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THE COMPETING-RISK ANALYSIS OF POST-IPO DELISTINGS

JUN CHEN[1]*, RONALD RUTHERFORD[2], PEIMING WANG[3]

1. Auckland University of Technology, Auckland, New Zealand
2. University of South Florida, Florida, United States
3. Xiamen University Malaysia, Malaysia

* Corresponding Author: Jun Chen, Department of Finance, Auckland University of Technology, 42 Wakefield Street, Auckland, New Zealand 1142 * jun.chen@aut.ac.nz

Abstract

This paper aims to investigate the impact of a set of covariates on the future status of IPO firms in the United States. After going public, these firms could be delisted for two primary reasons: merger and acquisition or liquidation and bankruptcy. Because these two reasons are mutually exclusive, we can implement a competing risk analysis to examine how the likelihood of delisting could be affected. There are two main findings in this paper. First, we find that the inclusion of the aftermarket performance in a competing-risk model helps distinguish the impact of those covariates on the two types of delistings. For example, profitability increases the chance of being delisted due to mergers, whereas decreases the chance of being delisted due to bad performance. Second, our evidence indicates that time-varying covariates may impact the delistings in different ways. For instance, profitability appears to affect the delistings due to merger and acquisition only until last year before delisting. In sum, our paper contributes to the literature by shedding new light on how to predict the delisting rates more accurately.

JEL: G20, G33, G34

Keywords: IPO, Delisting, Competing-risk

1. Introduction

Initial public offering (IPO, hereafter) has been intensively studied as one of the most significant corporate events. One strand of studies focuses on a major risk after firms go public, namely delisting risk. It refers to the probability that an IPO could be delisted from the exchanges. It is common to observe a firm being delisted after going public. For example, Lowry et al. (2017) show that more than 20 percent of annual cohorts of IPOs per year could be delisted in the United States. The prior literature has also well documented that delisting could entail significant consequences for shareholders. For instance, Macey et al. (2008) show that, on average, delisting from the exchanges such as NASDAQ/NYSE may cause a drop in price by about 50 percent and an increase in volatility by around 100 percent. Thus, accurate prediction of the delisting rate is significant for investors, especially institutional investors with the IPO shares allocated on the primary market.

The delisting may be triggered by different events, including merger and acquisition, migration to another exchange, liquidation, and bankruptcy. Many studies have investigated some factors as determinants of delisting rates after firms go public. However, most of these studies exclusively examine non-mutually exclusive risks. To the best of our knowledge, no work has been done by simultaneously examining multiple reasons for delistings in an integrated framework.

Thus, the first motivation of this paper is to fill this gap by implementing the competing-risk analysis of IPOs in the U.S. between 1980 and 2021. We believe such a model can enhance the prediction of delisting rates by treating different reasons for delistings as competing events because they are mutually exclusive to each other. In other words, one which occurs first causes the delisting of IPO firms, preventing other events from happening completely. For example, a firm cannot default if it has already been delisted because of an acquisition. As the prior literature suggests (e.g., Cressy et al., 2014), competing-risk analysis allows us to assess the delisting rate due to a specific event of interest more accurately while controlling for the effect of other competing-risk events simultaneously. We believe that such a model is more suitable for our analysis because of the interdependence among the possibilities of multiple cause-specific delistings.

Our paper is also motivated by the fact that the previous literature has focused on predicting the future states of IPO firms, only using the data available before the IPO or at the IPO date. Several papers find that a set of variables, such as firm size and age, can be used to forecast whether the IPO firm survives or delists. However, up to date, no study has included post-IPO financial accounting data in such analysis.

We believe that the post-IPO multi-period financial and accounting variables might be helpful in terms of more accurate prediction of post-IPO delistings. As suggested by the prior literature, the first few years after going public are crucial for IPO firms because they are exposed to significant changes in a business environment in terms of the possibility of being acquired, regulation requirements, and so on. Consequently, these firms may also show dramatic changes in their properties, such as profitability. Thus, we believe that the time-varying post-IPO data can provide new information on firm performance during the first several years after being public. Such information is not available on the IPO-deal properties.

In addition, the prior literature (e.g., Bharath et al., 2009; De et al., 2012) has shown that it is not unusual for public firms to time their significant decisions, such as merger and acquisition events, after going public. The managers will weigh the benefits and costs between remaining public and going private. Such decision-making processes are time-varying and dynamic, depending on after-market circumstances in terms of financial accounting variables, including profitability, leverage, operating expenses, and so on.

In sum, the main focus of our study is to assess post-IPO delistings due to different reasons based on the information provided by financial accounting covariates, which are updated periodically after going public. We also include the IPO deal-related characteristics at the IPO time in our analysis to be consistent with the prior literature.

The most widely used method to deal with the competing-risk dataset (e.g., Kalbfleisch et al., 1980; He et al., 2010) is to estimate the model separately for each type of failure while treating the different events as censored data. However, Lunn et al. (1995) argue that one drawback of the Kalbfleisch et al. (1980) method is that it does not treat the different risks jointly. Therefore, in this paper, we implement the method proposed by Fine et al. (1990) to fit a competing risk model to panel data of initial public offerings consisting of 7,438 IPOs from 1980 through 2022.

We classify all the delistings into two groups according to their reasons, which triggered the delistings. The information on all the delisting reasons is provided by the CRSP delisting codes. Based on delisting codes, there are three categories of aftermarket status of new firms after going public, including “active”, “delisted due to acquisition/merge”, and “delisted due to bad performance”. Here, we also refer to bad performance as liquidation or bankruptcy.

By taking competing-risk events into account to describe the effect of covariates on post-IPO delistings due to the two reasons, our study contributes to the current literature on IPO failure risk in two aspects. First, we apply the competing-risk model to the IPO panel data, which includes both IPO-deal

related properties at the IPO date and annually updated accounting information after going public. To our understanding, such analysis has yet been done. The competing risk analysis on the IPO panel data can help predict the possibility of delisting due to different reasons, more precisely, in terms of both the algorithm of the duration model and the amount of information.

Second, the prior literature (e.g., Bharath et al., 2009; Gao et al., 2013; McDonald et al., 2022) has provided some implications on how firms make the decision to exit from public markets. For example, Bharath et al. (2009) argue that firms weigh the costs and benefits of being public in the decision to go private. However, limited evidence has been provided on how time-varying factors affect the decision on voluntary delistings. Moreover, our sample shows that around 50% and 80% of delistings occurred within 5 and 10 years after the initial public offerings, respectively. Thus, it is interesting to view the pattern of time-varying covariates during the first five years after going public. Doing so helps our understanding of how the delistings are affected by those time-varying factors.

The results show that, by including the aftermarket annual accounting information, the competing-risk model can help distinguish the impact of those covariates on the delistings for three reasons. There are two main findings from our analysis. First, it is found that two time-varying covariates, including profitability and leverage, have opposite effects on different events triggering the delisting, either acquisition/merger or liquidation/bankruptcy. The increase of these covariates could increase the possibility of delisting generated by acquisition/merge but reduce the risk of delisting due to failure, either liquidation or bankruptcy. Second, we find that IPO firms which were delisted triggered by acquisition/merger only underperformed the surviving IPOs until last year before delistings. On the other hand, the IPOs delisted due to failure underperformed the surviving IPOs significantly and consistently across the whole period as being listed on public markets. Putting two and two together implies that the decision to exit the public markets through acquisition/merger is made only when firm performance is worse than comparable new firms at the same post-IPO stages.

In sum, the contribution of this paper is to provide new evidence on how we can make the prediction of post-IPO delistings more accurately by implementing competing-risk analysis and viewing the time-varying factors within the first several years after going public. The remainder of this paper proceeds as follows. Section 2 provides the literature review. Section 3 defines the hypotheses we like to test in this paper. Section 4 introduces the data and the methodologies implemented in our study. The empirical results and conclusions are summarised in Sections 5 and 6, respectively.

2. Literature Review

The delisting risk, also called failure risk, has been a hot topic understudies so far (e.g., Hensler et al., 1997; Algebaly et al., 2013; Colak et al., 2022; Espenlaub et al., 2012; Fu et al., 2023; Gilbey et al., 2013; Kim et al., 2019; Makrominas et al., 2021; Park et al., 2018). Many researchers suggest that some information available before the issuance or at the IPO date is related to the future state of the firm after going public. For example, Hensler et al. (1997) find that the survival time for IPOs increases with some firm properties, including firm size, age of the firm at the offering, the initial return, the IPO activity level in the market, and the percentage of insider ownership. Their results of duration models also show that survival is negatively related to other factors, such as the number of risk characteristics.

Fama et al. (2004) investigate the characteristics of new firms listed on major U.S. stock markets from 1973 to 2001 and find that both declining profitability and increasing growth lead more IPO firms to be delisted due to bankruptcy but have no impact on the possibility of IPO firm delisted due to acquisition/merge. Therefore, their results imply that both profitability and growth could be good candidates to distinguish between the survival and failure of IPO firms.

Howton (2006) studies the relationship between a firm's governance characteristics and the post-IPO state. His results show that IPO firms that are venture-backed have a CEO who is the original firm

founder, have an outside block holder present, use a more reputable underwriter, and have a more stable board directors are more likely to survive than be acquired in the first five years after the IPO whereas a larger percentage of grey directors on the board are associated with IPO firms that are more likely to fail. His analysis is performed by fitting one Logistic regression between each pair of three future states after going public, consisting of "survive", "delisted due to takeover", and "delisted due to failure".

Demers et al. (2007) study the survival rate of IPO firms by including IPO-deal characteristics and accounting information at the IPO time. The information that they used to predict the survival rate of IPOs is available around the issuing date. Moreover, they find that the possibility of IPO failure estimated by the logit model is negatively associated with one-year post-IPO abnormal returns. In other words, the information on IPO failure is not complete at the IPO date, implying that more post-IPO information is necessary for a more precise estimate of IPO failure.

Another school of recent literature put more focus on how IPO delistings are related to merger and acquisition events. As proposed, going public has been used as one way to accomplish the consequent acquisitions. For example, De et al. (2012) investigate why firms become acquisition targets shortly after their initial public offerings.

However, very few studies in IPO literature have attempted to assess the delisting risk by using the post-IPO accounting information over multiple periods after going public in the duration models. Therefore, examining whether or not including the aftermarket accounting numbers improves the predictability of duration models on the future status after going public is interesting.

3. Hypotheses: Competing Hazard of Delisting

In this study, we examine the impact of some variables on the likelihood of post-IPO delistings due to two primary reasons. Following the prior IPO literature, we consider two sets of covariates as potential determinants: fixed and time-varying. For example, Demers et al. (2007) include IPO-deal characteristics as fixed determinants, composed of a technology dummy, venture-backed dummy, underpricing, IPO proceeds, and number of IPOs per quarter. These covariates are defined as fixed since their values will remain unchanged once the issue has been finished at the IPO time. They also include the accounting determinants in their models to predict the IPO failure risk. However, they only estimate their models based on the accounting information over a single period around the issuing time. In other words, the information contained in annual financial statements after going public has not been considered in their study.

Unlike Demers et al. (2007), we are attempting to include more updated information to predict the chance of delisting possibility by adding the post-IPO financial accounting information, which is updated annually after going public. This group includes firm age, firm size, profitability, growth, research and development expenses, selling, general and administrative expenses, and leverage.

In sum, we include two sets of determinants in our competing-risk models: IPO deal-related characteristics, which are fixed at the IPO time, and aftermarket accounting variables, which are updated periodically. Therefore, there are multiple observations for each sample firm with time-varying accounting variables but fixed IPO deal-related properties.

The main purpose of this paper is to investigate the impact of a group of factors on delisting due to either (1) merger and acquisition or (2) bad performance, respectively. Therefore, drawing on the findings from the extant literature, our hypotheses on variables of interest are summarised as follows.

H1. Presence of Venture-Capital Firm

Many studies (e.g., Jain et al., 2000; Brav et al., 1997; Gill et al., 2016; Gomulya et al., 2016; Iliev et al., 2020; Pommet et al., 2017) have shown that venture capital firms improve the aftermarket performance of IPO firms. For example, both Jain et al. (2000) and Brav et al. (1997) argue that VC-backed IPOs outperform non-VC-backed firms, although the conclusion of the latter only holds when returns are weighted equally. Thus, we expect that VC-backed IPO firms are less likely to be delisted due to bad performance, either liquidation or bankruptcy, than non-VC-backed IPO firms.

Howton (2006) finds that a venture-backed IPO firm is more likely to survive rather than delist after a takeover, which can be explained by the post-IPO presence of the venture firm on the board, as proposed by Brav et al. (1997). On the other side, other studies find that institutional investors such as venture capital may use merger and acquisition as the option to cash out of the IPO firm and exit (e.g., De et al., 2012). Put these two together, and we do not have a specific prediction on the effect of venture capital firms on post-IPO delisting due to mergers and acquisitions. In sum, we propose the following hypothesis:

H1: VC-backed firms are less likely to be delisted due to bad performance, while the presence of venture capital firms does not affect the probability of delisting due to mergers and acquisitions.

H2. IPO Underpricing

The literature is still mixed about how to interpret the issue of IPO underpricing. IPO underpricing has been attributed to investors' uncertainty, signalling of firm quality by managers, or timing of primary market by managers. Therefore, we do not have a specific prediction on the effect of IPO underpricing on the post-IPO delisting, no matter how it is triggered. The hypothesis is defined as follows.

H2: IPO underpricing does not affect the probability of delisting due to either bad performance or merger and acquisition.

H3. Firm Size

Firm size has been proven to be a key issue when the firms are making decisions on takeover or other issues. The prior literature has documented that a larger firm is more likely to survive because of a lower default risk. Therefore, we expect that firm size can reduce the likelihood of delisting, no matter how it is triggered. The hypothesis is defined as follows.

H3: Larger firms are less likely to be delisted due to bad performance or merger and acquisition.

H4. Profitability

As proposed by Fama et al. (2004), we expect that profitability should help reduce the risk of delisting triggered by bad performance, either liquidation or bankruptcy. Meanwhile, their study did not find a significant association between profitability and the delisting risk originating from mergers and acquisitions. Thus, we do not provide specific predictions on how profitability may affect the delisting due to merger and acquisition. The hypothesis is proposed as follows.

H4: Firms with higher profitability are less likely to be delisted due to bad performance, while a firm's profitability does not affect the probability of delisting due to merger and acquisition.

H5. Research & Development (R&D) Expenses

Following the prior literature (e.g., Demers et al., 2007; Fedyk et al., 2018; Kim et al., 2021; Wu et al., 2021), we include R&D expenses to capture the scale of the firm's expenditures on R&D. The effect of R&D expenses on delisting risk could be either positive or negative. On one side, more R&D expenses may provide more growth opportunities for the IPO firm, indicating a negative link between R&D expenses and the delisting risk, i.e. R&D expenses will reduce the possibility of IPO firms being delisted after going public. On the other side, a higher level of R&D expenses could imply the management inefficiency of the assets-in-place. Therefore, it is hard to predict the direction of how R&D expenses will affect the delisting risk due to both reasons. We propose the hypothesis on R&D expenses as follows.

H5: Research & Development (R&D) Expenses do not affect the probability of delisting due to either bad performance or merger and acquisition.

H6. Selling, General, and Administrative (SG&A) Expenses

The same story applies to another variable, selling, general, and administrative (SG&A) expenses, with the exception that SG&A expenses are related to intangible assets. Again, the firm may benefit from more SG&A expenses if investing in intangible assets can create real future growth opportunities. Otherwise, higher SG&A expenses may do harm to the firm's performance, leading to a higher possibility of being delisted. Similarly, we do not provide any specific prediction on how SG&A expenses will affect the delisting risk due to both reasons. We propose the hypothesis on SG&A expenses as follows.

H6: Selling, General, and Administrative (SG&A) Expenses do not affect the probability of delisting due to either bad performance or merger and acquisition.

H7. Leverage

It has been documented that leverage plays an important role in predicting either a new firm's post-IPO status or a seasoned firm's default risk. Consistent with the findings in the prior studies, we expect a positive effect of leverage on the probability of delisting due to bad performance since higher leverage would increase default risk, leading to more delistings. On the other side, we do not have a specific prediction on the effect of leverage on the post-IPO delisting due to merger and acquisition. Put these together, we propose the following hypothesis:

H7: Firms with higher debt ratios are more likely to be delisted due to bad performance; meanwhile, borrowing more does not affect the probability of delisting due to mergers and acquisitions.

4. Data and Methodologies

4.1. Data

Our data collection originates from 9,396 IPOs from Jay Ritter's IPO database from 1980 through 2022, containing each firm's founding date and first trading date. The information on the date of the issue, the dollar value of proceeds raised, and the percentage change in the stock price on the first trading day (underpricing) are collected from the Securities Data Company (SDC) Database. Following Fama et al. (2003), our sample excludes REITs, closed-end funds, ADRs, unit offers, MLPs, and all issues with an offer price below 5 dollars. The SDC dataset covers the new issue in the United States from 1985 to 2022. We obtain the annual financial data for these IPO firms from the CRSP and COMPUSTAT databases.

To be included in the final sample, the firms must have unique 6-digital CUSIP identification across JayRitter/SDC/CRSP/COMPUSTAT datasets to ensure the data availability of all the data required for our analysis. There are about 80% matches between CRSP and COMPUSTAT among the initial list of 13,945 IPO firms from Jay Ritter. Then, about 6,507 firms are deleted due to the mismatches between SDC and CRSP/COMPUSTAT and 7,438 firms remain in our final sample for survival analysis.

Table 1 defines all the variables used in this paper. The variables include the IPO deal-related characteristics, which are fixed at the IPO date once the issue has been finished, and the post-IPO financial data, which are time-varying.

Table 1: Variable Definitions

Variable name	Definition
Survival time (months)	Number of months traded on the exchanges after IPO
Failure	One if the firm delisted due to failure after IPO, zero otherwise
Merger & Acquisition	One if the firm delisted due to acquisition/merge after IPO, zero otherwise
Venture dummy	One if venture firm backed, zero otherwise
Underpricing (%)	Initial return for the first trading day
Proceeds ($ millions)	Natural log of one plus Proceeds from the IPO in million dollars
IPO activity	Number of IPOs per quarter
Age (years)	Natural log of one plus Firm age in years
Firm Size ($ millions)	Natural log of one plus market value of common shares outstanding
Profitability (%)	Net income divided by total assets
Growth (%)	Growth in total assets, measured as percentage change in total assets
R&D expense (%)	R&D expenses divided by total assets
SGA expenses (%)	Selling, general, and administrative expenses divided by total assets
Leverage (%)	Total liabilities divided by total assets

Note: This table defines two sets of variables used in this paper, including (1) the variables related to IPO-deal characteristics and (2) the time-varying accounting variables regarding firm properties. The sample period is between 1980 and 2021

The aftermarket status of IPO firms is classified by their CRSP delisting codes. The firms are identified as "active" if their delisting codes are 100, "delisted due to merger and acquisition" if their delisting codes are in the 200 range, and "delisted due to move to another exchange" if their delisting codes are in the 300 range. The 200s indicate "acquired in merger", and the 300s indicate "issues acquired by exchange of stock". The firms are classified as "delisted due to bad performance" if their delisting codes are in the 400 range or 500 range, which we refer to bad performance as liquidation or bankruptcy. However, 55 firms whose delisting codes are from 501 to 520 and one with 575 are dropped from the final samples. Table 2 shows the status of all the remaining 7,438 IPO firms in the final sample.

Table 2 shows there are 5,432 delistings among 7,438 IPO firms from 1980 to 2021, including 3,780 acquisition/merge delistings and 1,652 failure delistings. Consistent with Fama et al. (2004), the number

of IPO firms on major U.S. stock markets increased in general from the 1970s to the post-1980 periods. Table 3 summarises the data.

Table 2: Status of IPO Firms from 1980 to 2021

IPO year	Total	Surviving	Merger & Acquisition	Liquidation & Bankruptcy
1980	2	0	2	0
1981	2	0	2	0
1982	0	0	0	0
1983	9	0	9	0
1984	2	0	2	0
1985	4	0	3	1
1986	350	30	207	113
1987	290	20	163	107
1988	128	6	73	49
1989	121	11	70	40
1990	89	8	52	29
1991	216	20	130	66
1992	346	32	216	98
1993	488	49	295	144
1994	398	30	242	126
1995	368	24	237	107
1996	534	36	332	166
1997	382	38	223	121
1998	255	28	143	84
1999	338	33	210	95
2000	260	26	165	69
2001	36	11	22	3
2002	75	30	42	3
2003	95	35	44	16
2004	213	61	125	27
2005	158	44	91	23
2006	174	51	94	29
2007	179	47	105	27
2008	23	7	11	5
2009	64	22	34	8
2010	10	5	3	2
2011	105	33	57	15
2012	129	62	54	13
2013	189	82	92	15
2014	204	91	93	20
2015	110	63	40	7
2016	86	60	23	3
2017	131	98	24	9
2018	136	115	19	2
2019	141	121	15	5
2020	197	186	10	1
2021	401	391	6	4
Total	**7438**	**2006**	**3780**	**1652**

Note: This table shows the status of all the remaining 7,438 IPO firms in the final sample during the period from 1980-2021. There are three possible aftermarket status of IPO firms, including (1) remaining publicly traded, (2) being delisted due to acquisition or merge activities, and (3) being delisted due to bad performance. In this table, we annotate these three categories as "Surviving", "Merger & Acquisition", and "Liquidation & Bankruptcy", respectively. It shows the number of IPOs are classified within each category, among all the IPOs issued in each year. For example, in 1986, there were 350 firms going public in total, among which 30 firms remain trading actively on the exchanges, 207 were delisted due to merger and acquisition events, and 113 were delisted due to liquidation or bankruptcy, respectively.

Following Demers et al. (2007), we adjust the value for those variables, which are measured in dollar amount, back to the value in 1973 dollar values according to the annual CPI growth rate to eliminate the effect of the inflation rate on our results. Such adjustment makes our results more comparable to the current IPO literature. The descriptive statistics of variable in our study is consistent with previous

studies such as Fama et al. (2004) and Demers et al. (2007). The IPO firms have an average survival time of 80.58 months and underpricing of 17.3%. Interestingly, the IPO firms are suffering a loss of -6.267% (measured by E/A) on average, most caused by those bad performance delisted IPO firms, which are suffering a loss of -21.295%.

Table 3: Descriptive Statistics for Subsamples

Variable name	Full Sample		IPOs Still Trading		IPOs Merges		IPOs Failed	
Number of firms	N=7,438		N=2,006		N=3,780		N=1,652	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Survival time (months)	80.577	70.679	105.697	79.723	64.613	59.399	58.980	52.060
Venture dummy	0.418	0.493	0.423	0.494	0.453	0.498	0.338	0.473
Underpricing (%)	0.173	0.319	0.182	0.322	0.18	0.327	0.141	0.291
Proceeds ($ millions)	3.341	1.129	3.645	1.114	3.212	1.07	2.946	1.103
IPO activity	29.515	19.09	29.866	19.051	28.975	19.268	29.860	18.780
Age (years)	16.227	20.976	17.753	23.260	15.457	18.985	14.507	19.368
Firm size ($ millions)	11.887	1.893	12.699	1.790	11.761	1.624	10.394	1.627
Profitability (%)	-6.267	29.415	-2.251	23.640	-3.125	23.919	-21.295	42.896
Growth (%)	17.746	163.506	21.353	143.512	20.428	181.632	4.533	164.358
R&D expense (%)	7.309	12.551	7.110	12.151	7.233	11.239	7.891	15.553
SGA expenses (%)	33.075	27.751	29.034	24.525	33.820	26.536	40.256	34.343
Leverage (%)	44.917	27.352	43.258	26.008	41.919	24.476	54.584	32.983

Note: This table shows the summary statistics of variables used in this paper during the period from 1980-2021. It includes two sets of variables, including (1) the variables related to IPO-deal characteristics and (2) the time-varying accounting variables regarding firm properties. We also classify all the IPOs in our sample into three groups, defined as "IPOs Still Trading", "IPOs Merges", and "IPOs Failed", respectively. Survival times refer to the number of months traded on the exchanges after going public. A venture dummy is defined as one if the IPO is backed by a venture firm, zero otherwise. Underpricing is defined as the initial return on the first trading day after going public. Proceeds are computed as Ln(1+Proceeds from the IPO in million dollars). IPO activity is measured using the number of IPOs per quarter. Age is calculated as Ln(1+Firm Age in years). Firm size is calculated as (1+Ln(MV)), where MV refers to the market value of common shares outstanding. Profitability is defined as net income divided by total assets. Growth is defined as a percentage change in total assets, calculated as (Total Assetst -Total Assetst-1)/ Total Assetst-1. R&D expenses is computed as research and development expenses divided by total assets. SGA expenses is computed as the selling, general, and administrative expenses divided by total assets. Leverage is computed as total liabilities divided by total assets.

4.2 Methodologies

As mentioned above, we believe that competing-risk analysis is suitable in case of IPO delisting. It is because two reasons for delistings are mutually exclusive to each other. If one event occurs first and causes the delisting of the IPO, the other event will never happen. For example, a firm cannot default if it has already been delisted, triggered by an acquisition. Competing-risk analysis helps assess the delisting rate due to one event by controlling for the effect of other events simultaneously because of the interdependence among the possibilities of two cause-specific delistings.

The most widely used method to deal with competing-risk datasets, proposed by Kalbfleisch et al. (1980), is to estimate the model separately for each type of failure while treating the different events as censored data. However, Lunn et al. (1995) argue that one drawback of the Kalbfleisch et al. (1980) method is that it does not treat the different risks jointly. Instead, they suggest that a data duplication method can avoid such disadvantages. For example, all the observations of their cancer datasets are counted twice in the final sample to estimate the model, one for each type of failure risk.

Based on the method proposed by Fine et al. (1999), we model the delisting rate due to reason *j* as a sub-hazard defined as

$$h_j(t|X) = \overline{h}_{j,0}(t)\, exp(\beta_{j,1}VCDummy + \beta_{j,2}Underpricing + \beta_{j,3}Proceeds + \beta_{j,4}IPOActivities + \beta_{j,5}FirmAge + \beta_{j,6}FirmSize) + \beta_{j,7}Profitability + \beta_{j,8}Growth + \beta_{j,9}R\&DExpenses + \beta_{j,10}SGAExpenses + \beta_{j,11}Leverage) \quad (1)$$

where *j*=1 and 2 denote the delistings due to merger and acquisition and bad performance, respectively. The dependent variable $h_j(t)$ is the instantaneous probability that a new list is delisted for reason *j, conditional on being* delisted the first time since its listing. *X* represents a set of variables, including fixed and time-varying covariates. β_j denotes the effect of covariates on the sub-hazard function caused by the *j-th* reason.

The independent variables are defined as follows. A venture dummy is defined as one if the IPO is backed by a venture firm, zero otherwise. Underpricing is defined as the initial return on the first trading day after going public. Proceeds is computed as Ln(1+Proceeds from the IPO in million dollars). IPO activity is measured using the number of IPOs per quarter. Age is calculated as Ln(1+Firm Age in years). Firm size is calculated as (1+Ln(MV)), where MV refers to the market value of common shares outstanding. Profitability is defined as net income divided by total assets. Growth is defined as a percentage change in total assets, calculated as (Total Assets$_t$ - Total Assets$_{t-1}$)/ Total Assets$_{t-1}$. R&D expenses are computed as research and development expenses divided by total assets. SGA expenses are computed as the selling, general, and administrative expenses divided by total assets. Leverage is computed as total liabilities divided by total assets.

In the following analysis, the competing risk models are estimated using the Stcrreg package in STATA, which implements the method proposed by Fine et al. (1999).

This paper also estimates a multinomial logit model on our sample as an additional test. The model is specified as

$$Logit(P_i) = \alpha_i + \beta_i X_i \quad (2)$$

where *i*=1 and 2 denote the delistings due to merger and acquisition and bad performance, respectively. X_i represents a set of variables, including fixed and time-varying covariates. B_i denotes the effect of covariates on the sub-hazard function caused by the *i-th* reason. As suggested by the previous study, such a model can help assess the likelihood of delisting due to different reasons directly.

Last, we investigate the pattern of time-varying covariates across the first several years after the initial public offerings. By doing so, we can see deeply how these factors can affect the delisting risk due to different reasons over the post-IPO period before being delisted from public firms.

5. Empirical Results

5.1 Life Table of Post-IPO Delistings

A life table is shown in Table 4, grouping the post-IPO delistings into different years. The delistings are summarised based on specific triggering events in Panel A and Panel B, respectively. Each panel tells us about the cumulative failure rate (the proportion of IPOs in the data that have been delisted due to specific reason during the interval), the average hazard rate for the interval, and the 95% confidence interval for the hazard rate (Pryce et al., 2006).

Table 4: Life Table for Time to Survive After IPO (1980-2022)

Panel A: Delisting due to Merger and Acquisition					
Time to survive (Years)		Cumulative %	Hazard	Hazard 95% Confidence Interval	
0	1	9.48%	0.0505	0.0444	0.0566
1	2	22.69%	0.0779	0.0699	0.0858
2	3	34.64%	0.0798	0.0712	0.0884
3	4	45.39%	0.0815	0.0723	0.0908
4	5	54.43%	0.0791	0.0693	0.0889
5	6	60.95%	0.0662	0.0565	0.0759
6	7	66.12%	0.0604	0.0505	0.0703
7	8	70.76%	0.0617	0.0510	0.0724
8	9	74.74%	0.0596	0.0484	0.0707
9	10	78.14%	0.0562	0.0449	0.0676
Panel B: Delisting due to liquidation					
Time to survive (Years)		Cumulative %	Hazard	Hazard 95% Confidence Interval	
0	1	6.57%	0.0166	0.0131	0.0202
1	2	19.42%	0.0358	0.0304	0.0413
2	3	33.18%	0.0435	0.0372	0.0499
3	4	44.04%	0.0390	0.0326	0.0454
4	5	54.51%	0.0433	0.0361	0.0506
5	6	62.23%	0.0371	0.0299	0.0444
6	7	69.65%	0.0410	0.0328	0.0491
7	8	74.62%	0.0313	0.0237	0.0390
8	9	79.43%	0.0341	0.0257	0.0425
9	10	82.42%	0.0233	0.0160	0.0307

Note: This table shows a life table as we group the post-IPO delistings into different years. The delistings are summarised based on specific triggering events in Panel A and Panel B, respectively. Each panel tells us about the cumulative failure rate (the proportion of IPOs in the data that have been delisted due to specific reason during the interval), the average hazard rate for the interval, and the 95% confidence interval for the hazard rate, following the methodologies in Pryce et al., (2006).

We see that more than half of delistings due to either reason occurred within the first five years, and a majority (around 80%) were delisted within ten years after going public. The hazard of delistings increases continuously for the first few years and then decreases gradually with some small exceptions for both reasons. The result implies that the likelihood of delistings varies during the period as being listed on public markets. It is consistent with the prior literature. For example, Bharath et al. (2009) find that firms are weighing the costs and benefits of being public to make and time the decision to go private.

5.2 Competing-risk Analysis

Next, we apply the competing-risk model to our sample, using the IPO deal-related characteristics and annual financial accounting data within 5 years after going public. We follow the method proposed by Fine et al. (1999), where the delisting rate due to reason j as a sub-hazard is defined as

$$h_j(t \mid X) = \bar{h}_{j,0}(t)\exp(Xb_j) \tag{3}$$

where j =1 and 2 for the merger and acquisition, and the bad performance, respectively. The results are reported in Table-5.

Table 5: Competing-risk Analysis of Delistings

Variable name	Delisting due to Merger and Acquisition		Delistings Due to Failure	
Venture dummy	0.2185	***	-0.2690	***
	[4.02]		[-3.29]	
Underpricing	0.0093		0.1803	*
	[0.13]		[1.66]	
Proceeds	0.1433	***	0.1144	**
	[4.27]		[2.22]	
IPO activity	0.0017		0.0009	
	[1.18]		[0.4]	
Firm age	-0.0014		-0.0117	***
	[-1.03]		[-3.82]	
Firm size	-0.0219		-0.7300	***
	[-1.17]		[-21.21]	
Profitability	0.0050	***	-0.0063	***
	[4.73]		[-7.27]	
Growth	-0.0002		-0.0001	
	[-1.15]		[-0.5]	
R&D expense	0.0002		-0.0076	***
	[0.09]		[-3.15]	
SGA expenses	0.0029	***	-0.0021	**
	[3.07]		[-2.06]	
Leverage	-0.0028	***	0.0136	***
	[-2.81]		[12.53]	
IPO Year (80-89)	-0.1196		1.0366	**
	[-0.53]		[1.99]	
IPO Year (90-99)	-0.1927		1.1040	**
	[-0.85]		[2.12]	
IPO Year (00-09)	0.0466		1.2688	**
	[0.21]		[2.42]	
IPO Year (10-19)	0.2381		1.6305	***
	[1.04]		[3.09]	
IPO Year (20-21)	-0.0115		1.6155	***
	[-0.05]		[3.00]	

Note: This table shows the results of completing-risk model specified as below.

$$h_j(t \mid X) = \bar{h}_{j,0}(t)\exp(Xb_j)$$

*The dependent variable is the likelihood of delisting due to reason j, including (1) acquisition/merger and (2) failure. The independent variables are defined as follows. Venture dummy is defined as one if the IPO is backed by venture firm, zero otherwise. Underpricing is defined as the initial return on the first trading day after going public. Proceeds is computed as Ln(1+Proceeds from the IPO in million dollars). IPO activity is measured using the number of IPOs per quarter. Age is calculated as Ln(1+Firm Age in years). Firm size is calculated as (1+Ln(MV)), where MV refers to the market value of common shares outstanding. Profitability is defined as net incomes divided by total assets. Growth is defined as percentage change in total assets, calculated as (Total Assets$_t$ - Total Assets$_{t-1}$)/ Total Assets$_{t-1}$. R&D expenses is computed as research and development expenses divided by total assets. SGA expenses is computed as the selling, general, and administrative expenses divided by total assets. Leverage is computed as total liabilities divided by total assets. *, **, ***, significant at the 10, 5, and 1 percent level, respectively.*

It is worth noting that how each covariate affects the likelihood of post-IPO delisting depends on which event triggers the delisting status. Some variables have the same impacts on two competing risk events in terms of the sign of coefficient estimates, whereas the others affect different events in different directions. There are three main findings based on the competing-risk analysis.

First, we find that only one covariate (issuing proceeds) significantly affects two competing-risk events (acquisition/merger and liquidation/bankruptcy) in the same direction. The issuing proceeds have a significantly positive coefficient estimate for both bad performance cases and takeover cases, implying that more issuing proceeds lead to a higher delisting rate. The positive effect could be attributed to the overvaluation of IPO firms, leading to an earlier delisting due to either event.

Second, four factors, including venture capital dummy, profitability, SG&A expenses, and leverage, have opposite effects on different events triggering the delisting, acquisition/merger and liquidation/bankruptcy. Specifically, the increase of these covariates could increase the risk of acquisition/merge delisting while reducing the risk of failure delisting. For example, the coefficient estimate for the venture capital dummy is 0.22 in case of mergers-related delisting risk, with a -0.27 for delisting due to bad performance, either liquidation or bankruptcy. Thus, it can be concluded that a venture capital-backed firm is more likely to be delisted due to mergers rather than survive while less likely to be delisted due to bad performance. Our results lend supportive evidence to Hypothesis-1 on venture capital dummy regarding the delistings due to bad performance.

However, our result is against the findings by Howton (2006), who finds that a venture-backed IPO firm is more likely to survive rather than delist after a takeover. He attributes his findings to the argument proposed by Brav et al. (1997), that the post-IPO presence of the venture firm on the board will reduce the delisting risk generated by a takeover. Our results prefer the opposite direction. Table 5 shows that venture dummy is significantly positively related to the possibility of delisting due to a takeover. In other words, the presence of venture capital can increase the chance for a firm to be delisted due to an event of merger and acquisition. Such a finding is consistent with another strand of the prior literature (e.g., De et al., 2012), implying that merger and acquisition has been used by venture capital firms as an approach to cash out their investment in IPO firms.

Regarding H4, the same pattern is also found for profitability, indicating that a higher firm value will increase the possibility of IPO firms being delisted caused by mergers while reducing the risk of delisting resulting from a bad performance. Our result is consistent with that of Fama et al. (2004), showing that profitability should help reduce the risk of delisting triggered by bad performance, either liquidation or bankruptcy. Meanwhile, their study implies a positive association between the growth of assets and failure rate. However, they argue that neither variable is significant for the delisting risk originating from acquisition/mergers.

Since SG&A expenses are related to intangible assets, higher SG&A expenses may do harm to an IPO firm's aftermarket performance, leading to a higher possibility of being delisted. However, our results are against the predicted direction specified in Hypothesis 6. Further study is necessary before it can be explained. Consistent with Hypothesis 7 originating from the prior studies, we find a positive effect of leverage on the probability of delisting due to failure since higher leverage would increase default risk, leading to more mandatory delistings. On the other side, lower leverage may make the IPO firms more attractive as an acquisition target.

Third, we find that some covariates, including underpricing, age, firm size, and R&D expenses, are significantly related to bad performance-triggered delisting without any impact on takeover-triggered delisting. For example, consistent with Hypothesis 2, underpricing has a positive coefficient estimate in case of failure-triggered delisting with an insignificant one for takeover-originated delisting. As we mentioned above, two theories have been suggested by the current literature to explain IPO underpricing, investor uncertainty, and signal of firm quality. The uncertainty one predicts a positive relationship between underpricing and delisting risk, while the latter expects a negative link, no matter

which reason triggered the delisting after going public. Our results support the theory of information asymmetry between firms and investors partially instead of the signalling model.

Our results show that the coefficient estimates of firm age are only significantly negative for bad delistings, implying that the probability of such delisting is inversely related to firm age. This conclusion is the same as those proposed by the prior literature, for example, Schultz (1983) and Hensler et al. (1997). Specifically, older firms are more likely to survive than delist.

As mentioned in Hypothesis-3, firm size has been documented as a key issue when the firms are making decisions on takeover or other issues. A larger firm is more likely to survive than delisted due to liquidation or bankruptcy because of a lower default risk, which is supported by our result. On the other side, we find no evidence to show that a larger firm is more likely to be involved in a takeover event.

In terms of Hypothesis 5, we find that R&D expenses will reduce the possibility of delisting due to failure based on our analysis. The negative link between R&D expenses and delisting risk supports the findings of Demers et al. (2007), who argue that higher R&D expenses mean a higher growth opportunity for the IPO firm. On the other side, such a result contradicts the theory of the management inefficiency of the assets-in-place, which predicts a positive link between R&D expenses and delisting risk.

Moreover, we also find that two variables, IPO activity and asset growth, are not significantly related to the likelihood of post-IPO delistings due to either reason. As for IPO activities, it is consistent with other studies, such as Hensler et al. (1997), who found no evidence to support the timing effect on the delisting risk in their study. However, Ritter (1990) argues that firms are attempting to raise capital when the cost of equity is relatively low during the hot time.

The coefficient estimates for the asset growth are inconsistent with the findings in Farm et al. (2004). In other words, the new firms are more likely to fail because of a high growth rate of total assets, which may be explained by overinvestment.

Put together, we can find that factors have a different impact on the delisting due to two different reasons. Therefore, it is essential and helpful to consider competing-risk events to help predict the future states of new firms after going public.

5.3 Multinominal Logit Model

Here, we estimate a multinomial logit model on our sample as an additional test. The model is defined as

$$Logit(P_i) = \alpha_i + \beta_i X_i \qquad (4)$$

where P_i=1 and 2 denote the delisting rates due to merger and acquisition and bad performance, respectively. X_i represents a set of variables, including fixed and time-varying covariates. B_i denotes the effect of covariates on the sub-hazard function caused by the *i-th* reason. The results are reported in Table 6.

Table 6 shows that most of the results from the multinomial logit model remain similar to those from competing-risk analysis, except for several variables. For example, the coefficient estimates of the venture dummy are insignificant for both groups of delisting, showing that venture capital firms have no significant impact on the delisting rate, no matter the triggering event. Another example is asset growth, which appears to be significantly positively related to the delisting rates in both groups. The difference between the two methods may be driven by how two groups of delistings are treated when estimating each model. As mentioned above, the competing-risk model treats one event as censored

while estimating another event's likelihood. Some future research in comparison between the two methodologies may improve our understanding of how to deal with such circumstances.

Table 6: Multi-nominal Logit Models of Delistings

Variable name	Delisting due to Merger and Acquisition		Delistings Due to Failure	
	Coefficient Estimate	Hazard Ratio	Coefficient Estimate	Hazard Ratio
Intercept	-1.1546**		-11.3592	
	[6.21]		[0.93]	
Venture dummy	0.0172	1.017	0.0197	1.02
	[0.06]		[0.03]	
Underpricing	0.0013***	1.001	0.0005	1.001
	[9.34]		[1.04]	
Proceeds	0.0002**	1.000	0.0005*	1.000
	[3.99]		[2.89]	
IPO activity	0.0018*	1.002	0.0052***	1.005
	[3.53]		[12.81]	
Firm age	-0.0042***	0.996	-0.0079***	0.992
	[7.01]		[9.32]	
Firm size	-0.2273***	0.797	-0.6557***	0.519
	[54.89]		[219.52]	
Profitability	0.0052***	1.005	-0.0137***	0.986
	[11.12]		[120.21]	
Growth	0.0005***	1.001	0.0008***	1.001
	[13.78]		[11.19]	
R&D expense	0.056**	1.058	-0.1325***	0.876
	[5.03]		[8.22]	
SGA expenses	0.1542***	1.167	0.1666***	1.181
	[15.89]		[9.99]	
Leverage	0.0019	1.002	0.0253***	1.026
	[1.71]		[178.37]	
IPO Year (80-89)	-1.2349***		8.4805	
	[8.00]		[0.00]	
IPO Year (90-99)	-1.398***		8.5230	
	[9.19]		[0.00]	
IPO Year (00-09)	-0.4413***		8.3506	
	[9.95]		[0.01]	
IPO Year (10-19)	-0.6571		9.2293	
	[2.07]		[0.00]	
IPO Year (20-21)	-1.2959***		8.7663	
	[7.97]		[0.00]	

Note: This table shows the results of a multinomial logit model on our sample as an additional test. The model is defined as

$$Logit(P_i) = \alpha_i + \beta_i X_i$$

The dependent variable is the log odds of delisting due to reason i, including (1) acquisition/merger and (2) failure. The independent variables are defined as follows. A venture dummy is defined as one if the IPO is backed by a venture firm, zero otherwise. Underpricing is defined as the initial return on the first trading day after going public. Proceeds is computed as Ln(1+Proceeds from the IPO in million dollars). IPO activity is measured using the number of IPOs per quarter. Age is calculated as Ln(1+Firm Age in years). Firm size is calculated as (1+Ln(MV)), where MV refers to the market value of common shares outstanding. Profitability is defined as net income divided by total assets. Growth is defined as a percentage change in total assets, calculated as (Total $Assets_t$ - Total $Assets_{t-1}$)/ Total $Assets_{t-1}$. R&D expenses is computed as research and development expenses divided by total assets. SGA expenses is computed as the selling, general, and administrative expenses divided by total assets. Leverage is computed as total liabilities divided by total assets. *, **, ***, significant at the 10, 5, and 1 percent level, respectively.

5.4 Time-varying covariates within the years after IPO

In this section, we like to examine the time-series patterns of those time-varying factors within the first five years after going public. In this table, we classify the observations of delisted IPOs into four groups, including (1) the observations at least one year earlier than the delisting year due to acquisition/ merger, (2) the delisting year due to acquisition/merger, (3) the observations at least one year earlier than the delisting year due to failure, and (4) the delisting year due to failure. Each group is compared to the surviving IPO firms which have been listed on the public markets for the same period. Viewing the difference between surviving and delisted IPO firms across post-IPO stages provides deeper insight into what happened to the firms around the delisting events due to specific events. The results are reported in Table 7 as follows.

Table 7: Time-series Pattern of Covariates

	Delisting due to Merger and Acquisition							Delistings Due to Failure					
Time after IPO	Group 1: Surviving IPO	Group 2: Years before Delisting Year	Diff. between (2) vs (1)		Group 3: Delisting Year	Diff. between (3) vs (1)		Group 3: Years before Delisting Year	Diff. between (3) vs (1)		Group 4: Delisting Year	Diff. between (4) vs (1)	
Panel A: Profitability													
1	-1.301	-0.882	0.419		-5.655	-4.354	***	-10.653	-9.351	***	-35.784	-34.48	***
2	-4.644	-2.805	1.839	*	-11.436	-6.792	***	-18.056	-13.41	***	-58.562	-53.92	***
3	-5.706	-6.112	-0.41		-9.554	-3.848	**	-22.29	-16.59	***	-56.874	-51.17	***
4	-5.044	-5.231	-0.19		-13.521	-8.477	***	-18.465	-13.42	***	-52.977	-47.93	***
5	-3.912	-3.769	0.143		-10.077	-6.165	***	-18.093	-14.18	***	-48.244	-44.33	***
Panel B: Leverage													
1	37.126	35.653	-1.47	*	41.918	4.792	***	38.89	1.765	*	46.233	9.108	***
2	39.278	38.465	-0.81		40.8	1.522		47.774	8.496	***	59.795	20.52	***
3	40.765	40.91	0.145		43.097	2.332		51.807	11.04	***	79.323	38.56	***
4	43.053	42.45	-0.6		44.674	1.621		53.839	10.79	***	83.309	40.26	***
5	44.058	43.328	-0.73		45.781	1.723		54.453	10.4	***	84.672	40.61	***
Panel C: Firm Size													
1	12.395	11.743	-0.65	***	11.947	-0.448	***	11.068	-1.327	***	10.587	-1.808	***
2	12.339	11.65	-0.69	***	11.531	-0.808	***	10.694	-1.646	***	9.966	-2.374	***
3	12.335	11.586	-0.75	***	11.734	-0.601	**	10.48	-1.855	***	9.356	-2.979	***
4	12.39	11.62	-0.77	***	11.416	-0.974	***	10.49	-1.899	***	8.837	-3.553	***
5	12.473	11.645	-0.83	***	11.541	-0.932	***	10.427	-2.046	***	9.202	-3.271	***
Panel D: Growth													
2	196.4	159.5	-36.9	**	173	-23.4		109.8	-86.6	***	75.898	-120.5	***
3	30.47	29.507	-0.96		29.092	-1.378		15.282	-15.19	***	-11.078	-41.55	***
4	22.262	23.586	1.323		9	-13.26	***	12.077	-10.19	***	-3.678	-25.94	***
5	21.01	26.182	5.172	*	10.211	-10.8	***	9.485	-11.53	***	-17.14	-38.15	***
Panel E: R&D Expenses													
1	6.339	5.991	-0.35		5.365	-0.975		5.303	-1.037	**	4.427	-1.913	
2	8.232	7.368	-0.86	*	7.63	-0.602		7.593	-0.639		9.059	0.827	
3	8.233	8.127	-0.11		8.084	-0.149		8.46	0.227		9.353	1.12	
4	8.125	8.207	0.081		9.778	1.653	*	8.154	0.029		9.45	1.325	
5	7.685	7.596	-0.09		10.085	2.4	***	8.042	0.357		12.109	4.425	***
6	7.723	7.41	-0.31		7.743	0.02		8.219	0.496		9.292	1.569	
Panel F: SGA Expenses													
1	26.362	29.279	2.917	***	33.166	6.804	***	30.056		***	40.624	14.26	***
2	29.333	32.247	2.915	***	36.019	6.687	***	35.907		***	52.985	23.65	***
3	29.632	34.548	4.916	***	34.346	4.714	***	39.26		***	45.429	15.8	***
4	29.327	35.456	6.129	***	37.336	8.009	***	38.71		***	52.665	23.34	***
5	29.29	35.26	5.97	***	40.433	11.14	***	39.566		***	50.453	21.16	***
6	29.571	35.099	5.528	***	36.698	7.128	***	41.67		***	49.691	20.12	***

Note: This table shows the time-series means of time-varying factors within the first five years after IPOs. Here, we classify the observations of delisted IPOs to four groups (Groups 2-5), including (1) the observations at least one year earlier than the delisting year due to merger&acquisition, (2) the delisting year due to merger&acquisition, (3) the observations at least one year earlier than the delisting year due to failure, and (4) the delisting year due to failure. Each group is compared to the surviving IPO firms (Group 1), which have been listed on the public markets for the same period. Profitability is defined as net income divided by total assets. Leverage is computed as total liabilities divided by total assets. Firm size is calculated as (1+ln(MV)), where MV refers to the market value of common shares outstanding. Growth is defined as percentage change in total assets, calculated as $(Total\ Assets_t - Total\ Assets_{t-1})/\ Total\ Assets_{t-1}$. *R&D expenses is computed as research and development expenses divided by total assets. SGA expenses is computed as the selling, general, and administrative expenses divided by total assets. *, **, ***, significant at the 10, 5, and 1 percent level, respectively.*

Panel A describes whether the profitability level of IPOs (computed as net income divided by total assets), which were delisted for either reason is significantly different from that of surviving IPOs. It is interesting to note that IPOs delisted due to acquisition/merger only underperformed the surviving counterparts until the last year before being delisted. Before the delisting year, there was no significant difference in profitability between the two groups during the first five years, with the exception of the second year. Such a pattern implies that the decision to exit the public markets through takeover events may be made only when the performance worsens compared to other new firms. Contrarily, the IPO firms which were delisted triggered by failure are found to underperform the surviving ones continuously since the first year after being public. It is consistent with Fama et al. (2004) that fundamentals play an important role in terms of default risk caused by failure.

Panel B shows the pattern of leverage as above. However, we find that leverage varies in a different way from profitability. There was no significant difference between these two groups through the post-IPO five-year period, including the delisting year due to merger/acquisition. It indicates that capital structure issues may not be considered in the decision to delist. On the other side, we find that IPO firms delisted due to failure have a higher leverage than surviving ones over a five-year period. Again, it seems that IPOs delisted due to failure have more debt than the surviving group since the first year after going public.

Another interesting result can be seen in Panel C, which summarises the pattern of firm size across groups. We find that firm size is significantly different between each group and the surviving group, implying that size effect on delisting is time-invariant.

In Panel D, growth has been shown to be significantly different only for the IPOs delisted due to failure. Such IPOs show a consistently slower growth rate than surviving ones.

Panel E indicates that expenditure and research expenses are not important issues to be considered regarding the delisting risk due to both events. On the other side, SG&A expenses show a similar pattern as firm size in Panel F; that is, such expenses may affect the delistings from the beginning of being public.

6. Conclusion

This paper investigates the impact of time-varying factors on the likelihood of delisting for two reasons, using one IPO panel data in the United States during 1980-2021. Doing so can allow us to identify the factors that can help more accurately predict delisting rates due to two primary events, merger and acquisition or liquidation and bankruptcy. In this paper, we perform a competing-risk analysis on a group of IPOs in the United States during the period of 1980-2021.

Following the extant literature, we include two groups of covariates in our analysis. The first is a set of IPO-deal characteristics, including venture-backed dummy, underpricing, IPO proceeds, and number of IPOs per quarter. The second group includes firm age, firm size, profitability, growth, research and development expenses, selling, general and administrative expenses, and leverage.

We find that including the aftermarket performance in a competing-risk model helps distinguish the impact of those covariates on the delistings caused by two events. For example, our result shows that profitability can increase the chance of IPO firms being delisted due to mergers and acquisitions, which decreases the chance of being delisted by liquidation and bankruptcy. In addition, our evidence indicates that time-varying covariates can impact the delistings in different ways. For instance, profitability is likely to cause delistings due to mergers and acquisitions only until the last year before the delisting year. In sum, our paper contributes to the literature by shedding new light on how to make accurate predictions of delisting rates.

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