CEO overconfidence and IPO survival

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Abstract

This study empirically examines the hypothesis of whether, how, and why CEO overconfidence substantially influences the Initial Public Offerings (IPO) failure risk. We construct CEO overconfidence measurement through a textual analysis by extracting optimistic sentiments within the entirety of the S-1 form and specifically the management discussion section, finding that overconfident CEOs correlate with a roughly 27% reduction in the probability of IPO failure. Our findings remain robust through various tests, and we use the instrumental-variable (IV) method to identify the causal effect of CEO overconfidence on IPO survival. We also use the Sarbanes-Oxley Act of 2002 as an exogenous shock to identify the causal effect of CEO overconfidence on IPO survival, the study finds that the inverse relationship between CEO overconfidence and IPO failure is more pronounced on post-implementation of the Sarbanes-Oxley Act. Additionally, our research illuminates that R&D investment acts as a moderating factor amplifying the positive impact of CEO overconfidence on IPO survival.

Keywords: CEO overconfidence, IPO survival, Survival analysis, text-analysis

JEL Codes: G33, G39, G41

1 Introduction

This paper seeks to answer an unsolved question in the area of initial public offerings (IPO) survival. Whether CEO overconfidence could explain the survival rate of IPO firms? Motivation of our research stems from evidence showing that IPO has a poor long-run performance with more than 30% of IPO (that either come from the U.S. or come from the international IPO market) failing or being acquired by other companies within five years (Ritter, 1991). Our paper aims to provide an alternative explanation of the low survival rate in the views of managers' psychological traits, to decrease the post-IPO risk and, to improve post-IPO performance by providing a guideline helping both investors and managers have a better understanding on the importance role of overconfidence when evaluating IPO performance and operating an IPO firm. Our research contributes two strands of literature, expanding IPO survival models in CEO personal traits level and providing empirical evidence on positive effects of CEO overconfidence on IPO firm value.

Although the many other studies believe overconfidence is a "bad" characteristics because overconfident peoples make more mistakes and hence harm firm's value, theories of Goel and Thakor (2008) and Gervais et al. (2011) suggest that overconfidence can increase firm value especially after the Sarbanes-Oxley Act 2002 (Sarbox). The effect of CEO overconfidence on firm performance remains controversy. We find that CEO overconfidence is positively related to post-IPO survival rate and we identified its causal effect on IPO survival by using IV method. We highlight that the positive effect of CEO overconfidence is moderated by R&D and Sarbox because higher level of CEO overconfidence can boost R&D outputs and Sarbox can curb bad behaviours of overconfidence such as earning management and over-investment. Our empirical results highlight that higher level of manager's overconfidence can decrease IPO failure risk and further increase its survival time. The results support theories of Goel and Thakor (2008) and Gervais et al. (2011) that CEO overconfidence can increase firm value and it is not always a bad characteristic especially in IPO firms.

We use text-based method based on Loughran and Mcdonald (2016) language sentiments word lists to construct confident level. The research considers various potential word list that may be relevant to CEO overconfidence as robustness check. By analysing S-1 forms and management discussion and analysis of financial statement (MD&A) section of S-1 forms, we extract key words that can reflect confidence level including positive, negative, strong, weak, and uncertainty, and then further construct our sentiment measurement to proxy CEO overconfidence.

We use different cut-offs when defining overconfidence, different survival models, and propensity score matching (PSM) to check if our results are robust. The robustness tests support our main arguments that CEO overconfidence can increase firms' survival rate and decrease further IPO failure risk when we take different gauges of CEO overconfidence measurements. Our results show that average treatment effect on treated (ATET) is negative and strongly significant including alternative measurements, which means CEO overconfidence can significantly decrease the occurrence of IPO failure. We then re-run the matched sample and receive same results compared with the main results. To identifiy the causal effect of CEO overconfidene on IPO survival, this research uses Lewbel (2012)'s internal instrumental variable (IV) method, and the IV results keep consistent with our main arguments.

Next, we tested potential mechanism of how and why overconfidence can increase IPO survival. Previous research found that overconfidence CEOs can bring firm more innovative inputs and outputs, which means CEO confidence can increase the firm value by achieve higher innovative success based on given research and development expenditure (Hirshleifer et al., 2012). Meanwhile, theories of Goel and Thakor (2008) and Gervais et al. (2011) indicate that the Sarbanes-Oxley Act can reduce some bad effect of CEO overconfidence such as earning management and over-investment. The most famous argument of CEO overconfidence is that overconfident CEOs overestimate the outputs of investment projects hence they can be harmful and can bring more risk to firms. If the Sarbanes-Oxley Act can reduce the over-investment level of overconfident CEO, it can moderate the negative

impact of over-investment from overconfidence and further increase the positive effect of CEO overconfidence. Consistent with above theories, our results highlight that higher level of R&D expenditure and the publication of Sarbanes-Oxley Act 2002 can significantly enhance the positive impact of CEO overconfidence on firm survival.

This research combines two strands of literature in the areas of CEO overconfidence and IPO survival. CEO overconfidence has been theoretically and empirically proved which has significant implications for both corporate managers and investors. Previous research focused more on firm-level factors rather than CEO-level factors; however, recent papers gradually focus more on CEO-level factors. Meanwhile, only limited research analyses the impact of CEO overconfidence on IPO survival. Some recent papers have shown that management-level and CEO-level characteristics have significant impact on IPO survival (Anagnostopoulou et al., 2021; Colak et al., 2021; Gounopoulos and Pham, 2018). Although the effect of CEO overconfidence is widely analysed for large public firms but its impact on IPO firms is nearly empty. Our paper is the first one to provide evidence of positive effect of CEO overconfidence on IPO survail and contributes a novel empirical research on both IPO and CEO overconfidence area. Moreover, we creatively propose text-based method to construct CEO overconfidence level by using sentiments of S-1 form and propose a quasi-natural experiment by using Sarbox to bridge the research gap of the impact of CEO overconfidence on IPO survival.

The rest of the paper is organised as follows. Section 2 discusses related literature and hypothesis development. Section 3 describes the sample and explains the survival analysis methodology. Section 4 reports empirical findings of the impact of overconfident CEOs on the probability of failure and time to survive of IPO firms. Section 5 presents several robustness checks of the results. Section 6 provides additional tests for endogenous. Section 7 provides discussion and analyses on potential channels that why CEO overconfidence affects IPO survival. Finally, Section 8 provides concluding remarks.

2 Literature Review

2.1 IPO survival review

2.1.1 Overivew

The failure of IPO firms is an important issue in markets and has negative consequences for both firms and other market participants, like investors, financial institutions and lenders. Brav and Gompers (1997) indicate that the characteristics of IPO firms have changed into low profitability, high growth and low cost of equity since the 1980s and the survival rate of IPO firms experience a significant decline in the 1980s and 1990s because of these changes. Identifying factors that potentially affect IPO survival is becoming a popular topic in recent years.

Adhere to the importance of IPO and the influence of their failure, previous studies started from analysing the impact of firm-level factors on IPO survival.Hensler et al. (1997) find that larger and older firms are more likely to survive from IPO. Larger firms have more resources to recover from mistaken corporate strategies; and older firms are more stable and can provide more historical data and more information to investors (Hensler et al., 1997). Meanwhile, their research indicates that higher initial returns and more insider ownership can also increase the IPO survival rate. Several studies argue that the quality of the underwriter (Schultz, 1993) and audit quality (Jain and Charles L. Martin, 2005; Demers and Joos, 2007) are important for IPO survival, prestigious underwriters and higher audit quality significantly decrease the failure rate of IPO. Jain and Kini (2000) propose that the involvement of venture capital increases the survival rate of IPO firms because firms with venture capital have relatively more opportunities to invest in research and development to achieve higher returns.

Remarkably, recent studies have linked CEO-level characteristics, such as CEO specialists (Gounopoulos and Pham, 2018) and tournament incentives (Colak et al., 2021), to the survival rate of IPOs. Studies show that CEOs play a vital role in making important corpo-

rate decisions, and those decisions could further affect the IPO firms' survival and growth (Gounopoulos and Pham, 2018). They argue that the survival rate of IPO firms with specialist CEOs is higher than that with generalist CEOs because specialist CEOs depend on the long-term performance of IPO firms and generalist CEOs prefer risky projects to show their managerial ability. Generalist CEOs may exacerbate the agency problem by taking on risky projects, and their employability does not rely on the future of the firm that they manage but on their working experience.

2.1.2 Firm-level factors

Many previous papers analyzed the survival rate of IPO firms from views of firms and IPO's characteristics. Demers and Joos (2007) analyze firms' factors that may influence the IPO survival. They define an IPO firm as failing if the firm was delisted within five years and find that venture capital (VC), hotness of IPO market, initial returns, offering price, firm age, and financial accounting variables are all affect IPO survival. Moreover, they find industry is an important moderator factor which affects relationship between these variables and IPO survival. Their empirical results show that (1) a higher reputation of underwriters could decrease the IPO failure risk. The audit quality is a significant variable for high-tech firms while it is not significant for non-tech companies. VC background is a significant variable for both non-tech and high-tech companies. (2) The hotness of the IPO market is a significant and positive variable for high-tech firms, which means higher returns to other IPOs in the 90 days before a high-tech company goes public are associated with a higher probability of failure within five years for the "hot market" high-tech IPO. (3) The first day's return is positively associated with high-tech firms' survivability but not significant for non-tech companies. Meanwhile, IPO firms with higher offering prices show less probability of failure. (4) Higher leverage and SG&A expenses would increase the failure rate of IPO firms. In terms of R&D, higher R&D would increase the survivability of high-tech companies, but R&D is not a significant variable for non-tech companies. Sales are positively related to IPO

survival. An accumulated deficit would increase the IPO firms' survival rate for high-tech companies, and it is not significant for non-tech companies.

Similarly, Hensler et al. (1997) focus on survival time and hazard rate of IPO firms. They apply an advanced accelerated failure time (AFT) model and Cox hazard model to determine the effects of age, size, initial returns, insider ownership, risk and market level on IPO survival. They find that the survival time of IPO firms is expected to increase with age, size, initial returns, and insider ownership, and decrease with risk and market level. They find heterogeneity across different industries, specifically, they find IPO firms from computer and data, wholesale, restaurant, and airline industries show a shorter survival time compared with the baseline hazard function. However, IPO from the optical and drug industries show a longer survival time.

Jain and Kini (2000) find VC involvement positively affect the IPO survival time. They analyzed the mechanism of how the VC background could affect the IPO firms from both internal and external aspects of the IPO process. From the internal view, VC involvement helps firms build better business strategies and make better business decisions because entrepreneurs are likely to have a technical specialist with limited managerial skills. VC firms could introduce mature management teams and talents with strong managerial and business skills. From the external view, the involvement of VC could express a signal to other financial market participants, such as institutional investors, investment bankers and analysts. The VC involvement could affect the attitude of financial intermediaries. Their attitude toward the IPO firms could significantly influence the market performance of IPO firms. If a firm receives a significant amount of VC, those analysts may feel this firm could perform better than those firms which do not have VC involvement.

Jain and Charles L. Martin (2005) analyze the impact of audit quality on the survival time of IPO firms. They suggest that IPO firms with prestigious auditors could perform better than other IPO firms without high-quality auditors. Investors could regard high audit quality as a positive signal when investing in IPO firms. They also find the impact of

underwriters on the survival time of IPO firms is significantly positive.

Jain and Charles L. Martin (2005) find that UK firms with a high level of earning management during the IPO year are unlikely to survive in the post-IPO period. The information asymmetry issue is significant among participants in the IPO process because different participants have different professional skills and have different levels of financial and business knowledge. The manipulating of the earning statements would exacerbate the information asymmetry problem. Hence, earning management may bring benefits for the early year of IPO firms but would pose a significant negative effect on stock returns in the later stage of IPO performance.

2.1.3 CEO-level and managerial factors

(Charitou et al., 2007) suggest that IPO firms with more independent boards and greater insider ownership are less likely to fail. Independent boards are more likely to protect shareholders' interests and insider ownership are effective incentives that keep boards' benefit aligned with shareholders' benefit. However, large boards are unlikely to make effective business decisions because coordination and communication problems are major issues that keep the whole management team performing slower when making corporate decisions. The board activity (board meeting frequency) is also a negative signal to firm performance. If firms face difficulties and face share price declines, the number of board meetings is likely to increase to keep the stock price stable. This paper uses a logistic regression model to detect the influence of corporate governance on IPO survival.

(Gounopoulos and Pham, 2018) find specialist CEO positively affects IPO survival. CEO with more general managerial experiences may not align with shareholders' benefit because their motivation is to demonstrate that they have a strong ability to take risky strategies. However, specialist CEO' working experience focus on limited industries or firms. They are unlikely to switch firms and have fewer choices to change their job. Hence, specialist CEO have strong motivation to keep their current position and to focus on the firm's future

development. Moreover, (Colak et al., 2021) find tournament incentives lowering the failure risk of IPO firms.

2.1.4 The impact of the Sarbanes-Oxley (SOX) Act 2002 on IPO survival

In response to financial reporting scandals, Sarbox became law on July 30, 2002 (Crutchley et al., 2007). In general, this act requires firms to disclose detailed financial information. Second, it requires firms to establish a system of financial controls and frequently monitor their systems to determine whether they are working properly. SOX also improves the reliability of audits by requiring that only outside board members of a firm be on the firm's audit committee. Sarbox prevents conflicts of interest between accounting firms and their audit clients and requires a regulatory review of audit firms every one to three years.

The benefits of Sarbox are improved internal controls and governance of the audit process. Crutchley et al. (2007) find that firms with higher percentages of outside directors and outside audit committee members are less likely to be involved in accounting scandals. Jain et al. (2008) show that the quality of financial reports and market liquidity have improved since Sarbox. Akhigbe et al. (2008) suggest that since Sarbox, firms are more willing to disclose negative information that they would prefer to withhold. Sarbox also has major implications for firms that are about to go public. First-time filers of a Securities Act registration statement are immediately subject to some provisions of Sarbox. The firm must compose an audit committee of independent directors, and one of the members must be a financial expert who has experience in auditing or analysing financial statements. A quality control process must be established, and a process for internal communication of information is also required. Internal controls must be in place for one year before an IPO. Since it is a legal requirement that firms going public have internal controls and procedures in place, there is more legal compliance to ensure that the document satisfies the law. Furthermore, the executives, such as the CEO and CFO, must be involved in establishing internal controls. Other governance issues, such as a code of ethics, must be articulated. In addition, there are

disclosure requirements for firms that do not meet the normal listing requirements of U.S. stock exchanges. Firms are subject to delays if they pursue an IPO without complying with Sarbox requirements.

Hence, the transparency of newly public firms arguably has increased. Consequently, the information asymmetry between the firm's managers and prospective investors should decrease. Thus, some firms avoid going public if they cannot justify the cost. Chhaochharia and Grinstein (2007) examine the announcement effects of Sarbox and other governance rules. They find that firms with a history of lower compliance experience positive and significant abnormal returns. For example, a portfolio of firms that have a history of financial restatements performs 8.5% above a matched portfolio. Sarbox also requires changes to address conflicts of interest when analysts recommend equity securities in research reports. The SEC and the major stock exchanges have also initiated similar reforms. The reforms separate the analysts from the investment banking division and prohibit the analysts from participating in the solicitation of investment banking business. Linck et al. (2009) find that since Sarbox, boards of directors are more independent, and CEOs are less likely to be chairmen of the boards. Aggarwal et al. (2011)find that firms have actively implemented new corporate governance policies since Sarbox.

Aggarwal et al. (2011); Ritter (1991) find that newly public firms experience weak aftermarket performance. Each of these studies suggests that irrational pricing at the time of the IPO could be the reason for the weak aftermarket performance. That is, the aftermarket performance reflects a downward correction to the excessively high price at the time of the IPO. Jain and Kini (2000) find that the financial reports of IPOs are more favourable at the time of the IPO than after the IPO. Put together, the studies cited here suggest that firms use window dressing at the time of the IPO, which could cause excessive optimism among investors and therefore a stock price correction over time in response to subsequent financial reporting. Cohen, Dey and Lys (2008) find that earnings management declines following Sarbox, which improves the quality of the reported earnings of firms going public

and reduces the uncertainty surrounding stock valuation. As a related point, Sarbox can serve as a screen for firms that go public. Firms that are more willing to be transparent would still pursue an IPO, while some firms that have something to hide can avoid the Sarbox provisions by remaining private. Thus, firms that pass the Sarbox screening process should exhibit relatively low risk, and there is less likelihood that investors would need to correct for over-optimism in the aftermarket. To the extent that Sarbox provisions reduce irrational pricing at the time of (or shortly after) the IPO, it could reduce or eliminate an aftermarket correction. Hence, this study hypothesizes that the IPO survival has improved since Sarbox.

2.2 CEO overconfidence and IPO review

2.2.1 CEO overconfidence overview

There are several different forms of overconfidence, including miscalibration, better-than-average effect, illusion of control, and excessive optimism (Sevenson, 1981). Evidence has shown that overconfidence can influence many aspects of our life. For instance, most people feel their driving ability (Sevenson, 1981) and memory capacity (Moore and Cain, 2007) are above average levels. Camerer and Lovallo (1999) propose that highly skilled individuals are more likely to be overconfident, hence, CEO are more likely to follow this bias and act overconfidently. According to the upper echelons theory (Hambrick and Mason) and Roll's (1986) hubris hypothesis, managerial overconfidence, as a key CEO psychological trait, play an important role in corporate decision making and corporate performance.

Some current studies support that overconfident CEO are highly optimistic about their ability to generate returns, hence those CEO are more likely to overestimate the profitability of corporate projects (Malmendier and Tate, 2015). Malmendier and Tate (2008) found that overconfident CEO are easier to take value-destroying merges because they overestimate the profitability of transactions and pay higher consideration to targets. Meanwhile, more studies also show that overconfident CEOs are prone to overinvest and further increase the

firms' default probability (Leng et al., 2021; Liu et al., 2022). Kim et al. (2016) found that firms with overconfident CEO face higher stock crash risk. They argue that overconfident CEO are reluctant to release negative feedback corporate decisions to markets and firms with overconfident CEO are likely to hoard bad news. Overconfident CEO overestimate the future profitability of corporate projects and underestimate the failure rate of those projects. Hence, overconfident CEO are more likely to lead a stock crash in their companies.

Although many studies have shown the negative impact of CEO overconfidence, a question would rise that why firms prefer to hire an overconfident CEO? There is also a bundle of papers argue that CEO overconfidence benefits firms. Some papers have revealed that overconfident CEOs bring more profits to shareholders by taking risky projects, encouraging innovation, and pursuing challenges in new technologies (Hirshleifer et al., 2012). Meanwhile, evidence shows that CEO overconfidence is positively related to level of innovation in various industries no matter the input of innovation (Research and development expense) or the output of innovation (patents and citations) (Galasso and Simcoe, 2011). Similarly,Hirshleifer et al. (2012) argue that firms with overconfident CEO invest more in innovative projects and could achieve a higher level of innovative success. Thus, those firms can acquire more patents and receive more returns from these research and projects and further achieve more growth opportunities.

2.2.2 CEO overconfidence theories

There are two theories that tried to answer the puzzle why firms prefer to hire an overconfident CEO. They argue that CEO overconfidence can help firm generate more innovative opportunities and increase the firm value (Gervais et al., 2011; **?**). Gervais et al. (2011) build a theoretical model showing that a risk-averse CEO's overconfidence can make him less conservative and hence firms can motivate CEO to purse riskier and more valuable projects with less incentives. Overconfident managers are also more attractive to firms than their rational counterparts because overconfidence commits them to exert effort to learn about projects.

Goel and Thakor (2008) also build a theory model demonstrating that CEO's overconfidence can promote firm value up to a certain point despite they can more likely to taking riskier and even value-destroying projects than rational CEO. IPO survival is a key measurement of IPO's long-run performance, it is essential to figure out the relationship between CEO overconfidence and IPO survival. Based on above two theories we make our first prediction:

Hypothesis 1: CEO overconfidence is positively associated with the IPO survival rate.

The purpose of the CEO is to maximise the shareholder's value, if the IPO is failed, shareholders would suffer enormous loss which should be tried best to avoid by a CEO. If the purpose of a CEO is the above and the overconfidence can increase the firm value, the IPO survival should positively related to the CEO overconfidence.

In Goel and Thakor (2008) theory, they also predict that Sarbox will improve the precision of information provided to investors, which means investors can better understand the CEO beccause more information relevant to the management team can become public and easy to understand following the item 404 in the Sarbox. We make following prediction relevant to the interaction impact of Sarbox and CEO overconfidence on the IPO survival:

Hypothesis 2: positive impact of CEO overconfidence will be enhanced after Sarbox.

The information of the firms' management roles become clearer and more detailed based on item 404 in the Sarbanes-Oxley Act 2002, and investors can use this information to have a better understanding of the firms' management team. The major negative behaviour of overconfident is overinvestment because they overestimate the future performance of their investment projects (Malmendier and Tate, 2015). However, Goel and Thakor (2008) theory indicates that CEOs will reduce project investment due to the impact of Sarbanes-Oxley Act 2002. Hence our paper predict that the Sarbanes-Oxley Act 2002 can moderate the negative

impact of CEO overconfidence.

2.2.3 The impact of the Sarbanes-Oxley (Sarbox) Act 2002 on CEO overconfidence

Banerjee et al. (2015) empirically analyse the effect of CEO overconfidence on shareholders, and they find positive effect of CEO overconfidence on shareholders by using Sarbox as a natural experiment. They find, after Sarbox was published, overconfident CEO reduce investment and risk exposure, increase dividends, improve post-acquisition performance, and have better operating performance and market value. Importantly, these changes are absent for overconfident-CEO firms that were compliant prior to Sarbox.

Goel and Thakor (2008) theory model suggests Sarbox has two potential effects on CEO overconfidence: It increases the precision of the information provided by the CEO to investors, and it reduces aggregate corporate investment. Over-investment has been regarded as a major negative effect of overconfidence which leads a higher corporate risk and a lower firm performance. If Sarbox can limit over-investment behaviour and improve firm performance, the IPO are leaded overconfident CEO would have higher survival rate after Sarbox. However, the changes of relationship between CEO overconfidence and IPO survival before and after Sarbox are unknown for current studies. This research predicts that after the Sarbox was published, the positive effect of CEO overconfidence would be pronounced, and the negative effects of CEO overconfidence would be weakened.

2.2.4 The bright side of CEO overconfidence

Apart from above two distinctive theory models explaining the relationship between overconfidence and firm value, some empirical evidence also indicates that management overconfidence is a key contribution on firms' innovative outputs and inputs (Gervais et al., 2011; Hirshleifer et al., 2012) as well as firms' stock price increase (Bharati et al., 2016). (Hirshleifer et al., 2012) found that the overconfidence CEOs can bring firm more innovative

inputs and outputs, which means CEO confidence can increase the firm value by achieve higher innovative success based on given research and development expenditure. CEO overconfidence can lead a firm greater level of innovative success by creating more patents and citations. Moreover, overconfident CEOs are likely to promote innovation and bring the creation of firm value Gervais et al. (2011). They find a significant positive relationship between CEO overconfidence and patent counts. Overconfident CEOs, although they prefer risky projects, promote innovative projects which could bring firms more opportunity and value creation. Based on above theory, we make our third prediction:

Hypothesis 3: positive impact of CEO overconfidence will be enhanced by R&D expenditure.

Overconfidence can boost firm's innovative projects and hence bring firms more value by more investing in R&D, hence we predict that higher level of R&D expenditure can increase the firms' value.

Other evidence also shows that overconfident CEOs have strong self-belief in their leadership, which makes them viewed as more competent, and therefore more respected and influential (Anderson et al., 2012). Phua et al. (2018) provide evidence that the leadership style of overconfident CEO who exhibit a strong belief in their firms' prospects attracts more suppliers and induces greater supplier commitments leading to lower input costs and higher profitability.

2.2.5 The dark side of CEO overconfidence

An potential explanation of IPO long-run under-performance is the overoptimistic bias of corporate managers (Ritter and Welch, 2002). Heaton (2002) argues that managers tend to be overoptimistic, and thus prone to over-invest if they have sufficient funds. Malmendier and Tate (2005) find empirical evidence that overconfident CEOs are prone to over-invest

when they have sufficient internal funds and curtail investment when external funding is required. Hence, overconfident CEO are more likely to take value-destroying and sub-optimal investment choices (Malmendier and Tate, 2015). Malmendier and Tate (2005, 2008) build a model to demonstrate the impact of overconfident behaviour on firms' corporate investment decisions. They define overconfidence as the overestimation of the value a manager believes he or she can create. The overconfidence bias influences the CEO's beliefs in two forms. First, an overconfident CEO believes that the company's current assets are undervalued by the market. Second, an overconfident manager overestimates the value of a potential investment he or she might pick.

Ben-David, Graham, and Harvey (2013) find overconfident managers underestimate the level of risk in appraising investment opportunities and hence invest more than optimal by incorporating lower discount rates to value future expected cash flows. Furthermore, prior work finds that overconfident managers not only underestimate the risk, but also overestimate the profitability, future growth prospects, and expected returns of firms. Evidence also shows that overconfident CEO are preferred a higher leverage level than the optimal leverage ratio (Hackbarth 2008; Malmendier, Tate, and Yan 2011), and they are more likely to choose riskier short-term debt (Huang, Tan, and Faff 2016), and engage in value-destroying M&As (Malmendier and Tate, 2008). Overconfident CEO are likely to believe that the value of their firms in the equity market is undervalued so they prefer to choose debt financing rather than equity financing.

Overconfident CEO are more likely to be involved in earnings management and the incidence of earning misstatement (Malmendier and Tate, 2015). CEOs with overconfidence bias overestimate future profits and earning ability of their projects, they borrow more aggressively against future earnings to avoid missing current earnings forecasts, and they are prone to practice less-conservation accounting practices (Bouwman, 2014), for instance, in delaying the recognition of losses (Bouwman, 2014; Ahmed and Duellman, 2013). Meanwhile, CEO's overconfident bias is more likely to lead to non-intentional earning misstatement, however, it

can raise CEO's incentive to misstate earnings intentionally in a subsequent period (Schrand and Zechman, 2012). Teoh et al. (1998) attribute some of the poor post-IPO stock performance to "optimistic" accounting early in the life of the firm. It is not surprising that firms are eager to look good when they conduct their IPO, and that the market has difficulties in disentangling carefully hidden warning signals. This suggests that at least a part of the poor long-run performance is due to a market that is unduly optimistic and unable to properly forecast tougher times (Ritter and Welch, 2002). Alhadab et al. (2014) analysed the effect of earning management on the probability of failure for UK IPO firms. Their empirical evidence shows that IPO firms with a high level of (real/accrual) earning management during the IPO year have a higher probability of failure and a lower probability of survival (Alhadab et al., 2014). Kim et al. (2016) found that overconfident CEO are positively related to the stock crash risk. Overconfident CEO tend to engage in value-destroying investments for too long, which causes poor performance and increases the probability of stock price crashes. Overconfident CEOs have strong self-belief to neglect the surrounding warnings of approaching failure or unintentionally negate the existence of negative news. Overconfident CEOs are likely to ignore bad news and negative feedback about the projects they chose. A rational CEO would change their expectation of future earning ability of investment plans they operate if they received negative feedback. However, unlike the rational CEOs, overconfident CEO are likely to ignore negative feedback and continue to believe the project they operate would bring them promising positive profits. They believe they can generate promising future profits and can control the outcome of their investment projects. Meanwhile, overconfident bias can also affect the CEO's behaviours in the supply of financial information for the stock market. They are reluctant to release privately observed negative information to the market. Leng et al. (2021) analyse the relationship between UK's firm default risk and CEO overconfidence. They find that firms with overconfident CEOs are more likely to face a higher probability of corporate failure.

2.2.6 CEO overconfidence and IPO survival: some other pioneer research

Boulton and Campbell (2016) conduct preliminary research on the impact of managerial overconfidence on IPO survival. They find that the relationship between managerial overconfidence and IPO survival is not significant. However, previous research shows that the impact of CEO overconfidence has a strong impact on corporate performance. Meanwhile, there is also evidence that shows that the optimism of managers could affect the long-run IPO performance. Hence, the research argues that the previous research on the impact of managerial overconfidence on IPO survival is limited and needs further analysis.

This research contributes two strands of literature. First, the research contributes literature on CEO overconfidence, this research would provide further empirical evidence of the impact of managerial overconfidence on IPO firms' long-run performance. Second, this research adds empirical evidence to IPO survival research, it will provide a new potential explanatory managerial factor that could affect IPO survival. Based on the research of Boulton and Campbell (2016) who find the relationship between managerial overconfidence and IPO survival is positive but not significant. However, this research argues that the research on the impact of CEO overconfidence on IPO survival is not sufficient. There is only limited research on this topic, hence to the best of my knowledge, this research will fulfil the research gap and provide a different technical method and analyse the influence of CEO overconfidence in detail.

3 Methodology and data

3.1 Survival analysis

3.1.1 Nelson-Aalen estimator

We use survival analysis (or duration analysis) framework to investigate the association between CEO overconfidence and IPO survival. This research will use the hazard function

and survival function to estimate the failure rate and survival rate respectively. Meanwhile, the research also use Cox proportional hazards model like large amount of papers which analyse the IPO survival (Jain and Kini, 2000; Gounopoulos and Pham, 2018; Colak et al., 2021).

We use the Nelson-Aalen estimator, which is defined as

$$\widehat{H}(t) = \sum_{t_i \leq t} \frac{f_i}{r_i} \tag{1}$$

where f_i is the number of failed firms at timet_i, and the r_i is the number of firms at risk at time t_i.

3.1.2 Kaplan-Meier estimator

The survival function of Kaplan-Meier estimator is defined as

$$\widehat{S}(t) = \prod_{t_i \leq t} \frac{f_i - f_i}{r_i} \tag{2}$$

where f_i is the number of failed firms at time t_i, and the r_i is the number of firms at risk at time t_i.

3.1.3 Logit model

The first groups of regressions in our empirical analysis are logit model, hence the dependent variable is IPO survival a binary choice where 0 presents survival 1 presents involuntary delist from the public, hence the logit model is suitable for our research.

$$\begin{aligned} Failure_{i,t} =& \alpha_0 + \beta_1 Overconfidence_{i,t} + Firm\ controls + IPO\ characteristic\ controls \\ &+ CEO\ controls + Industry\ fixed + Year\ fixed \end{aligned} \tag{3}$$

where β_i is the coefficient of independent variables X_i. The key to empirical research

is building a correct model. Previous research of IPO survival uses different models to estimate the IPO survival, there are two major models have been widely used: logit model and Cox hazard model. Unlike survival analysis, logit and discriminant models are only capable of predicting whether an event will occur, and not when the event occurs. These methodologies are unable to distinguish between firms that fail within six months from those that fail after five years (Lowers et al., 1999). However, survival analysis allows us to assess the conditional probability of failure given that the firm has survived up to the present time, hence our research also consider Cox hazard model as our second main model.

3.1.4 Accelerate Failure Time (AFT) model

The AFT model is defined as:

$$\begin{aligned} Ln(T) =& \alpha_0 + \beta_1 Overconfidence_{i,t} + Firm\ controls + IPO\ characteristic\ controls \\ &+ CEO\ controls + Industry\ fixed + Year\ fixed \end{aligned} \tag{4}$$

Where T present the life time of survived firms. The economical meaning of β is one unit of increasement of x_i will increase β % of the lifetime of the IPOs.

3.1.5 Cox proportional hazards model

The Cox proportional hazards model is defined as:

$$\begin{aligned} \log(\frac{h(t;x)}{h_0(t)}) =& \alpha_0 + \beta_1 Overconfidence_{i,t} + Firm\ controls + IPO\ characteristic\ controls \\ &+ CEO\ controls + Industry\ fixed + Year\ fixed \end{aligned} \tag{5}$$

where $h_0(t)$ is the baseline hazard and t are the time, $h_0(t)$ only depends on time (t) rather than x_i. The baseline hazard is the same for any individuals in the sample. The individual hazard functions depending on $e^{(b_1x_1+b_2x_2+...+b_nx_n)}$ are always positive and proportional re-

garding baseline hazard. $e^b i$ is the hazard ratio (HR), the economical meaning of HR is one unit of increasement of x_i will lead the new hazard rate become $e^b i$ times compared the old hazard rate. The results of logit model and AFT mode can be found in appendix.

3.2 Sample and data

3.2.1 CEO overconfidence measurement: Text-based method

CEO overconfidence is a psychological bias that cannot be directly measured, there are several proxies for the measurement of CEO overconfidence. Malmendier and Tate (2015) and Campbell et al. (2011) use option-based proxies to measure the overconfidence level, extracting information from the CEO's decisions of exercising options granted as a part of compensation and the CEO's trading in the firm's stocks. Malmendier and Tate (2005; 2008) use hand-collected data while Campbell et al. (2011) use data that comes from ExecuComp. However, these methods need a certain period to capture the CEO's stock and option-based compensation portfolio, and further estimate the overconfidence level by their holding behaviour, which is not available for IPO firms due to the limited CEO's holding information before the IPO. ExecuComp only covers large firms like S&P 1500 firms, as a result, holding information of IPO firms is also not available in ExecuComp database. Interestingly, Malmendier and Tate (2008) also use a text-based method extracting key words related to confidence from newspapers and media to measure overconfidence level. The text-based method is extracting key words from text (10-K annual form, medias, newspapers etc.) related to financial entity to measure the sentiments of the text. The sentiment of the text can reflect managers or investors' psychological behaviour.

Boulton and Campbell (2016) propose three alternative methods to measure the managerial overconfidence for IPO firms based on firm age, investment level and language in S-1 forms estimated by Diction. However, the first two methods are highly endogenous with IPO firms itself, it may not reflect the CEO overconfidence well. The text-based method by using S-1 language is reasonable, however, according to recent studies on text-analysis

in finance and accounting context, Diction is not a good choice to capture manager's sentiments as it misclassified vast majority of the word lists (Loughran and Mcdonald, 2016). For example, frequently occurring Diction optimistic words like respect, necessary, power, and trust will not typically have positive meaning when used by managers to describe future or current operations. They also question whether Diction pessimism words like no, not, without, gross, and pain will have negative meaning in the context of the typical accounting disclosure (Loughran and McDonald, 2013; Loughran and Mcdonald, 2011). Hence, to best capture the positive and negative words in SEC forms, we use Loughran and Mcdonald's (2016) word lists to construct our overconfidence measures.

Boulton and Campbell (2016) propose using text-based measurement to gauge managerial overconfidence by using Diction. However, Diction is designed for multiple contexts rather than financial languages. Loughran and Mcdonald (2016) argue that Diction is not designed for financial report and their result could be highly biased (for example, evidence shows that 75% words may be misclassified by Diction in context of finance and accounting). The word lists developed by Loughran and Mcdonald (2011) are better for financial language tones. Thus, this research will construct first measurement of CEO overconfidence by using S-1 form's language tones. We use (Loughran and Mcdonald, 2011) words lists to extract key words from full S-1 form and MD&A section of S-1 form. Then we use several dictionaries (positive tone, negative tone, strong tone, and weak tone) that especially match financial context (Loughran and Mcdonald, 2016) to construct CEO confidence level of the IPO year. The confidence level is measured as the ratio of difference between positive and negative word-lists and sum of positive and negative word lists in full S-1 fillings and MD&A section (Ataullah et al., 2018; Davis et al., 2012; Li, 2010), meanwhile, we also construct our second measurement of CEO overconfidence proxied by excess certainty:

$$Relative\_optimisim\_S - 1 = (\frac{positive\_full - negative\_full}{positive\_full + negative\_full}) * 100 \tag{6}$$

$$Relative\_certainty\_S-1 = (\frac{strong\_full - weak\_full}{strong\_full + weak\_full}) * 100 \tag{7}$$

$$Relative\_optimisim\_MDA = (\frac{positive\_MDA - negative\_MDA}{positive\_MDA + negative\_MDA}) * 100 \tag{8}$$

$$Relative\_certainty\_MDA = (\frac{strong\_MDA - weak\_MDA}{strong\_MDA + weak\_MDA}) * 100 \tag{9}$$

The key overconfidence variable (OC20 S-1, Certainty20 S-1, OC20 MDA, and Certainty20 MDA) take the top 20% of confidence level (Relative optimisim S-1, Relative certainty S-1, Relative optimisim MDA, Relative certainty MDA) based on our measurement, the 20% threshold is based on Malmendier and Tate's (2015) report that at least 20 percent of CEO demonstrate overconfidence and this threshold have been also applied in Boulton and Campbell's (2016) research.

Then, thirdly, we consider "optimism" and "certainty" jointly. we normalize both measures and take the average to construct Relative confidence S-1 and Relative confidence MDA and then apply top 20% measures to construct Average20 S-1 and Average20 MDA .

Finally, for robustness tests, we construct alternative cut-off points (OC10 S-1, OC10 MDA, Certainty10 S-1 , Certainty10 MDA , OC30 S-1, OC30 MDA, Certainty30 S-1 , Certainty30 MDA) including top 10% and 30%. In our notification of different CEO overconfidence measurement, "full" in variable names means the variable is constructed by using full S-1 language sentiments, and "MDA" in variable names means the variable is constructed by using MD&A section's language sentiments.

We collect the IPO issue date from Eikon's SDC new issue database and collect IPO delist information from the Center for Research in Security Prices (CRSP) stock's event database. The sample period of this study starts from 1st January 1998 to 31st December 2016 as the definition of a survival IPO needs to successfully run for at least 5 years. The reason we include the IPO year of 1998 to 2000 is because the early 21 century was experi-

encing internet bubble, we include these years to make sure our sample do not face bias of IPO year of crisis, meanwhile, limited CEO-related information for public firms which gone public before 1998.

We firstly collect IPO information (including issue date, proceeds, and offer price) from the Eikon's SDC new issue database. However, according to previous studies, we impose several restrictions when collecting data from the SDC new issue database. Firstly, the offer price is at least five dollars per share. Secondly, the IPO is not a spin-off, a privatization IPO, an American depositary receipt (ADR), a real estate investment trust (REITs), a unit offering, a right issue, a limited partnership, a closed-end fund, and a financial institution. This study focuses on domestic operating companies. ADRs, penny stocks (the offer price is less than five dollars per share), and unit offerings frequently have problems with the quality of the data from SDC (Ritter, 2005). The IPO information also includes the information of the underwriter and the auditor company. We further collect the quality of underwriter, venture capital (VC) information, and firm age from Jay Ritter's database (https://site.warrington.ufl.edu/ritter/ipo-data/).

We collect CEO-level control variables from BoardEx, and any hand-collected data from SEC form S-1 if necessary. Previous research mentioned Execucomp databased for collection overconfidence data. However, the Execucomp databased is largely limited as it only includes S&P 1500 firms' managers' information, as a result, we manually collect CEO-level information from S-1 forms including CEO education, CEO age, CEO tenure, gender, and chairman duality. We collect stock market index information to calculate hot market variable from CRSP. We collect all other firm-level data from Compustat IQ database.

To construct our confidence variable, we use Python to grab S-1 filling from SEC website and manually copy and paste MD&A sections from S-1 forms because there is technical problem if we try to automatically extract managerial discussion and analysis section in S-1 forms as it does not have a standard organization in each paragraph. Then we use python to conduct standard natural language process for text in financial context to exclude any noisy

information (such as HTML, XBRL, XML etc.) following Loughran and McDonald's (2016) method which is public for academic research (https://sraf.nd.edu/sec-edgar-data/cleaned-10x-files/10x-stage-one-parsing-documentation). The following dictionaries (Loughran and McDonald (2016) we use to extract language tones of 10-K fillings include: positive, negative, uncertainty, strong words, weak words, litigious, constrain.

3.2.2 Control variables

To control various firm-level and IPO-level characteristics that can have a significant impact on IPO survival suggested by previous research. Firstly, we consider control variables that are relevant to the pre-IPO firm characteristics suggested by previous studies (Anagnostopoulou et al., 2021; Boulton and Campbell, 2016; Colak et al., 2021; Gounopoulos and Pham, 2018). We include variables log (firm age +1), and log (sales) to account for the positive effects of firm age, and firm size on IPO survival as documented by Hensler et al. (1997). We also consider control variables that are relevant to the firm's financial situation, investment policies, firm growth as well as firm performance before the IPO (Alhadab et al., 2015; Anagnostopoulou et al., 2021; Colak et al., 2021; Gounopoulos and Pham, 2018). We add the variable leverage (Total debt/Assets) to control for the firm's leverage based on the finding of Demers and Joos (2007) that the leverage ratio of IPO firms is positively related to the probability of failure. Additionally, Jain and Kini (2008) argue that managers' strategic investment choices at the time of the IPO may influence the post-issue performance of IPO firms; particularly, the probability of IPO survival is positively associated with R&D intensity. We control for this effect by adding variables indicating strategic investment decisions of the firm, namely R&D (R&D/Assets), advertising (Advertising/Assets), and capital expenditure (CapX/Assets). We replace missing values of R&D as zero like previous papers, see e.g., Alti (2006). Furthermore, we account for the firm performance by including the variable profitability (EBITDA/Assets) and the growth opportunity proxied by the market-to-book ratio as suggested by Alhadab et al. (2015). Finally, to acknowledge Anagnostopoulou et al.

(2021) who find a negative association between earnings management and survival. We also introduce earning management proxied by unexpected core earning which was developed by McVay (2006) and is also the measurement for earning management in Anagnostopoulou's et al. (2021) research.

We first estimate unexpected core earning using following model developed by McVay (2006):

$$\begin{aligned} CE_{i,t} =& \alpha_0 + \beta_1 CE_{i,t-1} + \beta_2 ATO_{i,t} + \beta_3 ACCRUALS_{i,t-1} + \beta_4 ACCRUALS_{i,t} \\ &+ \beta_5 \Delta SALES_{i,t} + \beta_6 NEG\_\Delta SALES_{i,t} + \mu_{i,t} \end{aligned} \tag{10}$$

where $CE_{i,t}$ is core earnings for firm i in year t, defined as operating income before depreciation divided by sales; $ATO_{i,t}$ is asset turnover ratio, defined as $SALES_{i,t}/((NOA_{i,t}+ NOA_{i,t-1})/2)$, where NOA (net operating assets) is calculated as the difference between operating assets and operating liabilities; $ACCRUALS_{i,t-1}$ is total accruals, defined as net income before extraordinary items, minus cash from operations scaled by sales; $\Delta SALES_{i,t}$ is the percentage change in sales; and $NEG\_\Delta SALES_{i,t}$ is the percentage change in sales if the latter is negative, and zero otherwise.

Model (5) is estimated cross-sectionally for each industry-year where industry classifications are based on two-digit Standard Industrial Classification (SIC) codes. Unexpected core earnings are calculated as the difference between reported and expected core earnings, where the latter are estimated using the predicted coefficients from model (5). We then measure earnings management as unexpected core earnings if their number is positive and zero otherwise. Expected core earnings are calculated for each industry-year using all firms included in Compustat. To ensure that there are sufficient data for the estimation of expected core earnings, we require, following McVay (2006), at least 15 observations per industry-year group.

Secondly, we control the IPO characteristics including quality of other financial participants for in the IPO process and IPO outcomes (Anagnostopoulou et al., 2021, 2021;

Boulton and Campbell, 2016; Colak et al., 2021). We introduce log (proceeds), share overhang, and initial return as proxies of proceeds, insider ownership (Demers and Joos, 2007; Gounopoulos and Pham, 2018) and under-pricing as documented by Hensler et al. (1997). Moreover, Schultz (1993) finds a positive relationship between reputable underwriters and IPO survival. Jain and Kini (2000) indicate that the involvement of venture capitalists in the IPO process improves the survival profiles of IPO firms. Jain and Martin (2005) document that IPO firms audited by high-quality accounting firms survive longer in the following years. To capture the impacts of these financial intermediaries on IPO survival, we include indicator variables top-tier underwriter, venture capitalist, and big4 auditor. We use quality of underwriter, venture capital (VC) information from Jay Ritter's database; underwriter equals 1 if the underwriter ranked top with the highest score in a given IPO year, 0 otherwise; VC equals 1 if the firm is backed by VC, 0 otherwise; Big4 equals 1 if the firm is audited by big 4 auditing firms, 0 otherwise. Many studies use initial return to control the positive impact of underpricing. However, the initial return is an outcome of IPO process that can be based on many other control variables like age and size, hence, we would run separate regressions with and without initial returns to make our results robust.

Finally, we also control CEO characteristics including chairman and tenure as they have positive impact on IPO survival suggested by (Colak et al., 2021; Gounopoulos and Pham, 2018). We use CEO duality and CEO tenure to control them. Furthermore, we also control other variables that can influence the risk attitude of CEO including CEO age, CEO gender and CEO education (MBA and PhD).

3.3 Summary statistics

Table 1 firstly categorizes the sample of IPO firms during 1998 to 2016 in survived group and failed group. Then, it presents the distributional variation of these groups across industry.

Panel A shows that, when followed for five years after the issue date, 70.434% of the

Table 1
IPO distribution by issue year and 2-digit SIC codes.
The table presents the distribution of the overall sample and the two groups of IPO firms: survived, and failed firms. Survived firms are those that are still trading (delisting code of 100). Failed firms are those that are delisted for negative reasons (delisting code greater than or equal to 200). Panel A summarizes distribution of IPO firms by issuing years. Panel B summarizes distribution of IPO firms by two-digit SIC codes. Delisting is tracked for five years after the IPO.

Panel A: Distribution by issue year

	Survived		**Failed**		**Total**
	No.	%	No.	%	No.
Year					
1998	72	63.16	42	36.84	114
1999	121	53.07	107	46.93	228
2000	103	64.38	57	35.63	160
2001	25	83.33	5	16.67	30
2002	19	61.29	12	38.71	31
2003	23	63.89	13	36.11	36
2004	75	75.76	24	24.24	99
2005	69	84.15	13	15.85	82
2006	65	72.22	25	27.78	90
2007	73	73.74	26	26.26	99
2008	9	90.00	1	10.00	10
2009	18	72.00	7	28.00	25
2010	41	89.13	5	10.87	46
2011	31	79.49	8	20.51	39
2012	25	62.50	15	37.50	40
2013	49	71.01	20	28.99	69
2014	82	84.54	15	15.46	97
2015	54	79.41	14	20.59	68
2016	37	84.09	7	15.91	44
Total	991	70.43	416	29.57	1,407

Panel B: Distribution by industry

	Survived		**Failed**		**Total**
	No.	%	No.	%	No.
Industry (two-digit SIC codes)					
All others	104	71.72	41	28.28	145
Chemical products (28)	228	82.01	50	17.99	278
Computer equipment & services (35, 73)	282	61.44	177	38.56	459
Electronic equipment (36)	84	68.29	39	31.71	123
Entertainment services (70, 78, 79)	10	71.43	4	28.57	14
Food products (20)	7	87.50	1	12.50	8
Health services (80)	21	84.00	4	16.00	25
Manufacturing (30-34)	14	73.68	5	26.32	19
Oil and gas (13)	26	81.25	6	18.75	32
Scientific instruments (38)	72	72.73	27	27.27	99
Transportation & public utilities (41, 42, 44-49)	62	65.26	33	34.74	95
Wholesale & retail trade (50-59)	81	73.64	29	26.36	110
All others	104	71.72	41	28.28	145
Total	991	70.43	416	29.57	1,407

firms survived, and 29.566% failed either due to voluntary (delisting code is greater or equal to 300) or involuntary delisting (delisting code from 200-299) which is consistent with prior literature (Colak et al., 2021; Gounopoulos and Pham, 2018).

Panel B summarizes the distribution by 2-digit SIC codes. Failed IPO firms cluster in chemical products, electronic equipment, and transportation & public utilities. These industries also have the highest percentage of IPOs that are acquired within five years after the offering (over 30%). In all industries, the majority of IPOs survive for five years subsequent to the stock issue. In particular, the proportion of survived firms is highest in health services, food products, chemical products, and oil and gas (over 80%). The percentage of failed firms in other industries ranges from 12% to 29%.

Table 2 and table 3 presents descriptive summary of control variables (including CEO characteristics, firm characteristics, and offering characteristics) and confidence variables. Panel A summarizes all control variables. Around 4% of CEOs are female and 45.8% of CEOs are also chairman. Most of IPO firms are VC backed (62.8%) and have good underwriter (59.1%) and good auditor (80.8%). IPO firms are generally young with an average age of 14.4 years and an average sale of 286.23 million. Panel B presents confidence variables constructed by full S-1 forms and MD&A languages. Both S-1 form, and MD&A sections use more negative words than positive words by around 30% and 27% respectively. Meanwhile, IPO forms also use more weak words than strong words. Remarkably, optimism level measured by MD&A are significantly higher in sub-sample of survived IPO (-25.73%) with a 1% significant level compared with sub-sample of failed IPO (-31.40%). Negative optimism level means IPO forms use more negative words than positive words. Although the overall optimism level measured by full S-1 forms show no difference between survived and failed IPO, IPO firms with a top 20% (overoptimism_full_20) and 30% (overoptimism_full_30) of optimism level show significant difference between survived and failed IPO. This is consistent with theory that moderate overconfident CEO can be beneficial for firm values and extremely overconfident CEO and non-overconfident CEO have no significant impact on firm perfor-

mance. Then, it further shows that certainty seems have no impact on IPO survival because both survived IPO and failed IPO have similar certainty level. For S-1 forms, certainty level of survived IPO and failed IPO are -59.76% and -59.08%, and for MD&A, certainty level of survived IPO and failed IPO are -65.22% and -66.22%.

Table 2
Firm-level descriptive statistical summary (1998-2016).
The table presents descriptive statistics for the sample of U.S. IPOs over the period from 1998 to 2016.N denotes the number of observations. Firm, CEO-level, offering characteristics are reported in Panel A. Confidence variables from full S-1 forms and MD&A section of S-1 forms are reported in Panel B

	N	Mean	p25	p50	p75	sd
PanelA: Control Variables						
CEO age	1407	52.86	46.00	52.00	59.00	10.21
Tenure	1407	4.49	2.00	2.98	5.90	3.46
Ownership	1407	3.12	1.56	2.75	4.14	2.60
CEO dulity	1407	0.46	0.00	0.00	1.00	0.50
Gender	1407	0.96	1.00	1.00	1.00	0.19
MBA	1407	0.06	0.00	0.00	0.00	0.23
PhD	1407	0.03	0.00	0.00	0.00	0.16
VC backed	1407	0.63	0.00	1.00	1.00	0.48
Underwritter reputation	1407	0.59	0.00	1.00	1.00	0.49
Big 4	1407	0.81	1.00	1.00	1.00	0.39
Initial returns	1407	29.75	0.42	13.64	35.52	51.60
Offer price	1407	13.82	10.00	13.50	16.50	4.73
Proceeds (in millions)	1407	137.44	54.82	85.50	140.16	167.56
Earning management	1407	5.40	0.00	0.02	0.89	17.72
MTB	1407	4.10	1.38	2.61	4.62	5.10
Leverage	1407	0.40	0.00	0.03	0.29	0.95
R&D	1407	0.10	0.00	0.06	0.16	0.13
Advertising	1407	0.02	0.00	0.00	0.01	0.05
Capital expenditure	1407	0.06	0.01	0.03	0.06	0.07

Firm age	1407	14.43	5.00	8.00	15.00	18.96
Sale (in million)	1407	286.25	14.44	64.07	212.84	710.20
PanelB: Confidence measures						
Relative optimisim S-1	1407	-30.78	-38.53	-31.60	-24.25	10.70
Relative certainty S-1	1407	-59.56	-64.58	-60.89	-56.26	7.56
Relative confidence S-1	1407	0.00	-0.57	-0.12	0.48	0.80
OC10 S-1	1407	0.10	0.00	0.00	0.00	0.30
Certainty10 S-1	1407	0.10	0.00	0.00	0.00	0.30
Average10 S-1	1407	0.10	0.00	0.00	0.00	0.30
OC20 S-1	1407	0.20	0.00	0.00	0.00	0.40
Certainty20 S-1	1407	0.20	0.00	0.00	0.00	0.40
Average20 S-1	1407	0.20	0.00	0.00	0.00	0.40
OC30 S-1	1407	0.30	0.00	0.00	1.00	0.46
Certainty30 S-1	1407	0.30	0.00	0.00	1.00	0.46
Average30 S-1	1407	0.30	0.00	0.00	1.00	0.46
Relative optimisim MDA	1407	-27.41	-43.69	-29.81	-14.61	22.70
Relative certainty MDA	1407	-65.92	-75.00	-67.82	-59.73	13.39
Relative confidence MDA	1407	0.00	-0.52	-0.10	0.40	0.75
OC10 MDA	1407	0.10	0.00	0.00	0.00	0.30
Certainty10 MDA	1407	0.10	0.00	0.00	0.00	0.30
Average10 MDA	1407	0.10	0.00	0.00	0.00	0.30
OC20 MDA	1407	0.20	0.00	0.00	0.00	0.40
Certainty20 MDA	1407	0.20	0.00	0.00	0.00	0.40

Average20 MDA	1407	0.20	0.00	0.00	0.00	0.40
OC30 MDA	1407	0.30	0.00	0.00	1.00	0.46
Certainty30 MDA	1407	0.30	0.00	0.00	1.00	0.46
Average30 MDA	1407	0.30	0.00	0.00	1.00	0.46

Table 3
Univariate tests.
Tests of differences in means between the two sub-samples of IPO firms with a failed outcome and those with a survived outcome are based on t-tests.

	N	Survived	Failed	Difference
PanelA: Control Variables				
CEO age	1407	52.403	53.957	-1.554**
Tenure	1407	4.354	4.811	-0.457*
Ownership	1407	3.255	2.812	0.443**
CEO dulity	1407	0.462	0.447	0.015
Gender	1407	0.958	0.969	-0.011
MBA	1407	0.017	0.149	-0.132***
PhD	1407	0.021	0.036	-0.015
VC backed	1407	0.609	0.673	-0.064*
Underwritter reputation	1407	0.600	0.567	0.033
Big 4	1407	0.820	0.779	0.042
Initial returns	1407	28.166	33.538	-5.372
Offer price	1407	13.920	13.582	0.337
Proceeds	1407	146.295	116.340	29.955**
Earning management	1407	5.863	4.309	1.554
MTB	1407	3.958	4.429	-0.471
Leverage	1407	0.416	0.359	0.057
R&D	1407	0.104	0.094	0.010
Advertising	1407	0.015	0.020	-0.006*
Capital expenditure	1407	0.055	0.057	-0.003
Firm age	1407	16.007	10.668	5.339***

Sale	1407	327.081	188.982	138.100***
PanelB: Confidence measures				
Relative optimisim S-1	1407	-30.804	-30.712	-0.092
Relative certainty S-1	1407	-59.766	-59.079	-0.687
Relative confidence S-1	1407	-0.015	0.035	-0.050
OC10 S-1	1407	0.108	0.082	0.026
Certainty10 S-1	1407	0.096	0.111	-0.015
Average10 S-1	1407	0.099	0.103	-0.004
OC20 S-1	1407	0.217	0.161	0.056*
Certainty20 S-1	1407	0.195	0.214	-0.019
Average20 S-1	1407	0.202	0.197	0.005
OC30 S-1	1407	0.318	0.257	0.061*
Certainty30 S-1	1407	0.293	0.317	-0.025
Average30 S-1	1407	0.302	0.296	0.006
Relative optimisim MDA	1407	-25.738	-31.395	5.657***
Relative certainty MDA	1407	-66.215	-65.221	-0.994
Relative confidence MDA	1407	0.026	-0.062	0.087*
OC10 MDA	1407	0.111	0.075	0.036*
Certainty10 MDA	1407	0.096	0.111	-0.015
Average10 MDA	1407	0.106	0.087	0.019
OC20 MDA	1407	0.224	0.144	0.080***
Certainty20 MDA	1407	0.186	0.236	-0.050*
Average20 MDA	1407	0.212	0.173	0.039

OC30 MDA	1407	0.334	0.219	0.115***
Certainty30 MDA	1407	0.288	0.329	-0.042
Average30 MDA	1407	0.310	0.276	0.033

4 Empirical results

4.1 Survival analysis descriptive methods

This part demonstrates the differences of hazard rate and survival rate in two groups of IPO firms with overconfident and non-overconfident CEO intuitively by four survival analysis graphs. Figure 1 presents the KM survival estimators as suggested by formula (2), the KM survival estimator is a descriptive summary of survival analysis, it can directly reflect the basic hazard at different times. The hazard rate in KM estimators is only depending on time. As demonstrated by Figure 1, the blue line presents the sample with non-overconfident CEO and the red line presents the sample of overconfident CEO. The red lines are higher than the blue line, meaning firms with overconfident CEO face a lower failure risk and the risk can be decreased by around 9%. The results is similar when we use language of MD&A as a measurement of CEO overconfidence. Figure 2 is similar to Figure 1, it demonstrates the KM failure estimators. KM failure estimators can reflect the hazard rate only based on time. The red line presents the sample with overconfident CEO and the blue line presents the sample of non-overconfident CEO. The red line is below the blue line, suggesting that IPO with overconfident CEO can have a lower level of failure risk. The NA hazard estimators are calculated as formula (1), which presents the hazard rate based only on time. Figure 3 presents two samples of non-overconfident CEO and overconfident CEO. The red line is lower than the blue line, meaning the IPO with overconfident CEO has a lower failure risk. The same results are also demonstrated by Figure 4. Figure 4 is the smoothed hazard estimates, the red line, presenting overconfident CEO' IPO, is below the blue line. The blue line, on the other hand, presents the non-overconfident CEO. This figure suggests that the hazard rate of IPO with overconfident CEO is lower than those with non-overconfident CEO. In general, all four graphs suggest overconfident CEO can bring IPO firms with higher survival rate and lower risk intuitively and further regression and channel analysis will be provided below.

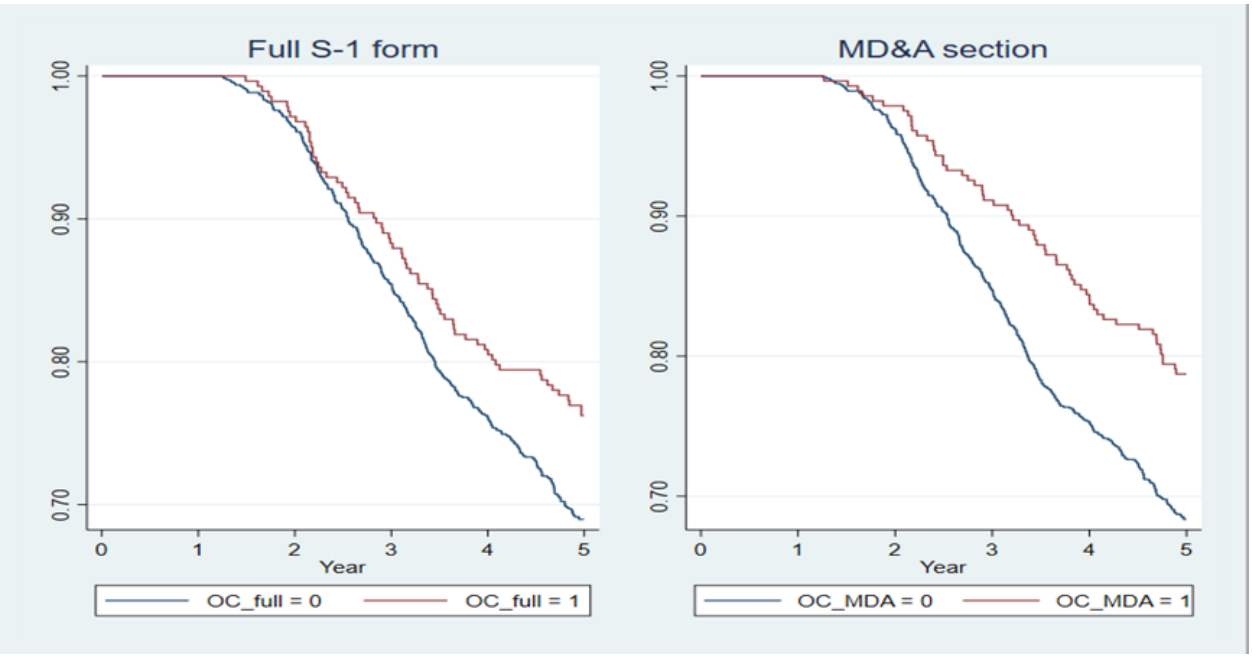

Figure 1 Kaplan-Meier survival estimates

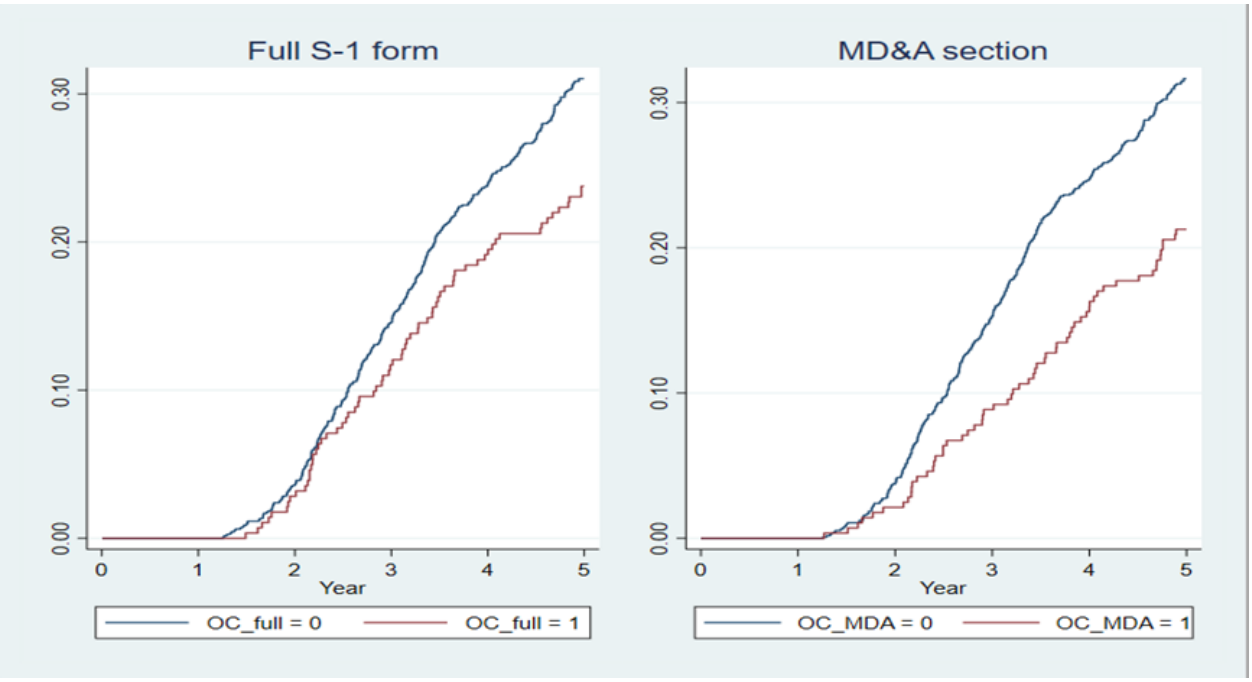

Figure 2 Kaplan-Meier failure estimates

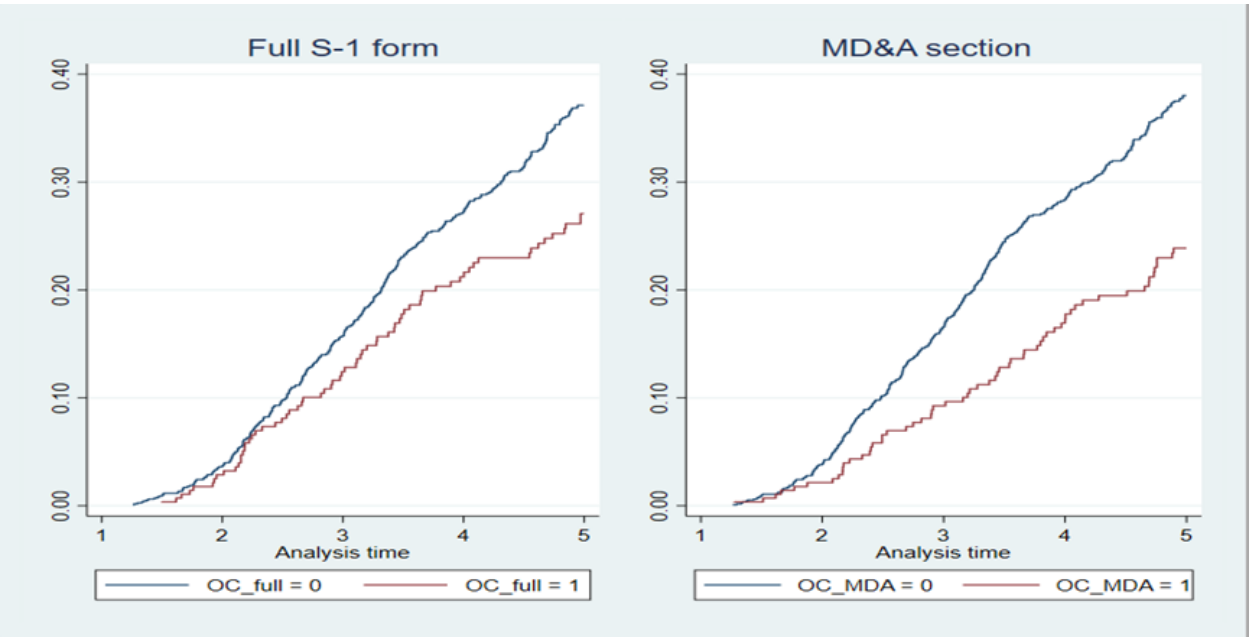

Figure 3 Nelson-Aalen cumulative hazard estimates

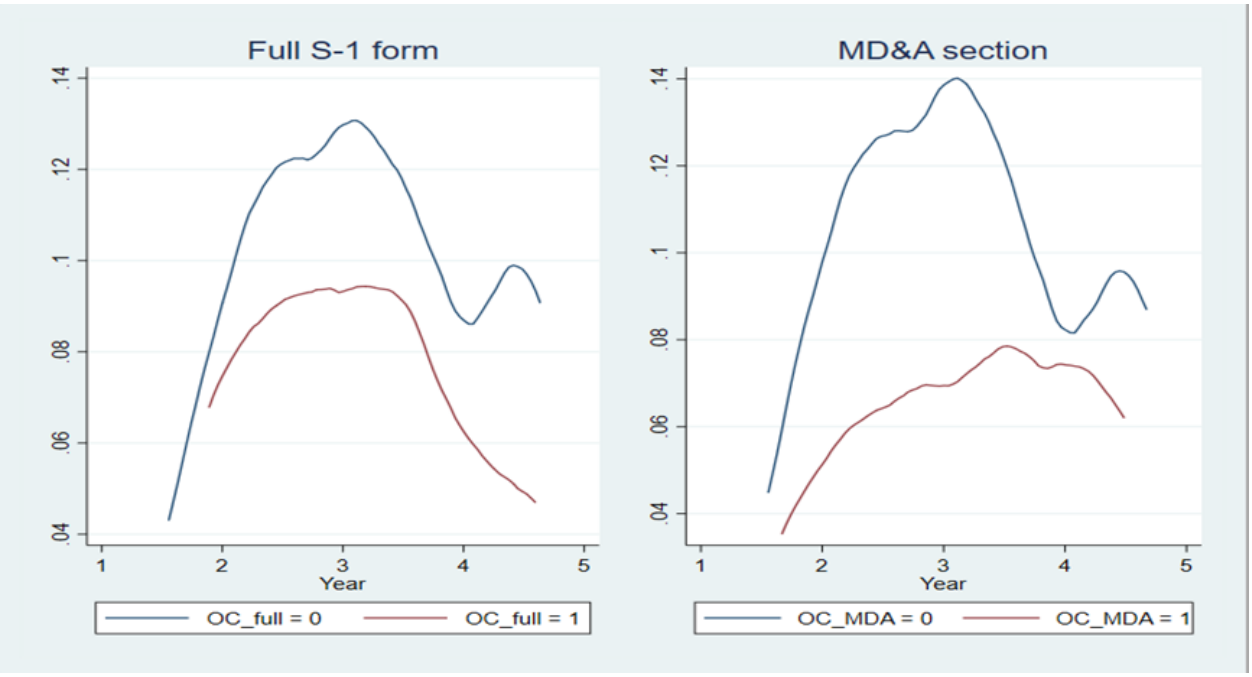

Figure 4 Smoothed hazard estimates

4.2 Main regression results of Cox proportional hazards model

Table 4 and Table 5 presents the results of the Cox proportional hazards model of probability of failure and time-to-failure which assesses the impact of having an overconfident CEO on IPO survival after controlling for various firm-level, IPO-level, and CEO-level factors affecting the IPO survival. Table 4 and Table 5 presents the results considering different sources of confidence including optimism, certainty, and the combination of both. We also report confidence variables measured by full S-1 language in Table 4 and that by MD&A section of S-1 form in Table 5.

In specification (1) of Table 4, the coefficient on OC20 S-1 is negative and significant at the 5% level, indicating that IPO firms with an overconfident CEO have a lower probability of failure and a longer time to survive in the periods following the offering. This result is consistent with our previous finding in the non-parametric analysis that IPO firms with an overconfident CEO survive for a longer period than those with a non-overconfident CEO. The hazard ratio of 0.725 suggests that the failure risk of IPO firms with an overconfident CEO is 72.5% of the failure risk of firms with a non-overconfident CEO. Similar results also in specification (1) of Table 5 when using full S-1 form as a measurement of overconfidence. The coefficient on OC20 MDA is negative and significant at the 5% level, indicating that IPO firms with an overconfident CEO have a lower probability of failure and a longer time to survive in the periods following the offering. The hazard ratio of 0.725 suggests that the failure risk of IPO firms with an overconfident CEO is 72.4% of the failure risk of firms with a non-overconfident CEO.

In specification (2) of Table 4 and Table 5, the coefficients of Certainty20 S-1 and Certainty20 MDA are not significant, indicating that the positive effect of overconfidence on the IPO survival do not come from certainty level but optimism level. This result also consistent with our descriptive analysis, potential reason is there is no difference on certainty word use between survived and failed IPO firms. In specification (3) of both tables, it presents the overall overconfidence level considering both optimism level and certainty level. However,

the coefficient of Average20 MDA is marginally significant and that of Average20 S-1 is not significant. Specification (4) of both tables consider continuous data of optimal level in both full S-1 form and MD&A sections. In table 5, the coefficient of Relative optimisim MDA is significant at 5% level, but the hazard ratio is 0.995 which means the positive effect of Relative optimisim MDA is limited. In table 4, the continuous optimism variable is not significant. This result is consistent with previous research that only certain level of overconfidence can be beneficial to firm value. Specification (5) and (6) further show that certainty level is unrelated to the IPO survival time and IPO failure risk.

Our initial empirical results suggest that higher level of CEO overconfidence can lower the IPO failure risk and increase IPO survival. However, although we find all our measurement of overconfidence suggest a positive effect of CEO overconfidence on IPO survival, the CEO overconfidence seems from their optimism rather than certainty as the coefficient of certainty level is not significant.

Table 4

Estimation of Cox proportional hazards model of the probability of failure time-to-failure

The table illustrates the estimation of the Cox proportional hazards model of the probability of failure and time-to-failure. All regressions control for industry and year-fixed effects whose coefficients are suppressed. All variables are defined in Appendix A. One, two and three asterisks denote statistical significance at the 10%, 5% and 1% levels respectively. The robust z-statistics are shown in parentheses below the coefficient estimates. The hazard ratio (HR) is provided for each regression

	(1)		(2)		(3)		(4)		(5)		(6)	
VARIABLES	Coef.	HR	Coef.	HR	Coef.	HR	Coef.	HR	Coef.	HR	Coef.	HR
OC20 S-1	-0.321**	0.725										
	(-2.19)											
Certainty20 S-1			-0.154	0.857								
			(-1.02)									
Average20 S-1					-0.206	0.814						
					(-1.39)							
Relative optimisim S-1							-0.005	0.995				
							(-0.81)					
Relative certainty S-1									-0.004	0.996		
									(-0.58)			
Relative confidence S-1											-0.071	0.931
											(-0.92)	
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,407	1,407	1,407	1,407	1,407	1,407	1,407	1,407	1,407	1,407	1,407	1,407
Chi2(p-value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 5

Estimation of Cox proportional hazards model of the probability of failure time-to-failure

The table illustrates the estimation of the Cox proportional hazards model of the probability of failure and time-to-failure. All regressions control for industry and year-fixed effects whose coefficients are suppressed. All variables are defined in Appendix A. One, two and three asterisks denote statistical significance at the 10%, 5% and 1% levels respectively. The robust z-statistics are shown in parentheses below the coefficient estimates. The hazard ratio (HR) is provided for each regression.

	(1)		(2)		(3)		(4)		(5)		(6)	
VARIABLES	Coef.	HR	Coef.	HR	Coef.	HR	Coef.	HR	Coef.	HR	Coef.	HR
OC20 MDA	-0.324**	0.724										
	(-2.11)											
Certainty20 MDA			0.056	1.058								
			(0.45)									
Average20 MDA					-0.240*	0.786						
					(-1.75)							
Relative optimisim MDA							-0.005**	0.995				
							(-2.26)					
Relative certainty MDA									-0.002	0.998		
									(-0.44)			
Relative confidence MDA											-0.123*	0.884
											(-1.84)	
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,407	1,407	1,407	1,407	1,407	1,407	1,407	1,407	1,407	1,407	1,407	1,407
Chi2(p-value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

5 Robustness check

Our initial regression analysis uses top 20% of optimism level as a threshold of overconfidence. This definition is consistent with previous research that at least 20% of CEOs are overconfident (Malmendier and Tate, 2008). For robustness check, we use different levels of confidence to gauge the overconfident CEOs. Table 5 provide further robustness check by applying different gauges (10%, 20%, and 30%) of overconfidence for the impact of CEO overconfidence on IPO survival.

In table 6, specification (1) and (4) present the top 10% of optimism level in full S-1 IPO form and MD&A sections. The coefficients of OC10 S-1 (-0.273) and OC10 MDA (-0.240) is negative, and the hazard ratios (0.761 and 0.787) are smaller than 1 which indicates extremely overconfident CEOs can have a positive relationship with a longer IPO survival time and lower IPO failure risk. However, they are not statistically significant. Interestingly, in specification (3) and (6), the coefficients of OC30 S-1 and OC30 MDA are -0.317 and -0.340 with significant level of 5% and 1% respectively, the hazard ratio of overoptimism_full_30 and overoptimism_MDA_30 are 0.728 and 0.712 indicating the IPO failure risk can be decreased to 72.8% and 71.2% if the CEO of IPO firms are overconfident. The overall result of robustness check is consistent with our previous main results and theory of Gervais et al. (2011) and Goel and Thakor (2008) that extremely overconfident CEOs have no impact on firm value, but moderate overconfident CEOs are beneficial for firm value. The results hold in log-rank tests and Schoenfeld residual-based tests for Cox hazard models.

Table 8 reports the regression results of the logit model; the dependent variable is the occurrence of failure within 5 years after the IPO date, which is a dummy variable, 1 presents failure occurred and 0 otherwise. Previous studies introduced initial return as a control variable to control the positive impact of under-pricing on IPO survival (Anagnostopoulou et al., 2021b; Colak et al., 2021; Demers and Joos, 2007). However, initial returns are also outcomes of IPO, it can be highly correlated to other control variables like firm's age and size. Hence, we run separate regressions and the result keep constant. It reports both coefficients

and odd ratio (OR) of each independent variable, specification (2) reports the coefficient of OC20 S-1 is -0.507 with a strong significance at 1% level. Although it suggests a negative relationship between excess optimism and IPO failure occurrence, the economic meaning of the coefficient is ambiguous and difficult to explain. Hence, specification (2) also reports the odd ratio of the binary choice model. The odd ratio of IPO firms with overconfident CEO failed within 5 years is 60.3%, which means if the IPO firms had an overconfident CEO, the failure risk would decrease 39.97%. The results is similar and consistent to Cox hazard regression results in table 6.

Table 8 reports the results of AFT model; the dependent variable is the nature logarithm of the survival time. Columns (1) to (3) report the relationship between the first sets of measurement of CEO overconfidence by using full S-1 language, and the time to IPO failure. The coefficients of the AFT model are semi-elasticity of the average survival time of IPO, the average survival time is increased by 14.9%, 17.7%, and 17.7% by OC10 S-1 , OC20 S-1 , and OC30 S-1 . Similarly, Columns (4) to (6) report the relationship between the second sets of measurement of CEO overconfidence by using MD&A language, and the time to IPO failure.the average survival time is increased by 11.4%, 14.8%, and 15.9% by OC10 MDA, OC20 MDA, and OC30 MDA.

To conduct survival analysis, this study follows strict and robust method to compare all potential models. The AFT model is built on survival time, depending on different assumptions of distribution on time (for example, exponential, Weibull, Gompertz, log-log, log-normal and gamma). The best model is selected by AIC. Firstly, this study estimates the first exponential regression, and the hazard ratio is smaller than 1 (which suggests that overconfident CEO can make the failure rate decreased by 29% compared with non-overconfident CEO). Secondly, this study runs Weibull regression, and it suggests exponential distribution is rejected, so Weibull regression is a better choice, however, the hazard ratio is similar to exponential regression. Thirdly, this study runs the Gompertz regression, and it also rejects the use of exponential regression, the hazard ratio is also similar to previous

models.

Then, this study compares AIC between the Weibull regression and the Gompertz regression, the AIC of the Weibull regression is 1911 and the AIC of the Gompertz is 1994, so the Weibull regression is better. Next, this research runs the log-normal model and the log-logistic model (accelerate time failure models), the log-likelihood of the log-normal model is higher than the log-logistic model, so this research will report the log-normal model. Finally, to consider the frailty (unobserved heterogeneity) in the sample, although the test of unobserved heterogeneity suggests evidence of unobserved heterogeneity, the result of the conditional hazard function seems the same.

Table 6

Estimation of Cox proportional hazards model of the probability of failure time-to-failure

Panel A illustrates the estimation of the Cox proportional hazards model of the probability of failure and time-to-failure. All regressions control for industry and year-fixed effects whose coefficients are suppressed. All variables are defined in Appendix A. One, two and three asterisks denote statistical significance at the 10%, 5% and 1% levels respectively. The test statistics are shown in parentheses below the coefficient estimates. Robust z-statistics in parentheses

	(1)		(2)		(3)		(4)		(5)		(6)	
VARIABLES	Coef.	HR	Coef.	HR	Coef.	HR	Coef.	HR	Coef.	HR	Coef.	HR
OC10 S-1	-0.273	0.761										
	(-1.37)											
OC20 S-1			-0.321**	0.725								
			(-2.19)									
OC30 S-1					-0.317**	0.728						
					(-2.51)							
OC10 MDA							-0.240	0.787				
							(-1.14)					
OC20 MDA									-0.324**	0.724		
									(-2.11)			
OC30 MDA											-0.340***	0.712
											(-2.66)	
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,407	1,407	1,407	1,407	1,407	1,407	1,407	1,407	1,407	1,407	1,407	1,407
Chi2(p-value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Robust z-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 7

The regression results of the logit model

The dependent variable is the delist dummy variable (1 presents the firm failed within 5 years, 0 presents the firm survived within 5 years). All regressions control for industry and year-fixed effects whose coefficients are suppressed. We use robust standard error in our regression. We also run separate regressions with and without initial return. All variables are defined in Appendix A.

	(1)		(2)		(3)		(4)		(5)		(6)	
VARIABLES	raw	OR	raw	OR	raw	OR	raw	OR	raw	OR	raw	OR
OC10 S-1	-0.335	0.715										
	(-1.43)	(-1.43)										
OC20 S-1			-0.507***	0.603***								
			(-2.89)	(-2.89)								
OC30 S-1					-0.488***	0.614***						
					(-3.11)	(-3.11)						
OC10 MDA							-0.322	0.725				
							(-1.22)	(-1.22)				
OC20 MDA									-0.395**	0.674**		
									(-2.13)	(-2.13)		
OC30 MDA											-0.450***	0.638***
											(-2.89)	(-2.89)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,407	1,407	1,407	1,407	1,407	1,407	1,407	1,407	1,407	1,407	1,407	1,407
Pseudo R-squared	0.137	0.137	0.140	0.140	0.141	0.141	0.137	0.137	0.138	0.138	0.141	0.14
F test (p-value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Robust z-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

6 Endogeneity issue instrumental variable test

6.1 Instrumental variable tests

As with other related studies, endogeneity is a potential issue in our setting. Specifically, it is possible that the documented relation stems from an omitted variable (or variables) correlated both with IPO survival and CEO overconfidence. To examine this issue, we undertake an internal instrumental variable estimation to identify the causal effect between CEO overconfidence and IPO survival (Lewbel, 2012). The results of the test support a causal interpretation of the documented relation.

We employ an internal instrumental variable (internal IV) estimation approach developed by Lewbel (2012). Instead of relying on external instruments, Lewbel (2012) approach uses the heteroskedasticity of regression model errors to generate instruments internally from within the existing model. Identification is achieved by having regressors that are uncorrelated with the product of heteroskedastic errors, which is a feature of many models where error correlations stem from an unobserved factor (Lewbel, 2012). This estimation approach has been widely applied across various disciplines and has recently gained momentum in finance research (e.g., Mavis et al., 2020; Hasan et al., 2021; Agca et al., 2022). As Lewbel (2012) points out, this approach is particularly appealing when existing theory provides little guidance on selection of external instruments or when external instruments are not available. The results of this estimation are Table 9 and show that the coefficient of instrumented Conf (OC10 S-1, OC20 S-1, Relative optimisim S-1) is significantly positive at 1%, 1%, and 5% level, the coefficient of instrumented Conf (OC10 MDA, OC20 MDA , Relative optimisim MDA) is significantly positive at 1% level, lending further support to a causal interpretation of the documented relation.

Table 8

Lognormal AFT regression

The table illustrates the estimation of the Accelerate Failure Time (AFT) model of the natural logarithm of time to failure. All regressions control for industry and year-fixed effects whose coefficients are suppressed. All variables are defined in Appendix A. The dependent variable is the logarithm of time to failure. One, two and three asterisks denote statistical significance at the 10%, 5% and 1% levels respectively. The test statistics are shown in parentheses below the coefficient estimates.

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	time	time	time	time	time	time
OC10 S-1	0.149*					
	(1.74)					
OC20 S-1		0.177***				
		(2.74)				
OC30 S-1			0.177***			
			(3.14)			
OC10 MDA				0.114		
				(1.32)		
OC20 MDA					0.148**	
					(2.24)	
OC30 MDA						0.159***
						(2.83)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,407	1,407	1,407	1,407	1,407	1,407
Chi2(p-value)	0.000	0.000	0.000	0.000	0.000	0.000

z-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 9
Lewbel (2012) Instrumental Variable Estimation

VARIABLES	(1) Failure1	(2) Failure1	(3) Failure1	(4) Failure1	(5) Failure1	(6) Failure1	(7) Failure1	(8) Failure2
OC10 S-1	-0.117***							
	(-4.39)							
OC20 S-1		-0.111***						
		(-4.23)						
OC30 S-1			-0.054					
			(-1.12)					
Relative optimisim S-1				-0.005**				
				(-2.09)				
OC10 MDA					-0.118***			
					(-4.28)			
OC20 MDA						-0.103***		
						(-3.14)		
OC30 MDA							-0.041	
							(-0.59)	
Relative confidence MDA								-0.014***
								(-2.59)
Observations	1,407	1,407	1,407	1,407	1,407	1,407	1,407	1,407
R-squared	0.156	0.159	0.157	0.151	0.156	0.157	0.159	0.245
$R^2\_adjusted$	0.121	0.125	0.122	0.116	0.122	0.122	0.125	0.215
Cragg-Donald Wald F statistic	46.86	14.18	3.898	2.700	35.47	6.937	1.112	42.09
Kleibergen-Paap LM statistic	225.6	457.7	159.7	57.49	224.9	467.1	72.71	455.1
P-value (LM statistic)	0.000	0.000	0.000	0.347	0.000	0.000	0.0456	0.000
Hansen J statistic	55.34	68.55	84.51	60.00	48.23	65.64	54.08	43.10
P-value (Hansen J statistic)	0.386	0.074	0.004	0.237	0.660	0.114	0.433	0.832

Robust z-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

6.2 PSM average treated effects on treated (ATET)

This section illustrates how we applies PSM to moderate reverse causality issues in our research. The research aims to determine the impact of CEO overconfidence on IPO survival; however, it also could be the overconfident CEO are attracted by firms with better performance. The research use PSM to match the IPO failure of firms with overconfident CEO from firms with non-overconfident CEO and vice versa. As reported by table 8, we use AI robust standard error to receive more reliable results. The difference between treatment groups (overconfident CEO (OC)) and control groups (non-overconfident CEO (non-OC)) are significant and negative which means the control groups have a higher level of IPO failure and firms with overconfident CEOs have a lower level of failure hazard and higher level of survival rate.

The average treatment effects of the treated (ATET) are all negative and significant for all measurement of CEO overconfidence excepting OC10 S-1, and OC10 MDA is marginally significant at 10% level. The ATET of OC20 S-1 and OC20 MDA is -0.079 and -0.1241 respectively and strongly significant at 1% level suggesting firms with overconfident CEO are more likely to have a lower failure risk. Moreover, OC30 S-1 and OC30 MDA are -0.053 and -0.1118 with significant level at 5% and 1% level. Negative treatment effect means the average failure rate in treatment groups (OC) is smaller than that in control groups (non-OC).

Table 10

Endogeneity control – Propensity score matching.

The table illustrates the analysis of the effect of overconfident CEOs on the occurrence of delisting in the five-year period subsequent to the offering. The variables used for matching include initial return, market-to-book, leverage, R&D, advertising, firm age, underwriter quality, big 4, CEO age, CEO gender, CEO duality, CEO MBA, CEO PhD, insider ownership, earning management, and crisis period. All variables are defined in Appendix A. The test statistic is shown in parentheses below the coefficient estimate. One, two and three asterisks denote statistical significance at the 10%, 5% and 1% level respectively. We use Abadie-Imbens (AI) robust standard errors to estimate the treatment effects. Our match method is k-nearest neighbour matching with 5 neighbours.

	(1)	(2)	(3)	(4)	(5)	(6)
	OC10 S-1	OC20 S-1	OC30 S-1	OC10 MDA	OC20 MDA	OC30 MDA
ATET	-0.051	-0.079***	-0.053**	-0.0794*	-0.1241***	-0.1118***
OC vs non-OC	(-1.43)	(-2.81)	(-1.96)	(-1.90)	(-3.91)	(-3.79)

Robust z-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

7 Mechanism

This section reports two channel analyses based on previous studies, serving for identify causal effect of CEO overconfidence on IPO survival. We found that CEO overconfidence is positively related to the IPO survival and this section provides further evidence that the positive effect of CEO overconfidence on IPO survival is more pronounced in firms with higher R%D inputs and after the introduction of Sarbox through heterogeneity tests.

Firstly, CEO overconfidence is a key contribution on firms' innovative outputs and inputs (Galasso and Simcoe, 2011; Hirshleifer et al., 2012) as well as firms' stock price increase (Bharati et al., 2016). One unit of R&D input will lead more outcomes and will increase the firm value if the CEO is overconfident. Secondly, Goel and Thakor's (2008) theory indicates that CEO will reduce project investment due to the impact of Sarbanes-Oxley Act 2002. The major negative behaviour of overconfident is over-investment because they overestimate the future performance of their investment projects (Malmendier and Tate, 2015a). If the over-investment behaviour is moderated by Sarbanes-Oxley Act, the positive impact of CEO overconfidence can be enhanced. The findings also support the arguments that higher level of R&D expenditure and Sarbanes-Oxley Act enhance the positive impact of CEO overconfidence.

7.1 R&D and overconfidence

Hirshleifer et al. (2012) find that the overconfidence CEO can bring firm more innovative inputs and outputs, which means CEO confidence can increase the firm value by achieve higher innovative success based on given research and development expenditure. CEO overconfidence can lead a firm greater level of innovative success by creating more patents and citations. Moreover, overconfident CEO are likely to promote innovation and bring the creation of firm value (Galasso and Simcoe, 2011). They find a significant positive relationship between CEO overconfidence and patent counts. Overconfident CEO, although they prefer

risky projects, promote innovative projects which could bring firms more opportunity and value creation. Overconfidence can boost firm's innovative projects and hence bring firms more value by more investing in R&D, hence we predict that higher level of R&D expenditure can increase the firms' value.

Table 11 reports the heterogeneity test results considering R&D level. The coefficient of OC20 S-1 from high R&D investment is -0.855 and significant at 1% level, which is lower than that from baseline model, -0.321. The coefficient of OC20 S-1 from low R&D level is -0.009 and not significant. This result suggests that the positive effect of CEO overconfidence is more pronounced in sub-sample of higher R&D, which confirms our argument that overconfident CEO can increase the IPO survival by boosting innovating investment. Moreover, the coefficients of interaction term OC*R&D in sample of Full S-1 language is -3.396 with a significance of 10% which suggest R&D inputs is negatively related to the marginal effect of CEO overconfidence on IPO failure. The coefficients of interaction term OC*R&D in sample of MD&A section is -2.402 with a significance of 10% which is consistent with our results above. Our results suggest that R&D inputs have moderate effect on the effect of CEO overconfidence on IPO survival which is consistent to the theories of Hirshleifer et al. (2012).

Table 11

Channel analysis based on interaction term and group regression (R&D)

The table illustrates the estimation of the Cox proportional hazards model of the probability of failure and time-to-failure. All regressions control for industry and year-fixed effects whose coefficients are suppressed. All variables are defined in Appendix A. One, two and three asterisks denote statistical significance at the 10%, 5% and 1% levels respectively. The test statistics are shown in parentheses below the coefficient estimates.

	Full S-1 language						**MD&A section**					
			High R&D		Low R&D				High R&D		Low R&D	
	(1)		(2)		(3)		(4)		(5)		(6)	
VARIABLES	Ceof.	HR	Ceof.	HR	Ceof.	HR	Ceof.	HR	Ceof.	HR	Ceof.	HR
OC*R&D	-3.396*	0.034					-2.402*	0.091				
	(-1.90)						(-1.94)					
OC20 S-1	-0.071	0.931	-0.855***	0.425	-0.009	0.991						
	(-0.40)		(-3.03)		(-0.05)							
OC20 MDA							-0.064	0.938	-0.514**	0.598	-0.213	0.808
							(-0.34)		(-2.26)		(-1.00)	
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,407	1,407	704	704	703	703	1,407	1,407	704	704	703	703
Chi2(p-value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Robust z-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

7.2 Sarbanes-Oxley Act and overconfidence

Banerjee et al. (2015) empirically analyse the effect of CEO overconfidence on shareholders, and they find positive effect of CEO overconfidence on shareholders by using Sarbox as a natural experiment. They find, after Sarbox was published, overconfident CEOs reduce investment and risk exposure, increase dividends, improve post-acquisition performance, and have better operating performance and market value. Importantly, these changes are absent for overconfident-CEO firms that were compliant prior to Sarbox.

Goel and Thakor's (2008) theory model suggests Sarbox has two potential effects on CEO overconfidence: It increases the precision of the information provided by the CEO to investors, and it reduces aggregate corporate investment. Overinvestment has been regarded as a major negative effect of overconfidence which leads a higher corporate risk and a lower firm performance. If Sarbox can limit bad behaviour (such as over-investment and earning management) and improve firm performance, the IPO leaded by overconfident CEO would have higher survival rate after Sarbox.

Table 12 reports the regression results before and after Sarbox act. The coefficient of OC20 S-1 before Sarbox is -0.158 and not significant, the hazard ratio is 0.854 which is higher than that in baseline model (0.725). Interestingly, the coefficient of OC20 S-1 after Sarbox is -0.765 and significant at 1% level, the hazard ratio is 0.465 which is smaller than that in the baseline model (0.725) suggesting that the effect of CEO overconfidence is more pronounced after the publication of Sarbox compared with the baseline model. The coefficient of OC20 MDA before Sarbox is -0.050 and not significant, while the coefficient of OC20 MDA after Sarbox is -0.930 and significant at 1% level which is consistent with sample of full S-1 language.

The coefficients of interaction term between CEO overconfidence and Sarbox (OC*Sarbox) in sample of Full S-1 language and MD&A section are -0.694 and –0.704 respectively, which are negative and significant at 5% level, suggesting that introduction of Sarbox have a positive effect on marginal effect of CEO overconfidence on IPO survival (or have a negative

effect on on marginal effect of CEO overconfidence on IPO failure). The results is consistent with our prediction and theories mentioned above, and further confirm the causal effect of CEO overconfidence on IPO survival

Table 12

Channel analysis based on interaction term and group regression (SOX)

The table illustrates the estimation of the Cox proportional hazards model of the probability of failure and time-to-failure. All regressions control for industry and year-fixed effects whose coefficients are suppressed. All variables are defined in Appendix A. One, two and three asterisks denote statistical significance at the 10%, 5% and 1% levels respectively. The test statistics are shown in parentheses below the coefficient estimates.

	Full S-1 language						**MD&A section**					
			After SOX		Before SOX				After SOX		Before SOX	
	(1)		(2)		(3)		(4)		(5)		(6)	
VARIABLES	Ceof.	HR	Ceof.	HR	Ceof.	HR	Ceof.	HR	Ceof.	HR	Ceof.	HR
OC*Sarbox	-0.694**	0.499					-0.704**	0.495				
	(-2.09)						(-2.18)					
OC20 S-1	-0.123	0.884	-0.765***	0.465	-0.158	0.854						
	(-0.69)		(-2.59)		(-0.84)							
OC20 MDA							-0.039	0.962	-0.930***	0.395	-0.050	0.951
							(-0.20)		(-3.36)		(-0.24)	
SOX	-1.820*	0.162					-1.766*	0.171				
	(-1.72)						(-1.69)					
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,407	1,407	852	852	555	555	1,407	1,407	852	852	555	555
Chi2(p-value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Robust z-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

8 Conclusion

In this study, we examine the effect of CEO overconfidence on IPO. We provide robust evidence of a positive relation between CEO overconfidence and IPO survival. Our results suggest that the behind mechanism are likely to be R&D inputs and introduction of Sarbox. Our further analysis reveal that the documented effect is amplified after the introduction of Sarbox and is more pronounced among firms with higher level of R&D inputs.

Our study extends the literature on both CEO overconfidence and IPO survival by casting CEO overconfidence as an important factor of IPO survival. Our findings also bear implications for practitioners, suggesting that corporate board members should be mindful of the positive effect of CEO overconfidence on IPO survival when assessing the cost-benefit balance of employing overconfident CEO.

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