Exploring the predictive ability of cost asymmetry on bankruptcy

Abstract

This study explores whether cost asymmetry intensity affects bankruptcy predictions. Cost asymmetry is positively associated with adjustment costs, empire-building behaviours, and managerial optimism. These factors may reduce resource availability, liquidity, and earnings predictability, increasing the likelihood that a firm will exhibit liquidity issues and subsequently file for bankruptcy. A high level of cost asymmetry implies additional financing requirements owing to a high volume of idle resources that are less likely (or more costly) to be satisfied by retained earnings or funds from the capital market. In addition, an elevated level of cost stickiness driven by intense empire-building behaviour consumes valuable resources and signals weaker corporate governance mechanisms and auditing efficiency. Finally, increased managerial optimism indicates an increased risk to future operating performance. Using 22,728 firm-year observations of publicly listed US firms over the period 1990-2020, we provide empirical evidence that the level of cost asymmetry is incrementally useful for bankruptcy prediction. The fundamental factors of cost asymmetry, including adjustment costs and managerial incentives, appear to reinforce its ability to predict corporate bankruptcy. Additional robustness tests reveal that our empirical results remain robust against (i) different fluctuations in sales revenue, (ii) the effects of financial constraints on the intensity of cost asymmetry, (iii) managerial and firm-specific characteristics, and (iv) the propensity score for cost asymmetry in partitioned samples.

Keywords: Asymmetric Cost Behaviour, Cost Asymmetry, Bankruptcy Prediction, Going Concern.

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1. Introduction

The risk of going bankrupt is of considerable interest to shareholders, creditors, and stakeholders. Bankruptcy is a state of insolvency wherein a firm or an individual is not able to repay the creditors the debt amount. A significant body of accounting literature examines the ability of a plethora of factors to cause this failure (Altman 1968; Beaver 1966; Beaver et al. 2005; Bharath and Shumway 2008; Chava and Jarrow 2004; Jones and Johnstone 2012; Shumway 2001; Zmijewski 1984). In the current study, we investigate whether the intensity of cost asymmetry matters for bankruptcy prediction.

An emerging stream in the field of cost accounting, and especially in cost behaviour literature, shows that, on average, costs exhibit asymmetric cost behaviour; that is, the response of variable costs is not symmetric towards the direction of operating activity change (Anderson et al. 2003; Ballas et al. 2022; Banker et al. 2013; Banker and Byzalov 2014; Liu et al. 2019; Venieris et al. 2015). The response of a variable cost to the direction of operating activity change is not symmetric when the decrease in the level of a variable cost is lower (higher) for decreasing than its corresponding increase for increasing (in absolute terms) activity levels. Cost asymmetry has been examined through different cost categories

(e.g. Anderson et al. 2003; Ballas et al. 2022; Shust and Weiss 2014; Venieris et al. 2015) and different national settings or industries (e.g. Anderson et al. 2003; Balakrishnan et al. 2008; Cannon 2014; Dierynck et al. 2012; Kama and Weiss 2013; Prabowo et al. 2018).

Asymmetric cost behaviour is attributed to a deliberate managerial commitment to retain unutilised resources when sales revenue decreases. Managerial decisions to maintain or dispose of idle resources when operating activity declines are driven by the level of adjustment costs, managerial expectations for future operating activity, how managers evaluate the economic implications of adjustment costs on a firm's operating performance (Anderson et al. 2003; Banker et al. 2014; Banker et al. 2018), and personal welfare (Chen et al. 2012). The above theorisis on the mechanisms that govern the manifestation of cost asymmetry empowers accounting literature with considerable interest in understanding the determinants or key drivers of asymmetric cost behaviour (e.g. Anderson et al. 2003; Ballas et al. 2022; Chen et al. 2012; Holzhacker et al. 2015; Venieris et al. 2015), as well as its relationship with earnings behaviour and other economic phenomena (e.g. Banker and Chen 2006; Banker et al. 2016; Dierynck et al. 2012; Hall 2016; Kama and Weiss 2013; Weiss 2010).

Asymmetric cost behaviour is positively associated with risk for investors and creditors because deliberate decisions to maintain idle resources after sales revenue decrease restrain cash liquidity cushions, increase earnings volatility, and deteriorate the information quality of earnings. Firms with increased cost stickiness are anchored by reduced future earnings and cash flow predictability (Weiss 2010) and increased analysts' forecast error (Weiss 2010; Cifti et al. 2016), which deteriorates the quality of information available to investors and increases stock price delays (Agarwal 2022). In addition, cost stickiness increases cash flow volatility and the cost of equity, which, in turn, has a decreasing effect on firm value (Costa and Habib 2023). Asymmetric cost behaviour is also considered an additional risk factor for creditors. Cost stickiness increases bank loan spreads (Kim and Zhou 2023) and bond risk premiums (Chou et al. 2018). Creditors may affect the manifestation of asymmetric cost behaviour through credit default swap (CDS) initiation (Dai et al. 2023). While creditors might control some empire-building behaviours, it is unclear if their monitoring can effectively offset the inefficiencies of corporate governance mechanisms and auditors in controlling opportunistic managerial actions.

Bankruptcy prediction models use as inputs in their analysis various financial and market-based factors (Shumway 2001; Beaver et al. 2005, 2012, 2019). Despite the relative importance of profitability financial ratios among bankruptcy prediction factors, no empirical evidence associates the intensity of asymmetric cost behaviour with the likelihood of bankruptcy. Exploring this association is significant for several reasons. First, asymmetric cost behaviour is considered an additional risk factor for creditors (Chou et al. 2018, Dai et al. 2023, Fang 2023, Kim and Zhou 2023) as it increases earnings volatility, decreases liquidity, and deteriorates the information quality of earnings. Moreover, creditors' concerns are further justified by the fact that managerial deliberate resource commitment decisions associated

with asymmetric cost behaviour may reflect same internal firm-specific characteristics that drive business failure: managerial mistakes, incompetence, and inefficient corporate governance mechanisms (Argenti 1976). However, there is no direct empirical evidence for the association of cost stickiness with future bankruptcy. Second, prior literature emphasizes the underlying agency driver of cost stickiness and creditors' ability to restrict its intensity to reduce adverse effects of cost stickiness on a firm's financial health and value (Costa and Habib 2021, Costa and Habib 2023, Dai et al., 2023). However, asymmetric cost behaviour may also reflect operating decisions driven by inherent firm-specific characteristics associated with value-generating activities (e.g. Venieris et al. 2015, Ballas et al. 2022). In this case, any exogenous attempt by creditors to restrict its intensity may undermine a firm's long-term cash flow-generating ability, potentially increasing financial risk, earnings volatility, and liquidity issues despite the creditors' intentions.

Managerial decisions to maintain or dispose of idle resources when operating activity declines are driven by the level of adjustment costs, managerial expectations for future operating activity, and agency issues arising from empire-building behaviour (Banker and Bylazov 2014, Banker et al. 2018). An increased level of cost asymmetry implies the presence of high adjustment costs and increased requirements for financing the maintenance of a high volume of idle resources in the event of a decline in sales revenue (Anderson et al. 2003; Banker et al. 2014; Banker and Bylazov 2014; He et al. 2020). Simultaneously, as firms exhibit higher cost stickiness, their additional financing requirements due to the high volume of idle resources become less likely (or more costly) to be satisfied by retained earnings or funds from the capital market. As previously mentioned, increased cost asymmetry increases earnings volatility (Chung et al. 2019; Liu et al. 2019; Zhang et al. 2019) and credit spreads (Kim and Zhou 2023, Chou et al. 2018).

Another critical driver of the intensity of cost stickiness is empire-building behaviour (Banker and Byzalov 2014; Chen et al. 2012). An elevated level of cost stickiness driven by intense empire-building behaviour is value-destroying; it consumes valuable resources and may restrict a firm's liquidity. In addition, corporate governance mechanisms (e.g. Chen et al. 2012; Chung et al. 2019; Hartlieb et al. 2020; Ibrahim 2018; Liang et al. 2014) and auditors (Cai et al. 2019; Höglund and Sundvik 2019; Liang et al. 2014) are relatively less efficient in controlling opportunistic managerial behaviour.

An increase in managerial optimism for future operating performance increases the intensity of asymmetric cost behaviour (Banker and Bylazov 2014, Banker et al. 2018), which indicates an increased risk of future operating performance (Banker and Chen 2006). Managers seem to recognise increased earnings volatility due to the presence of cost asymmetry, as cost stickiness increases the likelihood that a firm will issue management earnings forecasts (Cifti and Salama 2018; Han et al. 2020). However, managers fail to capture the exact impact of cost asymmetry on their forecasts (Cifti and Salama 2018).

The above analysis indicates that intense cost asymmetry is associated with factors that may deteriorate resource availability, liquidity, and operating profitability, increasing the likelihood of a firm exhibiting liquidity issues and subsequently filing for bankruptcy. Thus, we hypothesise that the intensity of cost stickiness is positively associated with the likelihood of a firm filing for delisting for bankruptcy or liquidity issues.

Following prior research (Beaver et al. 2005; Shumway 2001), we employ discrete-time hazard models to interpret the ability of cost asymmetry to predict bankruptcy. Using 22,728 firm-year observations of publicly listed US firms over the period 1990-2020, we provide empirical evidence that the level of cost asymmetry is incrementally useful for bankruptcy prediction.

In an additional analysis, we rationalise the relationship between asymmetric cost behaviour and bankruptcy prediction through the lens of the principal determinants of cost asymmetry, such as (i) the magnitude of economic activity change, (ii) the level of adjustment costs and unused resources, and (iii) the intensity of empire-building behaviour. Our findings indicate that cost asymmetry and its ability to predict bankruptcy are more acute in firms with high investments in employees and in firms associated with high managerial incentives to manage earnings. Furthermore, the observed relationship between cost asymmetry and default risk is also attributed to the influence of adjustment costs, which hinder firms' ability to adapt efficiently to changing circumstances. Specifically, firms with lower asset intensity may encounter fewer obstacles, such as collateral requirements, in managing adjustment costs, thereby enhancing the discernible predictive ability of cost asymmetry. Evaluating these findings for diverse types of economic activity changes and levels of unused resources did not seem to affect the validity of our empirical results.

We also examine whether the presence of cost asymmetry affects the quality of auditing services, particularly auditors' ability to issue going concern. Cost asymmetry seems to influence auditors' opinions of a firm's ability to continue as going concern. We provide corroborating evidence to Mayew et al. (2015) that auditors should emphasise both qualitative and quantitative information when issuing going concern opinions. Additional robustness tests reveal that our empirical results remain robust against (i) the effects of financial constraints and managerial characteristics on the primary relationship between cost asymmetry and bankruptcy, (ii) alternative econometric specifications and proxies for cost asymmetry and corporate bankruptcy, and (iii) the propensity score for cost asymmetry in partitioned samples.

This study contributes to the literature on bankruptcy and cost asymmetry. First, it contributes to the literature on bankruptcy predictions and default risk. To the best of our knowledge, this is the first study to examine the usefulness of cost behaviour and cost decisions in bankruptcy predictions and going-concern assessments (Beaver et al. 2005; Blay et al. 2011; Beaver et al. 2012; Bauer and Agarwal 2014; Carson et al. 2013; Desai et al. 2017; Kausar et al. 2009; Mayew et al. 2015; Mutchler 1985;

Shumway 2001). Since costs are the principal driver of firm profitability, it is crucial to understand how managers' deliberate resource commitment decisions, which trigger asymmetric cost behaviour, can predict default at horizons greater than one year. Our results corroborate prior research, underscoring the significance of resource adjustment decisions, which incorporate managerial expectations regarding future sales, in the development and assessment of cost asymmetry (Anderson et al. 2003; Chen et al. 2012; Banker and Byzalov 2014; Chen et al. 2019). Second, we extend the scarce literature on the economic consequences of asymmetric cost behaviour in earnings prediction and equity valuation (Banker et al. 2013; Banker et al. 2016; Weiss 2010). The role of cost behaviour in default predictions has likely been neglected in the literature on asymmetric cost behaviours. Our results corroborate previous research, underscoring the significance of resource adjustment decisions, which incorporate managerial expectations regarding future sales, in the development and assessment of cost asymmetry (Anderson et al. 2003; Chen et al. 2012; Banker and Byzalov 2014; Chen et al. 2019). This is a considerable consequence, as extant scholarly (e.g. Chen et al. 2012; Banker and Byzalov 2014) posit that cost stickiness manifests either from a value-driven approach to resource planning (economic rationale) or from non-value-driven motivations, such as agency or behavioural factors. In the context of bankruptcy prediction, we emphasise both approaches to cost asymmetry and provide evidence that firms with high cost asymmetry are more likely to file for bankruptcy.

Our empirical findings may be of use to managers, regulators, and professional communities of auditors, investors, and financial analysts, who could include the intensity of cost asymmetry in their bankruptcy prediction models. Cost asymmetry stemming from managerial resource adjustment decisions increases earnings volatility and intensifies earnings forecast errors (Ciftci et al. 2016; Ciftci and Salama 2018; Kaspereit and Lopatta 2019), as well as signifying higher operating risk (Anderson et al. 2013; Kuiate and Noland 2019; Xu and Zheng 2020). Thus, cost asymmetry increases the likelihood that a firm will file for delisting for bankruptcy or liquidity. Our empirical results are consistent with these findings.

The remainder of this paper is organised as follows: Sections 2 and 3 describe the background and hypotheses of the analysis. In Section 4, we describe the methodology and data selection process. Section 5 outlines the empirical results. We conduct additional analyses and robustness tests in Sections 6 and 7, respectively. Finally, section 8 concludes the study.

2. Background

2.1. Predicting bankruptcy

Bankruptcy is a state of insolvency wherein a firm or an individual is not able to repay the creditors the debt amount. According to Altman (1993), bankruptcy refers to a situation in which a firm's net worth is negative, or to a more observable way in the case that a firm or organisation has formally declared bankruptcy by filing a legal bankruptcy petition.

The initial theory of bankruptcy relies on the prediction that bankruptcy occurs if a firm generates high losses that cause negative equity; thus, the critical parameters affecting the risk of bankruptcy are profitability, variance of profitability, and solvency (Scott 1981). Altman (1993) added two other conditions that may lead a firm to failure: (i) the firm's realised return on invested capital is significantly lower than the return rates of similar investments, or (ii) the firm's average return on investment is below its cost of capital. These theories are in line with Beaver's (1966) theory for insolvency. A firm is a reservoir of liquid assets supplied by inflows and drained by outflows. As the reservoir of liquid assets decreases, the likelihood of insolvency increases. Furthermore, lower levels of profitability lead to increased requirements for debt financing, which generates even higher cash outflows and increases the likelihood of insolvency. The literature has devoted considerable effort to identifying factors that may cause bankruptcy and developing models to predict bankruptcy. The following sections briefly analyse the determinants and predictive models of bankruptcy.

2.1.1. Determinants of bankruptcy

Bankruptcy is a form of business failure, and there is a plethora of factors that may cause this failure. These factors may be internal, such as defects and mistakes, managerial incompetence, high financial leverage, extensive sales discounts, defects in accounting and internal control systems, and the failure to effectively respond to changes in the business environment (Argenti 1976). Additionally, several macroeconomic and industry-related factors may increase the likelihood of bankruptcy (Altman 1993). The literature (Beaver et al. 2012; Fabozzi et al. 2010; Jones 2017) categorises the main determinants of corporate bankruptcy into three groups: accounting, market-based, and non-financial variables.

Accounting-based measures are widely documented in bankruptcy prediction and default risk-related literature (Altman 1968; Beaver 1966; Zmijewski 1984). Several accounting proxies, such as working capital, cash flow, earnings, and financial leverage, have been proven to have predictive power for corporate bankruptcy. The literature also includes the magnitude of reductions in capital expenditure and dividend payments as significant contributors to the manifestation of bankruptcy (DeAngelo and DeAngelo 1990; Jones 2017).

Another major research stream investigates the effects of market-driven variables on the likelihood of bankruptcy (Beaver et al. 2005; Bharath and Shumway 2008; Chava and Jarrow 2004; Shumway, 2001). Examples of market-related variables include market capitalisation, market-to-book ratio, abnormal stock returns, and price volatility. The market value of equity is primarily related to the equity cushion and represents the amount by which the value of assets can be reduced prior to being sufficient to cover the present value of debt payments (Jones 2017). Furthermore, bankrupt firms face abnormal stock returns before bankruptcy (Dichev 1998; Frino et al. 2014).

Recently, scholars have combined accounting- and market-driven variables to increase the explanatory power of bankruptcy prediction models (Beaver et al. 2005; Beaver et al. 2012; Shumway, 2001). Relying solely on accounting- and market-driven variables to specify bankruptcy prediction models has certain limitations. For instance, accounting variables are backward-looking and may not capture volatility effects, which can predict bankruptcy models (Beaver et al. 2005). However, market price indicators are conditional on capital markets (Sloan, 1996), which cannot capture all the publicly available information.

In addition to accounting- and market-based variables, many other non-financial variables may provide incremental information on bankruptcy predictions. For instance, Precourt and Oppenheimer (2013) and Ramalingegowda (2014) show that long-horizon institutions and institutional investors are better informed and start selling stocks before bankruptcy. Clarke et al. (2006) and Jones and Johnstone (2012) examine the relationship between corporate bankruptcy and analysts' recommendations. Analysts rarely modify their forecasts or recommendations for failing enterprises. Finally, Beaver et al. (2012) and Franzen et al. (2007) document the importance of unreported intangible assets in the predictive power of bankruptcy models. Particularly, the bankruptcy prediction ability of the models is lower for firms with highly unreported intangible assets.

According to Altman (1993), internal firm-specific characteristics are the fundamental causes of business failure. From the discussion above, it seems that prior literature provides little empirical evidence on how observable managerial characteristics regarding firms' cost structures may provide incremental information on bankruptcy prediction.

2.1.2. Bankruptcy models

Various bankruptcy prediction models have been proposed. Beaver (1966) introduced a univariate analysis to document the bankruptcy predictive ability of various financial ratios. Altman (1968) introduced multiple discriminant analysis techniques to determine bankruptcy probability by employing five financial ratios. Multiple discriminant analysis has been adopted by other researchers (e.g. Alman et al. 1977; Deakin 1972; Edmister 1972). Later, logit (Ohlson 1980) and probit (Zmijewski 1984) models were introduced as econometric approaches for predicting bankruptcy.

Shumway (2001) was the first to assess bankruptcy using accounting and market data in a simple discrete-time logit model (e.g. hazard model). Similarly, Chava and Jarrow (1994) use profitability, liquidity, and market value to reflect accounting- and market-based variables. A major strand of the literature examines the forecasting accuracy of hazard models compared to accounting-based models, providing evidence that the former shows theoretical superiority and explanatory power (Bauer and Agarwal 2014; Charalambakis et al. 2009; Chava and Jarrow 1994; Shumway 2001).

In addition to statistical analysis, prior studies utilised machine learning-oriented intelligent algorithms, such as neural networks (Lennox 1999), genetic algorithms (Shin and Lee 2002), and

gradient boosting models (Jones 2017), to predict failure. Machine learning approaches appear to be anchored with better prediction power than traditional statistical techniques (Barboza et al. 2017). In addition to traditional statistical methods and intelligent systems, the literature proposes various theoretical approaches for bankruptcy prediction that utilise specific qualitative firm characteristics (Aziz and Dar 2006).

2.2. Asymmetric cost behaviour

A growing body of empirical research has documented the presence of asymmetric cost behaviour (e.g. Anderson et al. 2003; Banker et al. 2013; Calleja et al. 2006). Asymmetric cost behaviour is observed when the response of a variable cost is not symmetric in the direction of the change in operating activity (increase or decrease). The decrease in the level of variable cost is lower (higher) for decreasing than its corresponding increase for increasing (in absolute terms) activity levels.

This cost behaviour has been attributed to deliberate managerial resource commitment decisions to maintain idle resources when operating activities decline (Anderson et al. 2003; Noreen 1991). Managerial decisions to maintain or dispose of idle resources when operating activity declines are driven by the level of adjustment costs and how managers evaluate the economic implications of adjustment costs on their firms' operating performance and personal welfare (Banker and Bylazov 2014).

Adjustment costs increase when managers decide to change the available resource capacity due to changes in operating activities. On average, the adjustment costs are higher when the available resource capacity decreases than when it increases (He et al. 2020). When demand decreases, managers retain idle capacity if the adjustment cost is higher than the retaining cost. Managers continue to retain their idle capacity until they are indifferent to retaining or removing the marginal resource unit (Banker and Byzalov 2014). Managers' evaluation of the economic implications of adjustment costs is driven by numerous factors, of which the literature considers two as the most critical: empire-building behaviour and managerial expectations for future sales (Anderson et al. 2003; Banker and Byzalov 2014). The above view of the mechanisms that govern the manifestation of cost asymmetry has served as the theoretical background for a plethora of research initiatives that have explored the effects of several factors affecting the intensity and direction of cost asymmetry (e.g. Anderson et al. 2003; Ballas et al. 2022; Chen et al. 2012; Holzhacker et al. 2015; Venieris et al. 2015) or the relationship between cost asymmetry and earnings behaviour and other economic phenomena (e.g. Banker and Chen 2006; Banker et al. 2016; Dierynck et al. 2012; Hall 2016; Kama and Weiss 2013; Weiss 2010).

3. Research motivation and hypothesis development

Bankruptcy prediction models utilise a variety of prediction factors. The most important bankruptcy prediction tools are financial ratios and cash flow analyses (Fabozzi et al. 2010). Specifically, accounting-based financial ratios measuring profitability, liquidity, and solvency (Altman 1968) represent most bankruptcy prediction factors. However, the existing literature employs as bankruptcy predictor variables non-ratio financial information (e.g. firm size), market-based information (e.g. stock price volatility), macroeconomic information (e.g. economic slowdown), and other non-financial information (e.g. managerial ability) (Altman et al. 1977; Campbell et al. 2008; Derwall and Verwijmeren 2010; Hall 1994).

Despite the relative importance of profitability financial ratios among bankruptcy prediction factors, no empirical evidence associates the intensity of asymmetric cost behaviour with the likelihood of bankruptcy[1]. Exploring the association of cost stickiness with future bankruptcy is significant for several reasons. First, asymmetric cost behaviour is considered an additional risk factor for creditors Chou et al. 2018, Dai et al. 2023, Kim and Zhou 2023), but there is no direct empirical evidence for the association of cost stickiness with future bankruptcy. If a firm maintains excess cost stickiness, lenders may require additional ex-ante compensation and increased ex-post borrower monitoring. As a result, bank loan spreads increase with cost stickiness (Kim and Zhou 2023) and bond issuers with stickier cost behaviour pay higher risk premiums (Chou et al. 2018). Creditors affect the manifestation of asymmetric cost behaviour. For instance, credit default swap (CDS) initiation is associated with a decline in firms' cost stickiness (Dai et al. 2023) because CDS contracts shift bargaining power from borrowers to creditors. In addition, Fang et al. (2023) provide evidence that, after the inception of CDS trading, reference firms exhibit an increase in the elasticity of the cost structure. This increase is more pronounced for firms with greater credit risk and more restrictive covenants and for financially constrained firms that face greater product market competition and provide higher convexity in managerial compensation. Despite creditors' concerns for the implications of cost stickiness on financial risk and liquidity, there is no direct empirical evidence linking cost stickiness with bankruptcy.

Second, empirically exploring the predictive potential of cost asymmetry on bankruptcy enables creditors to evaluate whether a reduction on cost asymmetry decreases a firm's credit risk according to their expectations (Chou et al. 2018; Kim and Zhou 2023) or deteriorates its future value-generating

1. Bankruptcy is associated with financial distressed firms, which exhibit distinct behavioral characteristics compared to financially constrained firms, highlighting the nuanced effects of financial constraints on these different categories (Bhagat et al., 2005). While financial constrained firms contend with inherent financial limitations, financially distressed firms exacerbate these constraints due to their difficulties in securing external financing. Additionally, the investment opportunities for bankrupt firms are significantly influenced by their growth opportunities (López-Gutiérrez et al. 2015). Financial distress is characterized by a firms inability to cover financial and other obligations when they fall due, increasing the likelihood of default or bankruptcy (Gul et al., 2018). According to the previous literature (Besancenot and Vranceanu 2009), financial distress incentivize managers to commit accounting fraud, as difficult times foster managerial opportunism to meet market expectations, maximizing short-term managerial compensation, and influencing firm's outcomes.

capabilities. On the one hand, increased cost stickiness increases earnings volatility, decreases liquidity, and deteriorates the information quality of earnings (Weiss 2010; Cifti et al. 2016, Silge and Wöhrmann 2021, Agarwal 2022, Costa and Habib 2023). Moreover, creditors' concerns regarding the risk implications of asymmetric cost behaviour are further justified by the fact that deliberate resource commitment decisions associated with asymmetric cost behaviour may reflect the same internal firm-specific characteristics that drive business failure: managerial mistakes, incompetence, and inefficient corporate governance mechanisms (Argenti 1976). Therefore, prior literature emphasizes the underlying agency driver of cost stickiness and the creditors' ability to restrict its intensity to mitigate the adverse effects of cost stickiness on financial health (Costa and Habib 2021, Dai et al., 2023). For instance, Costa and Habib (2023) documented the negative value implications of cost stickiness primarily driven by agency issues and managerial expectations. Even the restricting effects of trade credit on the cost stickiness are more profound in firms with high agency issues (Costa and Habib, 2021). On the other hand, asymmetric cost behaviour may be viewed as an expression of operating decisions driven by inherent firm-specific characteristics associated with value-generating activities, such as the effective implementation of a business strategy (e.g. Ballas et al. 2022) or long-term investment decisions (e.g. Venieris et al. 2015). Cost stickiness reflects a firm's business model, and any exogenous attempt by creditors to restrict its intensity may undermine a firm's long-term cash flow-generating ability, thus inflate financial risk, earnings volatility, and liquidity issues despite the intention of creditors for the opposite.

Third, asymmetric cost behaviour is a source of risk not only for creditors but also for investors. Deliberate decisions to maintain idle resources after sales revenue decrease restrain cash liquidity cushions, increase earnings volatility, and deteriorate the information quality of earnings. Firms with increased cost stickiness are anchored in reduced future earnings and cash flow predictability (Weiss 2010), which reduces investors' ability to estimate their future value and discourages analysts from following them (Hong and Kubik 2003) or increases analysts' forecast errors (Weiss 2010; Cifti et al. 2016). As a result, cost stickiness reduces the quality of information available to investors, thereby increasing stock price delays (Agarwal 2022). In addition, cost stickiness is positively associated with cash flow volatility and the cost of equity, which, in turn, has a decreasing effect on firm value (Costa and Habib 2023). Finally, it is associated with negative market reactions, particularly when firms exhibit low long-term growth (Silge and Wöhrmann, 2021).

The research motivation of this study is to explore the ability of cost stickiness to predict bankruptcy. We expect that cost asymmetry is positively associated with bankruptcy. Managerial decisions to maintain or dispose of idle resources when operating activity declines are driven by the level of adjustment costs, managerial expectations for future operating activity, and agency issues arising from empire-building behaviour (Banker and Bylazov 2014, Banker et al. 2018). All these

factors may deteriorate resource availability, liquidity, and operating profitability, increasing the likelihood of a firm exhibiting liquidity issues and, subsequently, delisting for bankruptcy.

Adjustment costs increase when managers decide to change the available resource capacity due to changes in operating activities. They include either explicit expenditures or implicit organisational, psychological, personal, and opportunity costs (Banker and Bylazov 2014). On average, the adjustment costs are higher when the available resource capacity decreases than when it increases (He et al. 2020). When demand decreases, managers retain idle capacity if the adjustment cost is higher than the retaining cost. Managers continue to retain their idle capacity until they are indifferent to retaining and removing the marginal resource unit (Banker and Byzalov 2014). The above decision-making process relies on how managers weigh the cost of retaining the idle capacity of resources against the adjustment cost of disposing of these resources.

Literature has employed a variety of research instruments for measuring the level of adjustment costs, such as the intensity of asset intensity and employee intensity (e.g. Anderson et al. 2003; Banker and Bylazov 2014), firm size (e.g. Cheng et al. 2018; Dalla Via and Perego 2014; Kama and Weiss 2013), intensity capacity utilisation (Balakrishnan et al. 2004; Cannon 2014; Chen et al. 2019; Holzhacker et al. 2015), and level of the (gross/net) plant, property, and equipment (Kaspereit and Lopatta 2019; Lopatta et al. 2020; Yang 2019) or investments on working capital (e.g. Calleja et al. 2006). The nature of the above research instruments indicates that high adjustment costs increase a firm's requirements for financing the maintenance of a high volume of idle resources when sales revenue declines. Simultaneously, as firms exhibit higher cost stickiness, their additional financing requirements from increased adjustment costs become less likely (or more costly) to be satisfied by retained earnings or funds from the capital market. As previously mentioned, increased cost asymmetry increases earnings volatility (Chung et al. 2019; Liu et al. 2019; Zhang et al. 2019) and credit spreads (Chou et al. 2018; Kim and Zhou 2023).

Another critical driver of the intensity of cost stickiness is empire-building behaviour (Banker and Byzalov 2014; Chen et al. 2012). Chen et al. (2012) defines empire-building behaviour as managerial engagement in activities and resource allocation decisions for their own benefits rather than the benefits of the firm by expanding the firm beyond its optimal size or by maintaining unutilised resources to increase personal utility from status, power, compensation, and prestige. A high level of cost stickiness driven by intense empire-building behaviour is value-destroying (Costa and Habib 2023); it consumes valuable resources and may restrict a firm's liquidity (Kim and Zhou 2023). Further, Cheng et al. (2018) and Costa et al. (2021) provide empirically evidence that financially constrained firms tend to adjust resources more swiftly, as managers on those firms are required by creditors to

carefully consider the allocation of their resources[2]. It appears that creditors may exercise some control over empire-building behaviour and associated agency issues. Firms with high levels of trade credit exhibit lower cost stickiness, especially in the high agency sub-sample (Costa and Habib 2021). However, it remains unclear whether creditors' monitoring activities can effectively offset the observed relative inefficiency of corporate governance mechanisms (e.g. Chen et al. 2012; Chung et al. 2019; Hartlieb et al. 2020; Ibrahim 2018; Liang et al. 2014) and auditors (Cai et al. 2019; Höglund and Sundvik 2019; Liang et al. 2014) in controlling opportunistic managerial behaviour.

Managerial expectations of future operating performance are another determinant of asymmetric cost behaviour. An increase in managerial optimism for future operating performance increases the intensity of asymmetric cost behaviour (Banker and Bylazov 2014, Banker et al. 2018), which indicates an increased risk for future operating performance. Cost asymmetry may trigger an asymmetric earnings response to a decline in sales revenue, which inflates the intensity of earnings volatility (Banker and Chen 2006). Managers seem to recognise increased earnings volatility due to the presence of cost asymmetry, as cost stickiness increases the likelihood that a firm will issue management earnings forecasts (Cifti and Salama 2018; Han et al. 2020). However, managers fail to capture the exact impact of cost asymmetry on their forecasts (Cifti and Salama 2018). In addition, analysts find it difficult to incorporate into their forecasts the influence of cost asymmetry on earnings volatility (Ciftci et al. 2016; Kaspereit and Lopatta 2019; Weiss 2010).

Summarising the above analysis, firms with a higher intensity of cost asymmetry are associated with a higher level of adjustment costs and increased managerial empire-building behaviour, which consumes valuable organisational resources and may restrict a firm's future liquidity. Additionally, increased cost stickiness is associated with weaker corporate governance mechanisms, lower audit quality, increased earnings volatility, and larger earnings forecast errors. For these reasons, we expect the intensity of cost asymmetry to be positively associated with the likelihood that a firm will file a delist for bankruptcy or liquidity issues, and we empirically test the following research hypothesis:

H 1: A high degree of cost asymmetry increases the likelihood of a firm filing for bankruptcy or liquidity.

2. Our work relates to research papers by Cheng et al. (2018) and Costa et al. (2021) but differs in several aspects. The focus of these studies is to empirically estimate whether managers in financially constrained firms make more (or less) timely resource adjustment decisions. Our study instead empirically estimate the usefulness of cost behaviour and cost decisions, through the level of cost asymmetry, in bankruptcy predictions at horizons greater than one year. In other words, cost asymmetry decisions are linked with entrepreneurial resource allocation decisions influenced by fluctuations in sales revenue volatility over the fiscal year. These decisions occur throughout the fiscal year, with their financial impacts becoming apparent by the year's end. Additionally, we emphasize on corporate bankruptcy, and as outlined previously, the theoretical interpretation varies for firms experiencing different financial conditions. Finally, these studies also employ macroeconomic or accounting-based measures that may not fully capture firms that are actually delisted for bankruptcy and liquidity issues.

4. Data and default prediction model

4.1 Estimation of cost asymmetry

The firm-level cost stickiness measure proposed by Weiss (2010) is the primary variable used to capture the intensity of cost asymmetry. Weiss (2010) defines cost asymmetry for firm i in quarter q as the difference between two log ratios, one for upward adjustments (ì ï ç/ ñ) and one for downward adjustments (ì ï ç/ ñ). Specifically, this variable calculates the difference in the change in costs in the numerator and the difference in sales activity in the denominator.

/ 3.!43 = ì ïçC/ ñ − ì ïçC/ ñ Eq. (1a)

Where T (-)/T (+) is the most recent of the last four quarters (from quarters t – 3 through t) in which the firm records a sales decrease/sales increase. Weiss's (2010) measure was estimated annually by considering the average value of cost asymmetry over a three-year rolling window. Following prior literature (Golden et al. 2020; Rouxelin et al. 2018), we multiply Weiss's (2010) original measure by -1 so that higher values of # / 3.!43 imply more cost asymmetry over the past three years.

Weiss's (2010) measure has been employed in several studies as the main research instrument for investigating the implications of cost stickiness (Naoum et al. 2023), but it has a few limitations. The computation of Weiss's (2010) measure may result in a significant drop in the sample size because (i) it requires firms to have both a recent sales increase and a recent sales decrease, and (ii) the costs move in the same direction as sales (Costa and Habib 2023). Further, Weiss' (2010) measure could be "noisy for small sales changes due to the small denominator problem" (Banker and Byzalov 2014: 58). Following the methodology of He et al. (2020), we employ Anderson et al.'s (2003) model to estimate firm-level cost stickiness in year t by running the following regression model with the previous 16 quarters of data:

ì ïçC ñ = + ì ïçC ñ + ì ïçC ñ + $ ì ïçC ñ + ε Eq. (1b)

where $ estimates the direction of sales and equals one if sales revenue decreases in year t; otherwise, it is 0. The coefficient b_1 (b_2) captures the percentage modifications in the operating expenses when sales revenue increases (decreases) by 1% ($ = 0). The coefficient b_1 measures the percentage increase in ñ with a 1% increase in . The sum of coefficients b_1 and b_2 captures the percentage decrease in ñ with a 1% decrease in . The estimated coefficient b_2 captures the degree of cost stickiness (! "# / 3.!43). We multiply b_2 by -1, so that larger values imply higher levels of cost stickiness. To eliminate the possibility of extreme values driving our empirical results, we employ two additional measures of cost asymmetry intensity by obtaining the decile ranks of # / 3.!43 ($ # / 3.!43) and ! "# / 3.!43 ($! "# / 3.!43). To estimate the decile ranks of each variable, we annually rank

the variables of cost asymmetry into 10 groups from 1 to 10, where the bottom decile rank indicates lower levels of cost asymmetry[3].

4.2 Empirical specification

Following prior research (Beaver et al. 2005; Beaver et al. 2010; Mayew et al. 2015; Shumway 2001), we use hazard models to explore the incremental ability of cost asymmetry to predict bankruptcy. Shumway (2001) noted that, compared to a static model with a single firm-year observation for failed and non-failed firms, hazard models have the advantages of increased efficiency and decreased bias in the estimated coefficients. The general form of the hazard model is as follows:

Eq. (1c)

where È, Ô represents the hazard or the risk of bankruptcy at time t for firm i; | Ô is the baseline hazard risk; and D is a vector of coefficients relating to predictor variables X (non-financial, financial ratios). The model is estimated as a discrete-time logistic model using the maximum-likelihood method and provides consistent estimates of the coefficient D. Our sample consists of bankrupt and non-bankrupt firms with, and the variable " ! . + 2 ,5Ô0c4 added as one for firms facing bankruptcy (filling Chapter 7 or Chapter 11 of the Bankruptcy Code) for the three years prior to bankruptcy, otherwise 0. Therefore, we estimated the following hazard models:

Eq. (2)

In Eq. (2), we control for the financial and nonfinancial variables that can predict bankruptcy. In line with prior literature (Barth et al. 1998; Beaver et al. 2010; Beaver et al. 2012; Beaver et al. 2019; Bauer and Agarwal 2014; Mayew et al. 2015; Zhang 2015), we include the following financial and non-financial variables in the vector : (a) the intensity of cost asymmetry (# / 3 43) which is defined in Section 3.1; (b) a loss indicator variable (, / 3) which equals to one if net income is negative, otherwise 0; (c) the ratio of working capital to total assets (7 # 4); (d) the magnitude of financial leverage (, % that equals to the total debt to total assets; (e) the logarithm of market value of common equity (3) %(f) a sales growth (' 2 / 7); (g) the return on total assets (2 /); (h) the level of book leverage (" , % defined as the ratio of total liabilities to total assets; (i) the level of property, plant and equipment (0 0 ; and (j) the market value of equity scaled by total liabilities (- 6 %). Finally, we include the Altman Z-Score (: 3 # /) proposed by Altman (1968) to control for the effects of financial constraints and distress (Cheng et al. 2018; Costa and Habib 2021; Costa et al. 2021; Li and

3. We estimate our empirical results using the operating expenses as a measure of cost stickiness. Operating costs can capture the largest extent of cost management decisions, avoiding managers' discretionary categorization of costs as selling, general, and administrative (SGA) or costs of goods sold (COGS) due to a lack of clear guidance. Empirical results (untabulated) remain consistent when we utilize SGA expenses as an alternative measure of cost stickiness.

Zheng 2020; Ntounis and Vlismas 2022) and the successive sales decrease (3 5 #$%&'()#to control for the effects of managerial optimism on the predictive ability of cost asymmetry on bankruptcy. The subscripts i and t denote the firm ID and fiscal year identifier, respectively. Superscript j denotes the industry sector within which a group of firms is classified. Superscript x denotes the time horizon for bankruptcy. The primary focus of our analysis is on the sign and significance of the coefficient that captures the incremental effect of cost asymmetry (# / 3,34$%&'() on corporate bankruptcy using the four distinct proxies outlined in Section 4.1.

4.3. Data selection and mean difference analysis

Our sample consists of bankrupt and non-bankrupt firms identified in North American Compustat during the period 1990-2020. The bankruptcy test sample comprises firms presented in Compustat as having delisted, filling Chapter 7 or Chapter 11 of the Bankruptcy Code, identified by the Compustat delisting reason code (DLSRN=02). Additionally, to capture firms delisted because of liquidity issues, we include those with the Compustat delisting reason code (DLSRN=03). Financial and utility firms (four-digit SIC codes: 4800-4900; 6000-6999) were excluded from the analysis. We also discard observations where operating expenses are greater than sales revenue and observations for firms where sales revenue, operating expenses, and total assets have no positive values. Further, to avoid biased results when capturing the variables # / 3,34$%&'(), we exclude observations in which operating expenses move in the opposite direction to sales revenue (Weiss 2010). In line with previous literature (Golden et al. 2020; Lopatta et al. 2020; Rouxelin et al. 2018), all continuous variables were trimmed at the 1% and 99% levels to reduce the effect of outliers. Finally, the calculation of the primary independent research variable, # / 3,!43$%&'(causes a further reduction. Overall, the dataset consists of 201 firm-year observations corresponding to a three-year period preceding bankruptcy, supplemented by an additional 22,527 firm-year observations representing non-bankrupt firms.

Table 1 presents the descriptive statistics of the main variables used in the empirical analysis of bankrupt and non-bankrupt firms. We perform two-sample t-tests to assess the differences in the means of various financial indicators between bankrupt and non-bankrupt firms. For bankrupt firm-year observations, the descriptive statistics relate to the three years before bankruptcy. Non-bankrupt firm-year observations consist of all firms classified as non-bankrupt as well as observations from bankrupt firms that are not included in bankrupt firm-year observations. Firms that face bankruptcy in subsequent years seem to have a higher proportion of cost asymmetry than firms that do not face bankruptcy. Specifically, the mean values of cost asymmetry, as measured by # / 3,!43$%&'(and ! ",# / 3,!43$%&'() are 0.128 and 0.067, respectively, during the three-year period leading up to bankruptcy. Conversely, for firm-years where bankruptcy does not subsequently incur, the magnitudes of cost asymmetry are approximately 0.056 and -0.172, respectively. This preliminary analysis indicates that ceteris paribus, a

higher level of cost asymmetry, consumes valuable organisational characteristics and increases the likelihood that a firm will file for delisting for bankruptcy and liquidity issues.

Regarding the financial variables in Table 1 (Panel B), the mean values of loss (, / 3)3financial and book leverage (, %6 " , %)6level of successive sales decrease (3 5 #)#and property plants and equipment (0 0%are higher for bankrupt firms than for non-bankrupt firms. Moreover, firms facing bankruptcy have a relatively lower return on assets (-18.0% over -1.9% for non-bankrupt firms) and make inefficient investments in working capital (8.2% over 19.2% for non-bankrupt firms). Furthermore, bankrupt firms are not growth-oriented (4.2% versus 18.3% for non-bankrupt firms) and smaller in size (1.61 over 2.15 for non-bankrupt firms). Firms approaching bankruptcy have poorer economic performance, leading to liquidity issues and higher volatility than firms that do not face bankruptcy. The mean differences in the above variables between the two groups of firms are significant at the 1% level, which is in line with previous studies (Barth et al. 1998; Bauer and Agarwal 2014; Mayew et al. 2015; Zhang 2015).

- Insert Table 1 -

5. Empirical results

We explore the relative ability of cost asymmetry to serve as a warning signal one, two and three years before the year of bankruptcy. The regression model in Eq. (2) is estimated using white heteroscedasticity-corrected standard errors clustered by firm to control for autocorrelation and heteroscedasticity (Petersen 2009). The results reported in Table 2 provide robust evidence that the probability of bankruptcy is significantly higher for firms with high-intensity cost asymmetry.

The estimated values of the coefficient d_1 demonstrated statistical significance and a positive relationship across all measures of cost asymmetry and prediction periods. In particular, the estimated values of the coefficient d_1 ranged from 0.0280 for the ! " ,# / 3,!43 to 0.266 for the # / 3,!43 measure in the first year-ahead prediction model. A similar pattern persisted in the second- and three-year-ahead prediction models, where the coefficient estimates of # / 3,!43 ranged from 0.266 to 0.314 and for ! " ,# / 3,!43 from 0.0421 to 0.0517. The predictive efficacy of cost asymmetry becomes more extensive in the two-year-ahead and three-year-ahead prediction models for non-decile values of cost asymmetry. It is plausible that one year before bankruptcy, a firm's ability to finance the maintenance of idle capacity has deteriorated significantly, and the managerial incentive to reduce cost asymmetry is more intense (Dierynck et al. 2012; Kama and Weiss 2013). Consequently, the diminishing intensity of cost asymmetry as a short-term warning signal may reflect the evolving financial challenges faced by firms approaching bankruptcy.

To provide more concrete evidence, we estimate Eq. (2) using decile-ranked variables of cost asymmetry ($,# / 3,!43 $,! " ,# / 3,!43. Our empirical results are confirmed for each decile-

ranked measure, demonstrating that extreme values do affect the validity of our inferences. We also estimate our results using a conditional logit model. The estimation results (untabulated) of the conditional logit model indicate that cost asymmetry is an early bankruptcy warning signal. Overall, the baseline results suggest that cost asymmetry offers incremental bankruptcy ability, providing staunch support for our main hypothesis.

Furthermore, the control variables are broadly comparable to those used in previous studies on bankruptcy prediction, albeit insignificant in some cases. The probability of default decreases in firms with a high market value, whereas it increases in the case of losses and pessimistic managerial expectations. All the other control variables are insignificant but mainly have the same sign as in the previous literature[4].

- Insert Table 2 -

6. Additional analysis

Prior literature (e.g. Anderson et al. 2003; Ballas et al. 2022; Chen et al. 2012; Venieris et al. 2015) has attempted to explain the asymmetric cost behaviour through the lens of several economic determinants that have been associated with its manifestation, such as: (i) magnitude of economic activity change; (ii) incentives for managing earnings and agency issues; (iii) level of adjustment costs. In addition, we explore the relationship of going concern with cost asymmetry,

This analysis will offer insights to creditors when they attempt to reduce financial risk by mitigating cost asymmetry. Prior empirical evidence indicates that creditors' efforts to reduce the adverse effects of cost stickiness on financial health are more successful in firms with high agency issues (Costa and Habib 2021, Costa and Habib 2023, Dai et al., 2023). However, exploring whether the incremental effect of cost asymmetry on bankruptcy prediction depends on the determinants of adjustment costs will enable us to draw inferences regarding the effectiveness of monitoring managerial behaviour. For instance, changes in economic activity may be considered as exogenous shocks on a firm's cost behaviour allowing us to examine whether cost-related decisions can be properly harmonised to external demand changes, considering both cost and financial implication. The presence of intense incentives for managing earnings may be reflected on cost decisions providing creditors early signs for potential future financial issues. Finally, cost stickiness is an expression of a firm's business model, and any exogenous attempt by creditors to unconditionally restrict its intensity may not necessarily reduce financial risk but could undermine the firm's long-term cash flow-generating ability. Therefore, it would be beneficial to creditors to gain insights into whether the predictive ability of cost stickiness on bankruptcy varies across firms with different degrees of agency issues or adjustment costs.

4. Prior empirical research exhibited a similar pattern in terms of statistical significance for the control variables included in our analysis (e.g. Bauer and Agarwal 2014; Desai et al. 2020).

6.1. Changes in the magnitude of economic activity

The magnitude of economic activity change is considered a possible determinant of cost asymmetry. There are mixed results on whether large or small changes in sales revenue affect the intensity of cost asymmetry. Specifically, Subramaniam and Watson (2016) report that substantial changes in sales revenue trigger asymmetric cost behaviour. However, Calleja et al. (2006) and Ciftci and Zoubi (2019) provide evidence that cost asymmetry is higher for small current sales changes. Specifically, minor changes in economic activity increase managerial expectations for future sales and lower the perceived level of adjustment costs, signalling higher cost asymmetry.

In addition to cost asymmetry, changes in the magnitude of prior economic activities may affect the probability of company survival. Substantial changes in economic activity may be interpreted as signals of firms approaching bankruptcy (Fabozzi et al. 2010; Jones 2017). To examine whether the magnitude of economic activity changes triggers the effect of cost asymmetry on corporate bankruptcy, we partition our sample into three categories: (i) small current sales changes (-5% to 5 percent); (ii) medium sales changes (-10% to 10 percent); and (iii) large sales changes (-50 percent to -10 percent; 10 percent to 50 percent). The results in Table 3 clearly show that cost asymmetry increases the likelihood of bankruptcy across all the prediction models when firms experience small and medium current sales changes. However, our empirical findings for the first year-ahead prediction model are tempered for firms experiencing substantial changes in sales revenue. One plausible explanation is that substantial fluctuations in current sales increase the predictive power of failure outcomes (Jones 2017), which mitigates the incremental ability of all other factors in corporate bankruptcy. However, the ability of cost asymmetry to predict bankruptcy remains evident in the two- and three-year-ahead prediction models for firms experiencing substantial changes in current sales.

- Insert Table 3 -

6.2. Earnings management and the predictive ability of cost asymmetry on bankruptcy

The literature (Beaver et al. 2010; Beaver et al. 2012) examines the effect of discretion in financial reporting on the predictive ability of financial statements for bankruptcy. Particularly, the bankruptcy accounting model's predictive ability is lower for extreme accruals that increase or decrease earnings. On the other hand, Dechow et al. (2010) highlighted the importance of properly controlling for default risk in earnings quality studies. Furthermore, several empirical studies (Dierynck et al. 2012; Hall 2016; Huang and Kim 2020; Kama and Weiss 2013; Liang et al. 2014; Ma et al. 2021; Yang 2019) find that managers with incentives to meet earnings targets and engage in earnings management activities cut unutilised resources to increase earnings and reduce the intensity of cost asymmetry.

Investigating the predictive ability of cost asymmetry on corporate bankruptcy across various managerial incentives is essential for gaining insights into how different financial practices affect a firm's financial health. Firms with managerial incentives to meet targets exhibit vulnerability to

financial distortions, which can further exacerbate the likelihood of corporate bankruptcy (Francis et al. 2004). Further, managers in firms with high cost asymmetry may resort to earnings management techniques to artificially inflate their earnings in order to meet specific earnings targets. However, firms with increased cost asymmetry are anchored by reduced future earnings and cash flow predictability (Weiss 2010) as well as increased analysts' forecast errors (Cifti et al. 2016), exacerbating the risk for bankruptcy in the future. Therefore, we conjecture that our empirical results will be more profound for firms with high levels of earnings management or managerial incentives to meet earnings targets, given their susceptible to behaviours that can distort financial data and potentially lead to corporate bankruptcy.

To examine whether the predictive ability of cost asymmetry for bankruptcy is mitigated by the level of accrual earnings management or managerial incentives to meet earnings targets, we re-estimate Eq. (2) for two different subsamples divided according to the intensity of accrual earnings management (AEM) and incentives to meet earnings targets (MEET_TARGETS). For each year, we classify a firm as low (high) AEM-intensive if its earnings management level is lower or equal (greater) to the industrial median value. The AEM level is proxied by performance-adjusted discretionary accruals, as proposed by Kothari et al. (2005). The MEET_TARGETS group consists of firm-year observations with annual earnings deflated by total assets of previous year-end ranges from -0.075 to +0.075.

Panels A and B of Table 4 present the empirical results of the hazard models in Eq. (2) for the earnings management subsamples to meet earnings targets. Our baseline results are significantly affected by the level of earnings management and managerial incentives to meet earnings targets. The results reported in Panel A of Table 4 suggest that the predictive ability of cost asymmetry on bankruptcy is more profound for high AEM-intensive firms. For highly AEM-intensive firms, the estimated coefficients of d_1 are positive, statistically significant, and consistent across all prediction periods. However, lower AEM levels do not seem to activate the mechanism underlying the predictive ability of cost asymmetry for bankruptcy. Therefore, an increase in the intensity of AEM intensifies the probability of bankruptcy (Francis et al. 2004) and enhances the positive effect of cost asymmetry on bankruptcy. Moreover, as indicated in Panel B of Table 4, our empirical findings are more pronounced for firms with motives to meet earnings targets, suggesting that firms with high cost asymmetry tend to go bankrupt when they are driven by incentives to meet their targets.

Managerial empire-building behaviour is a significant driver of cost asymmetry (Ballas et al. 2022; Chen et al. 2012; Habib and Hasan 2019; Hartlieb et al. 2020; Liu et al. 2019; Zhang et al. 2019). Empire-building behaviour stems from managerial decisions to maintain unutilised resources for their own benefit rather than for shareholders. Accordingly, in high-agency conflict settings, managers may engage in suboptimal cost management decisions due to personal empire-building aspirations, which is why they retain unutilised resources and increase the intensity of cost asymmetry. Furthermore, Lopatta

et al. (2020) provide evidence that cost asymmetry is harmful to firm and shareholder value, which is supported by agency theory.

To rule out the possibility that agency issues affect our empirical results, we estimate our main hypothesis for firms facing high (or low) agency conflicts. In Panel C of Table 4, we differentiate our sample according to the level of managerial empire-building behaviour, using as a proxy the level of Free Cash Flow (& #(Chen et al. 2012). Therefore, we conducted an additional analysis to determine whether our main hypothesis holds for increasing or decreasing changes in the level of & # Our empirical results indicate that agency conflicts can moderate the prediction of cost asymmetry in corporate bankruptcy. In particular, for firms with increasing changes in the level & #and thus higher agency issues, cost asymmetry has predictive power for bankruptcy as the time horizon to bankruptcy increases. However, when there are decreasing changes in the level of & #cost asymmetry provides an incremental predictive ability for bankruptcy, mainly within a two-year-ahead prediction model. Overall, agency issues and personal motives seem to play important roles in the positive effect of cost asymmetry on the likelihood that a firm will file for bankruptcy delisting. The above empirical evidence supports prior empirical evidence provided by Costa and Habib (2021) that the restricting effects of trade credit on the cost stickiness are more profound in the firms with high agency issues. It seems that when trade credit is exercised on firms with agency driven cost stickiness the significance of the latter as a predictive factor of a potential bankruptcy is reduced.

- Insert Table 4 -

6.3. Adjustment costs and the predictive ability of cost asymmetry on bankruptcy

In addition to the negative impact of managerial motives on a firm's future liquidity, high adjustment costs can consume valuable economic resources and restrict firm liquidity, particularly in the case of sales revenue decline. Moreover, managers' discretion in resource adjustments and their expectations of future demand conditions are particularly relevant in the presence of adjustment costs (Chen et al. 2019). Consequently, in this section, we explore the importance of adjustment costs and the level of unused resources in our main empirical findings.

To estimate empirically whether our results are influenced by the level of adjustment costs, we emphasise two well-accepted proxies: (i) asset intensity and (ii) employee intensity. We categorise the sample into firms with high versus low adjustment costs based on the corresponding industrial median value. We also estimate the intensity of capacity utilisation within an indicator variable as equal to one if there is a prior period of sales decrease (<) and the prior period change in the number of employees is greater than or equal to the prior period change in sales revenue (Chen et al. 2019).

Panels A and B in Table 5 present the empirical results of the regression models in Eq. (2) for the subsamples of firms categorised based on the level of assets and employee intensity across the

various prediction horizons. The results in Panels A and B underscore the pivotal role of adjustment costs in shaping the predictive efficacy of cost asymmetry for default risk. Specifically, for asset-intensive firms, the estimated coefficient d_1 is positive and statistically significant, mainly in the sample of firms with low asset intensity. Conversely, a notable relationship between cost stickiness and business failure is observed in firms that make substantial investments in employee resources.[5] The observed relationship between cost asymmetry and default risk may be attributed to the influence of adjustment costs, which impede firms' ability to efficiently adapt to changing circumstances. More specifically, firms with lower asset intensity may face fewer obstacles (e.g. collateral) in managing adjustment costs, allowing the predictive power of cost asymmetry to be more pronounced. Conversely, in high-employee-intensity settings, the impact of adjustment costs on default risk may be exacerbated by the nature of labour-intensive operations, leading to a significant relationship between cost stickiness and business failure.

Panel C of Table 5 presents the empirical findings on the ability of cost asymmetry to predict corporate bankruptcy based on the degree of unused resources. Across all measures of cost asymmetry, the coefficients of d_1 exhibit positive and statistically significant results in predicting default events beyond the one-year horizon. However, in the first-year prediction model, our results were verified for firms with low levels of unused resources. One possible explanation is that firms with few unused resources are more vulnerable to the predictive power of cost asymmetry owing to their limited financial reserves, which magnifies the impact of cost fluctuations on bankruptcy risk. Conversely, firms with higher levels of unused resources may have greater financial resilience, thus dampening the immediate predictive effect of cost asymmetry on defaults in the initial year.

- Insert Table 5 -

The empirical findings above suggest that in firms characterized by high cost stickiness due to increased levels of adjustment costs, attempts to restrict cost stickiness may have minimal impact on the likelihood of a firm filing for bankruptcy. The presence of high levels of adjustment costs indicates that the managerial decision to maintain idle resources when sales decline is driven by the intention to enhance future operating performance, as the potential disposal of the idle resources may imposes firm higher sacrifices. This pattern of resource allocation decisions indicates that management make a responsible use of resources including those provided by debtors.

5. We further analyse our empirical findings by categorising firms based on annual changes in adjustment costs, distinguishing between those experiencing decreases or increases in asset and employee intensity. Our untabulated results indicate a heightened likelihood of bankruptcy associated with cost asymmetry, particularly among firms experiencing increased changes in adjustment costs.

6.4. Going concern and cost asymmetry

According to PCAOB (2002), auditors are required to issue a going concern modified opinion (GCO) "when there is a substantial doubt about the company's ability to continue as a going concern for a reasonable period of time". A significant issue for the PCAOB is the rate of client failure following a going-concern audit. Studies conducted on US samples (Desai et al. 2020; Garsombke and Choi 1992; Geiger et al. 1998; Pryor and Terza 2002) provide evidence that GCO firms are significantly more likely to file for bankruptcy. One stream of literature on going-concerns (Blay et al. 2011; Carson et al. 2013; Desai et al. 2017; Kausar et al. 2009; Mayew et al. 2015; Mutchler 1985) emphasises the various predictive factors (financial and non-financial) of firms that affect auditors' going-concern evaluation. Some of the documented factors that are primarily related to going concern are profitability, leverage, liquidity, firm size, balance sheet conservatism, and management discussion and analysis disclosure.

Cost asymmetry might affect the quality of auditing services and, in particular, auditors' ability to issue going concern. Thus, in the current section, we seek evidence that the intensity of cost asymmetry is incrementally useful for a GCO, which eventually leads to bankruptcy. We collected data from the Audit Analytics platform (U.S. audit market database) that received a going-concern opinion during the years 1998-2020. Therefore, we estimated the following hazard models:

0 Ò' # [illegible] Ä [illegible] Ä ɰ [illegible] Õ   Eq. (2)

where ' #/Ô is an indicator variable equal to one if the auditor expresses a going-concern opinion, and zero otherwise.

The evidence in Table 6 indicates that cost asymmetry offers an incremental ability to going concern audit opinions[6]. Specifically, the coefficient of cost asymmetry (! " # / 3!43 9 is statistically significant and in the predicted direction across all prediction models. However, the coefficient of # / 3!43 9 is negative and lacks statistical significance, potentially owing to the nuances in the estimation process of # / 3!43 9

– Insert Table 6 –

7. Robustness tests

7.1. Moderating effect of financial strength measures

This study shows that cost asymmetry offers an incremental predictive ability for future bankruptcy. The literature (Cheng et al. 2018; Costa and Habib 2021; Costa et al. 2021; Li and Zheng 2020; Ntounis and Vlismas 2022) has examined the intensity of cost asymmetry within the context of financial strength using diverse proxies such as access to capital, financial constraints, and financial

6. Our empirical results have been replicated by employing logistic regression models. The untabulated results are quite similar to the reported ones.

distress. Our research is related to the literature that empirically examines the effect of financial strength on the level of cost asymmetry, but it diverges in several important ways. While those studies focus on empirically estimating whether managers in financially constrained firms make more timely resource adjustment decisions, our study instead examines the predictive value of cost behavior and decisions, based on cost asymmetry, in forecasting bankruptcy over a horizon more than one year. This involves linking cost asymmetry decisions to entrepreneurial resource allocation decisions driven by fluctuations in sales revenue throughout the fiscal year, with financial impacts becoming apparent by year-end Moreover, we emphasize on corporate bankruptcy, noting that the theoretical interpretation differs for firms under financial constraints. Finally, previous studies utilize macroeconomic or accounting-based measures that may not fully capture firms delisted due to bankruptcy and liquidity issues.

To estimate the influence of financial constraints and distress on the predictive efficacy of cost asymmetry for bankruptcy, we include the Altman Z-score as a control variable in our research design. Table 7 presents the estimation results for the regression model outlined in Eq. (2), where financial distress is alterntatively measured using either the WW index proposed by Whited and Wu (2006) or the SA index developed by Hadlock and Pierce (2010). Our primary empirical conclusions remain consistent when employing alternative measures of financial distress instead of the Altman Z-score.

- Insert Table 7 -

7.2. Propensity score matching

To verify the robustness of our empirical findings, which remain unaffected by the endogenous determination of cost stickiness, we conducted a propensity score matching (PSM) analysis to mitigate potential endogeneity concerns stemming from self-selection bias (Amstrong et al. 2012; Shipman et al. 2017; Prabowo et al. 2018). PSM offers a key advantage over alternative methodologies by avoiding the assumption of a linear relationship between the control and outcome variables (Amstrong et al. 2012; Shipman et al. 2017). Consequently, if variations in the outcome variable (corporate bankruptcy in our case) between firms exhibiting high and low levels of cost stickiness can be attributed to observable factors beyond cost stickiness, we expect the coefficient of cost stickiness to be insignificantly different from zero within a matched sample. Conversely, if cost stickiness influences corporate bankruptcy, firms with high cost asymmetry and matched counterparts should manifest disparate levels and future years of corporate bankruptcy.

To validate our main empirical results, we perform a propensity score matching (PSM) analysis based on the firms' intensity of asymmetric cost behaviour. We classify firms as having low (or high) asymmetric cost behaviour based on the industrial median value of each of the four measures of # / 3,3414. To implement PSM and measure the propensity scores (p-score), we estimate a logit propensity score model that regresses the indicators in Eq. (2). Following the prior literature (Lawrence et al. 2011; McMullin and Schonberger 2022; Shipman et al. 2017), observations were matched using

a calliper of 0.01, resulting in a different number of pairs for each cost asymmetry measure. The untabulated results show that the average p-scores are sufficiently similar for the matched observations. Table 8 presents the results of the propensity matching score technique. Our evidence confirms that even after matching firms with high- and low-cost asymmetry, the level of cost asymmetry is still associated with a higher likelihood of corporate bankruptcy.

- Insert Table 8 -

7.3. Managerial and firm-specific characteristics

Managerial resource allocation decisions are contingent on a multitude of factors, including resource constraints (e.g. adjustment costs) and managerial biases (e.g. overconfidence and managerial ability). Extensive literature (Anderson et al. 2003; Banker and Byzalov, 2014; Chen et al. 2022; Li et al. 2020) underscores the pivotal role of managerial characteristics in shaping asymmetric cost behaviour, as managers may adjust costs differently based on their capabilities, incentives, and susceptibility to behavioural biases. Furthermore, firm-specific attributes and operational risks are critical considerations for these decisions. To comprehensively address these factors, we undertake additional robustness tests incorporating proxies such as (i) the level of managerial ability, (ii) managerial overconfidence, and (iii) firm-specific overconfidence.

According to the resource-based theory, managerial ability represents a valuable asset that can offer firms a competitive advantage (Holcomb et al. 2009). The importance of managerial ability in influencing equity market perceptions (Demerjian et al. 2012) and firm performance (Betrand and Schoar, 2003) has been thoroughly investigated in academic literature. In particular, high-ability managers enhance overall firm performance by effectively managing organisational resources and aligning their interests with subsequent financial outcomes (Baik et al. 2017; Cheung et al. 2017; Demerjian et al. 2013). Furthermore, this ability reduces borrowers' collection uncertainty and leads to higher credit ratings (Bonsal IV et al. 2017). Thus, we conjecture that managerial ability reduces the probability of bankruptcy and the effect of cost asymmetry on corporate bankruptcy.

Managerial ability scores are derived from Demergian et al. (2012). The results of the regression (Table 9-Panel A) indicate that higher levels of managerial ability decrease the probability of corporate bankruptcy across all prediction models. Further, the level of managerial ability on cost asymmetry seems to either have no effect or reduce the primary effect of cost asymmetry on bankruptcy. Hence, we find that a higher managerial ability is linked to a reduced likelihood of corporate bankruptcy and appears to attenuate the impact of cost asymmetry on bankruptcy risk.

The rationale underlying our primary empirical results is predicated on the assumption that managers behave rationally and make resource allocation decisions that increase the intensity of asymmetric cost behaviour and the probability of corporate bankruptcy without necessarily detrimentally affecting external stakeholders. However, this presumption of managerial rationality may

not be universally applicable because managers can exhibit irrationality and bias in their assessments of the likelihood of bankruptcy and their firms' prospects. One prevalent behavioural bias influencing their behaviour is overconfidence, wherein excessively confident directors may underestimate insolvency probabilities and overestimate future returns because of their perceived sense of control and optimism. Simultaneously, the literature documents that overconfident CEOs are reluctant to adjust idle resources, leading to higher cost asymmetry (Chen et al. 2022; Qin et al. 2015).

We capture managerial overconfidence using the following established measures: (i) an investment-based metric, following the methodology of Campbell et al. (2011) as implemented by Boulton and Campbell (2016), where firms classified within a match-adjusted firm investment above the 80th percentile in sample during the bankruptcy year and the year prior to bankruptcy are considered to have high managerial overconfidence (( ) '.I(6 %[illegible])[7], (ii) a firm-specific proxy proposed by Schrand et al. (2012), proxied through 5 measures of firm-level and investment-level (/ #.[illegible]), which prior literature has found to be associated with managerial overconfidence[8,9]. The results in Panels B and C demonstrate that the interaction term between cost asymmetry and the previous overconfidence measures is insignificant. Thus, we do not support the notion that overconfident managers trigger a positive relationship between cost asymmetry and corporate bankruptcy. Overall, the positive association between cost asymmetry and corporate bankruptcy is likely attributable to the direct adverse effects of cost asymmetry on firm value and earnings predictability, rather than being predominantly influenced by overconfident managerial conduct. More importantly, the coefficient on our variables of interest, remained similar in magnitude and significantly positive, suggesting that the predictive ability of cost asymmetry on corporate bankruptcy is mainly impossible to suffer from omitted variables.

– Insert Table 9 –

7.4. Additional tests

We also conduct a series of robustness tests to validate our empirical results and obtain additional insights into the impact of cost asymmetry on the likelihood of corporate bankruptcy[10]. First, we explore whether macroeconomic event-shocks influence the empirical results. Our dataset spans 1990 to 2020, encompassing two critical events: (i) the global financial crisis spanning 2007 to 2009 and (ii) the COVID pandemic, where many firms suffered financially and went out of business in 2020.

7 We additionally explore our empirical results, by employing a dummy variable denoting firms failing below the 20th percentile in the sample during the bankruptcy year and the year prior to bankruptcy, indicating low managerial overconfidence (, / 7/ 6 %[illegible]). Similar empirical results (untabulated) have been incurred.

8. This proxy is grounded on the premise that overconfident executives consistently exhibit optimism across various decision contexts, deriving indications of overconfidence from the executives' other actions. Its strength lies in its ability to generate scores for a wider dataset, as it relies solely on firm-level Compustat data.

9. Our results are substantially unchanged if we use the firm-specific measure with a firm-specific that is constructed using four measures of firm-level investing and financing activities (/ #.[illegible]).

10. Our empirical results in that section are untabulated for the shake of brevity. Detailed tables for all untabulated analyses in this study are available upon request.

To address concerns about potential noise in our data, we re-estimate our primary empirical results, excluding these years from the sample. Our findings remained consistent even after excluding these periods, indicating the robustness of our results.

In our baseline results, we initially relied on the Compustat classification (DLSRN=02; DLSRN=03) to identify firms delisting due to bankruptcy and liquidity issues. However, we acknowledge the potential limitations of this classification, including sample restrictions and possible biases, in our primary empirical findings. Therefore, drawing on prior literature (Colak et al. 2021; Demers and Joos, 2007), we categorise delisted firms based on three-digit CRSP delisting codes, distinguishing between (i) voluntary deaths (acquired firms: codes 200-290) and (2) involuntary deaths (liquidated firms: codes 400-490 or dropped: codes 500-591). Focusing on firms categorised as having involuntary deaths ( ) . $ % ! 4 ( ) we re-estimate our main empirical results using Eq. (1c). The untabulated findings underscore the robustness of our empirical findings across the pivotal measures of cost asymmetry.

Finally, we estimate the empirical results using an alternative econometric specification. Specifically, we employed an alternative survival model, namely the Accelerated Failure Time (AFT) model, to explore the factors influencing survival times. In contrast to the COX model, the AFT approach allows for variations in the impact of independent variables on survival time over the post-bankruptcy period, contingent on the duration since listing (Colak et al. 2021). The AFT model, a parametric framework typically expressed as a log-linear function of survival time, provides an additional analytical lens (e.g. Hensler et al. 1997).

ȕ ű4 سي ɭ Ô ط Ą # / 3 3 4 4 ط # / . 4 2 /Ô, 3 Eq. (3)

ȕ ű4 represents the natural logarithm of the survival time or time-to-failure (measured in months), and the exponential of the coefficient represents an 'acceleration factor', commonly known as the time ratio. This ratio quantifies the extent to which changes in the independent variables expedite or delay a delisting event. A positive coefficient indicates a time ratio exceeding one, suggesting that an increase in the covariate prolongs survival time, whereas a negative coefficient (a time ratio less than one) accelerates the occurrence of delisting. A Weibull distribution is used to estimate the parametric model. Our results reveal a discernible negative association between cost asymmetry and survival time. The coefficients of cost asymmetry (# / 3 3 4 4) were predominantly negative and statistically significant.

8. Conclusion

This study examines the implications of cost asymmetry in corporate bankruptcy. Other types of bankruptcy prediction models include contingent claims prediction and accounting-based bankruptcy models (Keenan and Sobehart 1999; Reisz and Perlich 2007). However, according to prior literature (Bauer and Agarwal 2014; Hillegeist et al. 2004; Saunders and Allen 2002), these models are often criticised for their lack of theoretical grounding, and their implementation is far from straightforward

compared with hazard models. Using discrete-time hazard models, we find that the intensity of cost asymmetry provides significant incremental information regarding the likelihood of bankruptcy. Additional analysis indicates that fluctuations in economic activity do not affect the ability of cost asymmetry to predict corporate bankruptcy. The fundamental factors of cost asymmetry (i.e. the level of adjustment costs and managerial empire-building behaviour) appear to affect the predictive ability of cost asymmetry on corporate bankruptcy. Robustness tests suggest that these findings are observable under (i) the effect of financial strength measures on the relationship between cost asymmetry and corporate bankruptcy, (ii) the propensity-matching score, (iii) managerial overconfidence, and (iv) alternative proxies of cost asymmetry and corporate bankruptcy, as well as alternative econometric specifications.

This is the first study to examine how asymmetric cost behaviour and deliberate managerial resource commitment decisions can have predictive power for default at horizons greater than one year. Asymmetric cost behaviour increases financial requirements and earnings volatility, intensifies earnings forecast errors, and signifies higher operating risk. Previous bankruptcy prediction and default risk-related literature provide little empirical evidence on how internal firm-specific characteristics predict bankruptcy. Thus, this study contributes to the literature by providing compelling evidence that internal firm-specific characteristics can predict corporate bankruptcy. More specifically, prior literature has highlighted creditors' consideration of cost stickiness as a factor that elevates financial risk and liquidity (Chou et al. 2018, Dai et al. 2023, Kim and Zhou, 2023). This study provides direct empirical evidence for the association of cost stickiness with bankruptcy. In addition, prior literature emphasizes on the underlying agency driver of cost stickiness and the ability of creditors to restrict its intensity for reducing the adverse effects of cost stickiness on financial health (Costa and Habib 2021, Dai et al., 2023). Although we confirmed that the association of cost stickiness is more profound in the case of firms with high agency issues and incentives for managing earnings; it seems that in the case of firms with high cost stickiness driven by high levels of adjustment costs an attempt to restrict cost stickiness is likely to have immaterial effects on the likelihood a firm to file for bankruptcy. In that case, creditors may consider that an attempt to restrict cost stickiness will not affect the likelihood of bankruptcy and at the same time it may have a negative effect on the future cash generating process. Finally, this study contributes to the limited literature on cost asymmetry by examining it as a determinant of economic phenomena.

Our study had some limitations. First, the bankruptcy prediction model includes many determinants, and it is difficult to control for many factors in one regression model. Another limitation of the current study is that it focuses on US-listed firms. Cost asymmetry has been observed across different national settings and macroeconomic environments (Calleja et al. 2006; Dierynck et al. 2012; Prabowo et al. 2018). Country- and macroeconomy-specific characteristics may be confounding factors in the predictive ability of cost asymmetry for corporate bankruptcy.

Appendix: Variables Definition

Variable	Description
! " ,# / 3,!43 9	A firm-level cost stickiness measure stems from Anderson et al. (2003) model.
! ' %	Number of years listed in North American Compustat.
! 3 3 0 4 3	The magnitude of total assets.
! 3 3 . 4	The log ratio of total assets to sales revenue (= , ï C 3 3 4 23 6).
" ! . + 2 5 0 4	A dummy variable coded as one for firms facing bankruptcy in year t+1, t+2 and t+3.
" , % 6	The ratio of book leverage calculated as the ratio of total liabilities to total assets.
# & /	The level of cash flow from operations.
# ! 3 (	The level of cash and cash equivalents.
# / 3,!43 9	A sticky score measure of the selling general and administrative expenses using the methodology proposed by Weiss et al (2010).
# / 3,34	The firm-level cost stickiness measure proxied by either # / 3,!43 9 or $,# / 3,!43 9 or ! " ,# / 3,!43 9 Ï $,! " ,# / 3,!43 9.
# 5 2 3 3 4 3	The level of current assets.
# 5 2) "	The level of current liabilities.
$,! " ,# / 3,!43	A decile continuous variable of ! " ,# / 3,!43 9.
$,# / 3,!43 9	A decile continuous variable of # / 3,!43 9
$	A dummy variable equals to one if sales decreased in year t and 0 otherwise
$ % " 4	The level of shorth term-debt plus the long-term debt.
$ % 0 2	The level of depreciation.
$) 6	Total dividends measured as common plus preferred dividends.
% " 4	The level of earnings before interest and taxes
% - 0) . 4	The log ratio of number of employees to sales revenue (= , ï % - 0 2 6).
% - 0	Number of employees.
:	A vector of observable determinants of cost asymmetry, such as: ! 3 3 %4- 0) and ' $ 0
& #&	The level of free cash flows which is calculated by the following formula: ($NI_{i,t}$– # 5 2 3 3 4#3! 3 (# 5 2) "3 ($ % + $ % 0 2$) 6 % - 0)/ $ASSETS_{i,t}$
' # /	A dummy variable equals to one if the auditor expresses a going concern opinion.
, % 6	The magnitude of financial leverage calculated as the ratio of $ % " 4o ! 3 3 4 3
, / 3 3	A dummy variable equals to one if . is negative, otherwise zero.
' $ 0	The percentage growth in real Gross National Product.
' 2 / 7 (	The growth rate of sales revenue.
( ) ',/(6 2	The level of managerial high overconfidence based on the methodology proposed by Campbell et al. (2011) and implemented by Boulton and Campbell (2016).
-	The level of Managerial Ability (MA) proposed by Demerjian et al. (2012). Managerial ability scores derived from the website of Demergian et al. (2012)
- / $! 3 9	A measure of cost asymmetry controlled for the effects of financial constraints and financial distress.
- 6	Sum of market value of equity, long and short-term debt, liquidation value of preferred stock, and deferred taxes and investment credit.
- 6 %	The market value of equity scaled by total liabilities.
.	Net income before extraordinary items.
/ #U	The level of firm-specific overconfidence based on the methodology proposed by Schrand et al. (2012).
0 ! 9 $) 6	A dummy variable equals to one if firms pay dividends.
0 0 %	The level of property, plant and equipment.

2 % 4 !) % $	The level of retained earnings.
2 $	The level of the research and development expenses.
2 /	Return on assets.
3	The index has been developed by Hadlock and Pierce (2010) using the following equation: 3 σ χ 3) % 4 3) : % 4 τ π ' %
3	The magnitude of sales revenues.
3	The level of the selling general and administrative expense.
3 ' 2 / 7 4 (	Three digits SIC code industry annual sales growth.
3 ($ %	The level of short-term debt.
3) %	The logarithm of market value (= , Ï 6).
3) : % 4 ! 3	The logarithm of total assets (= , Ï 3 3 % 4 .3
3 5 #	A dummy variable that takes the value of 1 if sales revenue decreases for two consecutive periods, and 0 otherwise.
4	The level of total liabilities.
7 # 4	The ratio of working capital to total assets
7 7	The index has been developed by Whited and Whu (2006) using the following equation: 7 7 ω # & 7 ! 3 3 % 4 φ ς $) 6 ς 4 7 $ % ' 4 τ 3) : % 4 ! 3 ' 2 / 7 4 σ ' 2 / 7 (
: 3 # / %	The index has been developed by Altman (1996) using the following equation: : 3 Ã Ï 7 # 4 2 % 4 !) % $ 3 % 4 % " 4 3 3 % 4 - 6 $ % ' 4 3 ! 3 3 % 4 3

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