companies to raise funds are relatively limited compared to public companies. Equity and/or debt financing is a common practice to address the money shortage issue for private companies. This study is focusing on the public companies in China. It is necessary to distinguish the fundamental differences in comparison to other industries, as well as comparing to other countries.

The book "The Dark Side of Valuation" (Damodaran, 2009) indicates that, when lenders are concerned about lending to firms with intangible assets, they tend to fund predominantly with equity. The value of many internet companies nowadays is largely constituted of intangible assets; for example: number of users, user experience, ability to monetise and entrepreneurship, etc. Also, when valuing growth-phase companies, an analyst will be facing an absence of historical data and difficulty estimating future cash flow and risk, as well as judging whether the growth rate can be maintained. A study by Moskowitz and Vissing-Jørgensen (2002) shows that more than half of the companies fail in their first 10 years.

There have been fewer efforts in past studies to focus on listed Chinese internet companies, as the majority of the literature is the empirical study of public internet companies in the US. From them, a variety of valuation methods are tested: state marginal price model (ZGPM) (Hering & Olbrich, 2006), real option and capital budgeting techniques (Schwartz & Moon, 2000), etc. In reality, whenever there are estimation challenges, the "common response is to bend the rules of valuation and use shortcuts to justify whatever price they are predisposed to pay for the company" Damodaran (2009). Other than the complicated process of valuation, it is also important to analyse whether a firm is constantly relying on external capital markets, which could cause the company to face funding constraints (Myers, 1984). With the

consideration of existing literature, it is interesting to examine whether some of the Chinese internet firms are valued fairly and their sustainability in raising funds. This will reflect in either contributing to or harming a company's productivity.

Companies at different stages of life are facing different kinds of challenges: companies, especially in the internet industry at the early and developing stage, are very much dependent on the key members or core team. Therefore, when analysing the performance of a company, it is important to examine the employee turnover rate. Only when the company develops into a more mature and well-structured stage is employee turnover beneficial for company effectiveness in improving diversity. A study by Meier and Hicklin (2008) shows that turnover is negatively related to firm performance. Also, Koys (2001) states that company effectiveness is affected by the employee attitudes and behaviours. A study by Spence (1979) suggests that "internal control and compensation systems may motivate managers to invest in accelerated growth at levels that promote their personal priorities, rather than shareholder's preferences. Agency problems may lead to over/underinvestment." Examples of this would be managers eager to run a larger company or in contrast being too conservative. This leads to a common practice of insider ownership. There are studies done in different countries analysing the effect of that, and some results suggest that increase in managerial ownership can improve firm performance and solve the agency problem at the same time. Empirical findings from Jelinek and Stuerke (2009) indicate that managerial equity ownership is nonlinearly and positively associated with return on assets and asset utilisation. It is nonlinearly and negatively associated with the expense ratio. Mustapha and Che Ahmad (2011) conducted a study on the Malaysian market and found that managerial ownership in various segments has an inverse relationship with total monitoring costs. Coughlan (1985) suggests that listed companies in the US are compensating top management based on how well the shareholders are benefited. It is well known that CEOs' performance valuations are commonly tied with how well their stock prices are performing. Therefore, a lot of the CEOs are acquiring strategies that are profitable in the short term but harmful for the company in the long term, such as laying off workers and cutting down on R&D, etc. This type of action is not limited to a particular industry like the internet industry; it has unfortunately become a common practice among a lot of companies in many countries. The majority of the studies in this area focus on the public companies from developed countries. When implicating the differences in cultural, economic and political environment, it is worth investigating this relationship in China. China, being a large economic entity, is still a developing country; it is in the transition from planned economy system to

market economy system, and the government is highly influential and still intervening in how the economy is operating. Damodaran (2009) suggests that a company's growth is heavily affected by the political developments of the country it is in.

One important factor affecting the firm performance is the background of the management and shareholder. Jo and Lee (1996) find a positive effect on growth if an entrepreneur has a professional knowledge of the product, and, therefore, it is important for the managers and shareholders to have work experience that relates to the service or product. Otherwise, lack of knowledge will lead to failure. Moreover, shareholders' different backgrounds will lead to different evaluations of the firm, industrial investment funds and financial investment funds being a good example. Other than that, different funds have different types of investment behaviour or preference, whether the incentive is wealth maximisation or strategic reasons. A study by Hendershott (2004) shows evidence that top investment funds and investors with internet industry backgrounds are generating a more successful return. This is helpful particularly when evaluating a target firm's current capital structure: firms with the investors mentioned above statistically have a higher possibility of success. In China, some of the successful internet companies are beneficiaries of the investment from BAT (Baidu, Alibaba & Tencent). These advantages include massive funding, enormous user base, political influence and technical support. The importance of management is also reflected in the managerial decision of a company's leverage level. Then it further influences the volatility of equity. A study by Carr and Wu (2017) states that "equity volatility increases proportionally with the level of financial leverage, the variation of which is dictated by managerial decisions on a company's capital structure based on economic conditions."

It is a characteristic of the internet industry that there are constantly potential opportunities to exploit new markets and innovate a new kind of product or service. Along with the opportunities is the fierce competition, part of the reason being that some markets have low or no entry barrier. But in some areas of business, the Matthew effect will occur where a company can accumulate advantages, for example, e-commerce and search engine, etc. In a market where there is already a dominating company existing, niche competitors can obtain a holding in the market by focusing on customer segments with differentiated needs (Liebowitz & Margolis, 1999). To retain then strengthen their position in the market, companies need to increase their value from the customer's perspective. The more loyal the customers are, the easier it is for a company to promote service and product. Woodruff (1997) suggests that for a

company to compete for advantage in the market, they need to deliver superior customer value. For a firm to acquire customer loyalty, Cooper and Kleinschmidt (1987) suggest that product superiority includes six elements: unique benefits for the customer; product quality; reduced customers' costs; product innovativeness; product superiority in the eyes of the customer, and solution to a customer's problem. In addition, Müller (1991) finds that superior service is a powerful advantage and, therefore, increases repurchase loyalty.

There follows further discussion on the characteristics of internet industry. In a premature area of business, first entrants normally need to invest heavily to cultivate a new consumption habit, acquire customers and consolidate their presence in the market. Likewise, when the company benefits from the increasing returns of network effects, they tend to generate the incentives to invest aggressively in growth. But with limited data available in these new markets, prediction may be imprecise, and behavioural biases may lead managers to overestimate pay offs (Langer, 1975). Eisenmann (2006) finds that first movers spent significantly more on upfront marketing, but, different to expectation, non-pioneers are the ones that benefit from the increasing return. There are situations where companies are investing significantly in customer acquisition. For example, the E-hailing market in China, where competitors are spending billions of dollars in compensating customers and drivers. This type of competitive strategy has existed for a long time and a study by Klemperer (1987) suggests that, in order to steal a customer from a competitor, the company needs to pay for the customer's switching cost. Again, the company should earn a profit for losing its customer. Another study, by Lieberman (1987), states that companies should be willing to reduce price or increase investment (for example, in marketing or capacity) up to the point where the current period margin reduction equals the discounted value of the ongoing benefit from incremental volume. But when there is no or low entry barriers, intense rivalry is likely to occur, and this will reduce industry profitability. In my study, one of the control group I am using for comparison with the internet industry is the high-tech industry. I have chosen the relatively new and popular areas of augmented reality and wearable smart devices. The reason is that these areas of businesses are at their early stage of developing, and it is likely that they are sharing some of the common attributes with the internet industry and are experiencing similar growth patterns. Another reason is that not only these two areas but a lot of the functions of these new technologies are based on the use of internet.

High-tech areas like augmented reality and wearable smart devices are in the rise nowadays like once the internet industry was. For example, Thierer (2015) suggests "Internet of Things and wearable tech will challenge existing social, economic, and legal norms." The connection between them is that many high-tech products or services are heavily dependent on the use of internet (Zlatanova, 2002). The difference between them is that a lot of these high-tech products or services are just new divisions of traditional firms, whether it is from manufacturing or pharmaceutical industries, etc. So, when it comes to valuing a particular firm or finding the factors causing a stock to be volatile, one needs to look at the company as a whole and every aspect of it, not only the high-tech part.

A study done by Kumari et al. (2017) suggests that:

> Idiosyncratic volatility is significant in emerging markets such as India, and that cross-sectional return variations of firms are associated with firm-specific characteristics such as firm size, book-to-market ratio, momentum, liquidity, cash flow-to-price ratio, and returns on assets. We find that the idiosyncratic risk documented in this study is associated with smaller size of company, higher liquidity, low momentum, high book-to-market ratio, and low cash flow-to-price ratio.

Another study done by Chok and Sun (2007) states that CEO stock option and board member age are contributing factors to the idiosyncratic volatility. A study done by Xu and Malkiel (2003) concludes that idiosyncratic volatility is affected with the degree to which their shares are owned by financial institutions. Also, they suggest that IV is positively related to expected earnings growth. Further on shareholder background, research done by Jiang et al. (2009) states that "idiosyncratic volatility anomaly is related to corporate selective disclosure, and the anomaly is stronger among stocks with a less sophisticated investor base."

Data and Methodologies

The sample of this study are 50 publicly-traded internet firms from Shanghai and Shenzhen stock exchanges. The list of these firms is shown in Table 1 as follows. The reason that I exclude private companies in my study is that the data is difficult to collect for private internet companies.

Table 1: Sample of 50 Internet Firms

000938	Unisplendour Corporation Limited 紫光股份	600373	Chinese Universe Publishing&Media Co Ltd 中文传媒
600271	AISINOCO. LTD 航天信息	603444	G-bits Network Technology Xiamen Co Ltd 吉比特
600100	Tsinghua Tongfang Co., Ltd 同方股份	002619	Egls Co Ltd 艾格拉斯
000977	Inspur Electronic Infmtn Indtry Co Ltd 浪潮信息	000835	Great Wall International ACG Co Ltd 长城动漫
000021	Shenzhen Kaifa Technology Co., Ltd. 深科技	002425	Kaiser China Culture Co Ltd 凯撒文化
002280	Hangzhou New Century Information Technology Co., Ltd 联络互动	300359	Qtone Education Group Guangdong Ltd 全通教育
000158	Shijiazhuang ChangShan BeMng Tech Co Ltd 常山北明	300295	Everyday Network Co Ltd 三六五网
300182	Beijing Jetsen Technology Co Ltd 捷成股份	300533	Shenzhen Bingchuan Network Co Ltd 冰川网络
600718	Neusoft Corporation 东软集团	002148	Beijing Bewinner Communications Co., Ltd 北纬科技
300431	Baofeng Group Co Ltd 暴风集团	002123	Montnets Rongxin Technology Group Co Ltd 梦网集团
300104	Leshi Internet Information & Technology Corp Beijing 乐视网	600640	Besttone Holding Co Ltd 号百控股
300315	Ourpalm Co Ltd 掌趣科技	300494	Hubei Century Network Technology Co Ltd 盛天网络
300059	East Money Information Co., Ltd. 东方财富	300467	Sichuan Xunyou Network Technology Co Ltd 迅游科技
603000	Peoplecn Co Ltd 人民网	300418	Beijing Kunlun Tech Co Ltd 昆仑万维
300113	Hangzhou Shunwang Technology Co Ltd 顺网科技	002261	Talkweb Information System Co Ltd 拓维科技
002315	Focus Technology Co., Ltd. 焦点科技	002103	Guangbo Group Stock Co., Ltd. 广博股份
300226	Shanghai Ganglian E-Commerce Holdings 上海钢联	603258	Hangzhou Dianhun Network Tech Co Ltd 电魂网络
600661	Shanghai Xin Nanyang Co Ltd 新南洋	603888	Xinhuanet Co Ltd 新华网
300052	Shenzhen Zhongqingbaowang Network Technology Co., Ltd 中青宝	600652	Shanghai U9 Game Co Ltd 游久游戏
002174	YOUZU Interactive Co Ltd 游族网络	300043	Rastar Group 星辉娱乐
300518	Shenzhen Shengxunda Technology Co Ltd 盛迅达	603533	IReader Technology Co Ltd 掌阅科技
600892	Dasheng Times Cultural Investment Co Ltd 大晟文化	300051	Xiamen 35.com Technology Co., Ltd. 三五互联
000676	Genimous Technology Co Ltd 智度股份	002555	Wuhu Shunrong Sanqi IE Ntwrk Tech Co Ltd 三七互娱
300031	Wuxi Boton Technology Co Ltd 宝通科技	002247	Zhejiang Dilong Culture Develpmnt Co Ltd 帝龙文化
002558	Giant Network Group Co Ltd 巨人网络	002095	Zhejiang NetSun Co., Ltd. 生意宝

Notes: The number in front is representing the stock code for each firm, follow by their company name in English and Chinese respectively.

The control firms to conduct comparison with internet firms are grouped into three kinds. The first group is all the other publicly traded companies on the Shanghai and Shenzhen stock exchanges. There are 3,524 firms in total. The second group comes within the first group. For each sample firm, I select a firm from another industry, which is the most similar in terms of firm size, capital structure and profitability. Thus, the second control group consists of 50 firms, each match a Chinese internet firm in the sample group. The third group also are picked

from the first group, including 50 high-tech firms from the area of business in augmented reality and wearable smart devices. The logic of conducting the comparison with three different groups is to understand the idiosyncratic volatility of the internet industry more comprehensively. In other words, I am comparing Chinese internet firms to three control groups, including (1) the average level of all A-shares firms, (2) firms of similar accounting figures, and (3) high-tech firms of similarities in industry characteristics. The data mainly consists of financial and accounting variables retrieved from DataStream. I will collect the data from 1st January 1990 to 30th June 2018.

The previous studies suggest that idiosyncratic volatility is important for pricing individual stocks (Chok & Sun, 2007). Moreover, many studies (e.g. Chen et al., 2012) use idiosyncratic volatility to measure firm-specific risk. Therefore, I will investigate the idiosyncratic volatility of Chinese internet companies and its determinants. I believe that my analysis can shed new light on how to value a Chinese internet firm given its firm-specific risk, due to its distinguishing characteristics mentioned above. There are three hypotheses I want to investigate in this study.

Hypothesis-1: *The idiosyncratic volatility of Chinese internet companies is significantly higher than that of the control firms, due to the nature of internet companies.*

Hypothesis-2: *The idiosyncratic volatility should have a more significant effect on the returns of the Chinese internet companies than those of control firms.*

Hypothesis-3: *The variables measuring future growth, such as B/M ratio, should have a more significant effect on the idiosyncratic volatility of the Chinese internet companies than that of control firms.*

The idiosyncratic volatility of individual Chinese internet companies is computed in three steps. Firstly, the Fama-French (1992) 3-factor model is implemented to estimate the factor betas of market, SMB (size), and HML (value). The 3-factor model is specified below. Secondly, I compute the daily excess returns of individual Chinese internet stocks, using the residuals from Equation-(1) below. Thirdly, the sample standard deviation of the excess returns within the prior 30 days is used to proxy the daily idiosyncratic return volatility.

$$Return_{i,t} = \alpha + \beta_1 Market_{i,t} + \beta_2 SMB_{i,t} + \beta_3 HML_{i,t} + \varepsilon_{i,t}, \quad (1)$$

Once idiosyncratic volatility is calculated, I will perform three analyses through this study. Firstly, I will use a two-group t-test to test Hypothesis-1 (*whether sample internet companies' idiosyncratic volatility is significantly higher than that of control firms*). Here, I use idiosyncratic volatility to measure firm-specific risk. Due to the nature of internet companies mentioned above, I predict that the sample (internet) firms should have more idiosyncratic risk, compared to the control ones. That is, there should be more uncertainty about future growth of Chinese internet companies.

Secondly, I will run the regression of return in Equation-(2) on both sample and control groups. The dependent variable is the daily excess return of each individual firm. The independent variables include on idiosyncratic volatility, and a set of control variables (including firm size, debt ratio, ROA, and so on). After estimating two regressions, I then apply a Chow test to test Hypothesis-2 (*whether idiosyncratic volatility should have a more significant impact on returns of sample firms than control ones*). The Chow test can help examine whether co-efficient estimates of interested independent variable (idiosyncratic volatility here) are significantly different between two groups.

$$Return_{i,t} = \alpha + \beta_1 IdiosyncraticVolatility_{i,t} + \beta_k ControlVariable_{k,i,t} + \varepsilon_{i,t}, \quad (2)$$

Thirdly, I will regress idiosyncratic volatility on future growth measure (e.g. B/M ratio) and a set of control variables (including firm size, debt ratio, ROA, and so on) in Equation-(3). Then, I will apply a Chow test to exam Hypothesis-3 (*whether the variables measuring future growth, such as B/M ratio, should have a more significant effect on the idiosyncratic volatility of the Chinese internet companies than that of control firms*). Similarly, I am interested in whether co-efficient estimates of interested independent variable (B/M ratio) are significantly different between two groups.

$$IdiosyncraticVolatility_{i,t} = \alpha + \beta_1 B/Mratio_{i,t} + \beta_k ControlVariable_{k,i,t} + \varepsilon_{i,t}, \quad (3)$$

Empirical Results and Discussion

Table 2: Descriptive statistics of internet firms, all A-shares firms, control firms based on size, leverage, and profit and high-tech firms

Panel-A: Internet firms

Variable	N	Mean	Std Dev	Minimum	Maximum
Annual excess return	278	0.103868	0.581734	-1.43042	1.616998
Idiosyncratic volatility	278	0.023943	0.008084	0.010078	0.0553
Leverage	278	0.143569	0.150134	0	0.552446
Return on total assets	278	0.042743	0.073202	-0.77781	0.306468
Book-to-market ratio	278	0.177823	0.153728	0.029374	0.702652
Firm size	278	0.755968	1.036237	0.007059	11.41992
Firm age in years	278	9.172662	6.696007	1	26

Panel-B: All other A-shares stocks

Variable	N	Mean	Std Dev	Minimum	Maximum
Annual excess return	17123	0.06167	0.461943	-1.95506	2.76678
Idiosyncratic volatility	17123	0.021654	0.007551	0	0.194398
Leverage	17123	0.230239	0.331424	0	25.69868
Return on total assets	17123	0.038426	0.938372	-48.2468	108.365
Book-to-market ratio	17123	0.258876	0.191851	0.029374	0.702652
Firm size	17123	0.611781	0.563226	0	11.50343
Firm age in years	17123	10.55025	6.682906	1	26

Panel-C: Control firms based on size, leverage, and profit

Variable	N	Mean	Std Dev	Minimum	Maximum
Annual excess return	228	0.10308	0.478427	-1.11198	1.410394
Idiosyncratic volatility	228	0.022572	0.008356	0.005888	0.091092
Leverage	228	0.183631	0.149194	0	0.560591
Return on total assets	228	0.034838	0.077722	-0.84044	0.160852
Book-to-market ratio	228	0.244879	0.186913	0.029374	0.702652
Firm size	228	0.607922	0.481119	0.006435	3.552882
Firm age in years	228	11.32895	6.783736	1	25

Panel-D: High technology firms

Variable	N	Mean	Std Dev	Minimum	Maximum
Annual excess return	277	0.119961	0.533264	-1.14285	1.593684
Idiosyncratic volatility	277	0.024471	0.006745	0.011633	0.061994
Leverage	277	0.194147	0.157044	0	0.754274
Return on total assets	277	0.03252	0.056309	-0.62028	0.168294
Book-to-market ratio	277	0.14421	0.121797	0.029374	0.669811
Firm size	277	0.702841	0.731302	0.047345	5.501032
Firm age in years	277	6.584838	5.539469	1	21

Notes: The idiosyncratic volatility of individual Chinese internet companies is computed in three steps. First, Fama-French (1992) 3-factor model is implemented to estimate the factor betas of market, SMB (size), and HML (value). The 3-factor model is specified as follows. Second, I compute the daily excess returns of individual Chinese internet stocks, using the residuals from Equation-($Return_{i,t} = \alpha + \beta_1 Market_{i,t} + \beta_2 SMB_{i,t} + \beta_3 HML_{i,t} + \varepsilon_{i,t}$,). Third, the sample standard deviation of the excess returns within the prior 30 days is used to proxy the daily idiosyncratic return volatility.

Table 2 is the fundamental data analysis that my three hypotheses' testing are based on. It shows a descriptive statistic summary including all the listed A-shares firms since 01/01/1990, which is the year both the Shanghai and Shenzhen stock exchanges were first established. The data retrieved from DataStream first is limited to equities from Shanghai and Shenzhen markets, then further filtered into currency of Chinese Yuan; then I excluded the exchange-traded fund (ETF) and closed-end fund. Lastly, I limit the data into active and major securities and primary quote. This gives me total subjects of 3524 firms, including the 50 sample internet firms. The data types retrieved are daily stock price, total asset, sales revenue, total debt, short-term debt, long-term debt, market capitalisation, book value per share and net income used to calculate fully-diluted earnings per share.

From Table 2 we can see that the 50 internet firms have a sample size of 278 years altogether. All A-shares firms, excluding the sample firms, have 17,123 firm-year observations in total. The second and third groups have 228 and 277 observations, respectively. The mean of internet firms' annual excess return is 0.103868, which is higher than the first control group's mean of 0.06167 and second group's mean of 0.10308 but it is lower than the third group's mean of 0.119961. The sample firms' idiosyncratic volatility level is at 0.023943, which is higher than the first control group's IV of 0.021654 and second group's IV of 0.022572 but is lower than the high-tech firms' IV of 0.024471. The leverage level of internet firms is the lowest among all: they have a mean of 0.143569 compared to the mean of all other A-shares firms' of 0.230239, the firms most identical in accounting figures' mean of 0.183631 and lastly the high-tech firms' mean of 0.194147. The result for sample firms' mean of return on total assets is 0.042743; this is higher than all three control groups respectively at 0.038426, 0.034838 and 0.03252. The sample firms' mean of book-to-market ratio is 0.177823; it is lower than the first control group's of 0.258876 and second group's of 0.244879. But it is lower than the high-tech group's mean of 0.14421. The sample firms' mean of size is 0.755968, which is higher than all three control groups respectively at 0.611781, 0.607922 and 0.702841. The last set of calculations is the firm age in years. The sample firms have a mean of 9.172662 years. They are younger than the first control group's average age of 10.55025 years and the second control group's average age of 11.32895 years. But they are older than the third control group's average age of 6.584838 years.

In the next table, I will show detailed comparisons between the internet firms and control groups by using two-group t-tests on the variables including annual excess return, idiosyncratic

volatility, leverage, return on total assets, book-market ratio, firm size and firm age. The result will show the differences and significance levels and I will follow with a discussion of the possible logic that leads those results.

Table 3: Comparison between internet firms and other groups

	Internet vs all others				Internet vs Second control group				Internet vs high tech group			
	Internet	All others	Difference		Internet	Control	Difference		Internet	High-tech	Difference	
Annual excess return	0.103868	0.0616696	0.0421984		0.103868	0.10308	0.000788		0.103868	0.1199613	-0.0160933	
Idiosyncratic volatility	0.0239432	0.0216539	0.0022893	***	0.0239432	0.0225724	0.0013708	*	0.0239432	0.0244709	-0.0005277	
Leverage	0.1435687	0.2302386	-0.0866699	***	0.1435687	0.1836313	-0.0400626	***	0.1435687	0.194147	-0.0505783	***
Return on total Assets	0.0427432	0.0384257	0.0043175		0.0427432	0.034838	0.0079052		0.0427432	0.0325199	0.0102233	*
Book-to-market ratio	0.1778234	0.2588763	-0.0810529	***	0.1778234	0.2448791	-0.0670557	***	0.1778234	0.1442101	0.0336133	***
Firm size	0.7559678	0.6117811	0.1441867	***	0.7559678	0.6079219	0.1480459	**	0.7559678	0.7028407	0.0531271	
Firm age in years	9.1726619	10.550254	-1.3775921	***	9.1726619	11.3289474	-2.1562855	***	9.1726619	6.5848375	2.5878244	***

*Notes: Here I use the two-group t-test for comparison, idiosyncratic volatility is being used to measure firm-specific risk. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.*

From the above table we can see that the idiosyncratic volatility level of internet firms is significantly higher at the 1% level than that of all other firms from the A-shares market. It is significantly higher at the 10% level than the second control group. The result supports of my first hypothesis, that the idiosyncratic volatility of Chinese internet companies is in fact significantly higher than that of the majority of the other firms. It is not surprising to know that the leverage level of internet firms is significantly lower at the 1% level than all three control groups of firms. This is due to the nature of the internet industry. Their operating strategy is normally asset-light. It is worth mentioning that, despite the fact that the high-tech firms used in the third group are from the new business areas of augmented reality and wearable smart devices. The firms themselves are mostly from traditional industries like pharmaceutical and manufacturing, etc. The comparison of book-to-market ratio is also not surprising to see. The Internet firms' B/M ratio is significantly higher at the 1% level than that of the average A-shares firms and second control group, but it is significantly lower at the 1% level than that of the high-tech group. It is understandable that internet firms used to be and still are more overvalued than firms from traditional industries. After existing for more than two decades, the internet industry is still developing at a fast pace and changing peoples' lives in every aspect. But some of the newer and popular areas like augmented reality and wearable smart devices are being more overvalued. One possible reason for this could be that these cutting-edge technologies are in the phase of transforming from lab to application, and the market is confident about their futures and betting on them. This can also be seen from the comparison of firm age. Internet firms are significantly older at the 1% level than high-tech firms. But they are significantly younger at the 1% level than average A-shares firms and the second control group.

Table 4: Regression of return on idiosyncratic volatility and control variables

Internet firm				All others				Difference	
Variable	Coeff. Est.	T-value	Significance	Variable	Coeff. Est.	T-value	Significance		
Intercept	-1.03904	-7.21	***	Intercept	-0.4117	-19.61	***	-0.62734	
Idiosyncratic volatility	46.32634	8.98	***	Idiosyncratic volatility	24.11636	29.81	***	22.20998	***
Leverage	0.50857	2.72	***	Leverage	0.02137	1.38		0.4872	**
Return on total assets	-0.16413	-0.56		Return on total assets	0.0012	0.44		-0.16533	
Book-to-market ratio	-0.62591	-2.89	***	Book-to-market ratio	-0.42421	-19.91	***	-0.2017	**
Firm size	-0.02001	-0.51		Firm size	0.00503	0.86		-0.02504	*
Firm age in years	0.01026	2.22	**	Firm age in years	0.00502	10.52	***	0.00524	
# of observations	278			17123					
adjusted r-square	50.07%			23.89%					
Internet firm				Second control group				Difference	
Variable	Coeff. Est.	T-value	Significance	Variable	Coeff. Est.	T-value	Significance		
Intercept	-1.03904	-7.21	***	Intercept	-0.65631	-2.98	***	-0.38273	
Idiosyncratic volatility	46.32634	8.98	***	Idiosyncratic volatility	27.11283	3.59	***	19.21351	***
Leverage	0.50857	2.72	***	Leverage	0.21122	1.13		0.29735	
Return on total assets	-0.16413	-0.56		Return on total assets	1.18514	4.53	***	-1.34927	***
Book-to-market ratio	-0.62591	-2.89	***	Book-to-market ratio	-0.40994	-2.13	**	-0.21597	
Firm size	-0.02001	-0.51		Firm size	0.07021	0.71		-0.09022	*
Firm age in years	0.01026	2.22	**	Firm age in years	0.01104	2.86	***	-0.00078	**
# of observations	278			228					
adjusted r-square	50.07%			30.80%					
Internet firm				High-tech				Difference	
Variable	Coeff. Est.	T-value	Significance	Variable	Coeff. Est.	T-value	Significance		
Intercept	-1.03904	-7.21	***	Intercept	-0.84925	-3.42	***	-0.18979	
Idiosyncratic volatility	46.32634	8.98	***	Idiosyncratic volatility	37.24449	3.75	***	9.08185	***
Leverage	0.50857	2.72	***	Leverage	0.26761	1.24		0.24096	
Return on total assets	-0.16413	-0.56		Return on total assets	1.88212	5.87	***	-2.04625	***
Book-to-market ratio	-0.62591	-2.89	***	Book-to-market ratio	-0.76209	-2.58	**	0.13618	
Firm size	-0.02001	-0.51		Firm size	-0.01117	-0.34		-0.00884	
Firm age in years	0.01026	2.22	**	Firm age in years	0.00948	1.77	*	0.00078	
# of observations	278			277					
adjusted r-square	50.07%			33.30%					

*Notes: I run the regression of return in Equation-($Return_{i,t} = \alpha + \beta_1 IdiosyncraticVolatility_{i,t} + \beta_k ControlVariable_{k,i,t} + \varepsilon_{i,t}$,) on both sample and control groups. The dependent variable is daily excess return of individual firm. The independent variables include on idiosyncratic volatility, and a set of control variables (including firm size, debt ratio, ROA, and so on). After estimating two regressions, I then apply a Chow test to test Hypothesis-2. The Chow test can help examine whether co-efficient estimates of interested independent variable (idiosyncratic volatility here) are significantly different between two groups. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.*

As shown in Table 4, I am using a Chow test to compare two regressions on several different variables. The primary object is to show that the effect of idiosyncratic volatility is showing a more significant effect on stock returns for internet firms than all three control groups at 1% significance level. The result is in line with the assumption from my second hypothesis. There are significant differences of the effect of return on total assets on stock returns between internet firms and the second and third control groups, both at 1% significance level. As for the all other A-shares firms, I believe it is because there are more than 3000 firms in this group, that, therefore, the figure for the first control group is prominently lower than the second and third control groups. However, all three control groups have a positive figure rather than the sample group's negative figure. Another set of variables worth mentioning is the effect of firm size on the returns of firms; it shows that there are significant differences between the sample group and first and second control groups, both at the 10% significance level. The coefficient estimate for the high-tech group is also negative at -0.01117, similar to the sample group of -0.02001. In the comparison between the internet firms and all other A-shares firms, there are significant differences between them that there are not when comparing with the other two control groups. Firstly, the effect of leverage on the returns is different at the significance level of 5%; secondly, the effect of book-to-market ratio on the returns is also different at the 5% significance level. The last variable is the effect of firm age in years, which on the returns for internet firms is significantly different from the second control group at the 5% significance level.

Table 5: Regression of idiosyncratic volatility on control variables

Internet firm				All others				Difference	
Variable	Coeff. Est.	T-value	Significance	Variable	Coeff. Est.	T-value	Significance		
Intercept	0.0276	27.99	***	Intercept	0.02575	192.11	***	0.00185	
Leverage	0.00235	0.78		Leverage	-0.00004661	-0.14		0.00239661	
Return on total assets	0.00975	1.46		Return on total assets	-0.00012027	-3	***	0.00987027	***
Book-to-market ratio	-0.02863	-11.56	***	Book-to-market ratio	-0.01737	-59.24	***	-0.01126	***
Firm size	0.00023007	0.39		Firm size	-0.00011345	-1.08		0.00034352	*
Firm age	0.000055	0.78		Firm age	0.00004562	5.18	***	0.00000938	
# of observations	278			17123					
adjusted r-square	26.83%			18.63%					

Internet firm				Second Control firms				Difference	
Variable	Coeff. Est.	T-value	Significance	Variable	Coeff. Est.	T-value	Significance		
Intercept	0.0276	27.99	***	Intercept	0.02782	24.11	***	-0.00022	
Leverage	0.00235	0.78		Leverage	0.00236	0.39		-0.00001	
Return on total assets	0.00975	1.46		Return on total assets	-0.01419	-2.41	**	0.02394	***
Book-to-market ratio	-0.02863	-11.56	***	Book-to-market ratio	-0.01907	-8.76	***	-0.00956	*
Firm size	0.00023007	0.39		Firm size	-0.0005233	-0.56		0.00075337	
Firm age	0.000055	0.78		Firm age	-0.00001784	-0.27		0.00007284	
# of observations	278			228					
adjusted r-square	26.83%			18.47%					

Internet firm				High-tech				Difference	
Variable	Coeff. Est.	T-value	Significance	Variable	Coeff. Est.	T-value	Significance		
Intercept	0.0276	27.99	***	Intercept	0.02769	28.28	***	-9E-05	
Leverage	0.00235	0.78		Leverage	-0.00261	-1.01		0.00496	
Return on total assets	0.00975	1.46		Return on total assets	-0.01324	-1.31		0.02299	**
Book-to-market ratio	-0.02863	-11.56	***	Book-to-market ratio	-0.0277	-8.69	***	-0.00093	***
Firm size	0.00023007	0.39		Firm size	0.00137	2.56	**	-0.00113993	**
Firm age	0.000055	0.78		Firm age	0.00011349	1.37		-0.00005849	
# of observations	278			277					
adjusted r-square	26.83%			18.97%					

*Notes: I regress idiosyncratic volatility on future growth measure (e.g. B/M ratio) and a set of control variables (including firm size, debt ratio, ROA, and so on) in Equation-($IdiosyncraticVolatility_{i,t} = \alpha + \beta_1 B/Mratio_{i,t} + \beta_k ControlVariable_{k,i,t} + \varepsilon_{i,t}$,). Then, I apply a Chow test to exam Hypothesis-3. Similarly, I test whether co-efficient estimates of independent variable (B/M ratio) are significantly different between two groups. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.*

In Table 5, I am also using a Chow test to compare two regressions on several different variables, in order to test the 3rd hypothesis of whether variables measuring future growth, such as B/M ratio, should have a more significant effect on the idiosyncratic volatility of the Chinese internet companies than that of control firms. The equation " $IdiosyncraticVolatility_{i,t} = \alpha + \beta_1 B/Mratio_{i,t} + \beta_k ControlVariable_{k,i,t} + \varepsilon_{i,t}$," is being used. The purpose of this testing is trying to identify the source of risk. From the test result we can see that the book-to-market ratio of internet firms has a more negative and significant effect on idiosyncratic volatility than that of average A-shares firms, accounting figure-similarity firms and high-tech firms, respectively at the 1%, 10% and 1% significance level. This result is in support of the 3rd hypothesis. It is worth mentioning that, among all the variables in the testing for internet firms, book-to-market ratio is the only variable showing a negative result. The comparison of the effect of leverage on idiosyncratic volatility between internet firms and other groups shows that there are no significant differences. For the effect of returns on total assets on idiosyncratic volatility. As shown in Table 5, there are significant differences between the sample group and all three other groups. The internet firm is showing a coefficient estimate of 0.00975 against the three negative values of -0.00012027, -0.01419 and -0.01324. The internet firms are significantly higher respectively at the 1%, 1% and 5% level. Moving onto the effect of firm size on idiosyncratic volatility, the result of comparisons shows that the difference with all other A-shares group and high-tech group are significant, at the significance level of 10% and 5% respectively. For the effect of firm age on IV, it shows that there are no significant differences when comparing internet firms against the three control groups.

Conclusions

The purpose of this study is to test and identify the determinants causing the internet industry's idiosyncratic volatility. I believe this particular industry is worth investigating because it differentiates itself from other industries in many ways. It is still evolving rapidly today as when it was first introduced into the market more than twenty years ago. Now, people are growing more and more dependent on it and use of the internet has spread into almost every aspect of modern business. Despite the industry having existed for some years now, it still remains a difficult task when it comes to capturing an internet firm's true value and ultimately investing in them. This difficulty is believed to be largely associated with the uncertainties of the future. A lot of the time we know a certain internet-related business will succeed, but who and how is unpredictable, because a lot of them are new and, therefore, there are no patterns to follow or look back on. This study is focusing solely on the listed internet firms in China. The reason is that, in addition to the industry differences, there are also significant differences among companies from different countries. They are as a result of political environment, cultural differences, investor perception, etc. The sample in my study is 50 internet firms listed in both Shanghai and Shenzhen stock exchanges. There are three control groups I am testing against. First are all the A-shares firms, excluding the sample firms; second is 50 firms that are most similar in accounting terms to the 50 sample firms; third is 50 firms from high-tech areas in augmented reality and wearable smart devices. The reason is to try to identify the industry-specific factors more comprehensively and prominently.

Testing of data shows that the results are in support of all three hypotheses. The idiosyncratic volatility level of internet firms is significantly higher at the 1% level than that of all other firms from A-shares market. It is significantly higher at the 10% level than the second control group. This supports the idea that idiosyncratic volatility of Chinese internet companies is in fact significantly higher than for the majority of the other firms. For the testing of my second and third hypotheses, I am applying a Chow test to compare two regressions on several different variables. The result shows that the effect of idiosyncratic volatility is showing a more significant effect on returns for internet firms than for all three control groups at the 1% significance level. There are significant differences of the effect of return on total assets on stock returns between internet firms and the second and third control groups, both at the 1% significance level. The last test shows that the book-to-market ratio of internet firms has a

more negative and significant effect on idiosyncratic volatility than that of average A-shares firms, accounting figure-similarity firms and high-tech firms, respectively at the 1%, 10% and 1% significance level. For the effect of return on total assets on idiosyncratic volatility, there are significant differences between the sample group and all three other groups respectively at the 1%, 1% and 5% significance level. As to the effect of firm size on idiosyncratic volatility, the result of comparisons shows that the difference with all other A-shares group and high-tech group are significant, at the significance level of 10% and 5% respectively. The result shows that, as regards book-to-market ratio, return on total assets and firm size, all three factors contribute to internet companies' idiosyncratic volatility.

The contribution of this study is to help identify the industry-specific risks of the factors causing the internet stocks to be volatile. In a practical sense, the findings may assist an investor in assessing the true value of a Chinese internet firm.

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